Impacts of Tannery Effluents on the Environmental Quality of Hazaribagh Area of Bangladesh and its Possible Remediation Measures: A Review

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Abstract

Tannery effluents are containing harmful inorganic chemical substances such as chlorides, sulphides, chromium, lead, mercury, nitrogenous compounds and tannins as well as trace organic chemicals. The increased use of synthetic chemicals like dyes and finishing agents are mainly responsible for these pollutants. In the last few decades, pollution from tanneries at the leading industrial site in Dhaka discharged into the Buriganga River. These substances are commonly toxic and persistent, posing health and environmental risks. In this article, we discussed the deterioration of environmental quality with tannery effluents. The health impacts, water quality, damaging ecology, and threatening people's livelihoods are directly and indirectly related to exposure to hazardous wastes, including carcinogenic effects, reproductive system damage, respiratory system effects and central nervous system effects. The goal of this review was to evaluate the environmental quality in the Hazaribagh tannery industrial area. This study discusses many remediation approaches that help improve environmental quality. These findings recommend monitoring and cleaning up tannery effluent simultaneously. This review examined heavy metal contamination, exposure toxicity, research gaps, existing regulations, and long-term remediation methods in Hazaribagh to enhance environmental quality.

Keywords: Buriganga River, Environmental Quality, Heavy Metals, Hazaribagh, Tannery Effluents.

1. Introduction

"Environmental Quality" refers to environmental properties and characteristics that affect humans and other species. It measures the condition of an environment based on the needs of one or more species or humans. Tannery effluents rank first among all industrial wastes in terms of pollution (Haque et al., 2019). In Bangladesh, the tanning industry is considered one of the oldest industries. About 95% of the total tanneries of the country are situated in Hazaribagh amidst a densely populated residential zone. In 2003, the government had taken the

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initiative to shift to Savar but still, there have been some tanneries and previous activities left some long-term impacts.

The capital city and the river Buriganga are badly damaged by these hazardous tannery effluents (Mondol et al., 2017). A persistent pollution issue threatens the Buriganga River. Pollutant sources in the Buriganga include mill and industrial waste, domestic garbage, clinical waste, sewage, dead animals, polymers, and oil. Eco-friendly solid and liquid wastes from tanneries are discharged directly into the Buriganga River and other related rivers without treatment (Zahid et al., 2006). The discharge of untreated tannery effluents into water bodies has long been a concern in Bangladesh's leather industry (Asaduzzaman et al., 2016). The soil becomes contaminated with hazardous heavy metals as a result of tanning processes, and crops accumulate heavy metals during cultivation. Solid waste from the tannery business, which contains a significant quantity of hazardous metal, is turned into protein concentrate and fed to chickens (Islam et al., 2014).

Almost every tannery industry generates comprehensive use of chemicals during the conversion of animal hides to leather for tanning purposes (Chowdhury et al., 2015). Pesticides, tanning chemicals, and processed hides and skins handled in an inexperienced or dangerous manner may pose toxic hazards to human health (Cooman et al., 2003). Discharging effluents with high sodium, chloride, total dissolved solids, ammonia, nitrate, and sulphate concentrations revealed excessive salinity. Pollutants surpassed the threshold level due to an improper tanning process, causing toxicity in the receiving river water and rendering it unsuitable for fish and other aquatic species survival, as well as human and animal usage. Furthermore, when people utilized contaminated river water for irrigation, it depleted soil fertility and causes soil toxicity. Inorganic chemicals and heavy metals such as lead (Pb), chromium (Cr), cadmium (Cd), zinc (Zn), manganese (Mn), and arsenic (As) were found in tannery effluents. Tannery effluents were mainly utilized in agriculture, poultry feeding, and fishing operations, among other things. Harmful tannery effluents accumulate in human health due to these processes, causing a variety of illnesses.

This study is primarily a review work that was conducted by gathering information from previous studies. The environmental condition of the Hazaribagh industrial area over the last ten years has been critically reviewed here. The purpose of the study was to look into the effects of tannery waste disposal on the environment, specifically water, soil, vegetation, animals, agricultural production, and human health. This review study compared environmental quality to the standard index and identified appropriate and cost-effective solutions.

2. Data Collection

The review was based on an environmental quality assessment of a former tannery in Hazaribagh. In this review, investigations were conducted from 2014 to 2021 about health impacts, water quality, degrading ecological, and affecting people's livelihoods in Hazaribagh tannery industrial area. Relevant scientific publications identified major databases and original research papers on tannery effluents and remediation approaches. ScienceDirect, SpringerLink, PubMed, and Google Scholar were searched for relevant information. Search criteria included tannery effluent, environmental quality, heavy metals, Hazaribagh, and bioremediation approaches. Only 12 relevant papers were reviewed. Imitated information was available on the internet as very few research works were conducted. Updated information was found limited in number. The research methodology flow diagram has been shown in Figure 1.

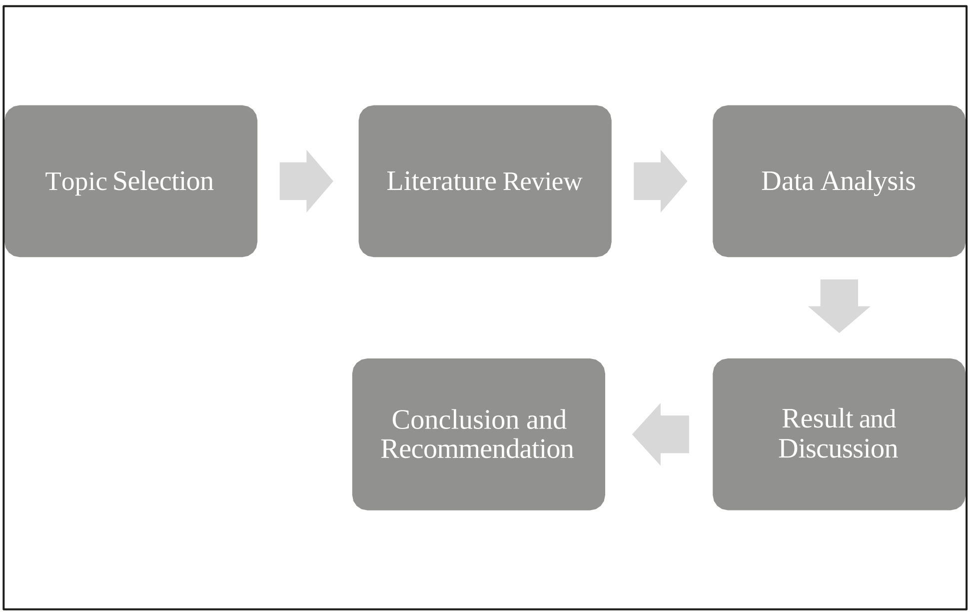

Figure 1: Research methodology flow diagram

3. Effects on Plants and Agriculture Production

Reducing tannery wastewater is a top priority for Dhaka City Corporation (DCC). Because tannery effluents are not treated, many hazardous elements end up in soils. Chromium accumulation in plants can reduce growth, photosynthesis, chlorophyll content, enzyme activity and cause chloroplast and mitochondrial destruction (Guilizzoni, 1991). The levels of lead (Pb) and arsenic (As) in rice farming have already exceeded WHO and Egyptian standards. Salt stress slows metabolic processes or prevents the production of seed germination enzymes (Ashraf et al., 2002). The soil in the Hazaribagh area had high levels of Pb, Cd, and Zn. They were deposited in the soil, absorbed by nearby crops, and eventually entered the human body via the food chain. The carcinogenicity of Cr, Pb, and Cd had a variety of negative effects on human and animal health. As a result, authorities should act quickly to prevent heavy metal contamination (Rahaman et al., 2016). Heavy metal levels in Helencha (*Enhydra fluctuans*), Fern (*Nephrolepis exaltata*), and Rice (*Oryza sativa*) exceeded acceptable limits in Hazaribagh tannery industrial area (Sultana et al., 2015).

According to the streams of the literature, it was revealed that applying tannery effluents to soils with varying textures reduced rice yield, with the effect being more pronounced in light soils than in heavy soils. The effluent was also found to negatively impact growth performance. Metal content in soil experiment found heavy metal amounts. The condition of jute (*Corchorus capsularis*) and spinach (*Basella alba*) was observed by reference (Ali et al., 2015). Those jute (*Corchorus capsularis*) plant and spinach (*Basella alba*) was taken as a representative sample of plants in that region. Heavy metal concentration accumulations in vegetable leaf and shoot segments (Vine spinach) are presented in **Table 1** and contrasted, as far as possible, with FAO/WHO, India, and China for these components in fresh vegetables (Juel et al., 2016). Because of the high quantity of ammonia near the tannery in Hazaribagh, certain floras are becoming extinct (Hashem et al., 2014).

Table-1: Heavy Metal Accumulation in Plants Grown in the Study Area (mg/kg dry wt.).

Species	Parts of plants	Cd	Cu	Cr	Pb	Ni	Zn	References
Vine Spinach	Leaf	--	**12.15**	**3.95**	**10.3**	**1.8**	**69.75**	(Juel et al., 2016)
	Shoot	--	**10.75**	**8.1**	**13.7**	**1.55**	**40.35**	
Jute	Root	**4.6**	--	**176**	**15**	--	--	(Ali et al., 2015)
	Stems	**2.0**	--	**170**	**18.4**	--	--	
	Leaves	**0.212**	--	0.852	**0.348**	--	--	
Spinach	Root	**3.5**	--	**183**	**10**	--	--	(Ali et al., 2015)
	Stems	**5.2**	--	**190**	**12**	--	--	
	Leaves	**0.212**	--	0.261	**0.132**	--	--	
Vine Spinach	Edible	--	**16.91**	**64.88**	**13.86**	**2.36**	**231.98**	(Mizan et al., 2020)

Spinach *(Spinacia oleracea)*	Edible	**0.32**	--	**44.48**	**11.48**	--	--	(Islam et al., 2018)
Safe limit[a]		0.02	10	1.30	2	10	0.60	
Safe limit[b]		--	30	20	2.5	1.5	50	
Safe limit[c]		--	10	0.5	0.02	--	20	

Safe limit[a]: WHO (1996)

Safe limit[b]: Awasthi (2000)

Safe limit[c]: Chinese national food standards (2012)

Vegetables contain more zinc than the other metals studied in this study, acknowledging the bioavailability or mobility of zinc mentioned previous section. Cu and Ni concentrations, on the other hand, were more significant than safe limits by Awasthi (2000) & Chinese national food standards (2012). As a result, regular consumption grown in the research area is hazardous to anyone's health. As a result, eating these vegetables grown in the study area must have serious health consequences for humans. Vegetables are more susceptible to heavy metal and metalloid contamination due to their rapid proliferation and direct transfer of metals and metalloids to leafy portions (Chang et al., 2014).

4. Effects on Poultry Feed Manufacturing and Livestock Production Sector

The most frequent solid wastes produced in tannery sectors were skin trimmings, fleshing, keratin, chrome shaving, and buffing waste (Kanagaraj et al., 2006; Bari et al., 2015). Protein was the predominant constituent of that waste, which was converted into protein concentrate for use in chicken feed, fish feed, and the manufacturing of organic fertilizer. Skin-cut wastes (SCW) were tanned by slicing dry skins into thin slices (Bari et al., 2015).

Bari et al. (2015) estimated the target hazard quotient (THQ) and hazard index (HI). When THQ is less than one, the risk of non-carcinogenic side effects is considered minimal. There may be concerns regarding potential health problems linked with overexposure when it exceeds 1. The THQs might be averaged among contaminants to establish a hazard index (HI) to quantify the overall risk of adverse health effects from numerous metal exposures. The HI is made up of several THQs for various drugs or exposure techniques. The HI was employed as a screening criterion in this investigation to assess if heavy metals from contaminated poultry posed a serious threat to human health. In this work, the hazard indices for the toxic components Pb, Cd, and Cr were estimated. When the risk index reaches 1.0, it raises concerns about the potential for health problems (Khan et al., 2008).

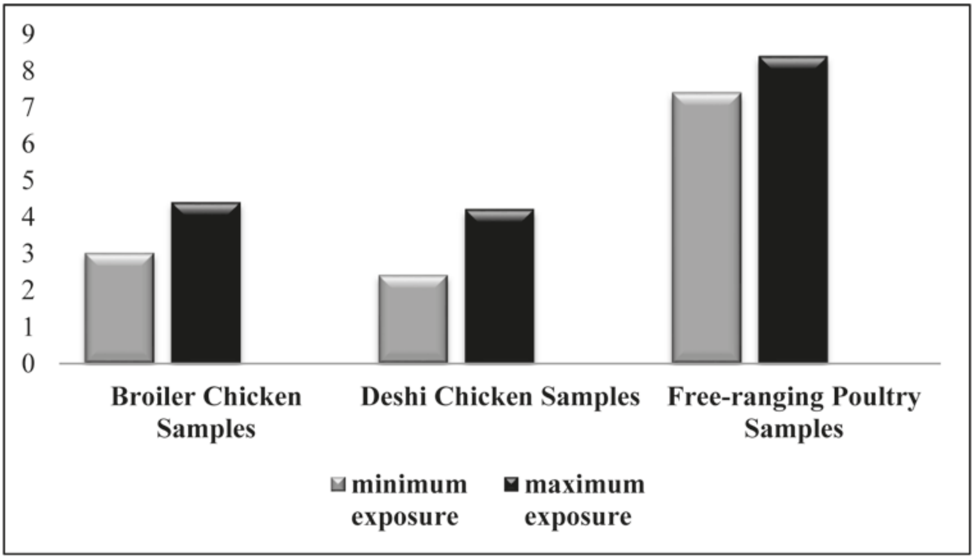

Figure 2: Target hazard quotient (THQ) for lead (Pb) Ingestion from Different Kinds of Chicken.

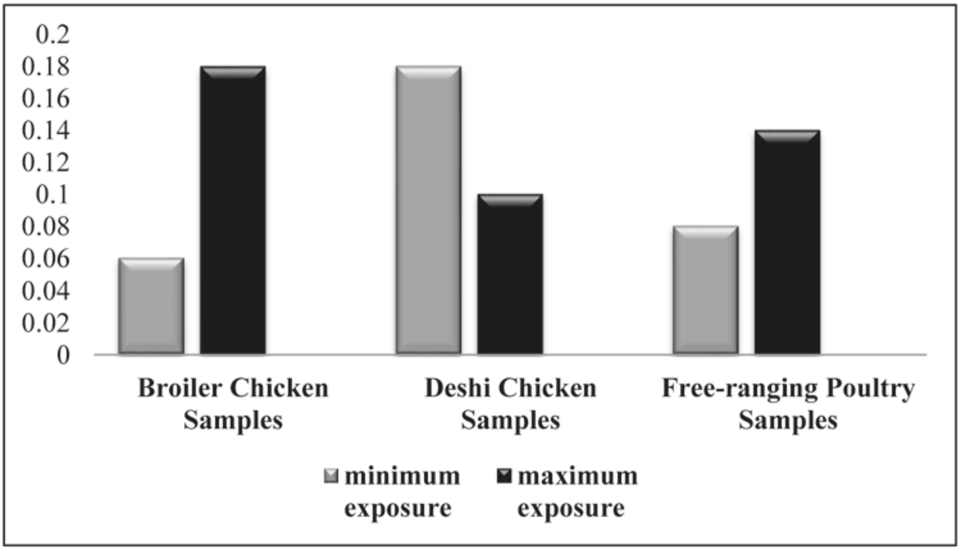

Figure 3: Target hazard quotient (THQ) for Cadmium (Cd) Ingestion from Different Kinds of Chicken.

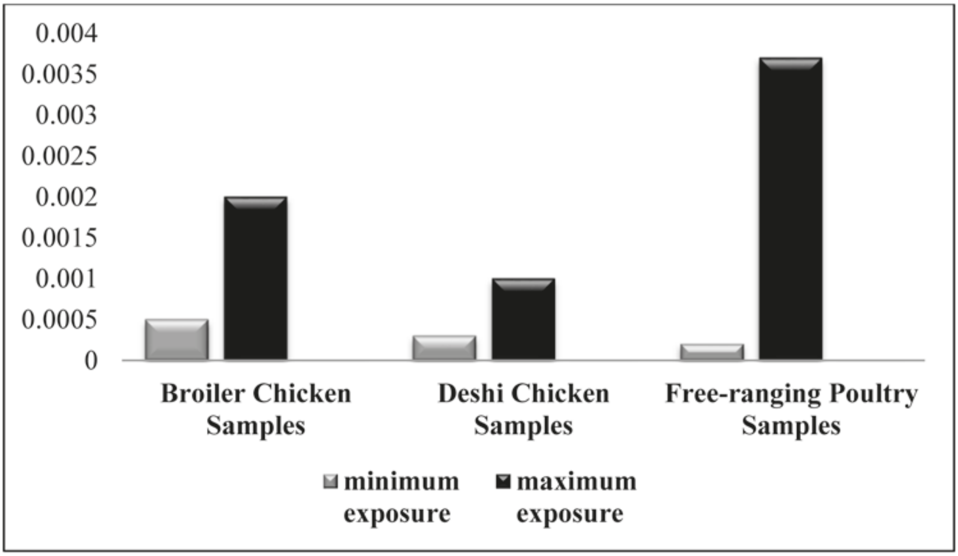

Figure 4: Target hazard quotient (THQ) for Chromium (Cr) ingestion from different kinds of chicken.

After analysing data (figure 2, 3, 4) from Bari et al. (2015), it was demonstrated that heavy metal contamination in feed enters into poultry and poses a potential risk to consumers through consumption of contaminated chicken meat.

Cadmium (Cd) and lead (Pb) levels from chicken foods had already exceeded WHO and Egyptian standard safe limits, indicating the health of the people in that area. Heavy metal contamination in feed penetrates birds, presenting a risk to humans who ingest contaminated chicken meat, according to analysis based on both studies (Islam et al., 2014).

Protein concentrates were made locally from tannery solid wastes, as well as other feedstocks was combined to provide a balanced diet. Two factors were considered. The first was the heavy metal content, which had been reduced due to dilution in the final feed. However, it made little difference where these protein concentrates were utilized to make poultry diets. The feed staffs, on the other hand, were combined with these proteins. Heavy metals may also be present in the feed staff (Hossain et al., 2007).

Tinni et al. (2014) conducted a survey on livestock production in the Hazaribagh tannery area and discovered that people involved in livestock production wanted to protect their animals from harmful chemical exposure but were unable to do so due to excessive chemical deposition. A large number of livestock died as a result of the disease. Due to the discharge of hazardous tannery effluents, the animal farm in that survey region was found to be declining unnecessarily. Solid waste was dumped and discharged in public areas. Liquid waste is discharged without treatment in an unplanned manner. These harmful wastes were also consumed by livestock, which then become infected with various diseases. The liver, kidneys, and nervous system were all affected by the heavy metals found in tannery effluent. Chronic heavy metal exposure to the reproductive system is caused by steroid genic dysfunction, chromosomal defect and embryotoxicity (Verma et al., 2018).

5. Effects on Fisheries Production

Various studies indicate that tannery effluents are not treated before discharge into water bodies, harming aquatic resources and reducing fish productivity (Tinni et al., 2014). A study by Tinni et al. (2014) discovered that tannery effluent harms commercial fishing. Uncontrolled and untreated tannery waste discharge into open water bodies reduced fish productivity. In the Buriganga River, these wastes caused physio-chemical changes. Fish ingested tannery effluent components.

During the rainy season, polluted run-off river water entered the hatchery, killing the fish (Tinni et al., 2014). The presence and consequences of six heavy metals in tannery effluents discharged into the Buriganga River in Dhaka, Bangladesh, were reviewed by Asaduzzaman et al. (2016). Three fish species were sampled from the nearby river: climbing perch (*Anabas testudineus*), spotted snakehead (*Channa punctata*), and black tilapia (*Oreochromis mossambicus*). The experiment predicted that Cr and Pb were the most commonly accumulating elements in fish. Muscles of three fish species contained 2.70 mg/kg Cr. Those living closer to the study area ingested more Cr and Pb from eating local fish than those living farther away (Cd). Despite high levels of hazardous heavy metals in the river water, the fish species studied had concentrations far below the acceptable Food and Agriculture Organization/World Health Organization limits. They appeared to be safe to eat. Heavy metal concentrations were found to be within FAO and WHO guidelines. The results of the experiment show that fish have acceptable levels of heavy metals. This may change if higher authorities do not take preventative measures (Asaduzzaman et al., 2016). Polluted lead (Pb), chromium (Cr), cadmium (Cd), zinc (Zn), nickel (Ni), and manganese (Mn) were found in fish feed ingredients in Hazaribagh. The average chromium (Cr) concentration of all sample types was many times higher than the maximum allowed in the capital for tannery waste. Tannery waste can harm the liver and kidneys, and cause cancer if ingested in fish and poultry (Akter et al., 2020). The chromium (Cr) concentration in Buriganga River fish was found to be higher than in fish from the local market. Heavy metal concentrations exceeded the WHO-approved threshold limit, indicating a serious health risk. They investigated *Heteropneustes fossilis* (stinging catfish) and *Channa punctata* (spotted snakehead) and found that metal content in fishes was higher than in sediment (Bashar et al., 2016).

Numerous studies have discovered that tannery effluents are not treated before discharge into bodies of water, resulting in harm to aquatic resources and decreased fish productivity, and one of those studies (Tinni et al., 2014) discovered that tannery effluents harm commercial fishing. Uncontrolled and untreated tannery waste discharge into open bodies of water reduced fish productivity. These wastes altered the physiochemistry of the Buriganga River.

The concentrations of heavy metals in fishes obtained in various studies were compared in **Table 2**.

Table-2: Targeted Heavy Metal Accumulation (mg/kg dry wt.) in Fisheries in the Study Area.

Species	Cr	Pb	Cd	Zn	Ni	Hg	Cu	As	References
Heteropneustes fossilis (Catfish)	**164.73**	**11.05**	**2.03**	**184.06**	--	--	--	--	(Bashar et al., 2016)
Channa punctata (Spotted snakehead)	**49.36**	**18.16**	0.717	**184.46**	--	--	--	--	(Bashar et al., 2016)
Channa punctata (Spotted snakehead)	**12.36**	**16.18**	**6.02**	--	--	**2.24**	--	3.39	(Islam et al., 2014)
Cirrhinus reba (Tatkini)	**12.89**	**15.76**	**6.03**	--	--	**1.67**	--	3.09	(Islam et al., 2014)
Oreochromis mossambicus (Mozambique tilapia)	**10.40**	**14.53**	**6.04**	--	--	**1.47**	--	3.10	(Islam et al., 2014)
Gudusia chapra (Chapila)	**6.31**	**10.92**	0.98	--	9.10	--	4.99	--	(Ahmad et al., 2010)
Glossogobius giuris (Baila)	**6.41**	**9.91**	0.87	--	9.7	--	5.03	--	(Ahmad et al., 2010)
Cirrhinus reba (Tatkeni)	**6.99**	**8.94**	0.87	--	9.60	--	4.33	--	(Ahmad et al., 2010)

Channa punctatus (Taki)	**5.65**	**9.10**	0.88	--	9.84	--	5.30	--	(Ahmad et al., 2010)
Mystus vittatus (Tengra)	**5.67**	**11.68**	1.13	--	9.41	--	4.31	--	(Ahmad et al., 2010)
Pseudeutropius atherinoides (Batashi)	**6.61**	**9.18**	1.04	--	9.15	--	4.85	--	(Ahmad et al., 2010)
Safe limits[d]	0.05	--	--	--	--	0.14	--	--	WHO (2004)
Safe limits[e]	--	1	2	0.05	--	1	--	--	Laws of Brunei (2001)

Fishes had higher concentrations of chromium (Cr), lead (Pb), and zinc (Zn) than the other metals studied in this study, confirming the bioavailability or mobility of chromium (Cr), lead (Pb), and zinc (Zn) indicated earlier in that article. However, quantities of chromium (Cr), lead (Pb), and zinc (Zn) were higher than FAO/WHO and Brunei guidelines. As a result, consuming these fish grown in the research area is harmful to human health. As a result, eating these fishes grown in the research location has severe health implications for humans.

6. Effects on Human Health

The main cause of health and safety violations is toxic chemical exposure in Bangladeshi tanneries (ILO, 2008). Skin and respiratory diseases are very common health problems among tannery workers as a result of exposure to hazardous chemicals (Azom et al., 2012). Tannery effluents can directly or indirectly affect human health and the food chain. Tannery effluents, which contain animal flesh, sulfuric acid, chromium, and lead, affect not only tannery workers but also the surrounding community (Biswas & Rahman, 2013). Tannery workers are thus potentially exposed to harmful agents and heavy metals, particularly Cr, which makes them vulnerable to health problems, particularly for those who have previously experienced respiratory tract and skin problems (Shahzad et al., 2006). Chromium hypersensitivity can lead to the production of complex antigens in tannery workers due to its ability to bind with skin proteins (Ali et al., 2015).

Hasan et al. (2016) found from the study that the common health problems (figure 6) among the tannery workers were Asthma (about 50% of workers), diarrhoea (71.7%), typhoid (43.5%), blood pressure (52.2%), gastrointestinal problems (71%) and eye problems (46.7%). In the case of occupational dermatitis among the tannery workers, the prevalence was found as scabies (73.9% of workers were affected), nail discoloration (69.6%), urticaria (59.7%), miliaria and folliculitis (56.6%), contact dermatitis (39.13%).

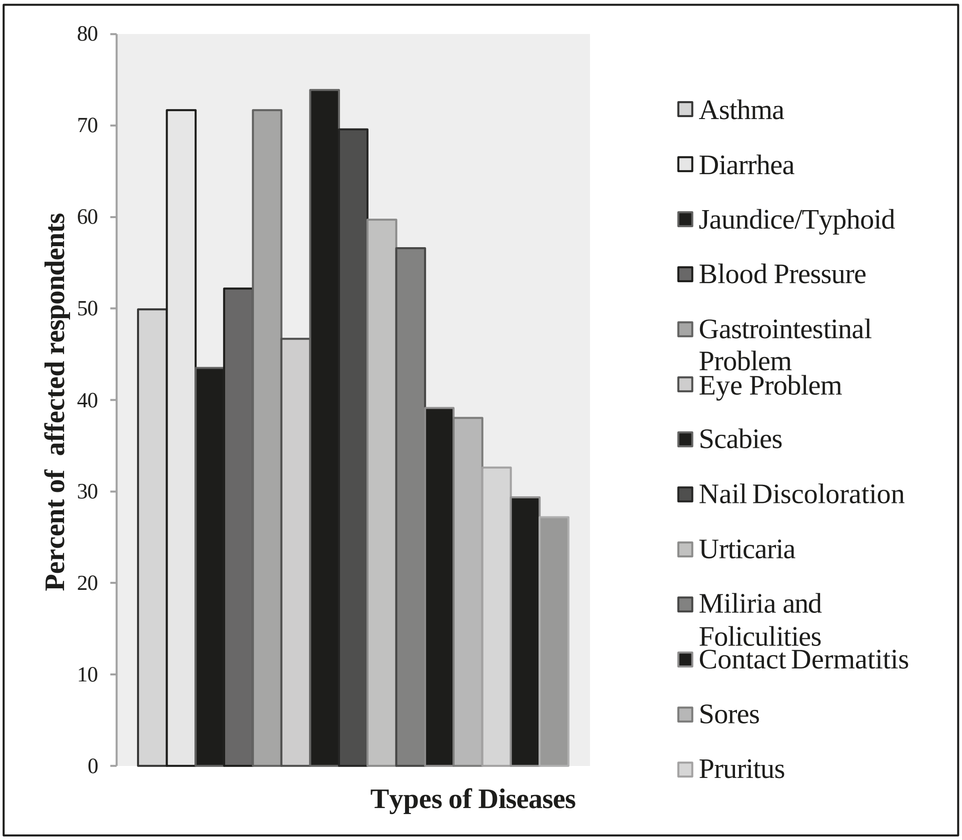

Figure 5: Percentage of affected people from suffering from various diseases.

The possibility of short-term health issues from chemicals like sulfuric acid and sodium sulphide has long existed. Several other chemicals, such as formaldehyde and azo colorants, have been linked to human cancer. They may swiftly invade the eye and cause long-term harm. During the deliming process, workers are exposed to high amounts of ammonia. With accessible acids in the environment, ammonia forms salts such as nitric acid (HNO_3), sulfuric acid (H_2SO_4), and hydrochloric acid (HCl). As a consequence, those who work in tanneries, whether wholly or partly, come into contact with ammonia or its hydroxide and experience a variety of problems. Thus, it causes sleepiness, nausea, and headaches (Hashem et al., 2014).

7. Effects on Reproductive Health

Das et al. (2015) surveyed that area and found some informative information about their reproduction health condition in the study area. From that survey, they found some important information about the reproductive health condition of the workers both male and female.

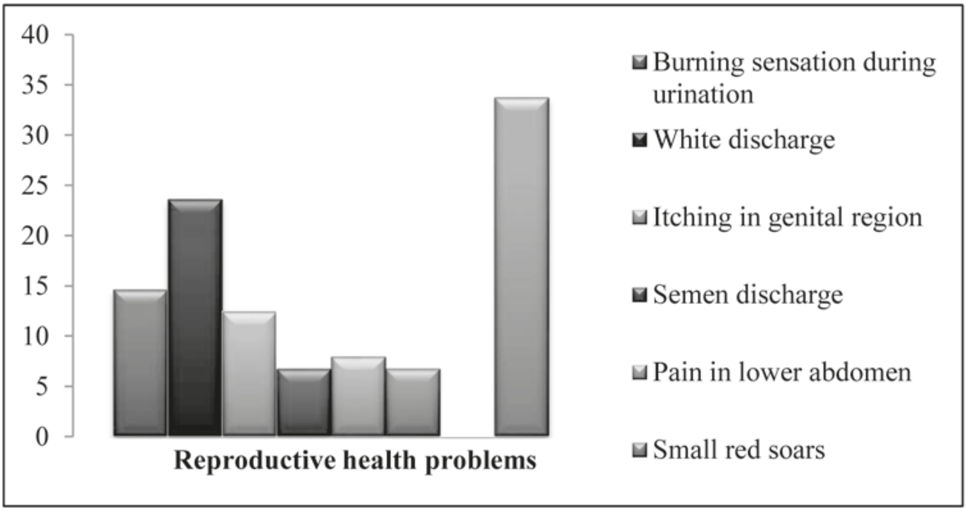

Figure 6: Reproductive health problems among female workers.

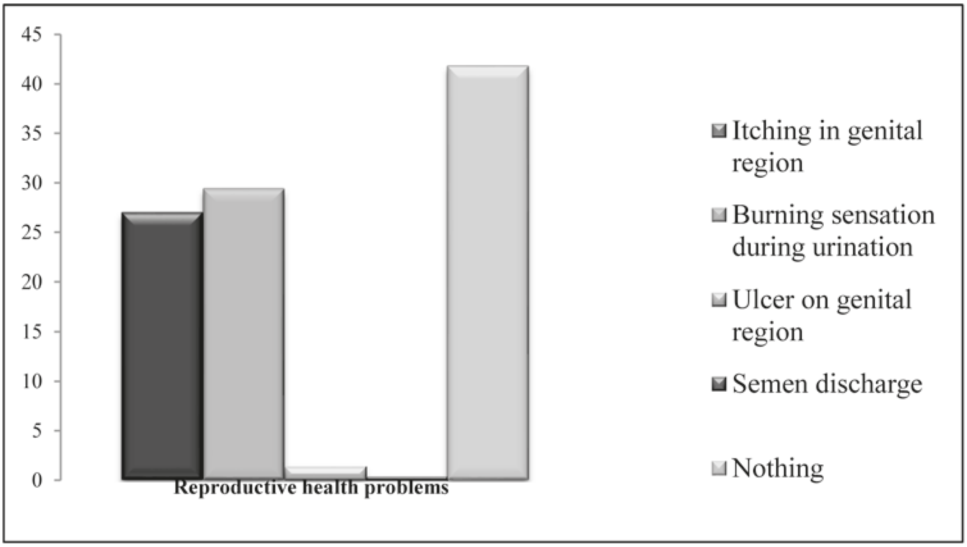

Figure 7: Reproductive health problems among male workers.

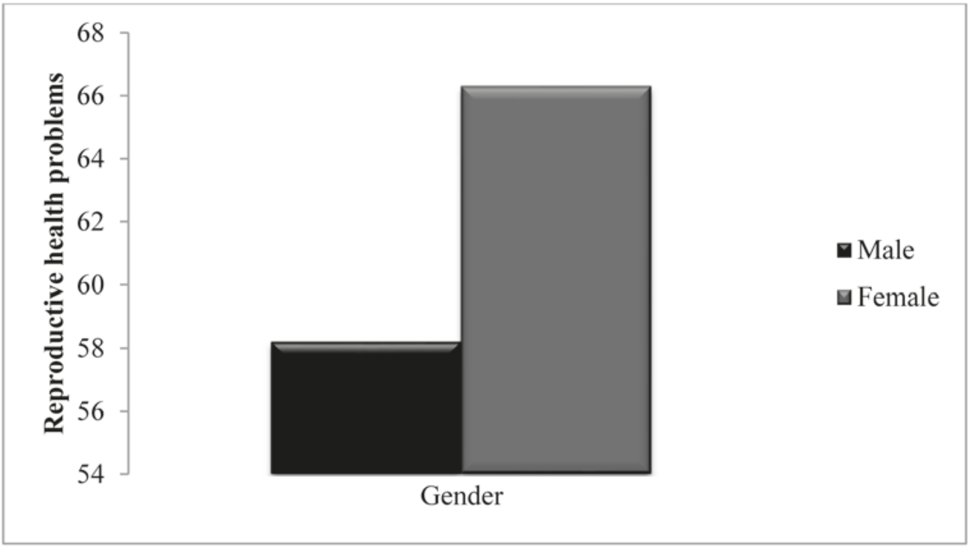

Figure 8: Percentage of reproductive health problems among male and female workers.

Burning sensations during urination, itching in the genital region, pus discharge from the urethra, ulcers on the penis, ulcers on the genital region, pain in the testis, warts on the genital region, and semen discharge were all reported by male workers (figure 7). It was clear that (figure 8) female reproductive health was more vulnerable than male reproductive health conditions.

According to the female participants, local pregnant women suffered from seizures during their pregnancies and had various reproductive issues. According to both male and female participants, environmental contamination caused by the incorrect disposal of a large volume of solid and liquid tannery wastes harms both tannery employees and residents of Hazaribagh (Haque et al., 2020).

8. Remediations of Tannery Effluents

The tannery sector consumes a lot of water and discharges a lot of tannery effluents that haven't been treated. Tannery effluent contains important concentrations of COD, BOD, TSS, TDS, and heavy metals. The traditional method of removing heavy metals have several drawbacks, including a high initial investment and operating cost, making it unsuitable for small-scale industries. One of the most important processes for removing heavy metals from tannery effluents is adsorption. Here this review work included two cheapest and most easily available processes for removing heavy metals contain from tannery effluents such as using spent tea leaves and phytoremediation processes.

According to Alam et al. (2018), the surface water of the Hazaribagh tanning site has a large amount of Cr (939.81 mg/L). This study explained that tea waste is easily available in our country and it is a cheap material. The treatment included the use of waste black tea leaves as an absorbent material. According to Thakur & Parmar (2013), the percentage of removals of metals increases rapidly as the dose of the adsorbents increases due to the increased availability of exchangeable sites or surface area.

According to their research, tea waste can be used as a low-cost, locally and freely available, environmentally friendly, and efficient bio adsorbent for removing Cr from tannery wastewater. The maximum removal of Cr by spent tea leaves was 95.42 percent at a 14 g/L adsorbent dose and pH 10 in the experiment. Cr's maximum adsorption capacity on tea waste was discovered to be 10.64 mg/g (Alam et al., 2018).

Table-3: Techniques Used for Remediation.

Name	Benefits	Drawbacks	Examples
Phytoextraction	The biomass of the plant, which contains pollutant extract, can be reused as a resource; environmental friendliness.	The plant's biomass must be harvested and removed. Commonly, hyperaccumulator plants have shallow root systems, fewer roots and more biomass.	*Thlaspi caerulescens*, *Alyssum bertolonii*
Phyto stimulation	Chlorinated solvents have also been used to target locations for demonstrations. Exudates from the roots are used.	Plants can be harmed by high levels of pollution.	*hornwort*
Phytovolatilization	More harmful pollutants are transferred to less	Contaminants accumulated in flora, which then	*Astragalus bisulcatus*,

	toxic contaminants using this method. Toxic substances are released into the environment.	moved into fruits and other edible portions. In-plant tissues, the level of metabolites drops.	*Stanleya pinnata*
Phytostabilization	Low-cast, less disruptive than other soil remediation systems. Revegetation aids ecosystem restoration.	This process prevents the leaching and re-release of different contaminants, the contaminants must be kept in place. This requires careful maintenance.	*Eragrostis, Gladiolu, Alyssum*
Rhizodegradation	Ex-situ and in situ applications of this technology are feasible. The use of both territorial and aquatic plants is permissible here.	In this technology, continual pH adjustment is required to maintain the flow rate and concentration of influent, as well as a well-engineered system. Plant removal and harvesting are required.	*Pseudomonas*
Phytomining	This technology is useful for the uptake of precious metals, where conventional mining is not economically feasible	The disposal of reagents results in achieving precious metals is a threat to the environment.	*Alyssum bertolonii*

Source: Kamran et al., 2014

Cr contamination occurred as a result of tannery wastewater discharge into the Dhaleshwari River, and we identified potential native plants for Cr phytoremediation. Additionally, samples of the root, stem, leaf, and fruit of four selected plants were collected from those sampling points (i.e., *Eichhornia crassipes*, *Xanthium strumarium L.*, *Cynodon dactylon*, and *Croton bonplandianum Baill.*). *Xanthium strumarium L.* had the highest translocation factors (TF) and bioconcentration factors (BCF) for Cr of all the plant species studied. According to this study's findings, *Xanthium strumarium L.* is a more suitable native species for phytoremediation of Cr (Hasan et al., 2021).

Table-4: List of Plant Species from Bangladesh that are Capable to Remediate Potential Contaminants.

Plant species	**Potential Contaminants**	**References**
Fern (*Pteris vittata*)	Inorganics (As, F)	(Dey et al., 2016)
Xanthium strumarium	Cr	(Hasan et al., 2021)
Water pennyworth (*Hydrocotyle ranunculoides*)	Inorganics (As, F) and metals (Pb)	(Dey et al., 2016)
Amaranthus viridis L.	Pb	(Azam et al., 2014)
Vetiver grass (*Chrysopogon zizanioides*)	Pb, Cd	(Dey et al., 2016)
Azadirachta indica A. Juss.	Cu, Ni, Zn and Pb	(Azam et al., 2014)
Sunflower (*Helianthus annuus*)	Zn, Ni, Pb, Cu	(Dey et al., 2016)
Blechnum orientale L.	Pb, Ni	(Azam et al., 2014)
Marigold (*Tagetes patula*)		(Choudhury et al., 2015)
Indian mustard (*Brassica juncea*)	Cr, Cu, Pb and Zn	(Choudhury et al., 2015)
Water hyacinth (*Eichhornia crassipes*)	Pb, Cr, Cu, Hg, Zn, Cs, Sr, U	(Dey et al., 2016)
Commelina benghalensis L.	Cu, Pb, Cd, Zn	(Azam et al., 2014)
Brahmi (*Bacopa monnieri*)	Pb, Cd, Cr, Cu, Hg	(Dey et al., 2016)

Momordica charantia L.	Cu, Co, Cd, Fe	(Azam et al., 2014)
Pistia stratiotes L.	Cr, Co	(Azam et al., 2014)
Water lettuce (*Pistia stratiotes*)	Cu, Hg, Cr, Pb, Cd	(Dey et al., 2016)
Tridax procumbens L.	Hg	(Azam et al., 2014)

In Bangladesh, these plants can be found in abundance all around the country. The intrinsic property of these plants can be used to rehabilitate toxic material contaminated areas. The phytoremediation technique was shown to have a significantly higher decrease rate than the sedimentation technique (Chakrabarty et al., 2017).

9. Conclusion

The results obtained in this review study clearly depict that in Bangladesh, the uncontrolled and unplanned growth of tannery processing industries has contaminated land and water, raising concerns about public health. Tannery effluents are mainly used as pesticides in agricultural lands, poultry feeding elements, and fisheries sectors for these reasons public health facing vulnerable conditions. Discharged tannery effluents with heavy metals without any treatment cause many environmental and health effects. Consumption of heavy metals contaminated food results in long-term accumulation in the human body such as through bioaccumulation. After several years of exposure, it was discovered that several adverse effects on humans, including thalassemia, dermatitis, brain and kidney damage, and cancer, may be observed. Used tea leaves are a readily available that can be converted into a valuable product as an adsorbent for chromium (Cr) removal from tannery wastewater and phytoremediation which was less expensive. Based on this review study, further study should be conducted about environmental impact analysis over the former tannery area which is adjacent to the Buriganga River.

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