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Mini Review

An Overview on the Impacts of Textile Effluents on the Aquatic Ecosystem in Turag River at Bangladesh

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Abstract

The Turag River has an extensive reputation for backing the coastal people's income for years; nonetheless, its burden is enormous owing to numerous anthropogenic drivers. DEPZ (Dhaka Export Processing Zone) can be considered one of the crucial zones for textile industries. DEPZ is situated in Savar, and the nearest river is Turag, the upper tributary of the Buriganga. The Turag originates from the Bangshi River, the latter an essential branch of the Dhaleshwari River. Since this area is a cluster area for the industries, Turag has been identified as the most affected waterbody by the industrial effluents. Some research was conducted on the characteristics of the effluents and the impact on the nearby land, water bodies, and the health of the human and aquatic systems of the adjacent area of DEPZ. Still, there is a gap in research on species richness and abundance in the Turag River. IUCN red list 2000, IUCN red list 2015, and the MACH project are reliable sources of information found. Since 2015, IUCN red list has not been updated, and limited research has been conducted to update the severity of the current status. This write-up tries to review and summarize findings from other research and find the gaps. There was no quantitative inventory information on fish abundance and richness. Hopefully, it will be helpful to project the importance of protecting aquatic biodiversity, and law enforcement will be strengthened. More research is needed to save the endangered native aquatic species' biodiversity. If used with more information, this article can be a stepping stone in the right direction for scholars.

Introduction

The textile industry has been the pillar of Bangladesh's economy for decades. In Bangladesh, the export value of the textile sector is approximately 28 billion USD per year, which subsidizes about 81% of the country's total export earnings and funds 20% of Bangladesh's GDP (gross domestic product) [1]. With all the silver linings, this sector is also one of the top contributors to environmental pollution. Approximately 5% of all landfills are textile effluents; textile dyeing, and printing treatment contribute 20% of water pollution [2]. Textile wastewater contains various chemicals such as oil, grease, caustic soda (NaOH), Glauber salt (Na_2SO_4), ammonia (NH_2), sulfide (S_2-), lead (Pb), heavy metals, and other toxic substances [3]. Also, the textile industry produced effluents comprised of high temperature, an array of pH values, BOD (biochemical oxygen demand), COD (chemical oxygen demand), TDS (total dissolved solids), heavy metals, and intense pigment.An enormous amount of water, dyestuffs, and synthetic chemicals, the carriers of heavy metals, are consumed during textile dyeing and printing treatment. Without proper waste management treatment, the effluents are disposed of in nearby rivers, lakes, land, or landfills. Toxic heavy metals and residues in river water and soil in the surrounding areas have been significant alarming factors during the last decade [1,4,5]. Crude textile waste can pollute groundwater, and waterbodies diminish dissolved oxygen in water and distress aquatic ecosystems [6]. Numerous studies have been done on the composition of effluents, and laws require a mandatory ETP in every textile unit. Still, the most common practice is dumping the affluent in the nearby waterbodies or lands. In 2016 textile industries in Bangladesh produced approximately 1.80 million metric tons of fabric originating about 217 million m^3 of wastewater (2016) containing an array of contaminants [6].

Bangladesh is a glaciofluvial nation of 147.570 km^2, and its population is about 160 million. This country is privileged in consuming widespread aquatic assets, which inlets cover an area of 4.70 million hectares in various forms such as ponds, natural despairs (haors and beels), lakes, canals, rivers and so on [8]. The fisheries sector contributed a significant GDP (4.39% to national GDP and 22.76% to agricultural GDP). Moreover, this sector contributed 2.46% of the total export earnings in Bangladesh [9]. Fish delivers Sixty Percentage (60%) of nationwide animal protein ingesting. Moreover, fisheries division performs a crucial part in creating employment in rural areas and scarcity mitigation. Currently, yearly fish demand is 33.90 metric tons, and fish consumption is 18.94 kg each year by a person. Therefore, it can decrease its undernourishment difficulty by growing aquatic fish production [9]. Many family members in rural areas are involved in freelance fishing work from aquatic sources such as the rivers and other open water areas. However, the aquatic environment's physical, chemical, and biological properties can be degraded by many textile effluents and could damage human health, livestock, and other biodiversity [10,11]. Heavy metals can be considered lethal pollutants as they are non-biodegradable and toxic, and they are capable of entering the food chain [13-15]. The Dhaka Export Processing Zone (DEPZ) is the 2nd EPZ, and the most significant industrial zone of Bangladesh started its maneuver in 1993; Ninety-two (92) industrial units are situated in this zone, which is creating pollution and degrading environment for the entire area [16]. The Turag River flowing by the side of Dhaka city is one of the most contaminated rivers in Bangladesh [17]. Turag River supposedly originates enormous contaminant loads from industrial wastes straight as this area is a cluster area of industries, textiles, dyeing, and pharmaceuticals. Several canals, channels, and pipes were detected to directly discharge industrial, municipal, and domestic sewage into the Turag [18]. Industrial effluents dumping without treatment into the water bodies have been alarming for local aquatic pollution, leading to fish death in many cases [19]. It does affect not only species richness but also species abundance in the specific aquatic ecosystem. To compare the situation, this report has researched several articles and IUCN red lists (2000) to categorize the endangered species and have an idea about abundance in the study area.

Methodology

Study area map

The Turag originates from the Bangshi River, an important tributary of the Dhaleshwari River, flows through the Gazipur district and joins the Buriganga at Mirpur in the Dhaka district (Figure 1).

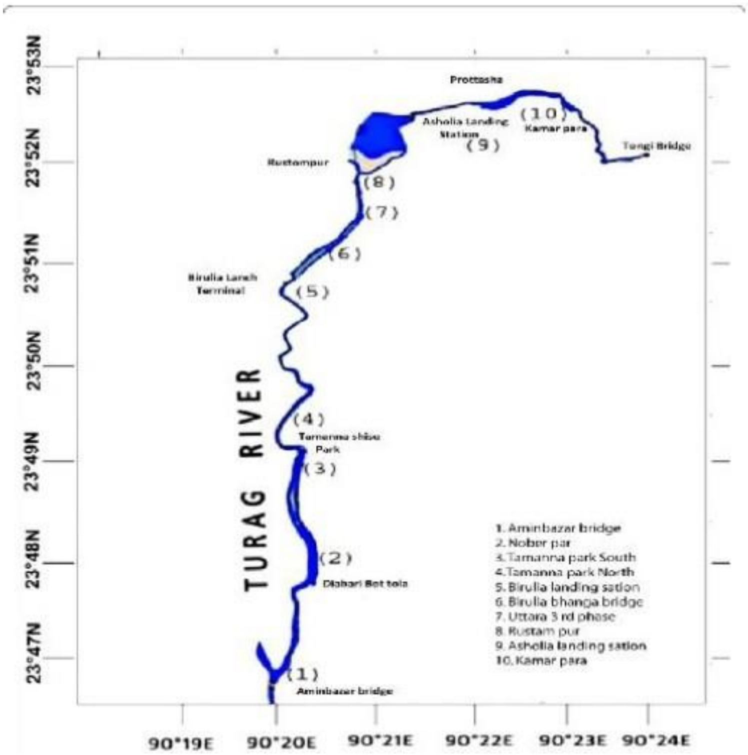

Figure 1: Geographical location map of Turag River [18].

Secondary data were collected from several papers relatedto the subject for this article. Google Scholar, Scopus, and Webof Science were searched using related keywords like "textile industries in Bangladesh," "effluents, "aquatic ecosystem," and so on. Finally, approximately 20 peer-reviewed articles were shortlisted. Most of the articles were from high impact journals of renowned publishers such as Elsevier, Taylor and Francis, Springer, etc. Most of the articles were published between 2014 to 2022. Related government policies were analyzed, some projects like "MACH ((Management of Aquatic Ecosystems through Community Husbandry), NSP (Nishorgo Support Project) were also reviewed for reliable information about species richness and abundance information. Some information has been collected from reputed newspaper as well. There was no quantitate information found on abundance of each species in this river. The information about abundance used here are driven from survey conducted by various research teams and the data collected from the local fisher and non-fisher communities.

The IUCN (International Union for Conservation of Nature) Red Booklist was used as a guideline to categorize the fish species of the study zone in terms of 'endangered,' 'critically endangered,' or 'vulnerable.' There are several policies in Bangladesh to protect endangered species. In 1982, the Government endorsed the amended fish conservation law and promulgated 'The Protection and Conservation of Fish (Amendment) Ordinance, 1982. It was furtheramended in 1995 and then in 2002. To boost the fishery sector, the Government ratified 'The Bangladesh Fisheries Development Corporation Act, 1973 and established the Corporation under this Act.

Results and Discussions

In the Dhaka district, 33% of industries are located, and 32% are in Narayanganj. There were 298 polluting textile mills listed by DoE in 1986, which is now 365 in number [11]. The typical characteristics of wastewater produced by the textile industry include high temperature, a wide range of pH values, biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), heavy metals, and intense pigment [20]. High-temperature wastewater discharged into rivers may increase the temperature of the water body, which in turn can affect flora and fauna [21].

Fishes are fairly receptive to deviations in their surrounding environment [18]. Fish communities has been considered as a good biological indicator and followed by several authors [22, 23]. Apart from fishes some aquatic plants like Ipomoea Aquatica (locally named as "Kolmi Shak"), Nymphaea nouchali (locally known as "Saluk") and Trapa natans (locally named as "Panifal, Singra") were also found to be part of Turag river aquatic system [44].

Table 1 presents the standard value for the physicochemical parameters, and Table 2 data was taken by Sarkar et al. in different seasons (dry-February, 2015 and wet-June, 2015) to compare and analyze whether they fall in the standard range [22].

Table 1: Department of Environment (DoE) standard value for the physicochemical parameters [22].

Parameters	Inland Surface water
pH	6-9
Temperature °C	40
Salinity	-
TDS (mg/L)	2100
TSS	-
DO (mg/L)	4.5-8
COD (mg/L)	200
BOD5 (mg/L) at 20 °C	50
Cr (mg/L)	0.5
Cu (mg/L)	0.5
Zn (mg/L)	5.0
Pb (mg/L)	0.1
Ni (mg/L)	1
Cd (mg/L)	0.05
Hg (mg/L)	0.01
Fe (mg/L)	2
As (mg/L)	0.2
Mn (mg/L)	5.0

Table 2: Physicochemical parameters in the Turag River [22].

Time	Sampling point	Color	Smell	pH	T(°C)	Salinity (mg/L)	TDS (mg/L)	TSS (mg/L)	EC (µS)	DO (mg/L)	COD (mg/L)	BOD (mg/L)
Dry (Feb)	SP-1	Dark	Acrid	9.43	27.2	596	872	193.5	1253	0.8	340**	218
	SP-2	Dark	Acrid	9.45**	27.3	612**	898**	182.6	1350	0.6	320	232**
	SP-3	Dark	Acrid	9.44	26.9*	603	892	196.8**	1362**	0.6*	338	230
Wet (Jun)	SP-1	Light	Unpleasant	8.23*	32.7**	436*	687	112.7	1095	1.2	260	96
		Dark										
	SP-2	Light	Unpleasant	8.3	32.5	502	684*	97.0*	1018	1.4**	240	82*
		Dark										
	SP-3	Light	Unpleasant	8.25	32.1	487	693	108.4	985*	1.3	232*	88
		Dark										
Average				8.85	29.78	539.33	787.67	148.5	1177.17	0.98	288.33	157.67

*Minimum value; **Maximum value

T = Temperature; TDS = Total Dissolve Solid; TSS = Total Suspended Solid;

EC = Electrical Conductivity; DO = Dissolve Oxygen;

COD = Chemical Oxygen Demand; BOD = Bio-chemical Oxygen Demand;

SP-1 is a River terminal

Dissolved Oxygen (DO) is a vital water quality parameter. Hence, it provides information about aquatic bacterial movement, photosynthesis, accessibility of nutrients, stratification, and so on [25]. The decrease of DO makes the water environment inhabitable for aquatic biota [26]. In table 2, DO ranges from 0.6 to 1.4 mg/L with an average value of 0.98 mg/L, which is lower than that recorded by Rahman et al. and Mobin et al. [27, 28] close to these points. Though the lower DO value on Sp-1 was explained by Akash et al. that sp-1 being a river terminal daily, a big load of human wastes and untreated oil are discarded into the river, which may be a likelysource of DO decrease [24].

COD denotes the organic content present in the water body. Higher COD value designates the higher organic pollution [26].The COD level ranged in this study by Akash et al. was between 232 to 340 mg/L and average value is 288.3 mg/L, which is higherthan the DO standard. The higher value of COD implies a higher amount of the industrial and municipal discharge load [24]. Apart from that, in the dry season, due to declined water flow, the growth of microorganisms rises greatly, which is another possible reason for a higher value of COD [24]. BOD specifies how much oxygenis required for microorganisms to oxidize for a given quantity of organic matter. BOD ranges from 82 to 232 mg/L with an average value of 157.7 mg/L, higher than the DO standard [26].

Saline content in water indicates the suitability of water use for drinking, washing, and irrigation purpose [26]. Salt content distresses the soil building, permeability, and ventilation on which the plant growth depends [30]. Salinity ranges from 436 to 612 mg/L with an average value of 539 mg/L, but there is no specific requirement for salinity in the DoE standard.

TDS represents the dissolved inorganic and organic content in water which may be present in the form of both colloidal and dissolved states [24]. Turbidness of water rises with the rise of TDS value [31]. Industrial, municipal, and untreated agricultural discharge can be blamed for the TDS increase in the Turag River [24].

TSS generally contains fine clay, plankton, organic and inorganic compounds, colloidal substances, and other microorganisms [24]. Unprocessed industrial, municipal, and agricultural wastage increases the TSS value [24]. TSS is liable to pH variation. With pH change, the dissolved matter can be aggregated and precipitated [32]. On the other hand, pH indicates the water quality, which determines the acidic nature of water [26].

pH ranged from 8.23 to 9.45, with an average value of 8.85 directing the alkaline nature of water. This alkaline pH is rooted in the untreated industrial (mainly textile and tannery) discharge in the Turag River [24].

The water temperature is vital for chemical, photochemical activity in water [24]. A drastic change in water temperature is fatal for fish and aquatic biota [26,34]. Temperature observed by Akash et al. was in the range of D0E standard [24].

A study was conducted during February–March 2012 (winter) and August–September 2012 to reported number of heavy metals found in fish muscles in Turag River. The data are shown in the below Table 3 [35].

Table 3: Concentration of Heavy Metal found in fish muscle.

Cr	Ni	Cu	As	Cd	Pb
2.2 (0.97-3.60)	1.2 (0.14-2.7)	2.9 (1.1-5.7)	0.22 (0.091-0.42)	0.018 (0.008-0.03)	0.84 (0.052-1.6)

Nickel usually befalls at an insignificant level in the environment, and it can be the reason of several pulmonary diseases, such as lung inflammation, fibrosis, emphysema, and tumors [35, 36]. The toxic effects of Arsenic (As) are dependent on the oxidation state and chemical species. Inorganic As has been measured as carcinogenic and is related to lung, kidney, bladder, and skin disorders [35,37]. Cr and Cu can be considered as the cause of nephritis, anuria, and extensive lesions in the kidney [35,38]. The effects can be deadly (can be acute, chronic, or sub-chronic depending on severity), neurotoxic, carcinogenic, mutagenic, or teratogenic [35, 39]. Cd was spotted in the lowest concentration in the studied fish species [35]. It has been recognized that Cd befalls in the aquatic organisms and marine environment only in trace concentrations [35]. However, it damages several organs such as kidney, lung, bones, placenta, brain and the central nervous system [35,40]. Lead (Pb) is an unnecessary element, and it is well recognized that Pb can be the cause of neurotoxicity, nephrotoxicity, and many others adverse health effects [35, 41].

A team conducted the research (Naser, et al ,2016) from December 2012 to November 2013; they also tried to categorize the inventory of fish in this same river. According to their experiment and finding, species richness was then 71 (71 species of freshwater fishes including 65 native and six exotic species) were found in Turag River. Among 71 fish species, nine endangered, five critically endangered and twelve vulnerable species were spotted according to IUCN red list 2000, as shown in Table 4 [18].

Table 4: Classification of threatened fish species in the Turag River, Kaliakoir, Gazipur, according to IUCN red list 2000 [18, 42].

Order	Family	Scientific name	English name	Local name	Local Status IUCN 2000 list
Osteoglossiformes	Notopteridae	*Chitala chitala*	Humped Featherback	Chital, Chetol	En
		Notopterus notopterus	Grey Featherback	Foli, Fholui	Vu
Cluperiformes	Clupeidae	*Tenualosa ilisha*	River Shad, Hilsa Shad	Ilish, Ilsha	
	Engraulidae	*Gudusia chapra*	Indian river shad	Chapila	
Channiformes	Channidae	*Channa punctata*	Spotted Snakehead	Taki, Lata, Lati	
		Channa striatus	Snakehead Murrel	Shol	
		Channa marulius	Great Snakehead	Gajar, Gajari	En
		Channa orientalis	Walking Snakehead	Gachua, Cheng	Vu
Cypriniformes	Cyprinidae	*Amblypharyngodon mola*	Mola carplet	Mola, Moa	
		Barbonymus gonionotus	Java Barb	Thai Sarpunti	
		Hypophthalmichthys molitrix	Silver Carp	Silver Carp	
		Aristichthys nobilis	Bighead Carp	Bighead	
		Labeo calbasu	Black Rohu, Kalbasu	Kalibaus, Baus	En
		Catla catla	Catla	Catla, Katla	
		Cyprinus carpio	Common carp	Carpu	
		Cirrhinus cirrhosus	Mrigal carp	Mrigal, Mirka	
		Labeo rohita	Rohu, Rohu Carp	Rui, Rohit	
		Labeo gonius	Kuria Labeo	Ghannya, Goni	En
		Labeo bata	Bata Labeo	Bata, Bhangan Bata	En
		Cirrhinus reba	Reba	Tatkini, Bata	Vu
		Labeo boggut	Boggut Labeo	Ghania , Gohria	
		Osteobrama cotio	Cotio	Keti, Dhela, Dhipali	En
		Puntius sarana	Olive Berb	Sar Punti	Cr
		Puntius sophore	Spotfin Swamp Barb	Punti, Jat Punti	
		Puntius chola	Swamp Barb, Chola Barb	Chalapunti, Punti	
		Puntius terio	One spot Barb	Teri Punti	Vu
		Puntius guganio	Grass barb	Mola punti	

		Puntius conchonius	Rosy Barb, Red Barb	Kanchan Punti	
		Rasbora daniconius	Common Rasbora	Darkina	
		Salmostoma phulo	Finescale Razorbelly Minnow	Fulchela	
		Salmostoma bacaila	Large Razorbelly Minnow	Narkalichela	
		Aspidoparia jaya	Jaya	Jaya, Peali	
	Cobitidae	*Botia dario*	Queen Loach, Bengal Loach	Rani	En
		Lepidocephalichthys guntea	Guntea Loach	Gutum	
Siluriformes	Bagridae	*Mystus bleekeri*	Stripped Dwarf catfish	Bajari Tengra, Bujri	
		Mystus tengara	Day's Mystus	Gulsha Tengra	
		Mystus cavasius	Gangetic Mystus	Kabashi Tengra,	Vu
		Mystus vittatus	Stripped Dwarf catfish	Tengra	
		Sperata aor	Long Whiskered	Ayre	Vu
	Siluridae	*Wallago attu*	Boal	Boal, Boali	
	Schilbeidae	*Ailia coila*	Gangetic Ailia	Kajuli, Bashpata	
		Ailia punctata	Jamuna Ailia	Kajuli, Bashpata	Vu
		Clupisoma garua	Garua Bacha, Gagra	Garua Bacha	Cr
		Eutropiichthys murius	Murius vacha	Muri bacha	
		Eutropiichthys vacha	Batchwa vacha, Bacha	Bacha, Garua Bacha	Cr
	Pangasiidae	*Pangaius pangaius*	Pungas	Pangas	Cr
	Sisoridae	*Bagarius bagarius*	Gangetic Goonch	Baghair	Cr
		Gagata cenia	Indian Gagata	Cenia, Jungla	
	Heteropneus-tidae	*Heteropneustes fossilis*	Stinging Catfish	Shing, Jiol	
	Loricariidae	*Hypostomus plecostomus*	Suckermouth catfish	Choshok machh	
Synbranchiformes	Synbranchidae	*Monopterus cuchia*	Cuchia	Kuchia, Kuicha	Vu
Perciformes	Ambassidae	*Pseudambassis lala*	Highfin Glassy Perchlet	Lal Chanda	
		Pseudambassis baculis	Himalayan Glassy Perchlet	Kata Chanda	
		Chanda nama	Elongate Glass-perchlet	Nama Chanda	Vu
		Pseudambassis ranga	Indian Glassy fish	Ranga Chanda	Vu
	Sciaenidae	*Otolithoides pama*	Pama Croaker, Pama	Poa, Poma	C
	Nandidae	*Nandus nandus*	Mottled Nandus	Bheda, Meni	Vu
	Cichlidae	*Oreochromis mossambicus*	Tilapia	Tilapia	
		Oreochromis niloticus	Nile Tilapia	Nilotica, Tilapia	
	Gobiidae	*Glossogobius giuris*	Tank Goby	Bele, Bailla	
	Anabantidae	*Anabas testudineus*	The Climbing Perch	Koi, Kai	
	Osphronemi-dae	*Colisa lalia*	Red Gourami	Lal khalisha	
		Colisa fasciata	Stripled Gourami	Khalisha, cheli	
		Ctenops nobilis	Indian paradisefish, Frail Gourami	Naftani, Napit khailsha	En
	Mastacembe-lidae	*Macrognathus pancalus*	Striped Spinyeel	Guchi Baim	
		Macrognathus aculeatus	Lesser Spiny Eel	Tara Baim	Vu
		Mastacembelus armatus	Tire-track Spiny Eel	Sal Baim, Bro Baim	En
	Mugilidae	*Rhinomugil corsula*	Corsula Mullet	Khalla	
Beloniformes	Belonidae	*Xenentodon cancila*	Needle Fish	Kankila, Kakila	
Tetraodontiformes	Tetraodon	*Tetraodon cutcutia*	Ocellated pufferfish	Tepa, Potka	
		Tetraodon fluviatilis	Green puffer fish	Potka	

Another research by Kamrujjamna et al. (2015) was conducted during July 2010 to June 2012 about the species composition in Bangshi River which is the origin of Turag River.

According to the study, the species abundance was comprised of 33.33% Siluriformes which was the most dominant order, then the percentage is as follows Cypriniformes (31.25%), Perciformes (14.58%), Clupiformes (6.25%), Channiformes (6.25%), Osteoglossiformes (4.16%), Synbranchiformes and Beloniformes of each 2.08% [43].

During October 2014 to September 2015, the composition was found little different. Cypriformes was the most abundant occupied about 39% of the total fish species. Siluriformes was about 22% of fish species and the less abundant fish species were beloniformes, mugiliformes and symbranchiformes each of which obtained only 1% of the total fish species [45].

In the last century, where considerable demand of freshwater arises, the environmental deprivation and habitat loss has been observed, and has threatened several aquatic species [45, 46]. Khanna and Ishaq (2013) recognized that the blame for of the low species diversity of fishes in River Asan (India) goes to the releases from industries, high rate of deposit and effluence due to domestic and commercial wastewater [46, 47].

There was another study conducted in Turag River to know the local community's observations about the indicators and significances of climate change in 2012. The duration of this study was a three-month period from September 17, 2012. There were participants from fishermen and non-fishermen both groups. They were asked about the perceived changes in temperature, rainfall, flood event, fish abundance and taste. About 80 percent participants (both non-fishers and fishers) noticed that the fish breeding season is altering. Same percentage of people also perceived that fish growth and taste have changed. The majority of them noticed that fish biodiversity has radically declined for 15 years, and they mentioned that the recent temperature has been warmer than in the past, and the occurrence of drought has also been showing the rising tendency [47]. Apart from climate change, overfishing, use of pesticides in the agricultural land which washes off in the river through rains, lack of fish reservation and consciousness, andabuse of fish acts are also responsible for the destruction of fish biodiversity [47].

The growth of fish or catch per unit effort deterioration gradually, even in certain months of the year, fish availability is close to zero in the river Buriganga and Turag due to pollution of the river water [48]. This points towards the lower abundance of the species, and pollution of this river can be blamed for the degraded aquatic ecosystem.

Limitations

There was no current information available on the species biodiversity and no quantitively information about species richness in Turag river. Thus, comparing the situation with old date was not possible, we had to depend on the available data and assume a trend. Also, there was contradictory findings in different studies conducted during closer time duration. More research and government projects like "MACH", can improve the situation and can have reliable record of fish inventory.

Suggested conservation intervention

- Using natural dyes can eliminate toxic substantially from the source. Consumers also have drawn their attention worldwide regarding the application of textiles (preferentially natural fiber products) dyed with eco-friendly natural dyes and biological chemicals such as enzymes due to increasing awareness concerning the significance of eco-friendly materials [49].

- Water-efficient dyeing technology can save water and, ultimately, water bodies and, consequently, the ecosystem.

- Regular monitoring of the discharge system and ETP of the mills can help reduce pollutants in the river.

- There are policies in place, but proper implementation is needed. Overfishing is another reason to blame for the biodiversity loss. There were about 500 people found who are directly or indirectly dependent on fishing from this river [50]. Law implementation can reduce overfishing tendency and raising awareness among the fishing community would help in the long run to save this river. At the same time creating alternative livelihood for a part of them can reduce overfishing to some extent.

- The water bodies which have been contaminated already should go under monitoring and processing if needed.

- Using improved technology, adopting greener production options, reusing, and recycling treated water may reduce water consumption, effluent volume, water stresses and help preserve aquatic ecosystems.

- The insights from local fishing communities and critical plaintiffs demands an ecosystem assessment at the Turag River to see how changes are maintained by an array of natural and anthropogenic factors and concerns [51]. The localcommunity knowledge and experience should be taken into consideration when implementing a restoration process.

- The Riparian ecosystem restoration can be a groundbreaking way to manage the critical river system [52]. The Riparian ecosystem concept emphasizes greenery on the riverbank to create habitat for many species, boost the quality of soil and offer an uplifting environment for restoration. Riparian zones offer substantial housing for aquatic creatures, water temperature adjustment, dropping deposits and corrosion, etc. This theory also displays that the Riparian zones diminish surface overflow pollution and improve water quality. The bank of the Turag River could be a suitable location to develop the Riparian Ecosystem.

Conclusion

Sustainable and green new technologies should be implemented to continue Bangladesh's socio-economic growth and develop a healthier ecosystem. Environmental Management, proper law enforcement, sustainable material usage, Riparian Ecosystem all can contribute to the restoration of the Turag River. All of them are appropriate for Bangladesh and can benefit the people living

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near the Turag River. Since there has been limited research on biodiversity in Turag River, we had to depend on the available secondary data sources. Further research is required on this area to know the extent of damage has been done and more steps needed to be implemented to restore this valuable ecosystem.

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Conflict of Interest

Authors declare no conflict of interest.

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