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SUDDEN DEATH OF FISHES IN MEGHNA RIVER ESTUARY: A FIRST REPORT OF MASS FISH DEATH IN MEGHNA RIVER

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ABSTRACT:

Water bodies and its biodiversity are being hampered as results of water pollution. Sudden death of fishes in the river Meghna have been observed for the last 5 years during pre-monsoon periods. This study was conducted to report the causes of sudden fish mortality in six-kilometer-wide areas of the Meghna River from Motlob Uttar Upazila of Chandpur to Gazaria Upazila of Munshiganj from March 20 to April 4, 2023. Nine types of death fish, including Bearded worm goby (*Taenioides cirratus*), Pama croaker (*Otolithoides pama*), Indian river shad (*Gudusia Chapra*), Tank goby (*Glossogobius giuris.*), Spotted snakehead (*Channa punctata*), Striped snakehead (*Channa Striata*), Pangas catfish (Pangasius pangasius), Long-whiskered catfish (*Sperata aor*), Ganges river sprat (*Corica soborna*) etc. and other aquatic animals like *Macrobrachium sp*,Crabs, Mussels, Oysters etc were observed in these affected areas. Key water quality parameters including Dissolve Oxygen (1.0-2.5 ppm), PH (6.0-6.2), Ammonia (1.6-2.1 ppm), water colour and odor, were not congenial during the mortality periods. Other parameters like Temperature, Alkalinity were within suitable ranges. As frequently occured this phenomena, further intensive investigation is required to identify the cause of sudden fish death and better management.

KEY WORDS: *Sudden Fish death, Meghna Estuary, Pollution, Water Quality.*

INTRODUCTION:

Estuaries are dynamic habitats with significant variations in environmental conditions since they are the meeting point of freshwater from rivers and saltwater from the sea (James et al., 2007). Many regions of the world recognise the value of estuaries as fish breeding and nursery grounds. Meghna river estuary is the largest estuarine ecosystem of Bangladesh and support diverse fisheries communities compared to others (Hossain et. al, 2012). Essentially, the Surma, Dhaleswari, Brahmaputra, Buriganga, Shitalakshya, and Ganges or Padma come together at this estuary. The branches of the Padma join the Meghna in Mohanpur of Matlab North Upazila of Chandpur, and on the upper reaches of the Meghna at Narayanganj, Shitalakshya and Buriganga fall into the Meghna. This region is known hydrographically as the Upper Meghna, extending down to Chandpur.

It is known as the Lower Meghna and flows into the Bay of Bengal after the Padma joins. The four main mouths of the Meghna, Tetulia, Shahbazpur, Hatiya, and Bamni, empty into the Bay of Bengal. The estuary is where salty ocean water from the Bay of Bengal meets fresh water from the rivers. In terms of natural biodiversity, the Meghna River Estuary is crucial (Rahman et al., 2017). Hydrological parameters have been identified as critical components for the dispersion of 53 fish species that call this estuary home (Hossain et al., 2012). Currently, Bangladesh's Meghna River supplies most of the country's hilsa. Millions of fishing communities and business organisations are directly and indirectly active in the Meghna, which provides 38.94% of Bangladesh's inland open water catchment resources (about 1.98 million tonnes) (FRSS 2020-21).The hydrochemistry of the upper branch of Meghna Like Shitalakshya River was revealed that the water was not safe for aquatic lives as well as human health (Islam et. al., 2015). Water pollution and climate change are major global concerns. Pollution from water sources is becoming a major worldwide environmental issue that endangers both human health and the aquatic ecosystem (mustafa et al., 2024).Water pollution is hindering the biodiversity of the water bodies that are linked to it. The contamination in the water courses near Dhaka, specifically Buriganga, Turag, Tongi Khal, Balu, Shitalakshya, Bangshi, and Dhaleswari, was the subject of a government research carried out in 2007 by the Institute of Water Modelling (IWM). According to the government, the rivers Buriganga, Shitalakhya, Balu, and Turag encircle Dhaka city. The Ministry of Environment and Forests (MoEF) of the Government of Bangladesh designated the river as an Ecologically Critical Area (ECA) in 2009. Among the industrial zones, Narayanganj is the nation's second-largest developed industrial area. This region is home to a variety of industrial facilities, primarily related to the textile and dyeing sectors. The Shitalakkhya River receives untreated dye containing heavy metals discharged by the textile and dyeing industries. Different kinds of solid, liquid, and gaseous wastes are all included in industrial wastes. These wastes have distinct qualities than commercial and municipal wastes (Rahman and Bakri, 2002). Bangladesh's waterways are the worst affected by pollution,

endangering millions of people, particularly in the capital city of Dhaka and the surrounding areas where river pollution levels are extremely high. For the past few years, there have been reports of fish in the Meghna River suddenly dying during the pre-monsoon season. From March 20 to April 4, 2023, a study was carried out to report the scnery of unexpected death of fish in six-kilometer-wide sections of the Meghna River, spanning from Motlob Uttar Upazilla of Chandpur to Gazaria Upazilla of Munshigonj.

MATERIALS AND METHOD:

Sampling sites and duration:

The Meghna River saw an abrupt outbreak of fish death from March 20 to April 4, 2023. Approximately 06 km along the Meghna River separates Shatanal Union of Matlab Uttar Upazila of Chandpur and Ghazaria Upazila of Munshiganj District, which includes Ekhlaspur, Mohanpur, Sotaki Lunch Ghat, Babubazar Shatnol, Shatnol Lunch Ghat, Sholoani Gozaria, and its adjacent villages. In the aforementioned regions, a sampling was carried out between March 25, 2023, and April 7, 2023. The primary water quality parameters within the study region were collected and examined from these locations over the designated times.

Table-1: Geographical co-ordinations of sampling areas

Sampling areas	Longitude	Latitude
Ekhlaspur	90.605428	23.376447
Mohonpur	90.597707	23.395774
Sotaki Lunch ghat	90.592071	23.449515
Babubazar shatnol	90.592255	23.46322
Shatnol Lunch Ghat	90.592589	23.478656
Sholoani gozaria	90.5945122	23.513434

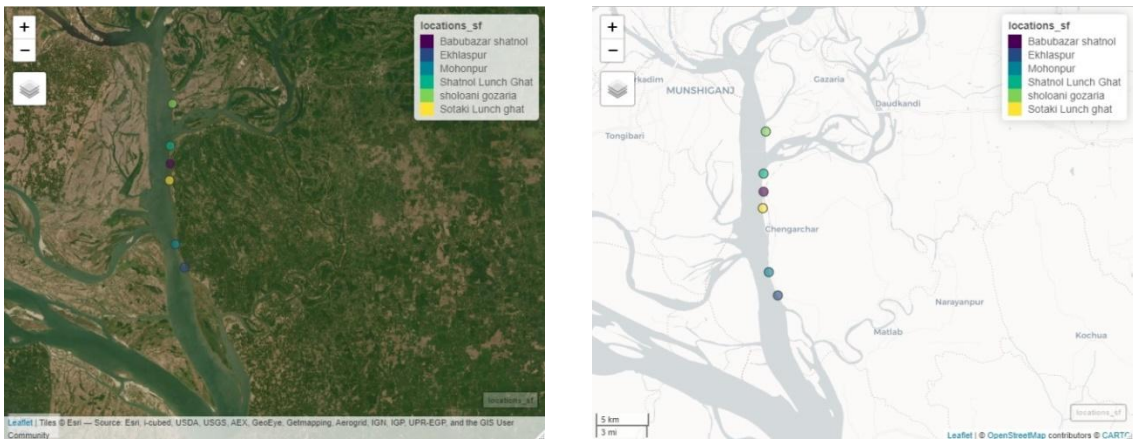

Figure-1: Geographical Location of sampling areas (satellite and normal view)

Physico-chemical parameters:

There have been reports of fish deaths in certain areas. Samples of water and fish were taken from the sampling sites and examined right away using the HACH kit (FF-2 USA). A digital Celsius thermometer (Hanna portable HI 98128 water resistant temperature metre) was used at the sampling point to record the temperature of the air and water. The following parameters were measured using a HACH test kit (Model-FF-2, USA): alkalinity, hardness, PH, free carbon dioxide (CO2), and dissolved oxygen (DO). Using a secchi disc and measuring tape, transparency was assessed.

RESULT AND DISCUSSION:

Physico-chemical parameters

Table-2: Water Quality parameters of sudden fish death areas in the River Meghna:

Serial No.	Water Quality	Results (In between fish death)	Tolerable levels	Comments
01	Water color	dark	light green	not safe for fish
02	Odor	A musty odor	As usual	not safe for normal fish
03	Air temperature(°C)	28.5 - 30.1	20-30 (EQS,1997)	safe for fish
04	Water temperature (°C)	26.5 - 28.2	20 – 30 (EQS,1997)	Safe for fish.
05	dissolved oxygen (mg/L)	1.0 - 2.5	4.0-6.0 (EQS,1997)	Extremely low than normal which was very intolerable for fish and was the main cause of widespread fish kills.
06	pH	6.0 - 6.2	6.5-8.5 (EQS,1997)	pH below 6.5 is not favorable for fish. At a much lower pH, the fish's body begins to secrete large amounts of mucus - which can easily kill the fish by becoming infected with pathogens.
07	Ammonia (mg/L)	1.6 - 2.1	<0.02 (Rahman,1992)	The amount of ammonia found in the river water was very high. Such water is conducive to fish disease and directly responsible for death.
08	Alkalinity (mg/L)	95 - 102	>100 (Rahman,1992)	Safe for fish.

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Upon investigation, the water in the areas affected by the fish outbreak had a dark, foul odour. Dead fish of several sorts were visible floating in the river. An analysis of water samples from various locations within the impacted zones revealed that the dissolved oxygen content ranged from 1.0 to

2.5 mg/l, while the ammonia content ranged from 1.6 to 2.1 mg/l. These values are approximately 3–4 times greater than the acceptable threshold, which is typically between 0.02 and 0.02 (Rahman, 1992) (Table 2).

Scenario of dead fishes:

Among the observed species, The most percentage of dead fishes were Bearded worm goby (*Taenioides cirratus) and* Tank goby (*Glossogobius giuris*). Among the fish species, two of them were Vulnerable and critically endangered but most of them were least concern according to local and global aspect of IUCN Red list, 2015. These were Bearded worm goby (*Taenioides cirratus*), Pama croaker (*Otolithoides pama*), Indian river shad (*Gudusia Chapra*), Tank goby (*Glossogobius giuris*.), Spotted snakehead (*Channa punctata*), Striped snakehead (*Channa Striata*), Pangas catfish (Pangasius pangasius), Long-whiskered catfish (*Sperata aor*), Ganges river sprat (*Corica soborna*) etc. and other aquatic animals like *Macrobrachium sp*,Crabs, Mussels, Oysters etc (table-3)

Out of all the species that were seen, Bearded Worm Goby (*Taenioides cirratus*) and Tank Goby (*Glossogobius giuris*) had the highest percentage of dead fish. According to local and global aspects of the IUCN Red List, 2015, most of the fish species were of least concern, with the exception of two that were classified as critically endangered or vulnerable. These included the following: Pangas catfish (*Pangasius pangasius*), Long-whiskered catfish (*Sperata aor*), Bearded worm goby (*Taenioides cirratus*), Pama croaker (*Otolithoides pama*), Indian river shad (*Gudusia Chapra*), Tank goby (*Glossogobius giuris*.), Spotted snakehead (*Channa punctata*), Striped snakehead (*Channa Striata*), and other aquatic creatures such as *Macrobrachium* sp, crabs, mussels, oysters, etc. (table-3).

Table-3: List of sudden death fishes in the affected areas of Meghna River estuary :

Order	**Family**	**Scientific Name**	**English Name**	**Local Name**	**IUCN status (2015)**		**Global Population trend**
					Global	**Local**	
Clupeiformes	Clupeidae	*Gudusia chapra* (Hamilton, 1822)	Indian river shad	Chapila	LC	NO	DE
		Corica soborna (Hamilton, 1822)	Ganges river sprat	Kachki	LC	NO	UN
Perciformes	Gobiidae	*Glossogobius giuris* (Hamilton, 1822)	Tank goby	Bele	LC	NO	UN
		Taenioides cirratus	Bearded worm	Chewa	LC	LC	

Order	Family	Scientific Name	English Name	Local Name	IUCN status (2015)		Global Population trend
					Global	Local	
		(Blyth, 1860)	goby				
	Channidae (Snakeheads)	*Channa punctata* (Bloch, 1793)	Spotted snakehead	Taki	LC	NO	UN
		Channa striata (Bloch, 1793)	Striped snakehead	Shol	LC	NO	UN
Perciformes	Sciaenidae	*Otolithoides pama* (Hamilton, 1822)	Pama croaker	Poa	LC	NO	UN
Siluriformes	Bagridae (Bagrid Catfishes)	*Sperata aor* (Hamilton, 1822)	Long-whiskered catfish	Ayre	LC	VU	ST
	Pangasiidae (Shark Catfishes)	*Pangasius pangasius* (Hamilton, 1822)	Pangas catfish	Pangus	LC	CR	DE

Global conservation status: DD, Data Deficient; LC, Least Concern, NT, Not Threatened

Local conservation status: CR, Critically Endangered; DD, Data Deficient; EN, Endangered; EX, Exotic; NO, Not Threatened; VU, Vulnerable

Population trend: DE, Declining; NA, Not Assessed; ST, Stable; UN, Unknown

Possible sources of fish death:

The possible source of fish death might be

- Buriganga and Shitalakshya rivers might be 15-20 Km distance from death spot.
- Various cement, fertilizer, garments, paints, oil refineries and other industries have been built unplanned on the banks of all these rivers.
- According to the fishermen of Malopara fishing village of Babubazar, Shatanal, untreated waste from various factories located on the banks of Shitalakshya and Buriganga Rivers in

DISCUSSION:

The concentration and distribution of contaminants in aquatic environments might differ based on the particular site, pollution sources, and surrounding circumstances (Gavrilescu et al., 2015). The fish death zones had foul-smelling, dark water at the time of examination. Dead fish of various types

were observed floating in the river. An important factor to consider while evaluating the aquatic environment is the temperature of the water. Since oxygen is essential to aquatic life, colder water has more of it than warm water (Mandal et al., 2012). Fish and biota perish from sudden changes in water temperature (Patil et al., 2012). A study of water samples taken from several locations within the impacted areas revealed that the water's dissolved oxygen content ranged from 1.0 to 2.5 mg/l. which, according to EQS,1997, is much lower than normal values (4.0–6.0 mg/L). According to Islam et al. (2015), DO is the most important water parameter that detects the presence of life in the body of water. Aquatic biota cannot survive in a body of water if DO decreases. The PH ranged from 6.0 to 6.2, and the amount of ammonia was 1.6 to 2.1 mg/l, which is almost 3–4 times higher than the acceptable threshold, which is typically <0.02 according to Rahman, 1992 (Table 2). The fish had first been thought to have died due to an increase in the amount of contaminated ammonia gas in the river water and an unusual drop in the concentration of dissolved oxygen. The most crucial factor in determining the corrosive nature of water is its pH level. A lower pH value suggests that the water is more corrosive and acidic (Patil et al., 2012). For fish, a pH of less than 6.5 is not ideal. The fish's body starts to create a lot of mucus at a much lower pH, which can quickly cause the fish to become infected and die. A similar result was noted in 2012–13 at a different location of the Shitalakkhya River, Bangladesh, for water quality parameters ranging from temperature 20.5–31.3 C, pH 6.9–8.0, TDS 80–754 mg/L, and DO 0.5–3.5 mg/L (Islam et al., 2015). Aquatic species can be impacted by pollution in a variety of ways, such as by hazardous chemicals being introduced, the pH of the water being altered, and the amount of dissolved oxygen being reduced. These changes may result in widespread mortality and be fatal to a variety of aquatic species. (Mustafa and others, 2024). Village fisherman in Chandpur's Shatanl Matlab Uttar Upazila had reported that abrupt fish deaths had been happening in the river between March and April for the previous five to six years. However, compared to previous years, there were much more fish deaths in the river this year. Examining the potential cause of the alteration in the physico-chemical quality of the water reveals that the Meghna River lies roughly 15-20 km away from the impacted region. The rivers Buriganga and Shitalakshya are off in the distance. The river's dissolved oxygen content had been drastically decreased due to recent factory discharges of dirty effluents, and ammonia levels had risen. Fishermen from the Malopara fishing village in Babubazar, Shatanal, claim that untreated garbage from several companies near the banks of Shitalakshya and Buriganga contains different untreated wastes, poisonous ammonia, and other contaminants. Rivers in Narayanganj flowed into the river either continuously or sporadically.Human health and aquatic life was not safe in the Shitalakkhya River, according to hydrochemistry research (Islam et al., 2015).These nutrients mostly reach water bodies by stormwater runoff from cities, wastewater discharges, and agricultural runoff. They alter aquatic ecosystems and cause toxic algal blooms as well as oxygen depletion (Chislock et al., 2013; Mustafa & Jha, 2022). Urban runoff, oil spills, and industrial discharges can all introduce oil and petroleum

products into aquatic habitats (Mironov, 1968; Guo et al., 2022). Fish, seabirds, marine mammals, and species that reside in or close to the water's surface can all be seriously threatened by these pollutants (Gavrilescu et al., 2015). Fish could not survive in the river water due to these physico-chemical factors. The Meghna River is home to 21 species of threatened fish, of which 11 (10.28%) are vulnerable (VU), 8 (7.48%) are endangered (EN), and 2 (2%) are critically endangered (CR), according to the IUCN. The abrupt fish death in the Meghna River poses a severe threat to the ecological ecosystem given its precarious state. About nine distinct kinds of fish were found to have perished during the examination of the river's impacted areas. Among the observed species, The most percentage of dead fishes were Bearded worm goby (Taenioides cirratus) and Tank goby (Glossogobius giuris). Among the fish species, two of them were Vulnerable and critically endangered but most of them were least concern according to local and global aspect of IUCN Red list, 2015. After that, in the preliminary observation of the overall aspect, it is evident to the scientists that due to the discharge of the polluted waste of the factory into the river, due to the abnormal lack of oxygen dissolved in the river water and the increase of ammonia, there is a widespread disease of fish in the river since March 20, 2023. Effective pollution control methods, adequate waste management, and sustainable practices are vital to safeguard and maintain water quality, given the detrimental effects of these pollutants on aquatic ecosystems and human health (Bashir et al., 2020; Perkumiene \et al., 2023).Thus authorities should take necessary steps to prevent the untreated industrial and municipal discharge by installing effluent treatment plant (ETP) and no permission should be given to setup new industries without setting an effluent treatment plan (Islam et. al., 2015). Environmental risk assessment, best management practices, and monitoring systems must be established to reduce the negative effects of pollutants on aquatic environments. This occurrence was influenced by a combination of natural and human factors. Hence, addressing the underlying causes is essential for mitigating their impacts on ecosystems and human health.(Mustafa et.al., 2024). Further, it is essential to develop approaches to mitigate these threats and protect the aquatic environments and organisms within them, including fish (Bundschuh et al., 2019). Further studies are needed to find out the specific cause and mitigate the fish death in future.

CONCLUSIONS:

River water pollution is a threat to fish and other aquatic life. As a result of excessive pollution in the Meghna River, there is a fear of destruction of the habitat of Hilsa and other fishes and various aquatic animals, reduction of reproduction, change in reproduction, increase in the mortality rate of larvae of many species and above all, there is a fear of reduction in fish production. If it is not possible to prevent the pollution of Meghna and its tributaries, there is a risk of fish biodiversity and disease spreading in the future.

RECOMMENDATIONS:

- Collection of water sample and analysis must be in consistent way and on regular basis
- Stop setting up new unplanned factories in places along Buriganga, Shitalakshya and Meghna rivers
- Ensuring discharge of polluted waste from factories located on the banks of the river into the river by purifying and decontaminating it through ETP system.
- Ensuring installation of ETP plants in each factory and central ETP plant in river Meghna if necessary.
- Stop dumping of household waste and sewage into rivers.(5)
- To strengthen the monitoring and enforcement of the Department of Environment to keep the relevant areas of the Meghna River free from pollution
- Forming a national policy by forming an inter-ministerial task force committee to protect river biodiversity and prevent water pollution
- To prevent the pollution of river water, to make arrangements to obtain clearance from the Department of Environment before discharging the waste of each factory
- To increase public awareness to prevent river pollution in places along Buriganga, Shitalakshya and Meghna rivers..

CONFLICT OF INTEREST:

We declare that we have no conflict of interest.

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ETHICAL APPROVAL OR CLEARANCE:

Not applicable.

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