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Microplastic in Freshwater Fish Culture Pond of Darbhanga

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Abstract: *Plastic, a synthetic organic chemical product, is being reasoned as one of the most important aquatic pollutant. The present communication deals with assessment of one of the largest fish culture pond of Darbhanga town from microplastics contamination (Less than 500µm in size) point of view is surface water samples. Findings suggests that the pond reasonably contaminated with plastic materials in form of fibre (51-55/m^3), film (32-34/m^3), foam (0-2/m^3), Fragments (29-33/m^3) and beads(0-2/m^3). The main source of plastic were find to be primarily due to domestic waste flows and secondarily from the materials disposed around the pond or landfills that washes away into the pond. The study needs further elaborate investigation which is being pursued.*

Keywords: *Microplastics, Aquatic contaminants, Fish culture ponds.*

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I. Introduction

During recent years the plastics are being looked upon as one of the most important aquatic pollutant, due to their worldwide distribution and various applications. Their efficient use particularly in packaging of food materials, almost all medical items, electrical products, construction materials, agricultural industries, fishery products, automobiles and many others have made them increasingly popular in day to day life.

Plastics are synthetic organic chemicals comprised of a variety of materials to meet very different needs. Some common type of plastics include polyethylene terephthalate (PET), Polypropylene (PP), Polystyrene (PS), Polyethylene (PE), Polyvinyl-chloride (PVC), Expanded polystyrene (PS-E), High density polyethylene (HDPE), Low density polyethylene (LDPE). These all products are persistent in nature and pose serious threats to flora and fauna (Shimao, 2001 and Barnes *et. al.*, 2009). Thompson *et al.*, (2004) and Halle *et. al.*, (2016) have emphasized that mechanical or biological fragmentation of all plastic debrises leads to formation of microplastics. It has been also emphasized that microplastics are persistent and accumulate water born contaminants like heavy metals (Ashton *et. al.*, 2010; Wagner *et. al.*, 2014 and Brennecke *et. al.*, 2016). Besides, deposition of pesticides and organic pollutants have also been reported on plastic debrises making them far more toxic than expected (Barnes *et. al.*, 2009).

The plastic industry in India, since its establishment in 1960s has observed a steady growth. According to a study indicates that plastic industries in India has grown at a compound annual growth rate of 10% in term of volume (FICCI, 2017). Current per capita consumption of plastic in India is about 11 kg per annum (NRI, 2019). Eerkes-Medrano *et. al.*, (2015) in his recent review on microplastics have listed twelve studies on the occurrence of microplastics in freshwater system of which five studies were on freshwater sediments. The present study however, deals with surface microplastics in one of the largest pond of Darbhanga Town routinely used for fish culture and popularly known as Dighi pond. The pond is located in middle of the town with domestic house hold all around receives a huge quantity of domestic sewage discharge. It has a rectangular shape and measure about 731m in length and 365m in width. This study has been conducted to estimate the presence of microplastics in surface water of Dighi pond and identify their nature.

II. Materials And Methods:

Parameters like general appearance of the pond and water color were usually observed and registered. The depth was measured using routine technique with the help of boat. Temperature, pH, total alkalinity, Dissolved oxygen and redox potential were measured by employing portable water analyser (Systronics) and Gri pH meter (Hana, Japan).

The water samples were collected through plankton net (50-300µm). The water surface was meshed with the floating microplastics by using a boat run across at the speed of 10km/hr. The volume of the water

filtered was recorded with a flow Meter (10-100LPH, Ocean star Make) fixed at the net opening as suggested by Loader and Gredts (2015). The operation was continued till the net appeared as clogged. The planktons that concentrate on cod–end of the net were thoroughly and carefully rinsed following the method of Doyle *et. al.,* (2011).

The remaining sample was carefully removed from the net and fractioned in two units (A and B). The first half (A) was put in a sample container (Borosil) and fixed with formalin (Sigma, AR Grade). The second half (B) was sun dried and kept in light proof coated bag until further analysis.

Extraction of microplastics was done following Loader and Gredts (2015) by "classical filteration set up". The samples were suspended in saturated NaCl solution (Browne *et. al.,* 2011) and agitated by 'wrist-action-shaker' for 15-20 minutes. The plastic particles float to the surface or stay in suspension. Subsequently, microplastics are recovered by removing the supernatant.

Size fractionation of the extracted sample was performed by using 500µm sieve made of steel. Microplastics >500µm were selected manually under a stereoscopic microscope with the help of a forecep. Further fragmentation was done by using a similar sieve of 300µm. The residual samples on mesh were collected with the help of saturated salt solution and treated with 20ml of 30% Hydrogen Peroxide overnight to remove natural organic materials. Thus, the two sizes of microplastics (>500 and <500) were studied.

About 1g of each sample was subjected to visual quantification of microplastics by adding 1ml of water. One drop of the solution was put on a slide, spreaded by putting a coverslip and observed under bright field microscope (Olympus, CH40) at 40 fold magnification to differentiate different shapes like fiber, fragment, spherical etc.

III. Results

Table : 1. Showing physico-chemical parameters of Dighi pond (DP) from January 2019 to December 2019.

Parameters	Jan	April	July	Sept.	Dec
General appearance	N	G	DG	DG	N
Water colour	LG	G	DG	DG	LG
Depth (in m)	15±0.15	15±0.12	15±0.12	16±0.11	15±0.10
Temperature (in ºC)	17.0±3	18.7±3	27.0±5	31.0±5	20.0±5
pH	8.1±0.04	8.4±0.031	9.5±0.02	10.5±0.03	9.0±0.03
Transparency (in cm)	138±0.45	131±0.30	152±0.28	153±0.34	138±0.42
Total alkalinity (in mg/L)	380±0.37	335±0.33	320±0.41	310±0.40	365±0.30
Dissolved O_2 (mg/L)	2.5±0.04	3.0±0.01	5.2±0.023	6.0±0.041	2.8±0.07
Redox potential (mmhos/cm)	556±0.44	568±0.40	582±0.12	571±0.31	548±0.36

N=Normal, G=Green, DG=Dark Green, LG= Light Green

Table 2: Visual quantification of Microplastics/identification in surface sample of Dighi pond (DP) from January 2019 to December 2019.

No. of samples	Fibre	Film	Foam	Fragment	Beads (spherical)	Coloured
In per m^3						
1	41-45	32-34	0-1	15-18	0-1	0-1
2	45-49	16-20	0	19-22	0-2	0-1
3	45-50	11-15	0-2	21-25	0-1	0-1
4	42-46	12-17	0-1	27-30	0-2	0-1
5	46-49	26-30	0	11-15	0-1	0
6	41-44	23-28	1-2	21-26	0	0
7	51-55	10-13	0	11-15	1-2	0-2
8	50-54	11-16	0-1	20-24	0-1	0-1
9	48-51	21-24	0	12-16	1-2	0-1
10	42-49	17-21	0-2	22-26	0-1	0
11	37-41	22-26	0-1	23-28	1-2	0-1
12	41-46	21-24	0-1	18-22	0-2	0-2
13	41-43	19-22	0-1	26-30	0-1	0-2
14	40-45	16-18	0-2	29-33	0	0
15	43-49	17-19	0-1	22-26	0-2	0-1
16	42-47	18-21	0	18-21	0-2	0-2
17	37-40	28-31	0	12-17	0-2	0-1
18	39-42	30-33	0	14-18	0-1	0-2
19	41-44	13-19	0-1	11-15	1-2	0-2
20	42-45	16-20	0-2	19-22	0-2	0-2

Fig 1: Dighi Pond (DP).

IV. Observations And Discussions

The physiochemical properties of the pond under investigation (Fig. 1) has been presented (Table 1). Further, table 2 depicts the visual quantification of microplastics in surface samples of the ponds. Altogether 20 samples were studied. Perusal of the table clearly indicated that microplastics fibre (Fig. 1) dominated in all samples (51-55 in numbers) followed by film (32-34 in number) and fragment (29-33 in number). Spherical beads, sometimes colored ones were also recorded.

Finding suggest that the plastics debris recorded from the present pond comes primarily from the domestic wastes outflows and secondarily from the material disposed around the pond or landfills that washes away, entering the pond water. Similar findings have been also suggested by Ambeck *et. al.,* (2015) and Lechner *et. al.,*(2014) in case of oceans. As these debris accumulate in convergence zone under the influence of wind or water pressure, the light level may be reduced in underlying water causing depletion in oxygen level. Subsequently affecting the benthic habitat and structure as well.

A review of the literature relating to microplastic ingestion and its toxicity in aquatic environment shows the fish are most commonly affected (Blettler *et. al.,* 2018) species. Degradation of habitats, ingestion of unintentional toxic feed in form of microplastics are the main concern. Reports suggest that the POPs such as polychlorinated biphenyles often carry pesticides increasing the magnitude of toxic potentials (Rios *et. al.,* 2007). It is apparent that plastics have the potential to absorb chemicals of concern from the environment and serves as a potential global transport mechanism for contaminants of concern (EPA, 2011b). Microplastics resembles phytoplankton, which are eaten by fish (Boerger *et. al.,* 2010). These ingested plastics debris has been found to reduce stomach capacity, hinder growth cause internal injuries, are create intestinal blockage (Plot and Georges, 2010).

Further, the consumption of plastics by aquatic organism adds persistent, bioaccumulative and toxic substances to the aquatic food chain (Pascall *et. al.,* 2005). Microplastics can be ingested by low trophic suspension, filter and deposit feeders (Murray and Cowie, 2011). Toxicity could also arise from monomers and plastic additives, capable of causing carcinogenesis and endocrine disfunction (Talsness et al., 2009). A major concern about the toxic compounds associated with the plastics is that they can disrupt hormone regulation in cells of organism (Oberdorster and Cheek, 2001).

Galafassi *et. al.,* (2021) have presented a review on current knowledge of microplastics ingestion by wild freshwater fish with a focus on identification of possible factors leading to ingestion of microplastics and the consequences on fish health. The present study is an addition to the national as well as global documentation of condition of the freshwater bodies with microplastic contamination point of view. Further studies, highlighting its impact on fish health is underway.

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