Assessment of Microplastics Contamination along the Stretch of Wangchhu River in Thimphu, Bhutan

Ugyen Tshomo
Bhutan

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Overview

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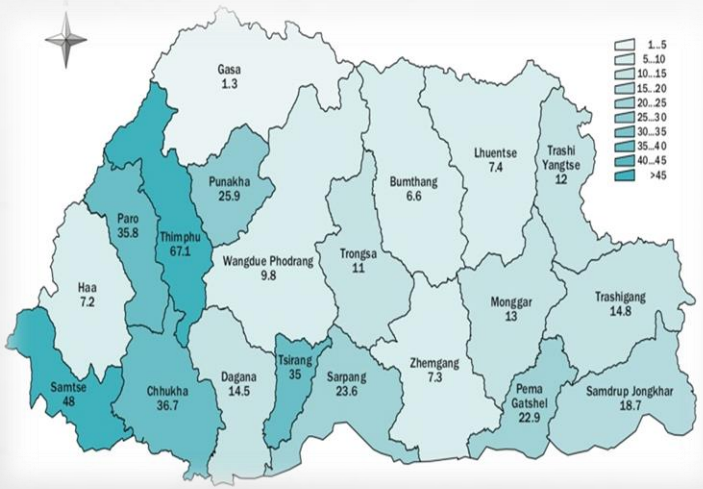
Background of Bhutan



Population of Bhutan (PHCB 2017)

- Bhutan is a small developing country sandwiched between China in the north and India in the south.
- Total size of Bhutan is 38,394 km with a total population of 7,31,553 (PHCB, 2017)
- In late 1980s, 90% of the Bhutanese people lived in rural areas with population of 600,000 depending on subsistence agriculture.
- In 2017, urban population increased to 37.8.9 % and rural population reduced to 62.2 % (PHCB 2005).
- Rapid economic development, urbanization with shift in consumption pattern of goods from organic to commercial goods (industrial manufactured goods) and increased population has resulted in mounting waste generation in Bhutan especially urban towns.

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Problem Statement

- When the Ganges of South Asia has already been studied for microplastics pollution (Baroth et al., 2019; Nelams et al., 2020), the Brahmaputra is not studied yet.
- In addition, several studies of microplastic pollution in marine ecosystem have been conducted; whereas, freshwater bodies require more studies particularly in Bhutan.
- Therefore, a study on plastic contamination in freshwater bodies is required to identify the exposure and threat of microplastic to aquatic life and the environment for better management of plastic wastes.

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Objectives

The specific objectives are as follow:

1. Study the amount of microplastics at the upstream and downstream of the Wangchhu river flowing through Thimphu Municipality in Bhutan;

2. Provide recommendations on reduction of microplastics in the Wangchhu river.

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Scope of the Study

- This study collected the samples during May 2022 which do not cover the period of high and low water in the river;
- Effluents from waste water treatment plants which are considered as sources of microplastics have not been collected due to time limitation and;
- Thus, the recommendations on microplastic mitigation measures were based on the desk study only.

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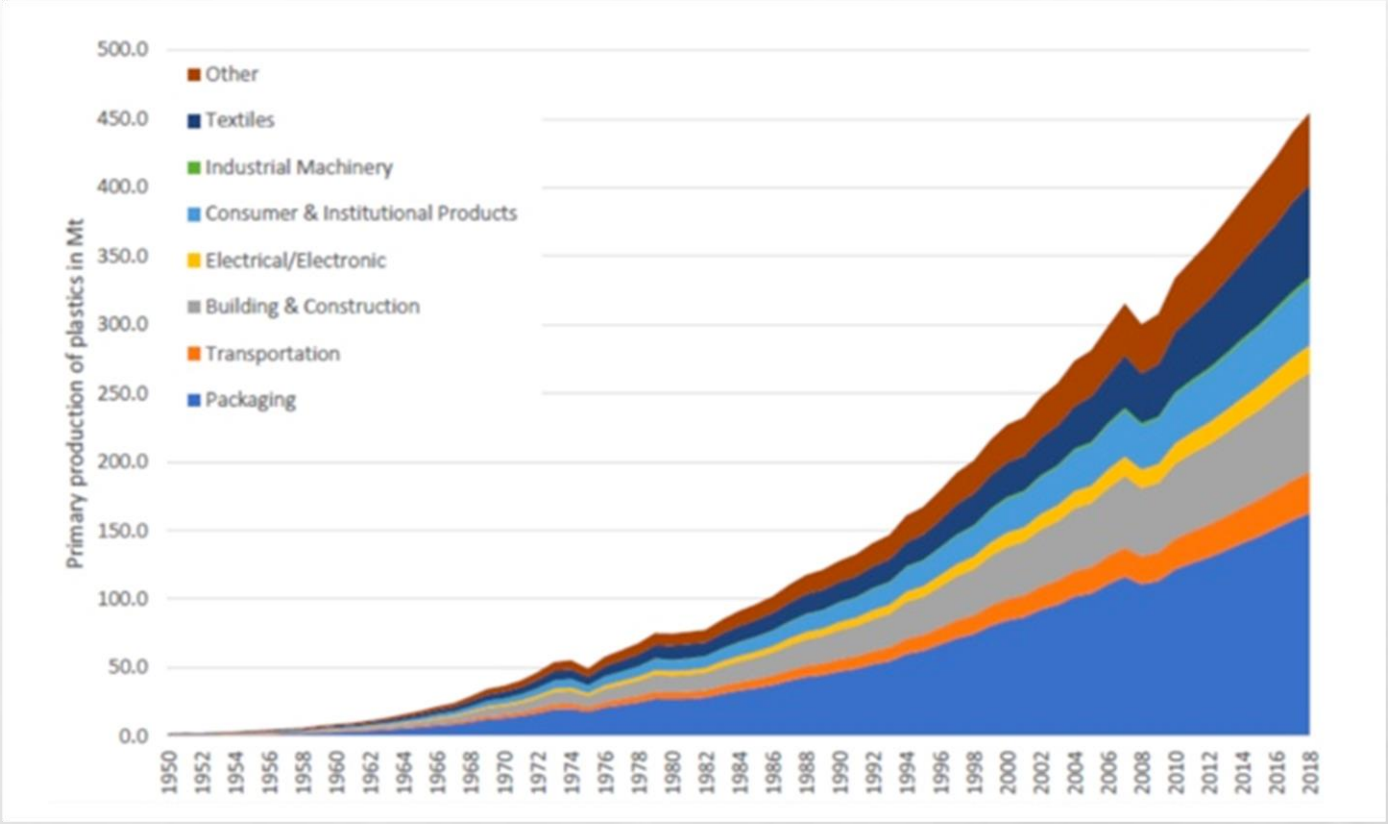
Global Plastic Production

- Plastics are polymers with properties: lightweight, resistant, and long-lasting, impermeability, and low cost (Thompson et al., 2009; OECD 2022);
- In 1950-2018, plastic packaging sector alone contributed about 163 million tons from total of 460 Mt, making up to 36 % of global yearly resin production (Geyer, 2020).



Source: Geyer et al., 2020

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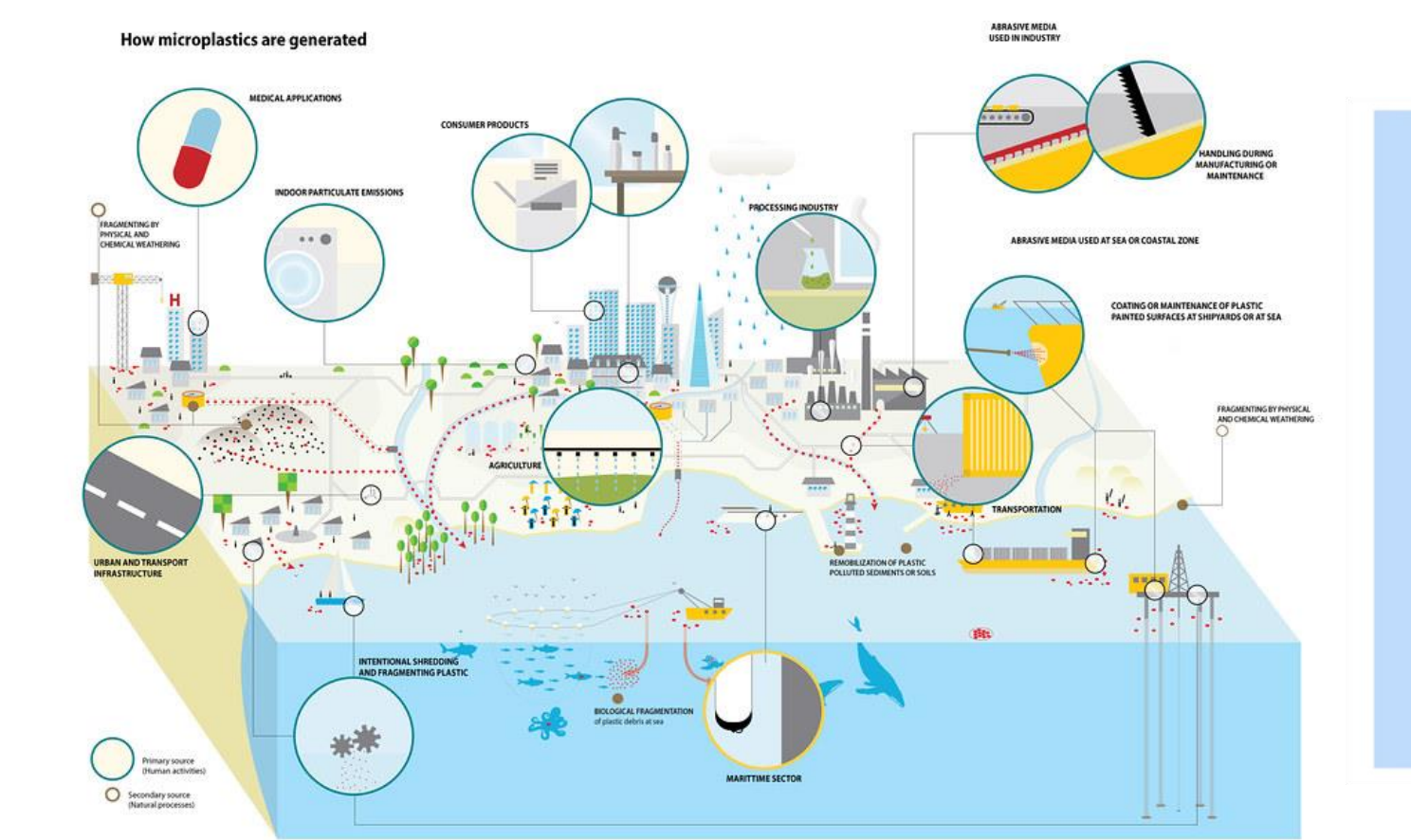
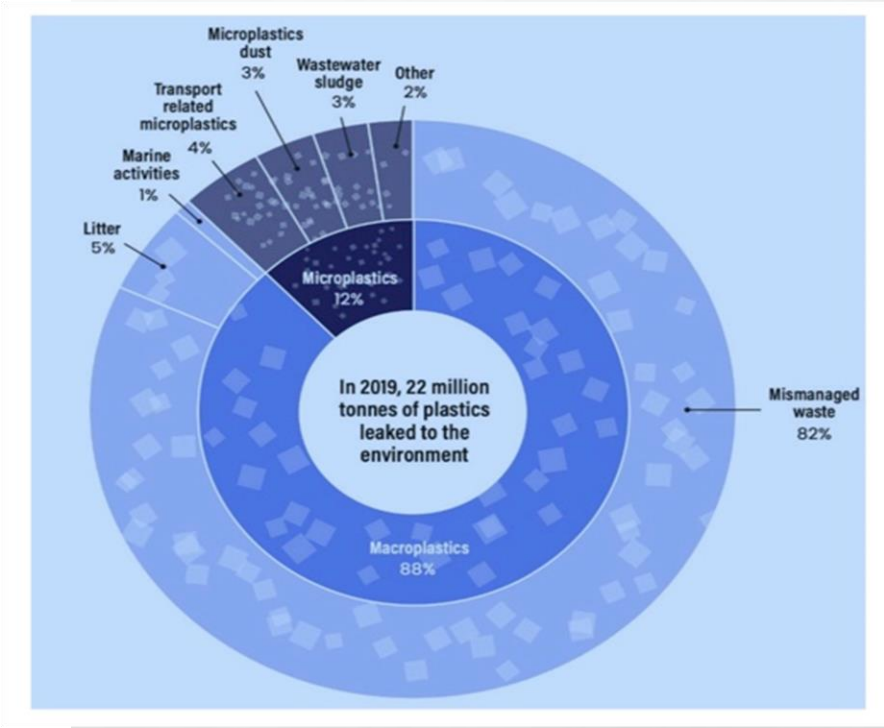
Generation of Microplastics





Source: OECD, 2020

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Classification of Plastic Size and Type

Microplastic characteristics	Classes	Description
Size	mega	> 1 m
	macro	25 mm-1 m
	meso	5 mm-25 mm
	micro	< 5 mm
Morphology	fragments	irregularly shaped particles, crystals, fluff, powder, granules, shavings
	fibres	filaments, microfibres, strands, threads
	beads/spheres	grains, spherical microbeads, microspheres
	films/sheets	polystyrene, expanded polystyrene
	pellets	resin pellets, nurdles, pre-production pellets, nibs

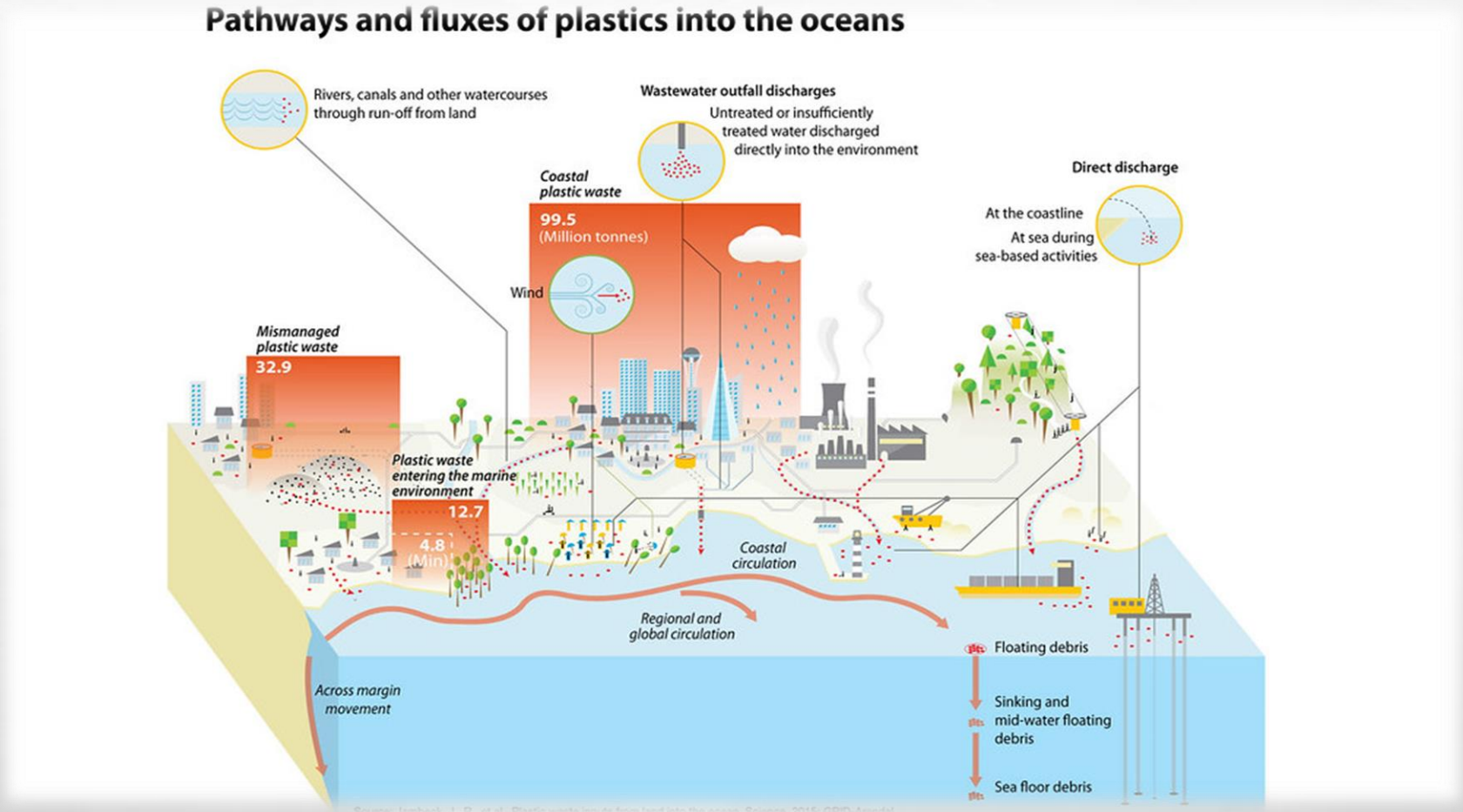
Source: Lusher et al., 2017

Polymer	Abbreviation	Examples of use
Polypropylene	PP	Food packaging, automotive parts
Low-density polyethylene	LDPE	Reusable bags, food packaging film
High-density polyethylene	HDPE	Toys, shampoo bottles, pipes
Polyvinylchloride	PVC	Window frames, floor covering, pipes, cable insulation
Polystyrene	PS	Food packaging, insulation, electronic equipment
Polyethylene terephthalate	PET	Beverage bottles
Polyurethane	PUR	Insulation, mattresses
ABS, elastomers, biobased plastics, PBT, PC, PMMA, PTFE, ...	Other	Tyres, packaging, electronics, automotive, ...
Fibres made of different polymers	Fibres	Textile applications but also in many other sectors

Note: ABS stands for Acrylonitrile butadiene styrene, PBT for Polybutylene terephthalate, PC for Polycarbonates, PMMA for Poly (methyl methacrylate) (also known as plexiglas) and PFTE for Polytetrafluoroethylene.

Source: OECD, 2020

Mode of Marine Plastics Pathway

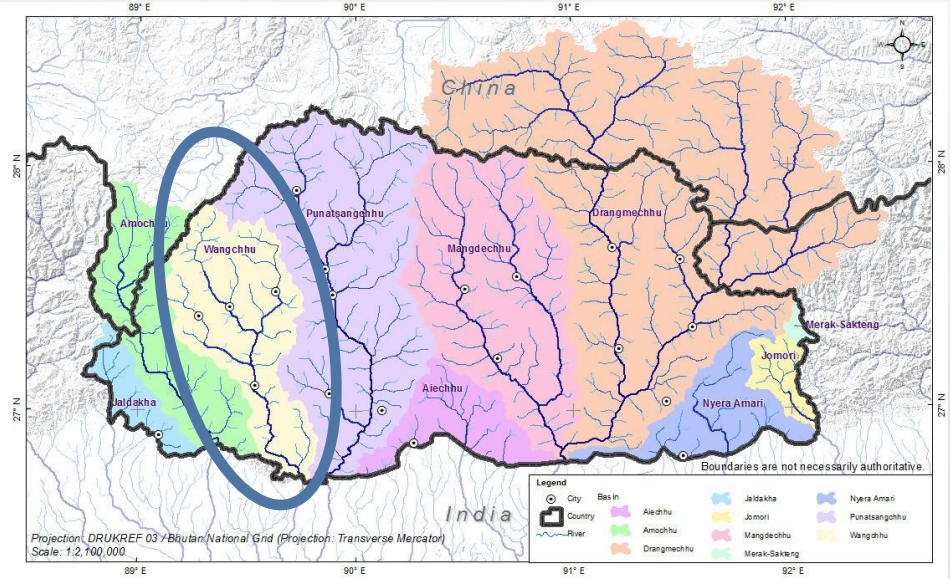


Source: OECD, 2020

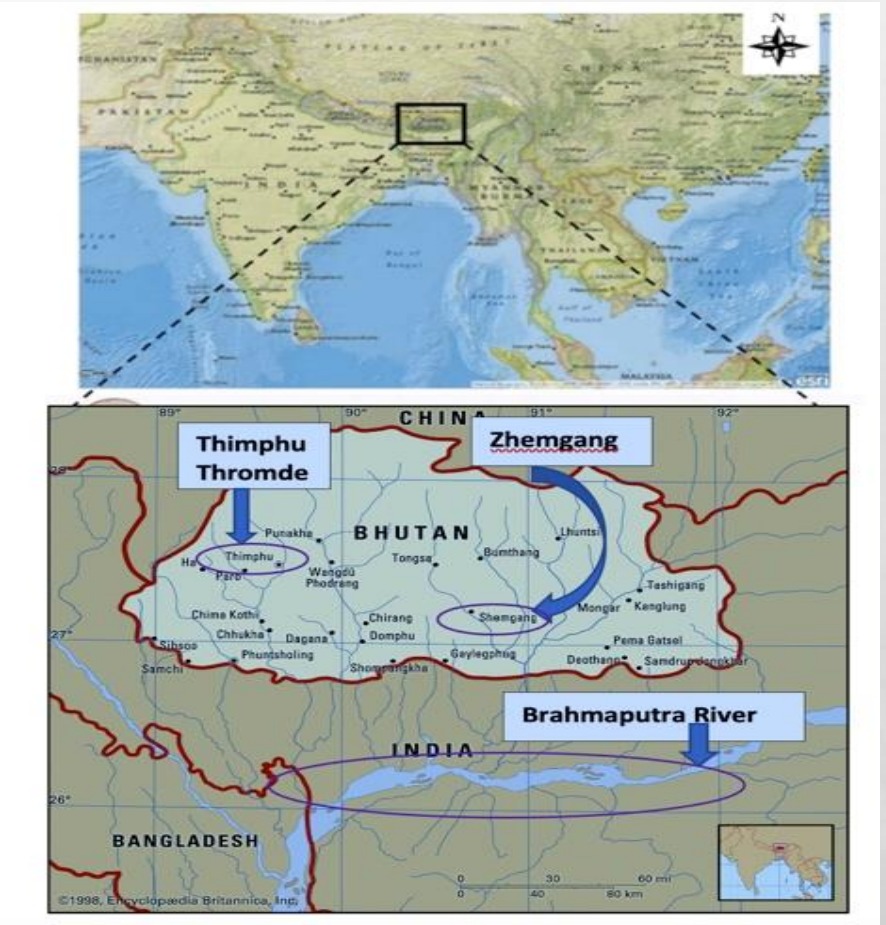
Methodology

Area Sampling

- The selected Wangchhu River in Thimphu Municipality is one of the tributaries of Brahmaputra River from Bhutan.



Study area river



Map of study area

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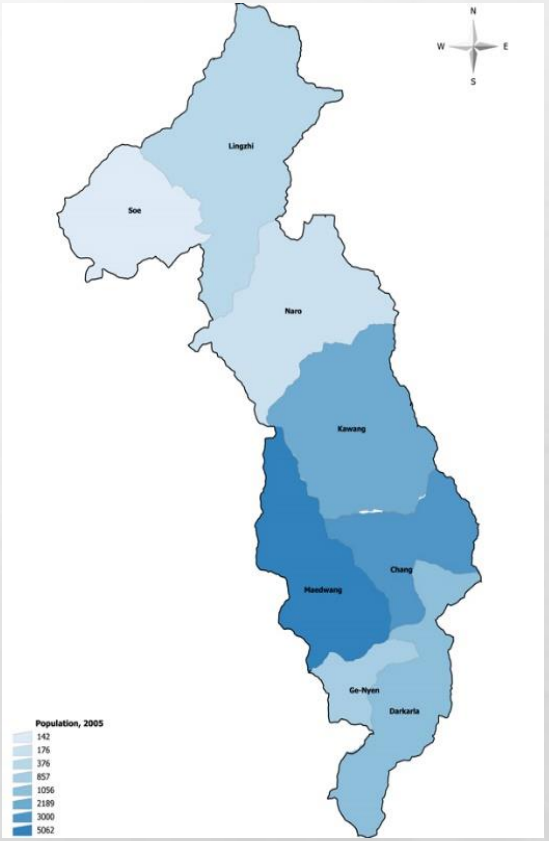
Thimphu Municipality Profile

- Thimphu Thromde is one of the most urbanized areas of Bhutan with around 83 percent of the population living in urban areas;
- The total population of Thimphu thromde is 114551, residing in 24049 households from total of 29084 number of households and a total population of 138736 ;
- In 2027 the thromde population is projected to increase by 28 percent to 146635.



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Selected Sampling Locations

- The total stretch of Wangchhu is 370 kilometers flowing from Thimphu, meets at a confluence from Haa Chhu, Pa Chhu and then flow through Chhukha that eventually reaches Brahmaputra River through West Bengal, India;

- Under Thimphu Municipality's jurisdiction, Dechencholing LAP has a total household of 828 with 2813 population. At the selected Location 1 of Dechencholing sit upstream of Wangchhu River, it has 28 households;

- Similarly, Babesa LAP consists of 817 households with 3205 population. At Location 2 of Babesa, downstream, it has Babesa WWTP above the sampling points and more than 50 households including commercial just few meters above the river bank. Babesa WWTP is connected to sewer networks of other LAPs under Thimphu Municipality such as Changbangdu,Changzamtog and the Core Area with total population of 24,644 and 7099 households.

Households near Location 1, Dechencholing

Households near Location 2, Babesa

Babesa WWTP

Sample locations of Wang Chhu , upstream and downstream

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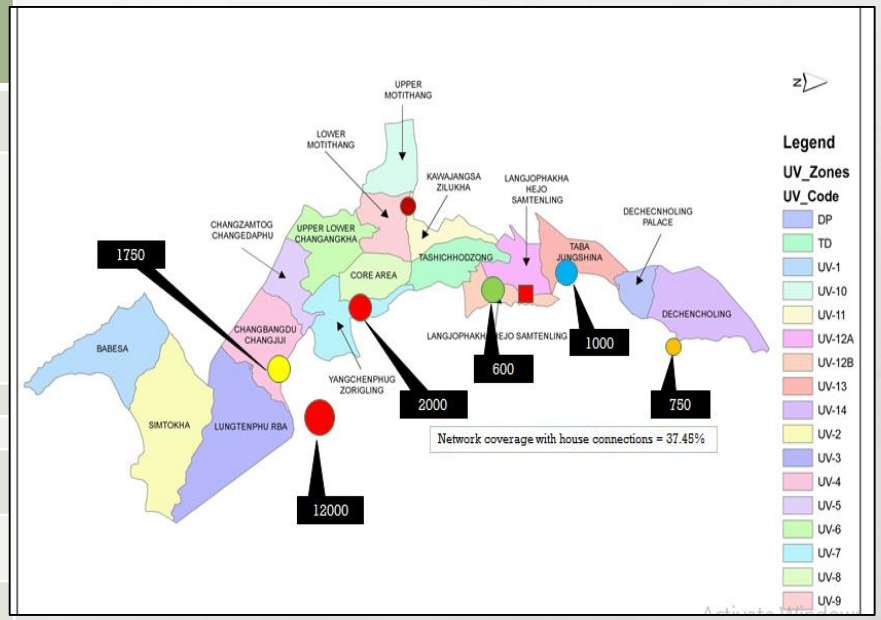
Detail of WWTPs, Capacities, Location within Thimphu Municipality

Sl. No	Type of Treatment Plant system	Capacity of Treatment plant	Location of Treatment of plant	Year of Commission	Name of areas Served	Daily Average Waste (m3)
1	Moving bed Bio film Reactor	0.75 MLD	Dechencholing	2013	Dangrina,Dechencholing	300 m3
2	Oxidation Pond(Natural Process)	1.75 MLD	Babesa	1996	Core Area(Lower Changangkha,RBP,Changedaphu, Lower Changzamtog,ZilukhaSunay Market,JDWNRH,Old PWD colony),Olakha LAP,Lungtenphu LAP,Changdelo	1640 m3
3	Eco line	1 MLD	Lower Taba	2019	Upper Taba,Lower Taba	696 m3
4	Mokan Joka System	0.1 MLD	Hejo	2019	Hejo	56m3
5	Activated Sludge Process	0.6 MLD	Langjopkha	2017	Langjophaka	120 m3
6	Activated Sludge Process	2 MLD	Near RSTA	2018	Yhss Area,Lower Motithang area,Kawajangsa	320m3
7	Sequential Batch Reactor	12 MLD	Babesa	Under Construction	Lungtenphu LAP,Simtokha LAP,Babesa Lap, Network towards to Old Babesa STP will be diverted to the new STP once completed.	Recently commissioned



Source: Thimphu Thromde, 2022

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Sampling Locations

Sampling Site	Station Level	Place name and Coordinates	Number of Samples
1.Water and sediment samples from the Upstream of Wang Chhu before wastewater treatment plants and;	Location 1	Dechencholing, Thimphu 27°31'52.67"N 89°38'56.84"E	6 (3*2): D1, D2 and; D3
2. Water and sediment samples from the Downstream of Wang Chhu after wastewater treatment plants.	Location 2	Babesa,Thimphu 27°26'3.47"N 89°38'50.12"E	6 (3*2): B1, B2 and; B3
Total Samples	**2 Locations**		12

Location 1, Dechencholing, upstream

Location 2, Babesa, downstream

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Sample Collections

Water Sample

- Each sample was collected during morning, noon and evening in one day and combined as one sample from each location;
- For three days, 3 samples were collected each from Dechencholing location 1 (upstream) and Babesa location 2 (downstream) of Wangchhu River;
- So, in three days, 6 samples were collected from at each location.




Water pump and PVC pipes , sieves, zip loc bags

Sediment Sample

- For sediment sample, the sediments were collected only one time per day at the middle of the river;
- At each location, three days were used to collect the sample. So, for three days, 3 samples were collected each from Dechencholing location 1 (upstream) and Babesa location 2 (downstream) of Wangchhu River;
- So, in three days, 6 samples were collected from at each location.



Grab Sampler

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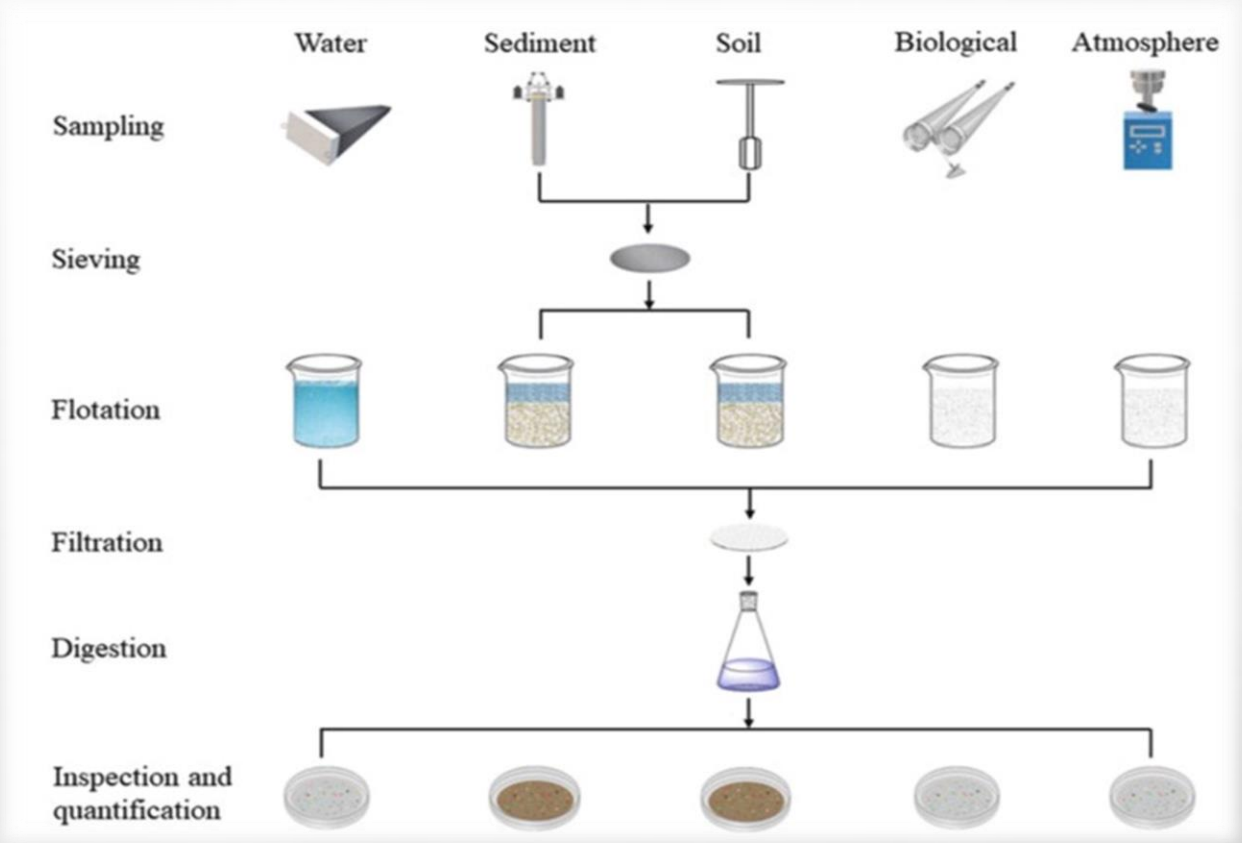
Observation, Identification and Validation of Microplastics

- Microplastics were quantified using Liu et al. (2020) method as illustrated;
- Samples were observed under a stereo microscope (40X), and plastic particles observed, visually identified, and captured by a camera for the records;
- The types of plastic items were categorized based on the physical characteristics described by Li et al. (2016) and Romeo et al. (2016).



Source: Liu et al., 2020

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Methodology

Water Sample Procedures

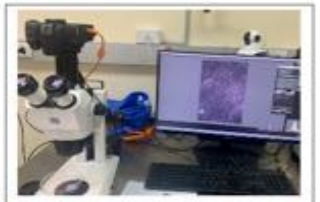
1. **1st Transfer Sieved Solids**
   - Transferred the remained solids to a 250 ml beaker;
   - Dried beaker at 90^{0}C for 24 hours.

2. **Wet Peroxide Oxidation (WPO)**
   - Added 20 ml Iron (II) and 20 ml H_2O_2;
   - Covered the beaker with a watch glass;
   - Left it for 5 minutes at ambient room temperature;
   - Moved beaker to hotplate with magnetic stirrer;
   - Removed beaker out from the hotplate when the solution started boiling until bubbles disappeared;
   - Moved the beaker to the hotplate for heating at 75^{0}C for 30 minutes.

3. **Density Separation**
   - Added 6 g Nacl and waited until the Nacl dissolved;
   - Heated the mixture to 75^{0}C until the salt dissolved;
   - Transferred the solution to funnel separation
   - Left it to separate for 24 hours.

4. **2nd Transfer Sieved Solids**
   - Filled the solution after passing through 0.3 mm;
   - Transferred the remaining solids to petri dish;
   - Dried petri dish at 90^{0}C for 24 hours

5. **Microscopic Examination of Microplastics**
   - Used forceps to collect identifiable microplastics;
   - Measured the Feret's diameters and the physical characteristic of the microplastics.



Sediment Sample Procedures

1. **Determine the Mass of Dry Sand**
   - Added 200 g of sediment sample;
   - Dried the beaker at 90 ^{0}C for 24 hours.

2. **1st Density Separation**
   - Added 100- 200 ml of Zncl into the dried sample;
   - Mixed the sample with spatula stainless steel for 5 minutes;
   - Left it to settle at ambient room temperature for 15-30 minutes.

3. **Wet Sieving**
   - Supernatant was passed through 0.3 mm sieve.

4. **1st Transfer Sieved Solids**
   - Transferred the remained solids to 250 ml beaker;
   - Dried the beaker at 90 ^{0}C for 24 hours.

6. **Wet Peroxide Oxidation (WPO)**
   - Added 20 ml iron (II) and 20 ml H_2O_2;
   - Covered the beaker with watch glass;
   - Left it for 5 minutes at ambient room temperature;
   - Moved the beaker to hotplate with a magnetic stirrer;
   - Removed the beaker from the hotplate after it boiled;
   - Moved the beaker to the hotplate after bubbles disappeared and left it to heat at 75 ^{0}C for 30 minutes

8. **Density Separation**
   - Added 6 g of Nacl and allowed it to settle until Nacl dissolves;
   - Transferred the solution to funnel for density separation;
   - Left the solution for 24 hours.

7. **2nd Transfer Sieved Solids**
   - Passed the solution through 0.3 mm sieve;
   - Transferred the remaining solids to petri dish;
   - Dried the petri dish at 90^{0}C for 24 hours

9. **Microscopic Examination of the Microplastics**
   - Used forceps to collect identifiable microplastics;
   - Measured the Feret's diameters and the physical characteristics of the microplastics

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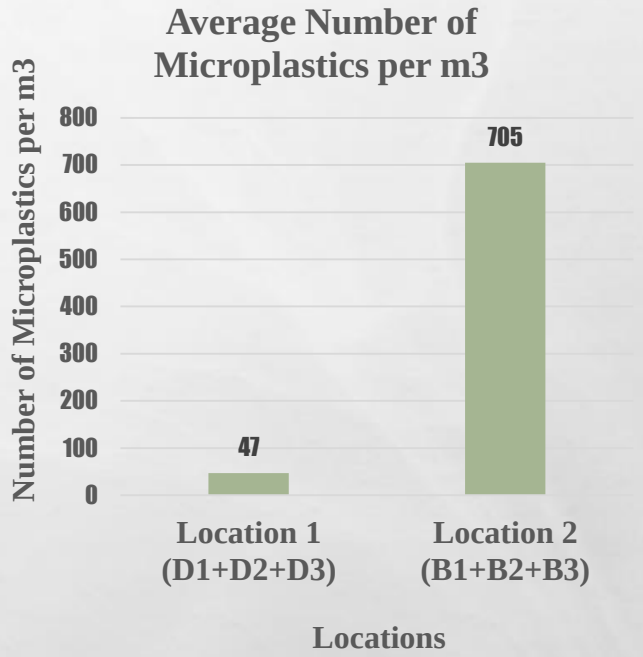
Results & Discussion for Water Samples

1. Abundance of Microplastics by Locations in Water Sample

- At location 1, three water samples were collected and analyzed from Dechencholing under the North Zone of Thimphu Municipality.
- Similarly, at location 2, three water samples were collected and analyzed from Babesa under the South Zone of Thimphu Municipality.
- The average number of microplastics per m^3 was higher at location 2 with 705 compared to location 1 with 47 particles per m^3.
- At both locations, there was no proper waste disposal facility observed near the river banks. An open disposal pit was spotted just above the bank of the river, sampling location 2 of Babesa. At location 1 of Dechencholing, similar waste disposal site was observed.
- The weather paraments, such as wind, rain, floods, can act as transport pathways of macro and mesoplastics to the river (Figure 4.4). Over the years, these macros and mesoplastics would fragment into smaller microplastics in the river as detected in water samples

Waste disposals at Location 1 and 2



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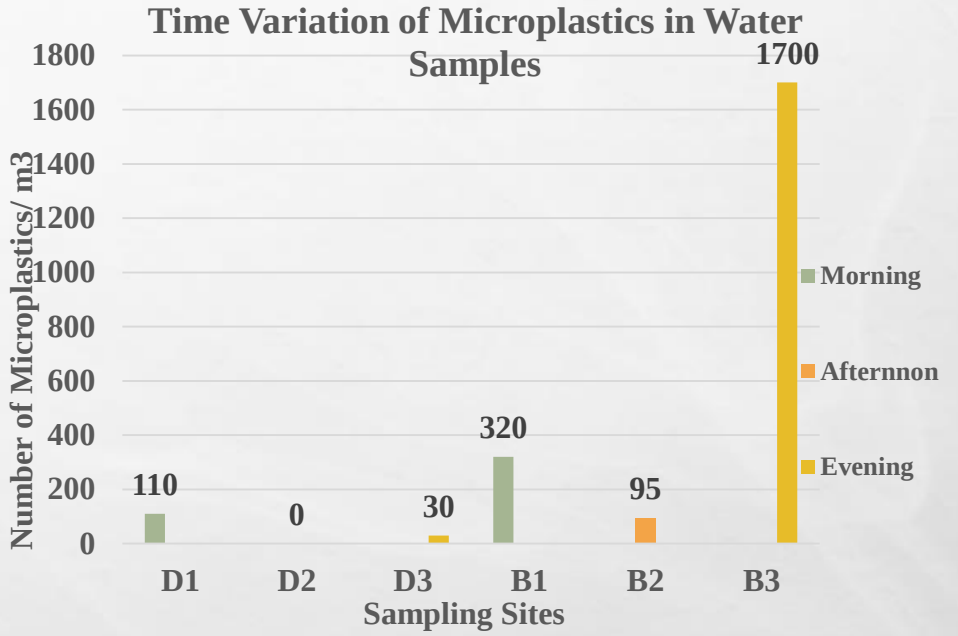
Results & Discussion for Water Samples

2. Microplastic concentrations by time variation

- Overall, evening sample collected from location 2 (Babesa) recorded the highest number of microplastics of 1700 per m^3.
- At the location 2 of Babesa, the presence of WWTP with capacity of 13.75 MLD releases its effluent in the evening effluent discharge released from other five WWTPs, high loads of microplastics to biofoul, human settlements on the other side of the river bank which falls out of Babesa lap, dense households and commercial hubs and slow flow of river contributed to high record of microplastics at Location 2 of Babesa compared to Dechencholing in absence of any WWTPs.
- However, Location 1 of Dechencholing recorded highest number of microplastics in the morning. The low-income households where high wastewater discharge from kitchen and toilets were carried out in the morning.The waste water was directly discharged to Wangchhu river stretch of Dechencholing without the presence of proper septic tanks. Therefore, microplastics were detected in Dechencholing Location 1 despite the absence of any WWTPs and fast flowing rocky river.



Toilets in open area at location 1 , dechencholing

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Results & Discussions for Water Samples

1.75 MLD WWTP during in Location 2, Babesa

Effluent discharge from 12 MLD WWTP during in evening(right) at Location 2

Effluent discharged from 1.75 MLD in river in Location 2, Babesa

Waste water discharge from households at location 1

Abundant of waste discharge

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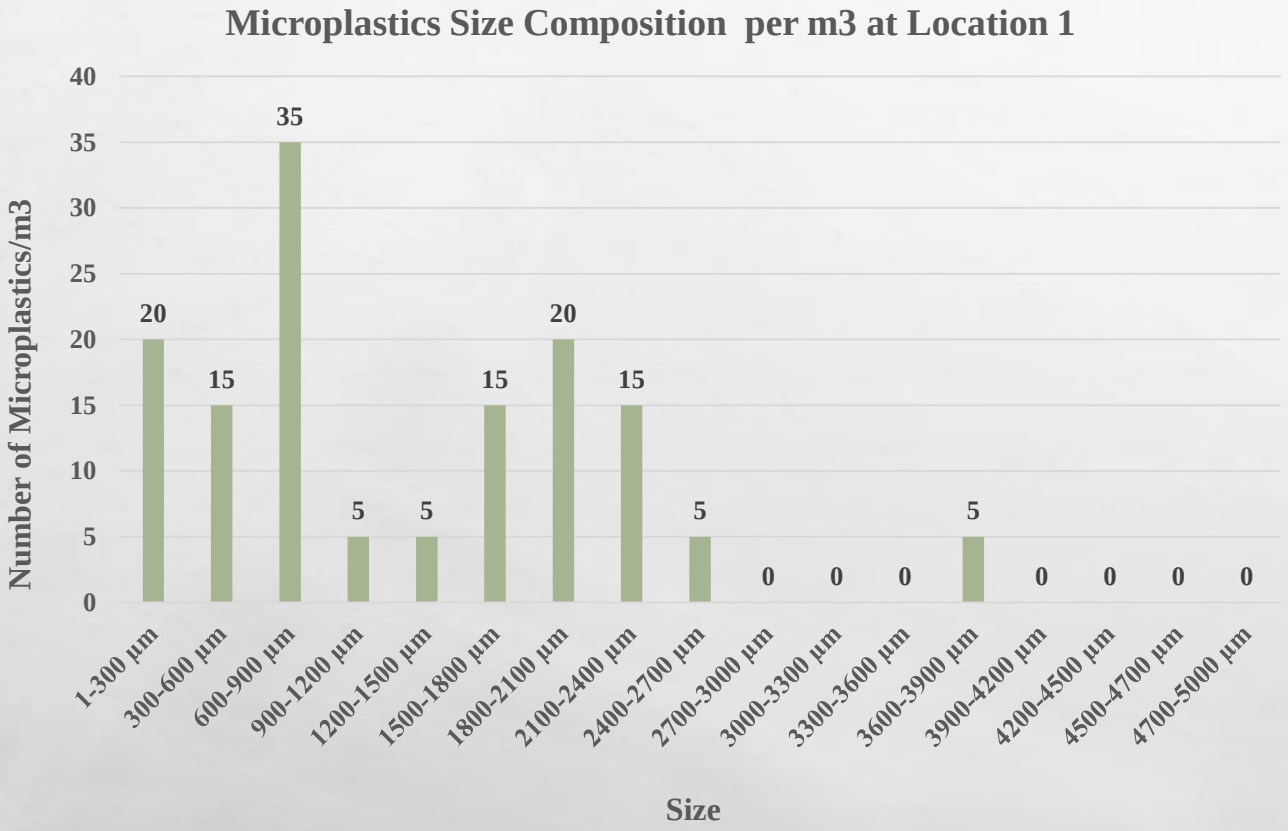
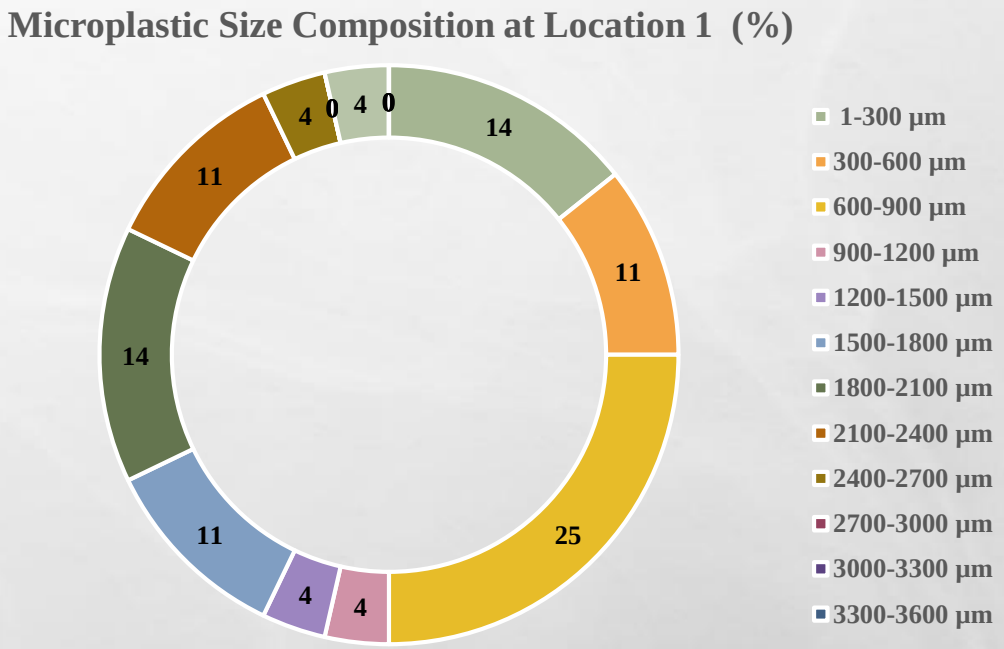
Results & Discussions for Water Samples

2. Size Composition of Microplastics in Water Sample by Locations





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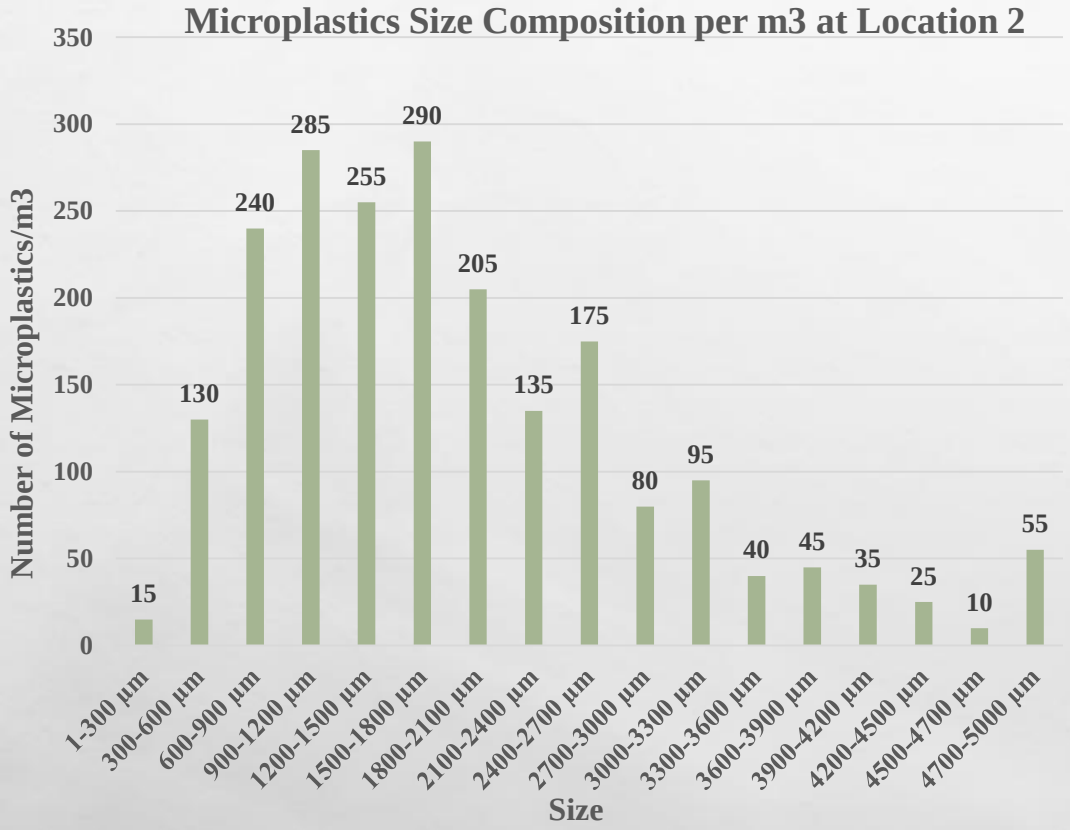
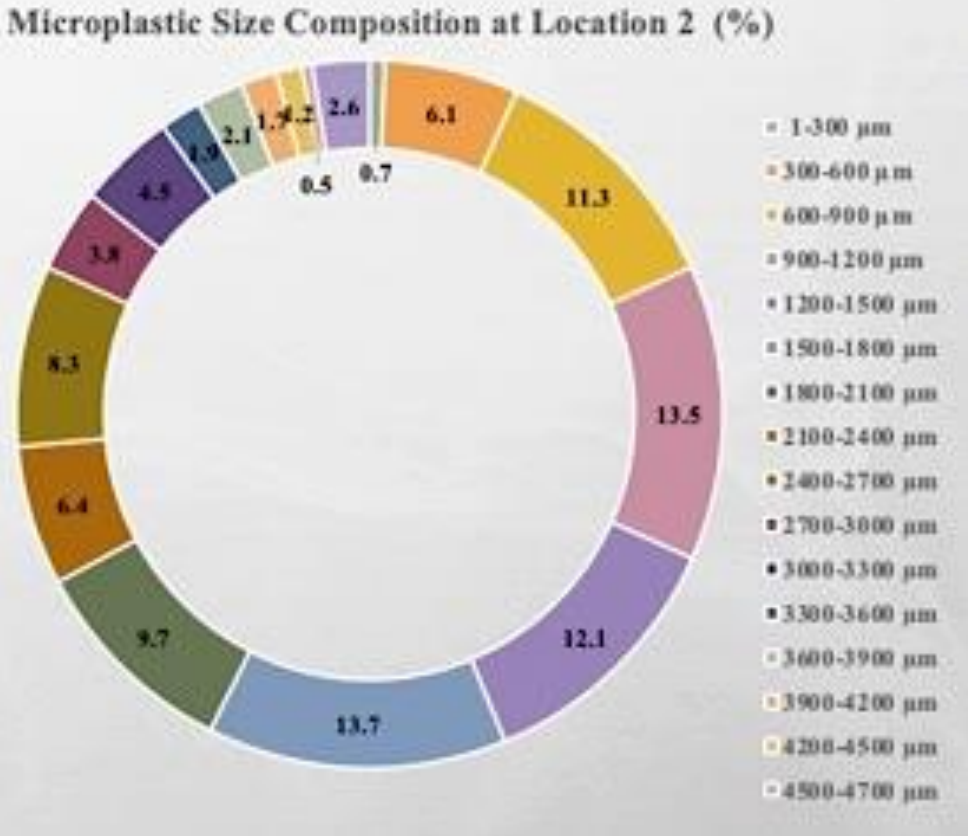
Results & Discussion for Water Samples





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Results & Discussion for Water Samples

- The dominant size of microplastics in Location 1 was in the range of 600-900 µm with 35 numbers of microplastics per m^3 which contributed 25 % to the total sample in location 1, downstream of Wang Chhu River;
- The dominant size of microplastics in Location 2 was in the range of 1500-1800 µm with 290 numbers of microplastics per m^3 which contributed 13.7% to the total sample in location 2, downstream of Wang Chhu River;
- The following other dominate ranges were below 1800 µm.
- The least visible size of microplastics present in the water samples was in the range of <4500-4700 µm in both locations 1 and 2.
- In location1, the upstream of Wangchhu River, dominant sizes were less than 900 µm. As the size of microplastics grow bigger from 3000-5000 µm, the concentration of microplastics per m^3 decreases and few in numbers compared to microplastic size <3000-300 µm.
- The smaller sized particles were mostly relased by WWTP with low removal efficiency and light size microplastics floating freely on the surface water.

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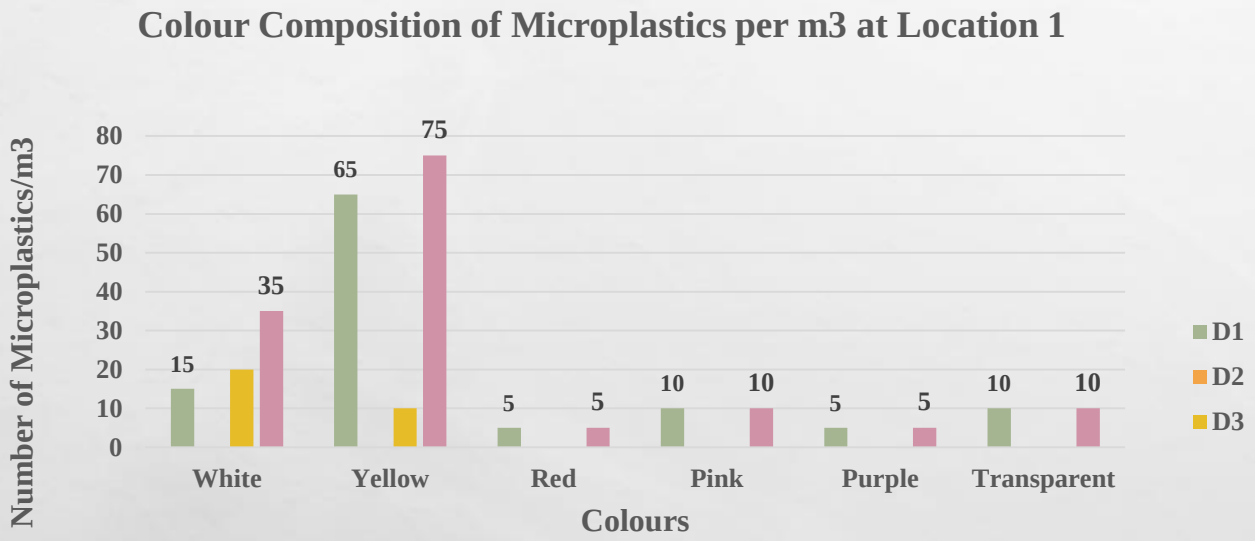
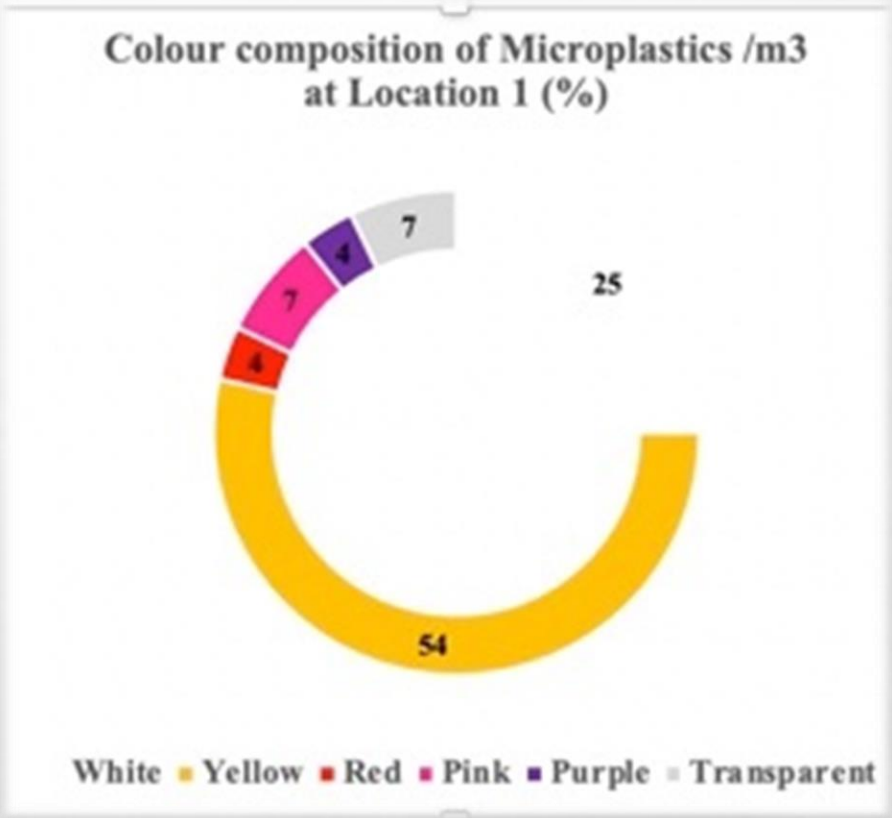
Results & Discussions for Water Samples

3. Colour Composition of Microplastics in Water Sample





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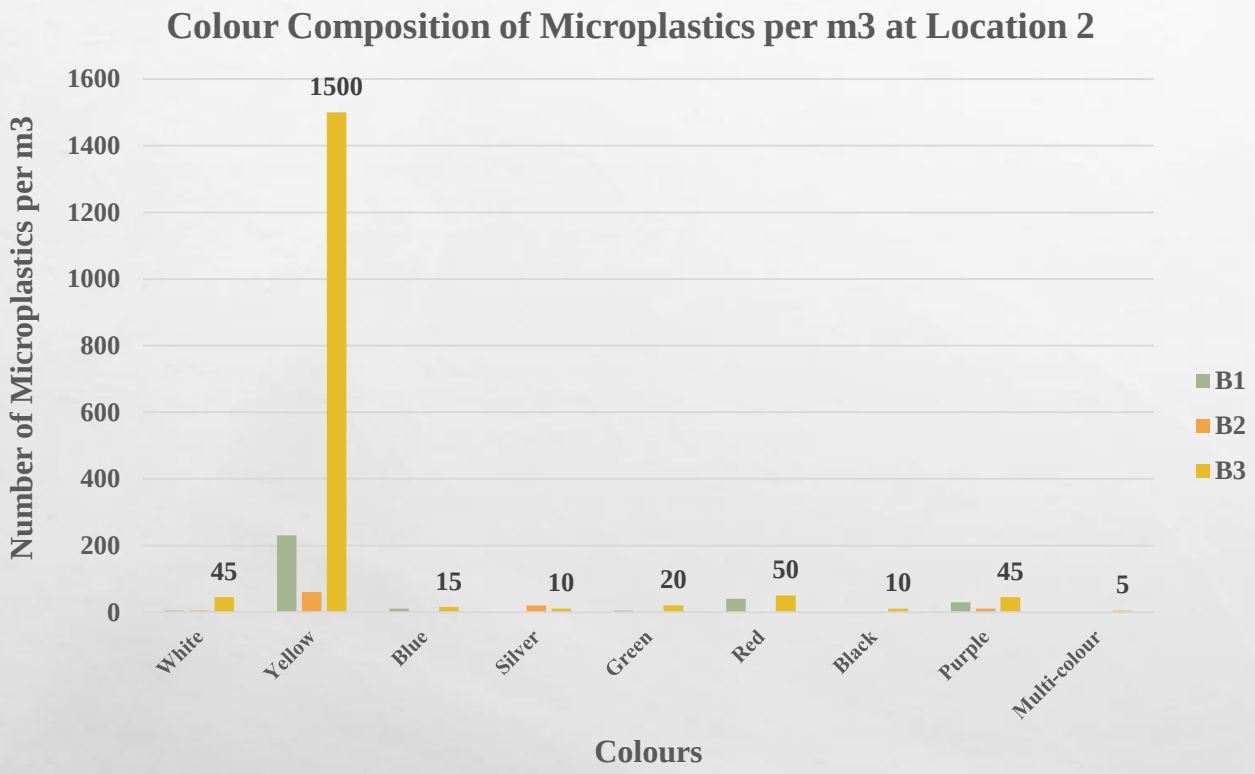
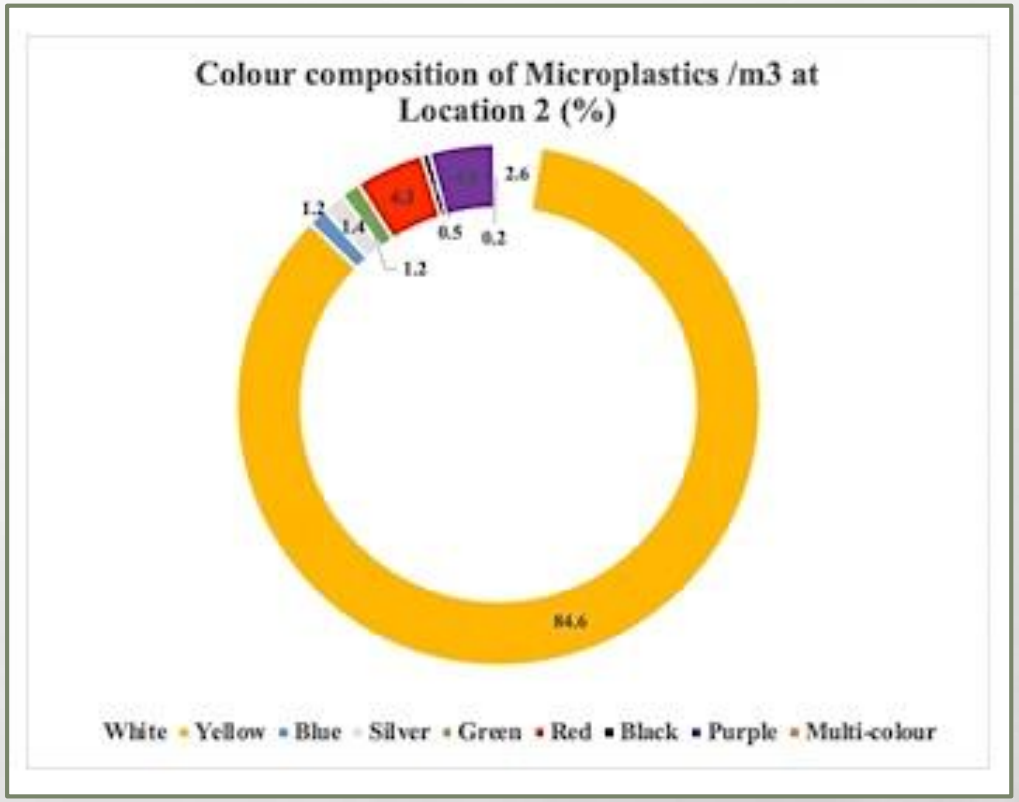
Results & Discussion for Water Samples





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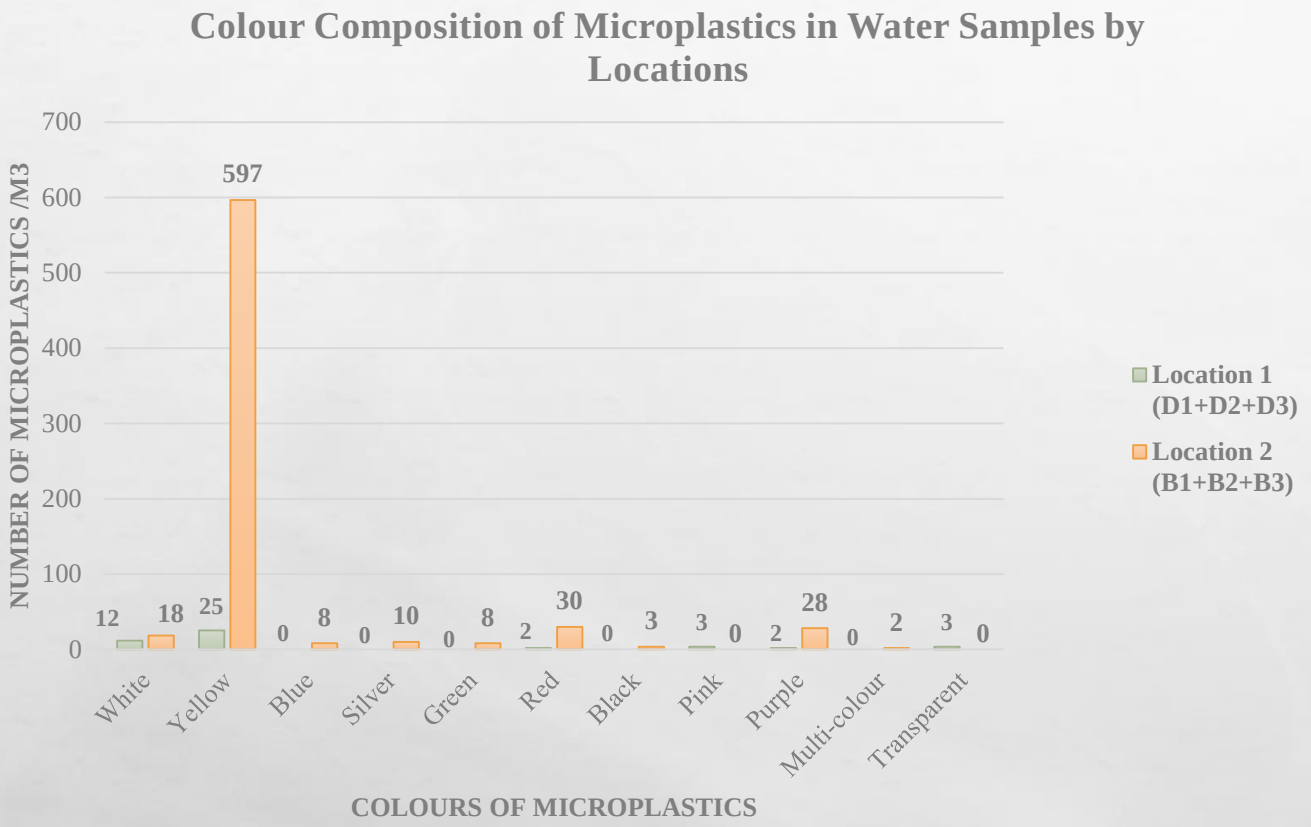
Results & Discussion for Water Samples



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Results & Discussion for Water Samples

- In location 1, the most prominent colour observed in water samples was yellow followed by white, pink, transparent, red and purple 54%, 25%, 7%, 7%, 4%, and 4% respectively.;

- Similarly, at the location 2, the most prominent colour observed in water samples was yellow followed by red and purple with 84.6%, 4.3% and 4.0% respectively. Location 2 generated highest yellow microplastics in its average calculation compared to Location 1 with 597 per m^3 compared to 25 per m^3.;

- The dominant presence of yellow microplastics could be due to widely usages of PS in domestic applications, breakdown of additives, due to chemical and weathering events over the long time of disintegration from meso and macroplastics to microplastics,accumulations of organic loads have changed the coloured microplastics into yellow.

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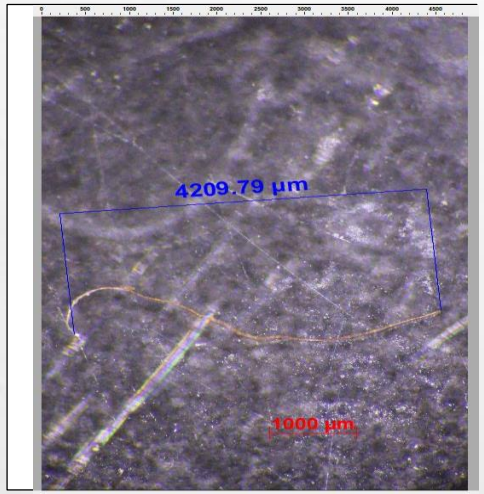
4. Shape Composition of Microplastics in Water Sample

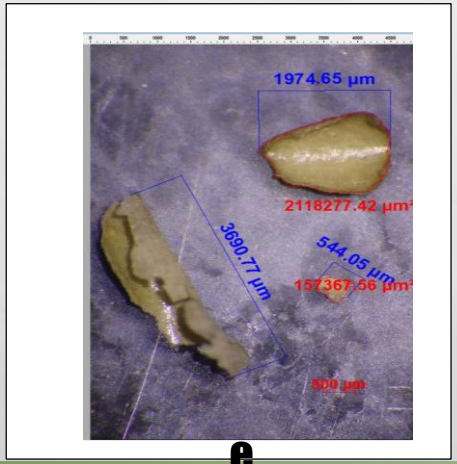


a

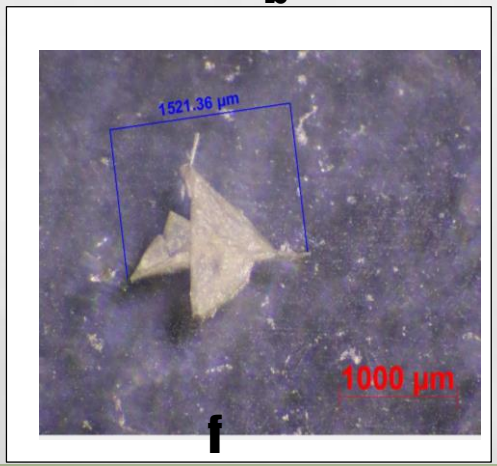
b


c

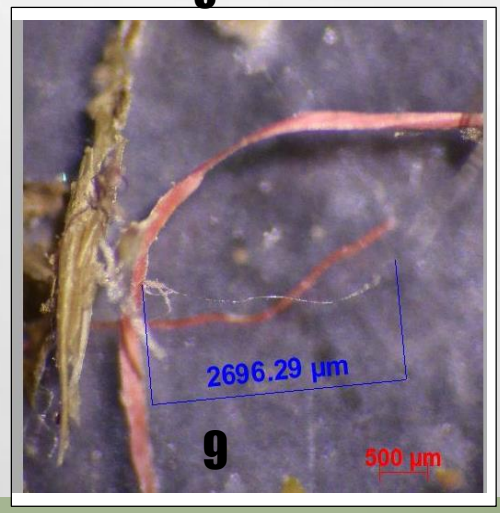
d



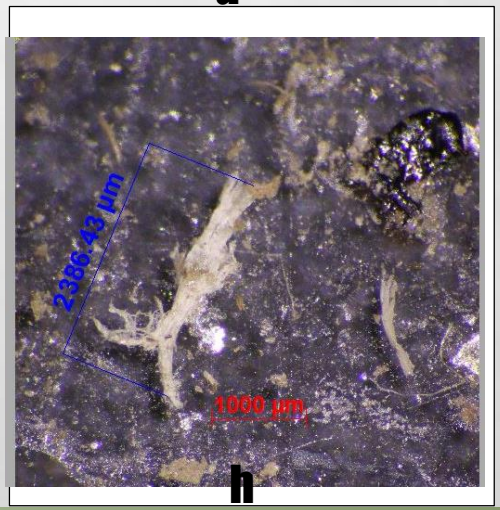
e



f



g



h

Different shapes of microplastics at Dechencholing Location 1 and Babesa Location2

Fibre: a-c, Foam-d, e, fragment-f, filament-g-h

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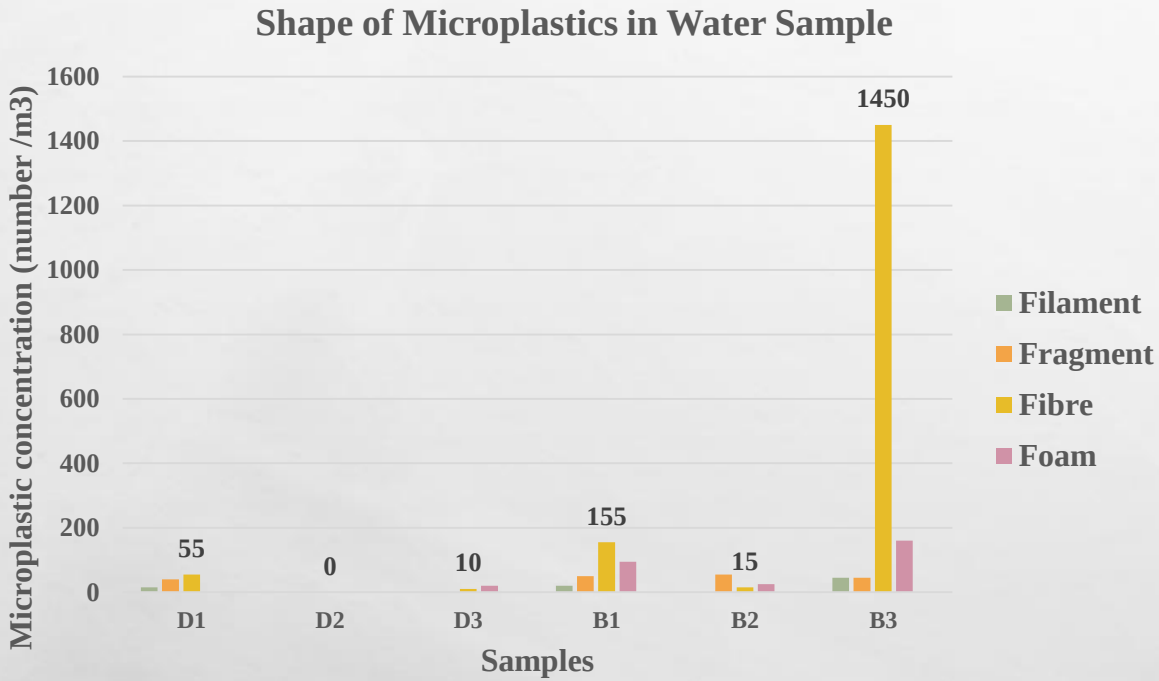
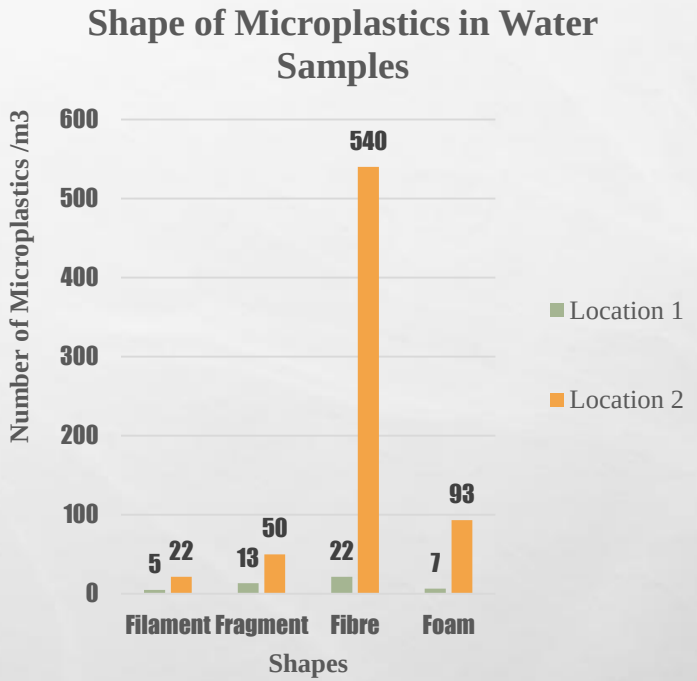
Results & Discussion for Water Samples

5. Shape Composition of Microplastics in Water Sample





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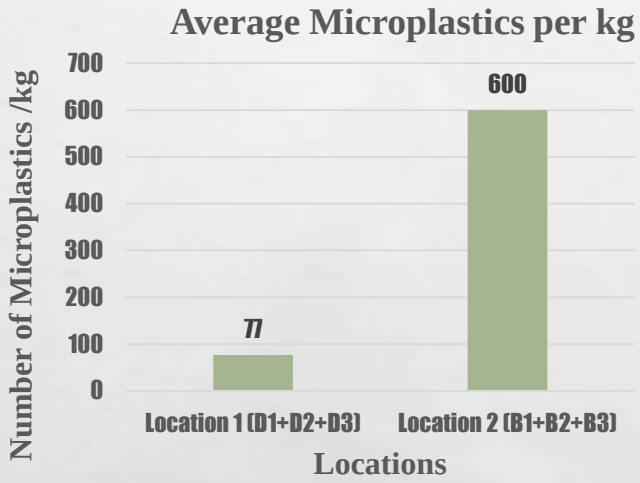
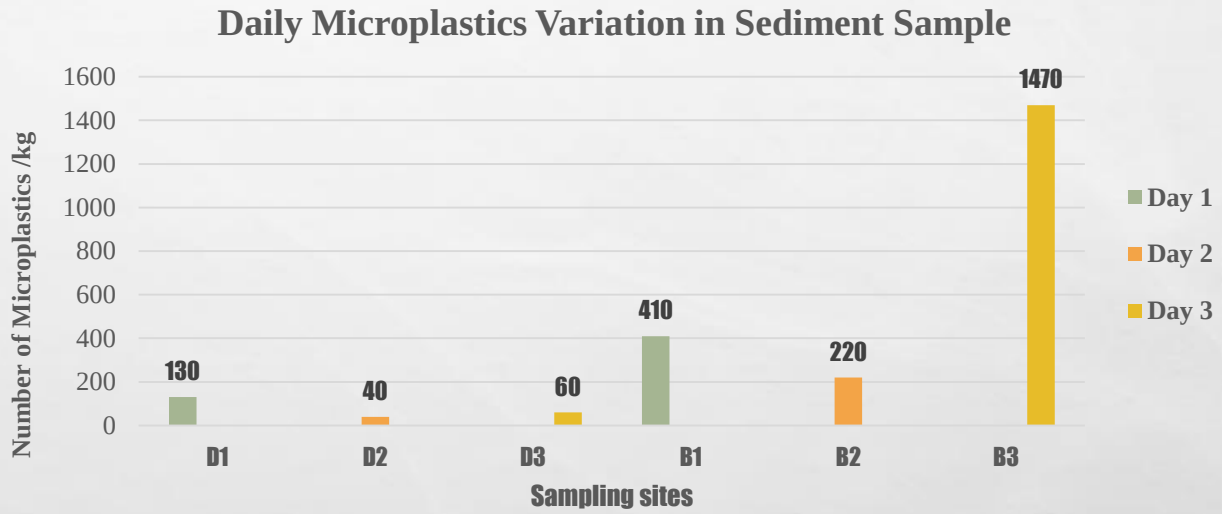
Results & Discussion for Water Samples

- The prominent shapes observed in the samples collected from location 1 and 2 were filament, fragment, fibre and foam.
- In sample B3 of Babesa, Location 2 recorded the highest fibres of 1450 per m^3
- The average of fibres in the samples were highest in location 2 of Babesa with 540 per m^3 compared to Location 1 of Dechencholing with 21.67 per m^3. Followed by Foam with 93.33 per m^3 of Babesa location 2, fragments with 50 per m^3 of Babesa Location 2 and Filament with 21.67 per m^3 of Babesa location 2.
- Overall, four prominent shapes listed above were found abundant in location 2 of Babesa compared to Dechencholing of Thimphu Municipality.
- The reason for ubiquitous presence of fibres in location 2 of Babesa, downstream of Wangchhu River could be from 6 WWTPs releasing their daily effluent discharges. The effluent discharges are mainly from domestic households and commercial area where laundry is one of the most common activities.
- Synthetic clothes can be possible source of fibres from laundry that directly connects to to sewer network as grey water.
- And presence of PET bottles in the river could be another.

Results & Discussion for Sediment Samples

1. Abundance of Microplastics in Sediment Sample by Locations and Days





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Results & Discussion for Sediment Samples

- For the two sampling locations 1 and 2 of Dechecholing and Babesa, a total six sediment samples were collected.
- At location 1, three sediment samples were collected and analyzed from Dechencholing under the North Zone of Thimphu Municipality.
- Similarly, at location 2, three sediment samples were collected and analyzed from Babesa lap under the South Zone of Thimphu Municipality.
- The average number of microplastics per kg was higher at location 2 with 600 compared to location 1 with 77.
- Day 3 had the highest daily concentration of microplastics per kg in location 2 of Babe, downstream of Wangchhu River after the WWTPs.
- In Location 1 of Dechencholing, Day 1 had the highest microplastics per kg.

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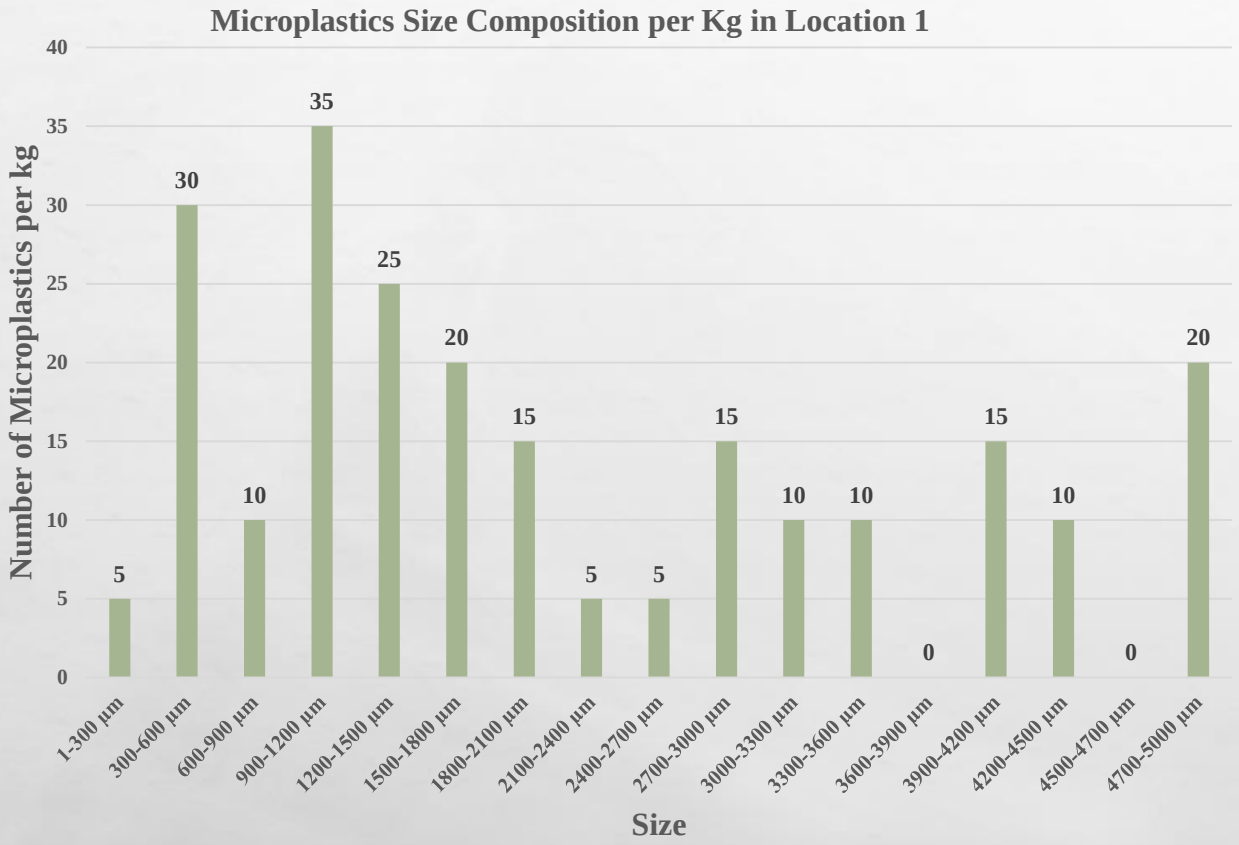
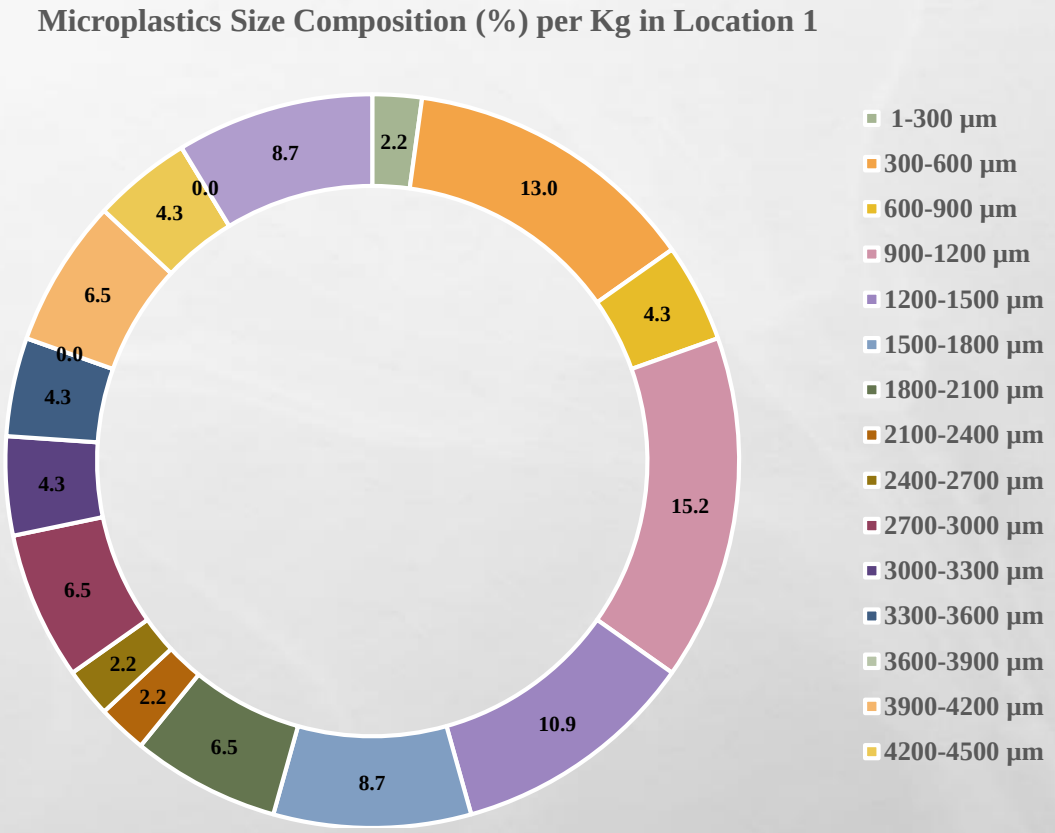
Results & Discussion for Sediment Samples

2. Size Composition of Microplastics in Sediment Samples by Locations





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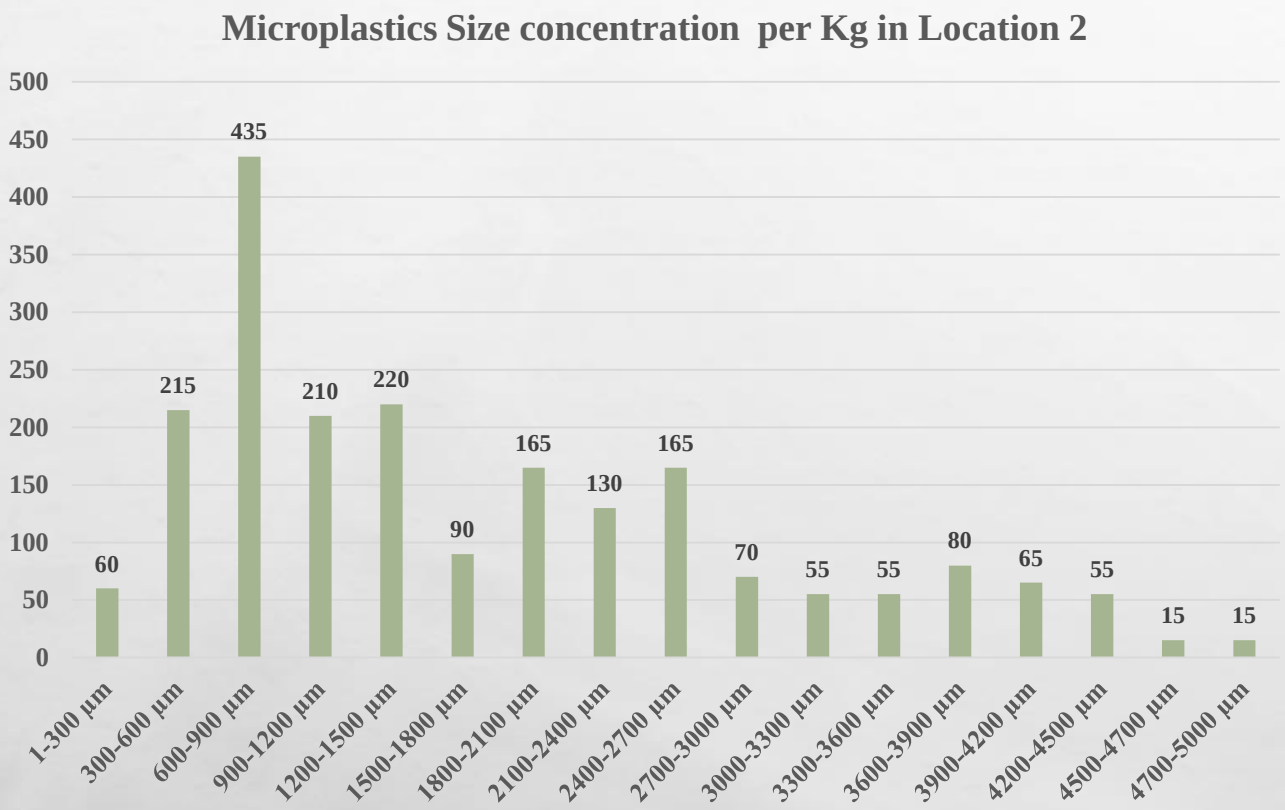
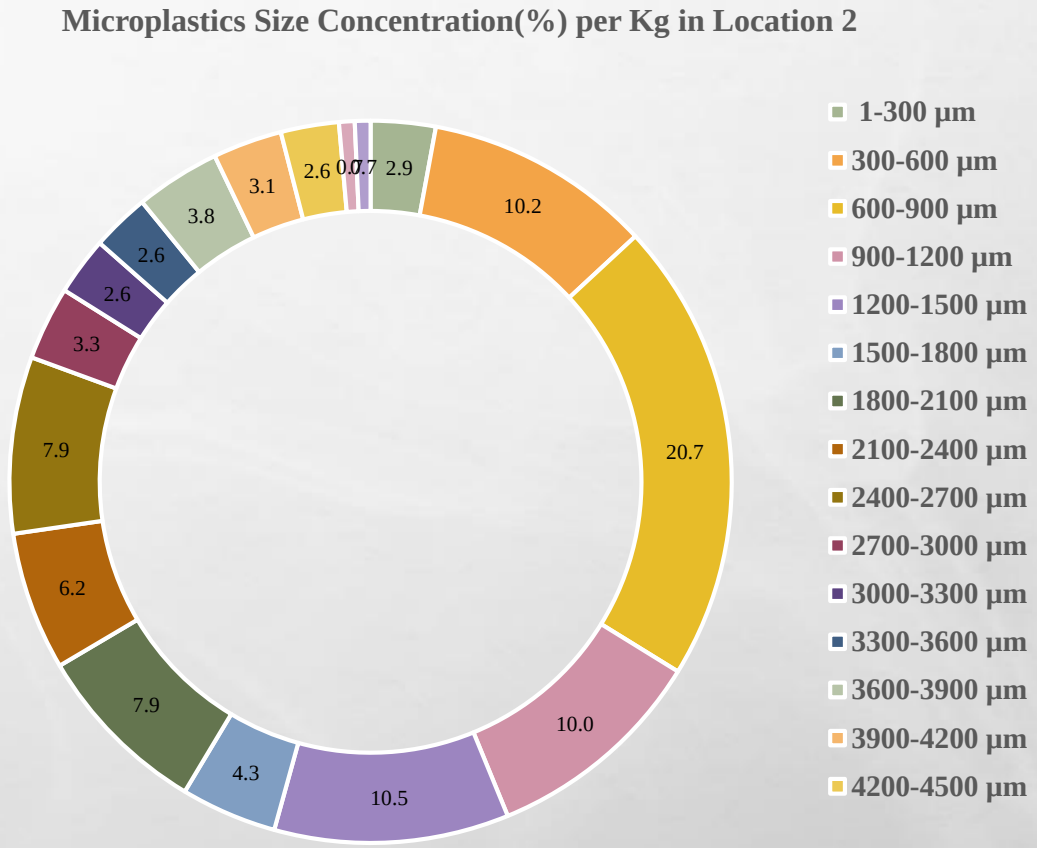
Results & Discussion for Sediment Samples

2. Size of Microplastics in Sediment Samples by Locations





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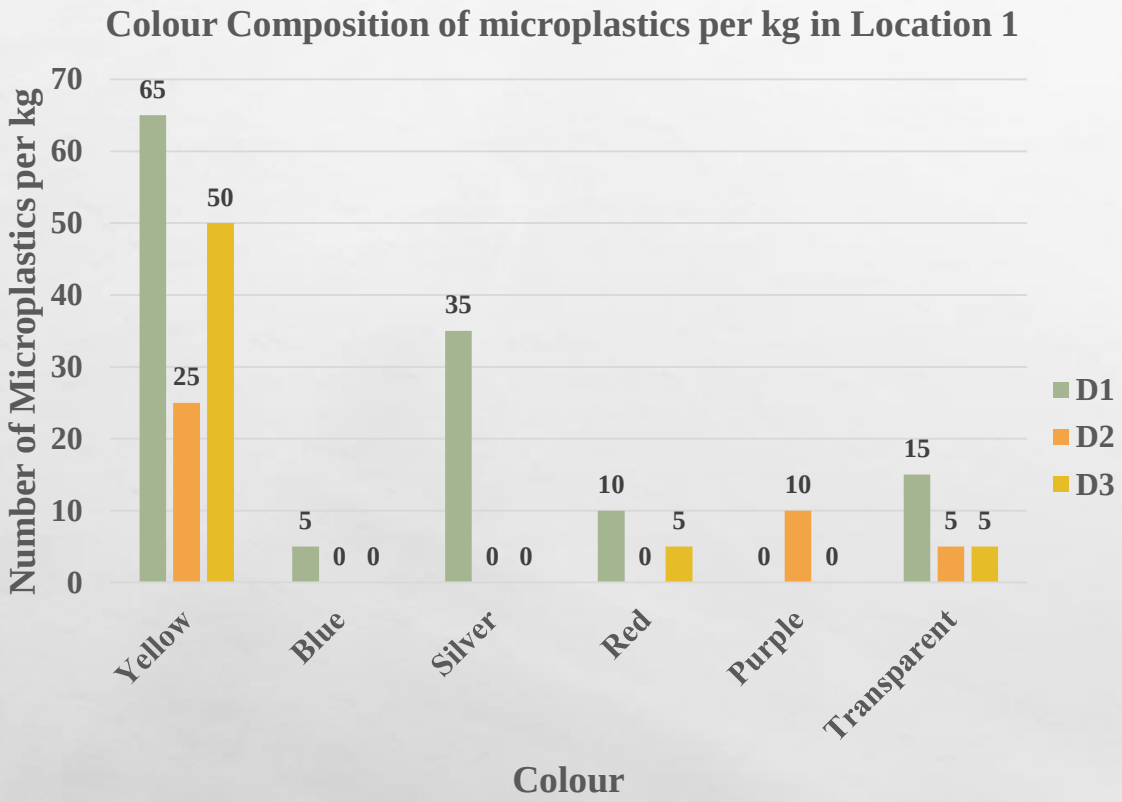
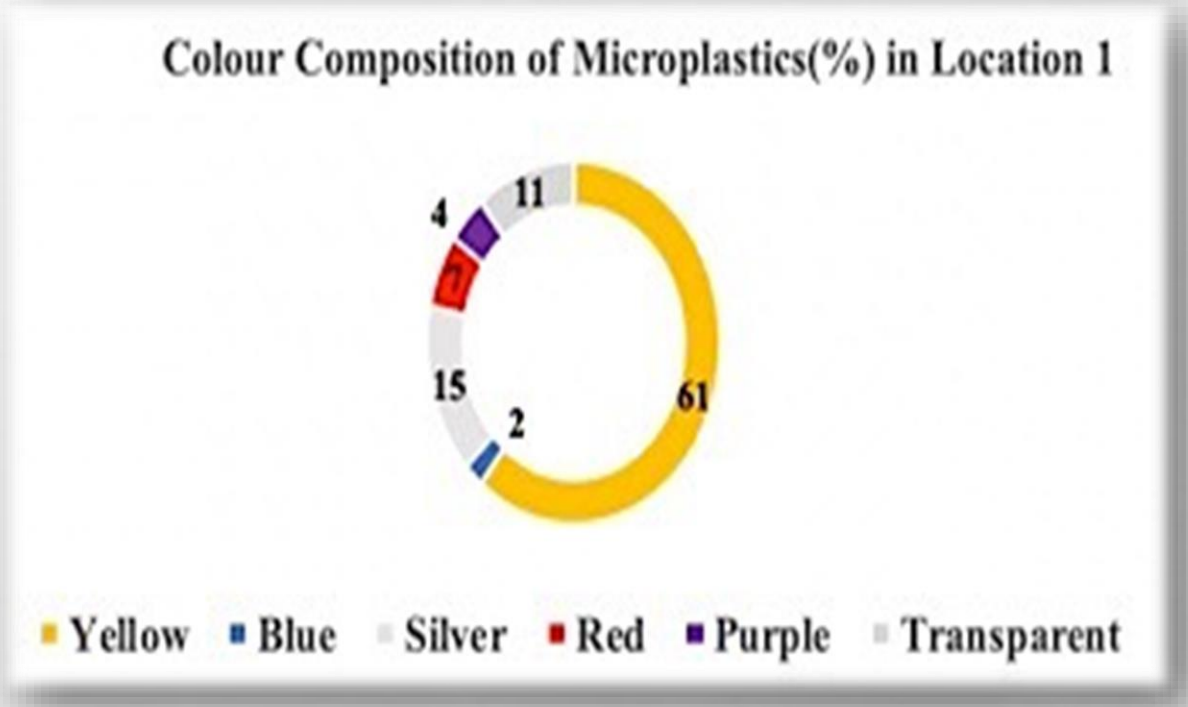
Results & Discussion for Sediment Samples

- In location 1 of Dechencholing , the dominant size of microplastics was in the range of 900-1200 µm with 35 numbers of microplastics per kg which contributed 15.2 % to the total samples.
- As the size of microplastics increased from 1200 µm, the concentration of microplastics decreased.
- At location 2 of Babesa, the most prominent size was in the range of 600-900 µm with 435 microplastics per kg, contributing about 20.7% to the total samples.
- As the size of microplastics increased from 900 µm, the concentration of microplastics decreased.
- At location 2 of Babesa, downstream of Wangchhhu River with all six WTTPs releases their effluent discharges, the maximum small size microplastics could be from the inefficient removal system of WWTPs to trap smaller microplastics and released into the river.
- The bigger sized microplastics remained in the water column and biofouling unlike the light size microplastics sinking freely in sediments. On the contrary, the concentration of microplastics was observed less below the size of 300 µm due to the limitation in magnification of stereomicroscope, visual observations and sieve size of 300 µm.

Results & Discussion for Sediment Samples

3. Colour of Microplastics in Sediment Sample by Location





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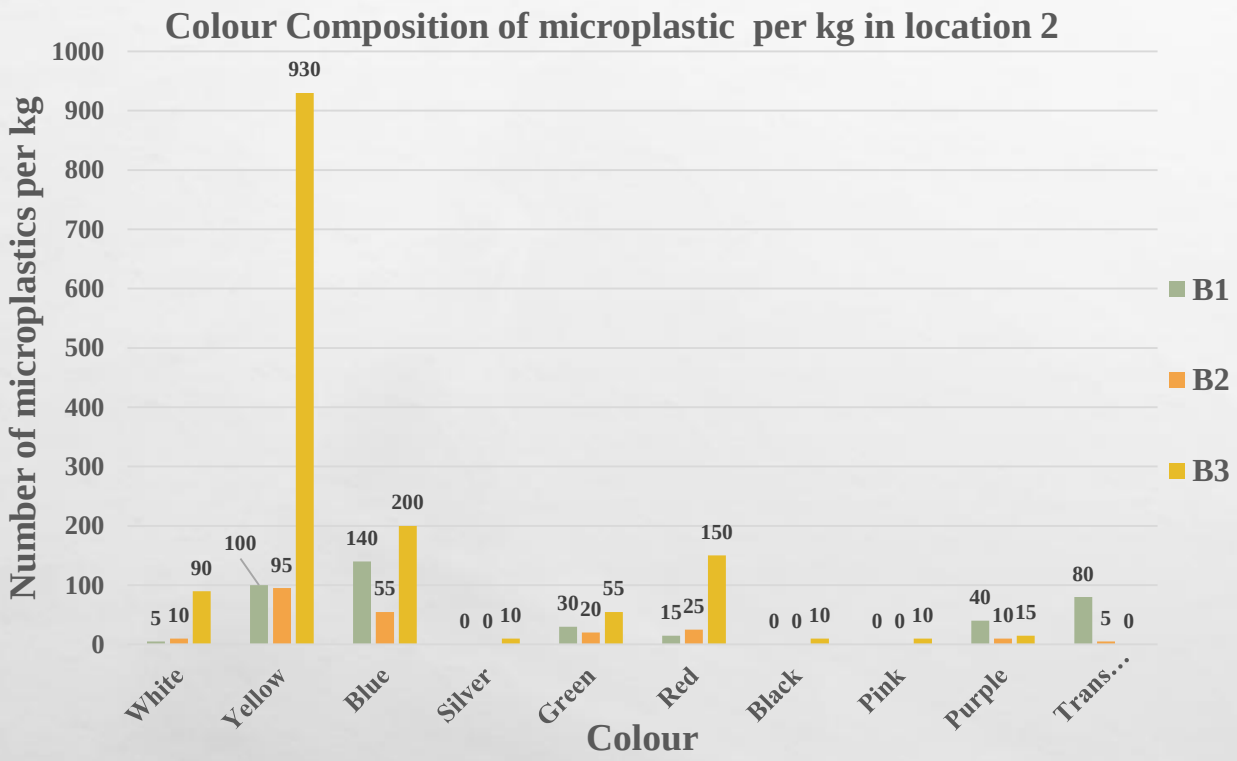
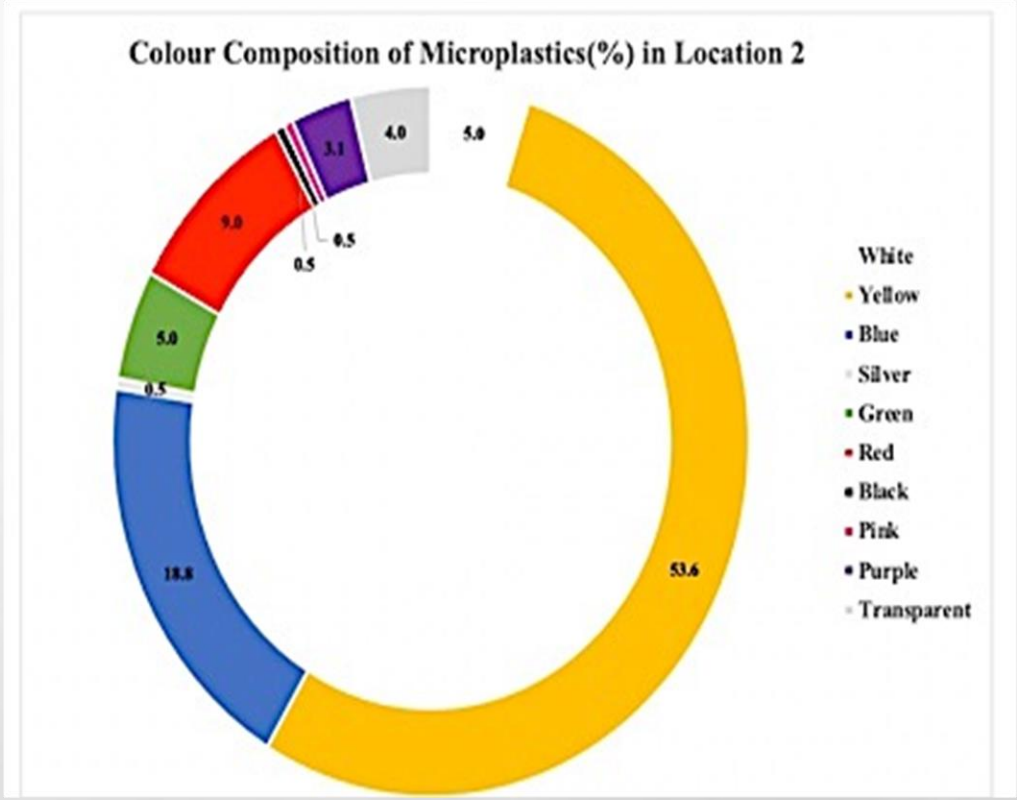
Results & Discussion for Sediment Samples





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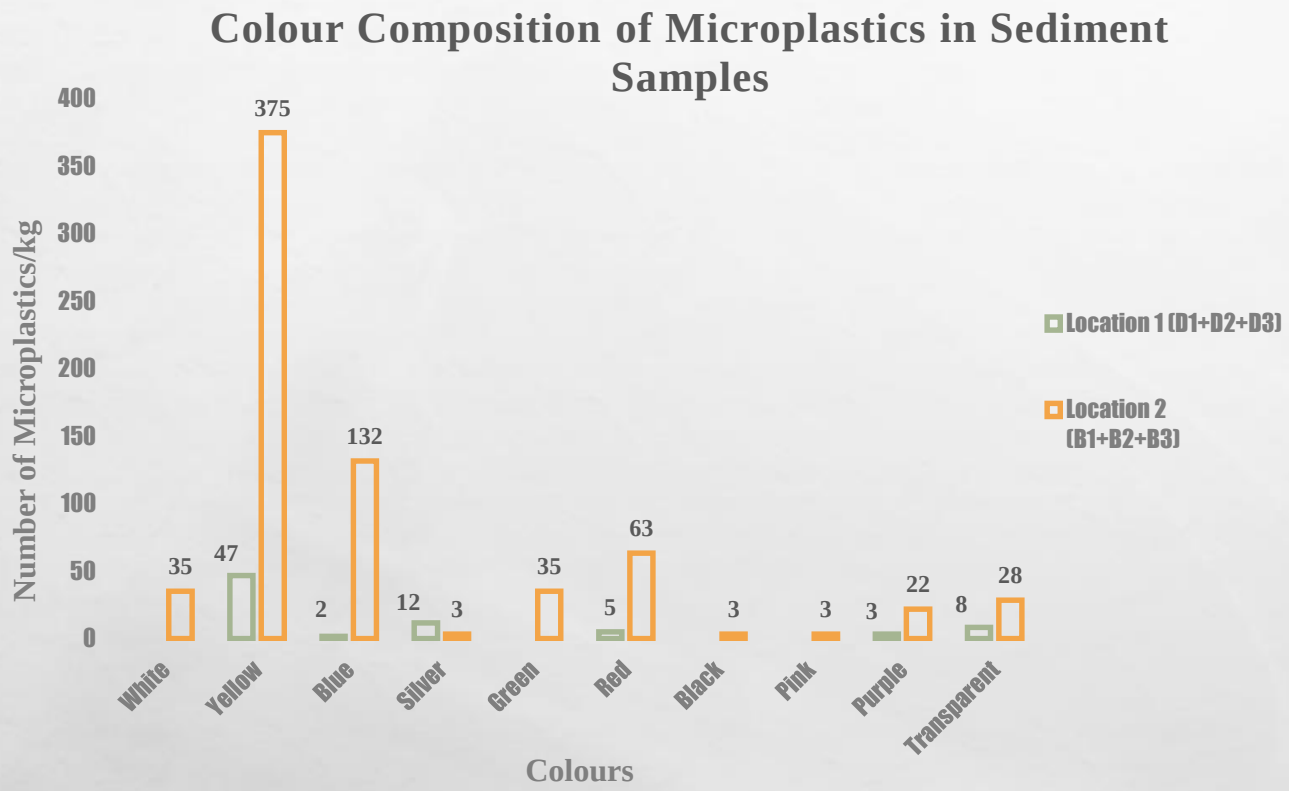
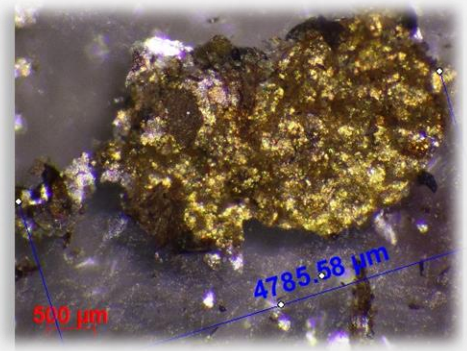
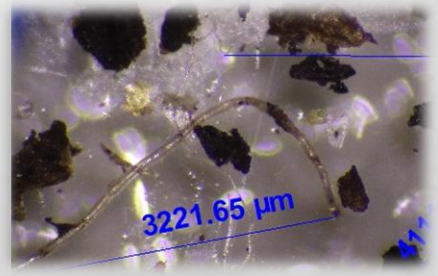
Results & Discussion for Sediment Samples







Yellow microplastics found most prominent in sediment samples

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Results & Discussion for Sediment Samples

- In Location1 , the most prominent colour observed in sediment samples was yellow with 65 particles per kg with 61 % to the total.
- In location 2, the most prominent colour observed was yellow with 930 particles per kg contributing 53. 6 % to the total. Other colours were followed by blue, red and transparent.
- The location 2 generated highest yellow microplastics in its average calculation compared to Location 1 with 375 per kg compared to 47 per kg.

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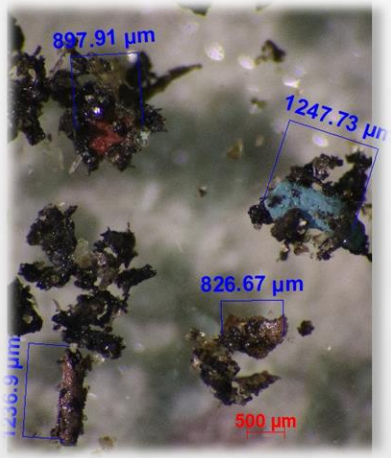
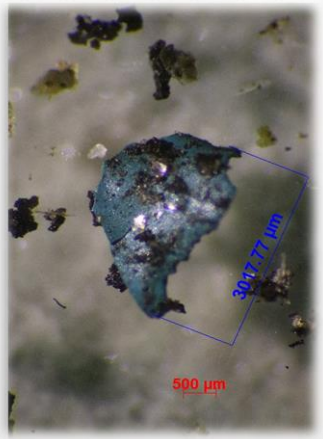
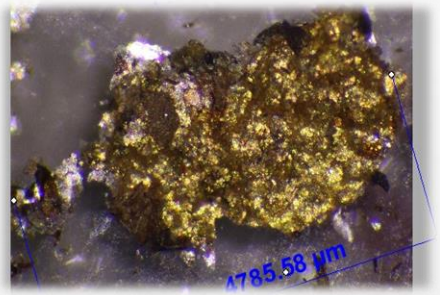
5. Shapes of Microplastics in Sediment Sample



a

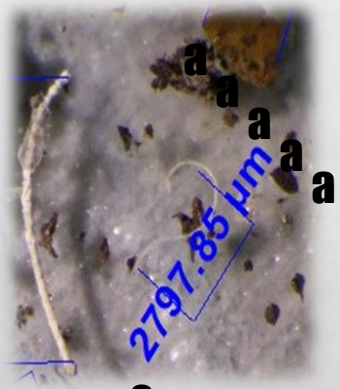


b

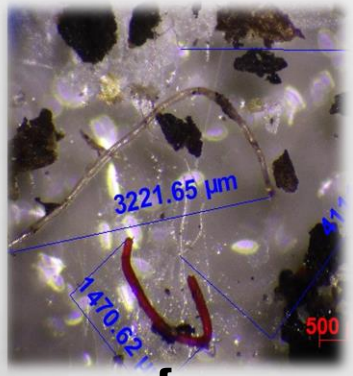


c

d



e



f

g

Shape composition of microplastics in sediment samples

Fragment: a-c, Foam: d, Fibre: e-f, filament: g-h

h

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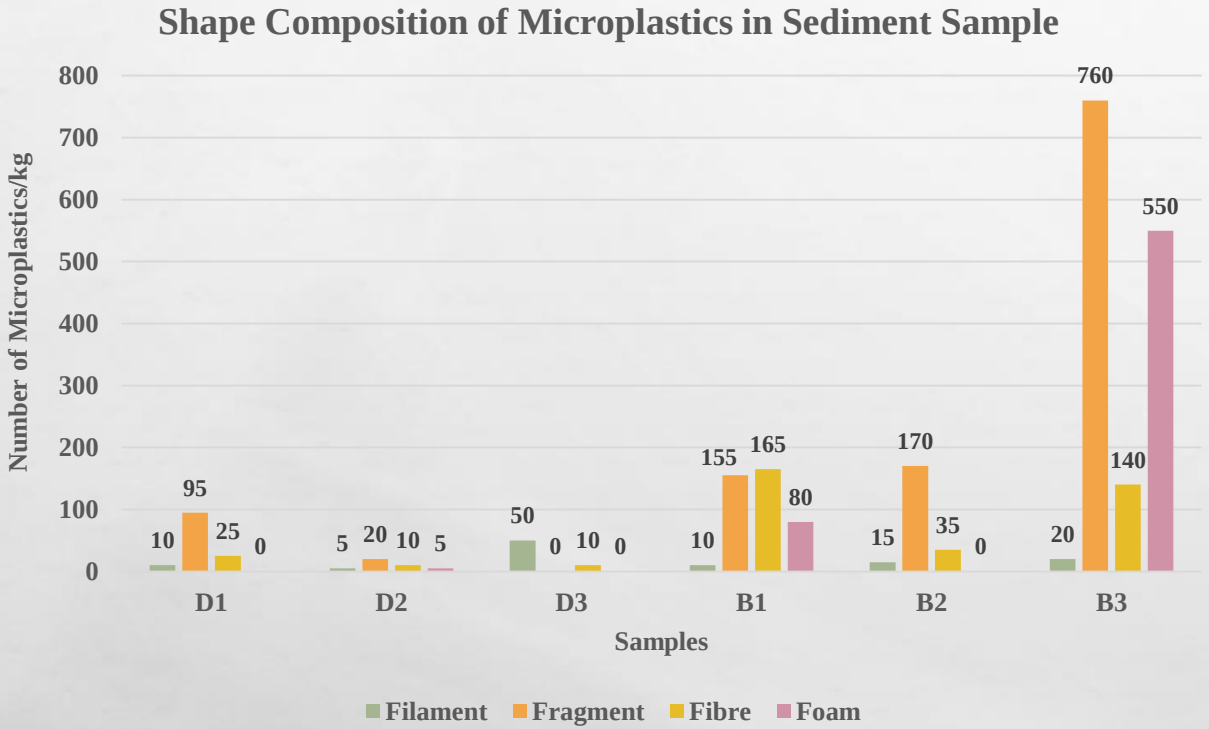
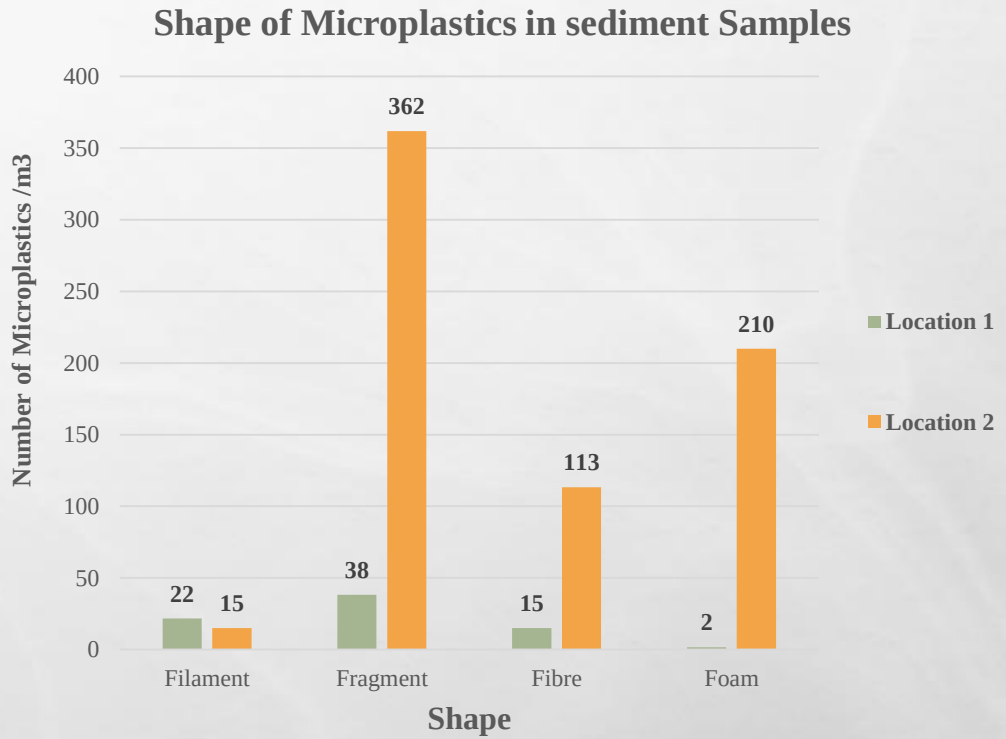
Results & Discussion for Sediment Samples

5. Shapes of Microplastics in Sediment Sample





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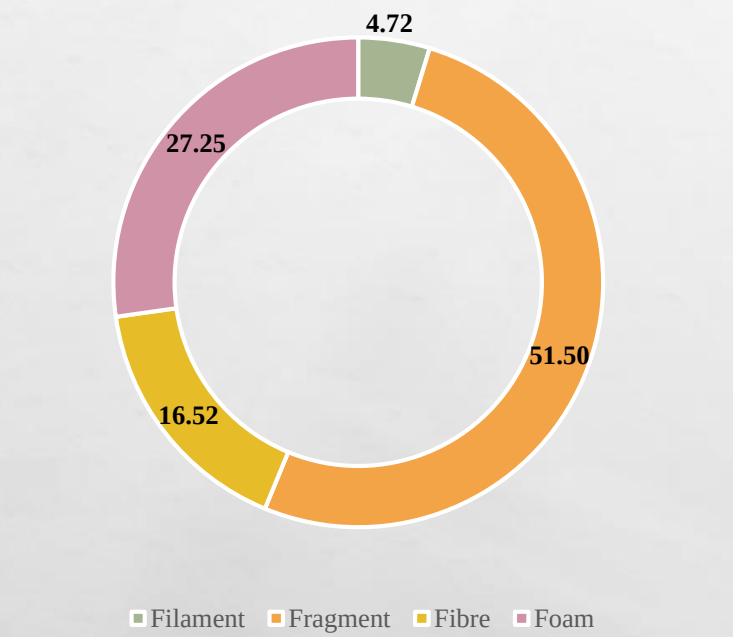
Results & Discussion for Sediment Samples



- The prominent shapes observed in the samples collected from location 1 and 2 were filament, fragment, fibre and foam.
- The most common shape of microplastics observed in sediment samples was fragment with a total number of 1200 per kg from location 1 and 2. It comprised of 51.50 % to the total concentrations of microplastics in samples.
- The sample B_3 of Babesa, Location 2 recorded the highest fragment of 760 per kg. The least shape of microplastics observed in water samples was filament with a total number of 110 per kg of which the highest filament was in D_3 sample of Dechencholing, location 1- containing 50 per kg of the total.
- The highest average of fragments in the samples were also observed in location 2 of Babesa with 361.67 per kg compared to Location 1 of Dechencholing with 38.33 per kg.
- Followed by Foam with the average of 210 per kg of Babesa location 2, fibre with 113.33 per kg of Babesa Location 2 and Filament with 21.67 per kg of Dechencholing location 1.
- Overall, four prominent shapes listed above were found abundant in location 2 of Babesa compared to Dechencholing lap of Thimphu Municipality except filaments.
- Meso and macro plastics over the years must be broken down into fragments by anthropogenic activities or physical agents like weather, sunlight and settled in the sediments.

Conclusion

- In conclusion, the study detected higher concentration of microplastics in downstream location 2 of Wangchhu river compared to the upstream location 1.

- Dominant sizes in both locations were from 600-1800 micrometers which are relatively small sizes. Fibers was the most common shape of microplastics in water samples and fragment in sediment samples.

- Yellow colour was found relatively higher in both samples.

- From this study, we can conclude that WWTPs is one of the potential sources of microplastics pathways to the rivers. Presence of fibers in water samples can deduce the source of microplastics as domestic and commercial laundry including manufacturings of synthetic clothes.

- This study confirms the presences of fragments shape microplastics in sediment samples as a result of fragmentation of mismanaged meso and macro plastics over a long period of time under physical conditions. Understanding the smaller sizes of microplastics found in the study, aquatic lives including filter feeders will have greater health threats from ingestion of microplastics with absorbed chemicals.

- Therefore, accounting the result of this study, freshwater conservations, plastics policies and environmental standards can be improved to protect terrestrial, marine ecosytems and to resolve challenges faced by Bhutan with mismanaged wastes.

Recommendations

- Underscoring the limitation of this research period as a year master's program, seasonal sampling collections can be included to understand variation in microplastic concentrations;

- Careful examination of influents into the WWTPs can be studied to understand daily inflow of microplastics in WWTPs and compare with the effluent samples. This can enhance the removal efficiency of WWTPs;

- The National Environment Commission in Bhutan can include microplastics as one of the water quality parameters including safe drinking water in Environmental Standards 2020. This policy drive can help the government to partake effective guidelines in monitoring, plastic waste management and also to assess pollution level considering permissible standard. Such recommendations can help Bhutan in developing plastic management policy, conserving its pristine freshwater bodies, aquatic and public health and minimize transport of microplastics to marine ecosystem from land;

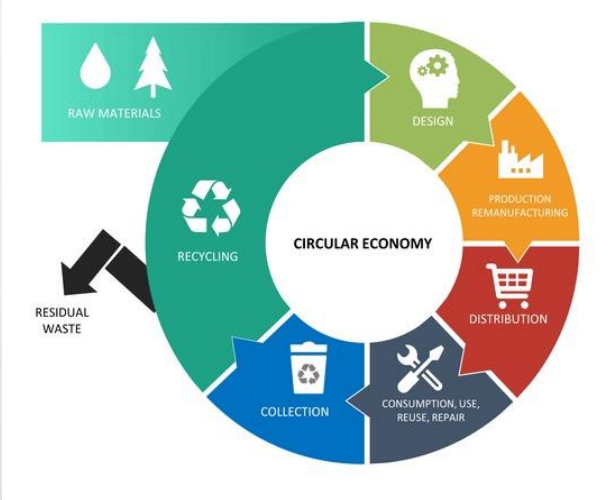
- To conduct FTIR analysis for polymer type and;

- Requirement of strict enforcement of existing rules and regulations on illegal dumplings of waste along road sides, trails, public and other open areas and to inculcate behavioral change waste management from sources through environmental education

Zero Waste Bhutan

- Waste Management Flagship Program launched by Her Majesty The Queen on 02 June 2019 coinciding with the Coronation Day of The Fourth King

To continuously move/promote towards **"Zero Waste Bhutan by 2030"** in partnership with the public, industry, civil society organizations, and government authorities at local and sectoral levels, municipalities, …embarking on the concept of "Circular Economy



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Outcomes of the Research at Policy level

- More than 100 District/ Municipality Environment Officers and De-Suung participants across the country during the Training of Trainers on Zero Waste Bhutan App were sensitized about the presence of microplastics contamination along the Stretch of Wangchhu River in Thimphu, Bhutan, as a part of knowledge sharing and environmental education.

- Conducted cleaning campaigns along the stretch of rivers in Bhutan

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- Presence of microplastics in the freshwater rivers of Bhutan was acknowledged by the Bhutan State of Environment Report 2022.

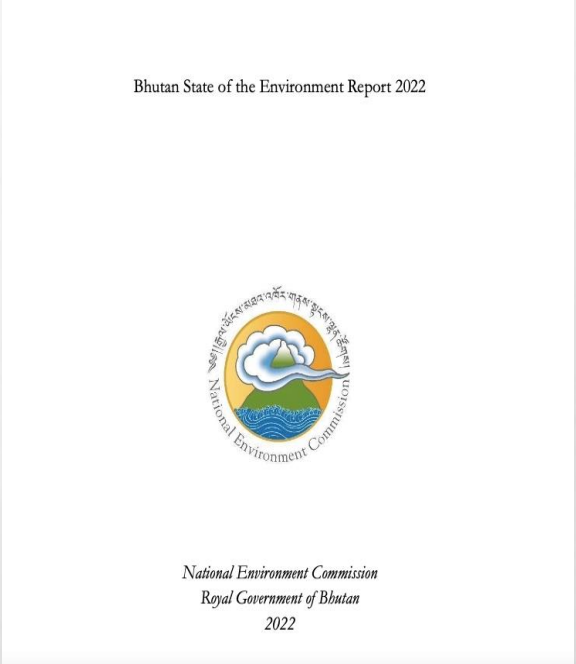
- Requirement of strict enforcement of existing rules and regulations on illegal dumplings of waste along road sides, trails, public and other open areas was integrated in the report

- On environmental education and t behavioral changes to reduce waste from sources- Success stories of environmental education of Ecology Note and Youth Action for 4 Rs in schools were highlighted in the report

- The Bhutan State of Environment Report is part of the periodic assessment of the environmental conditions and trends published after every five years.

Following are the main objectives of the report:

- Provide information on the State of the Environment;
- Provide information to decision-makers for informed decision-making in the development of 13th Five Year Plan of the country;
- Make recommendations for strengthening enforcement and implementation of environmental policies, plans and programmes



Link: http://www.nec.gov.bt/publications/download/bhutan-state-of-environment-report-2022

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