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Accumulation of Microplastics in Surface Water, Soil, and Asian Clam (*Corbicula* spp.) Due to Municipal Wastewater in the Lam Pao Dam, Thailand

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ABSTRACT

This study aimed to investigate the accumulation of microplastics in surface water, soil, and Asian clams (*Corbicula* spp.) as a result of municipal wastewater discharge into the Lam Pao Dam. Sampling was conducted once during the summer season (May–June 2024). The findings revealed a total of 54 microplastic particles in the freshwater clams. Notably, Location 16 (Ban Sukjai) exhibited the highest concentration, with 18 microplastic particles—accounting for 33% of the total detected. In terms of bioaccumulation, the highest average concentration of microplastics in Asian clams was 3.0 ± 2.75 particles per individual (43% of all samples), which corresponded to 6 particles per gram of tissue (36%). Regarding particle characteristics, microplastics sized between 1000 and 2500 µm were the most prevalent, with 30 particles (56% of the total). Fibrous microplastics were identified in 18 cases (65%), while blue-colored particles were detected in 15 instances (56%). The extracted microplastic samples were further analyzed using Fourier Transform Infrared Spectroscopy (FTIR). The analysis revealed that the predominant polymer type was polyamide (PA), accounting for 58% of all identified particles. These findings suggest that daily water use and land-based activities around Lam Pao Dam—including the use of textiles, fishing nets, electrical equipment, conduit pipes, packaging materials, and operations from auto repair shops—are major contributors to microplastic contamination and bioaccumulation in Asian clams in the area.

INTRODUCTION

The situation of municipal solid waste in Thailand, based on an assessment of the waste generated in 2021, revealed a total of 24.98 million tons, representing a 1%

decrease from 2020. Of this waste, 8.61 million tons were sorted at the source and recycled, marking a 3% increase compared to 2020. Proper disposal was achieved for 9.68 million tons, a 6% increase from 2020, while approximately 6.69 million tons were improperly disposed of, reflecting a 15% decrease from the previous year. One contributing factor to the reduction in municipal solid waste was the outbreak of the Coronavirus Disease 2019 (COVID-19), which led to restrictions on international tourist arrivals in Thailand. Concurrently, work-from-home measures and the increased use of food delivery services led to a rise in single-use plastic consumption. Items such as foam containers, plastic food boxes, plastic bags, hot-cold plastic bags, condiment bags, plastic spoons, forks, knives, and plastic cups from department stores, supermarkets, convenience stores, and food delivery service platforms like Grab Food, Line Man, Wongnai, Gojek, Food Panda, and Lalamove saw increased use **(Pollution Control Department, Thailand, 2024)**.

Building on this understanding, microplastics are a novel pollutant introduced into the environment primarily through human activities. During rainfall, microplastics are washed into reservoirs, rivers, seas, and other water bodies, leading to their accumulation in aquatic organisms. This accumulation subsequently degrades ecosystems and disrupts the food chain **(Baldwin *et al.*, 2020; Saemi-Komsari *et al.*, 2022)**. Microplastics can be categorized into two types: primary and secondary. Specifically, primary microplastics are particles smaller than 5 millimeters, such as microbeads found in facial cleansers or plastic pellets used as raw materials in plastic production **(Barnes *et al.*, 2009)**. Secondary microplastics, on the other hand, originate from larger plastic items or commonly used plastics with a size greater than 5 millimeters, such as plastic bags, plastic straws, aquatic litter, debris from landfills, synthetic fibers from textile waste, fishing nets, and commercial or agricultural sources **(Kole *et al.*, 2017)**. From a chemical perspective, microplastics are synthesized from various molecules and consist of different types of polymers. The most commonly synthesized and utilized polymers include polypropylene (PP), low-density polyethylene (LDPE), high-density polyethylene (HDPE), polyvinyl chloride (PVC), polyurethane, polycarbonate (PC), polyethylene terephthalate (PET), polyethylene (PE), acrylic (PMMA), and polystyrene (PS). Moreover, they come in different shapes, such as fibers, fragments, rods, pellets, films, and foams, and in a range of colors including blue, black, transparent, sky blue, gray, red, pink, green, white, orange, yellow, brown, and purple. These microplastics have diverse characteristics and originate from numerous sources, varying in size and other properties **(Peng *et al.*, 2017; Wu *et al.*, 2018; Barcelo, 2020)**.

Given these escalating concerns, the issue of microplastic pollution in freshwater, seawater, soil, and aquatic organisms has become a significant and increasingly severe problem **(Yuan *et al.*, 2019; Vidal *et al.*, 2023; Hamdy *et al.*, 2024)**. The direct effects of microplastics on aquatic animals are both physical and nutritional. In addition to these direct impacts, plastic ingredients and additives can be indirectly transferred through aquatic food webs, thereby impacting food safety and human health **(Kasamesiri *et al.*, 2023; Yadav & Agwuocha, 2023; Ghani *et al.*, 2024)**. The extent of toxicity, especially for human health, may vary depending on factors such as size, shape, chemical composition, surface charge, and hydrophobicity. When microplastic size decreases to below 1 micrometer, forming nanoplastics, these ultrafine particles can penetrate primary tissue barriers in the body, enter capillaries via the bloodstream, and disperse throughout the body **(Lee *et al.*, 2023)**. Once inside the human body, microplastics can affect various systems, including the digestive, respiratory, and reproductive systems, and may contribute to cancers, organ damage, and respiratory impairments. Ultimately, the overall toxicity of microplastics primarily results from their ability to interfere with metabolism, their absorption into the circulatory system, and their persistence within the body **(Eze *et al.*, 2024; Lee *et al.*, 2024)**.

Against this backdrop, the Lam Pao Dam is a large earth dam in Thailand, whose construction began in 1963 and was completed in 1968. The dam spans several districts, including Tha Khantho, Nong Kung Si, Nong Mek, Sahatsakhan, Kham Muang, Yang Talat, and Mueang Kalasin Districts in Kalasin Province, as well as Wang Sam Mo District in Udon Thani Province. Currently, the Lam Pao Dam can store up to 1,980 million cubic meters of water. It was constructed to mitigate flooding, supply water for agriculture, and generate electricity. Furthermore, the surrounding area supports local communities who benefit from recreational and tourism activities, making it a popular spot for relaxation. The daily and occupational activities of residents around the Lam Pao Dam generate domestic wastewater from cooking and cleaning in households and buildings. Fishing activities involve the use of ropes and nets, and the dam is the largest site for the Nile tilapia cage culture in northeastern Thailand. Additionally, the presence of sugar factories and cassava starch processing plants contributes to wastewater discharge into the Lam Pao Dam **(Royal Irrigation Department, 2022)**.

The Asian Clam of the genus *Corbicula* is widely distributed and easily collected. It is one of the world's most widespread invasive species, morphologically variable and taxonomically complex, and serves as a bioindicator in water sources. This species has undergone significant global range expansion and is now found in regions such as North America, Southeast Asia, East Asia, Australia, and Africa **(Su *et al.*, 2018; Haponski & Ó'Foighil, 2019; Benson & Williams, 2021)**. In Thailand, the Asian Clam inhabits various water bodies and can adapt to both freshwater and brackish environments, dwelling on riverbeds or burrowing into the sand. Locally, it is known by different names such as "Hoi Sai," "Hoi Kee," "Hoi Tao Hoi Tak," "Hoi Hoei," "Hoi Liat," "Hoi Ta Wua Num Chuead," "Hoi Fa Muang," and "Hoi Talap" **(ONEP, 2008; Bodon *et al.*, 2020)**. In Kalasin Province, it is called "Hoi Gib Ki," "Hoi Leb Ma," or "Hoi Jintara." As a major protein source for the local population around Lam Pao Dam, the prevalence and ecotoxicological effects of microplastics in freshwater clams significantly affect aquatic food security. Aquatic resources from Lam Pao Dam, including clams, are sold as fresh and processed products and exported to countries like Indonesia, Malaysia, and Japan **(ONEP, 2008)**.

In this context, the present study investigated how domestic wastewater discharges from activities around Lam Pao Dam influence the abundance and morphological characteristics of microplastics. Microplastic pollution in the dam was assessed in terms of abundance and characteristics, including size, color, shape, and polymer type. The study also quantified and compared microplastic concentrations in surface water and freshwater clams and evaluated the impact of domestic wastewater discharges on microplastic prevalence in Lam Pao Dam, Thailand.

MATERIALS AND METHODS

1. Sampling and preservation of water, soil, and Asian clam samples

1.1 Water and soil sampling

A total of 18 sampling sites were designated, divided into two sections: (1) Water and soil sampling points at the water ingress area of Lam Pao Dam, comprising 12 points (Points 1–12), and (2) sampling points in areas inhabited by the Asian clam, comprising 6 points (Points 13–18).

Sampling was conducted once during the rainy season, from May to June 2024, as shown in Fig. (1) and Table (1).

1.2 Water sampling

Water samples were collected from all 18 sampling points, with one sample per point, each consisting of 1 liter. Specifically, water was collected using a pump to transfer it into a galvanized tank. The pumped water was then filtered through a filter bag with a pore size of 20 micrometers. The filtered water was transferred into glass bottles and stored at 4°C to preserve sample integrity.

1.3 Soil sampling

Soil samples were collected from all 18 sampling points, with one sample per point. A galvanized shovel was used to collect 1 kilogram of soil per point, which was placed in a sample bag. To maintain sample quality, each bag was sealed tightly and stored at a temperature of 4°C.

1.4 Asian Clam sampling

Asian Clams were collected from 6 sampling points (Points 13–18), with a total weight of 1 kilogram per point. The collected clams were chilled and stored at a temperature of –20°C to preserve them.

2. Analysis of microplastics in water, soil, and Asian Clam samples

2.1 Analysis of microplastic accumulation in water

A 1-liter water sample was poured into a 2000-milliliter beaker. Then, 100 milliliters of hydrogen peroxide solution (H_2O_2, 30%) was added, and the mixture was left to react for 4 hours. Afterward, 165 grams of salt (based on a ratio of 150 grams per liter of water) was added, and the mixture was left overnight to facilitate density separation. The treated sample was then filtered using glass fiber filter paper No. 4 with a 20-micrometer pore size. After filtration, the residue was placed on a glass plate and dried at 55°C for 4 hours. This methodology was adapted and modified from **(Xu *et al.*, 2018; Barcelo, 2020)**.

2.2 Analysis of microplastic accumulation in soil

A saturated sodium chloride (NaCl) solution of 600 milliliters was prepared. Then, 300 grams of sediment soil was added to a 1-liter conical flask. The mixture was shaken for 2 minutes at a speed of 200 revolutions per minute and allowed to settle. After sedimentation, the supernatant was filtered using glass fiber filter paper No. 4 (pore size: 20 micrometers). The filtered material was then placed on a glass plate and dried at a temperature of 50–55°C for 4 hours **(Masura *et al.*, 2015)**.

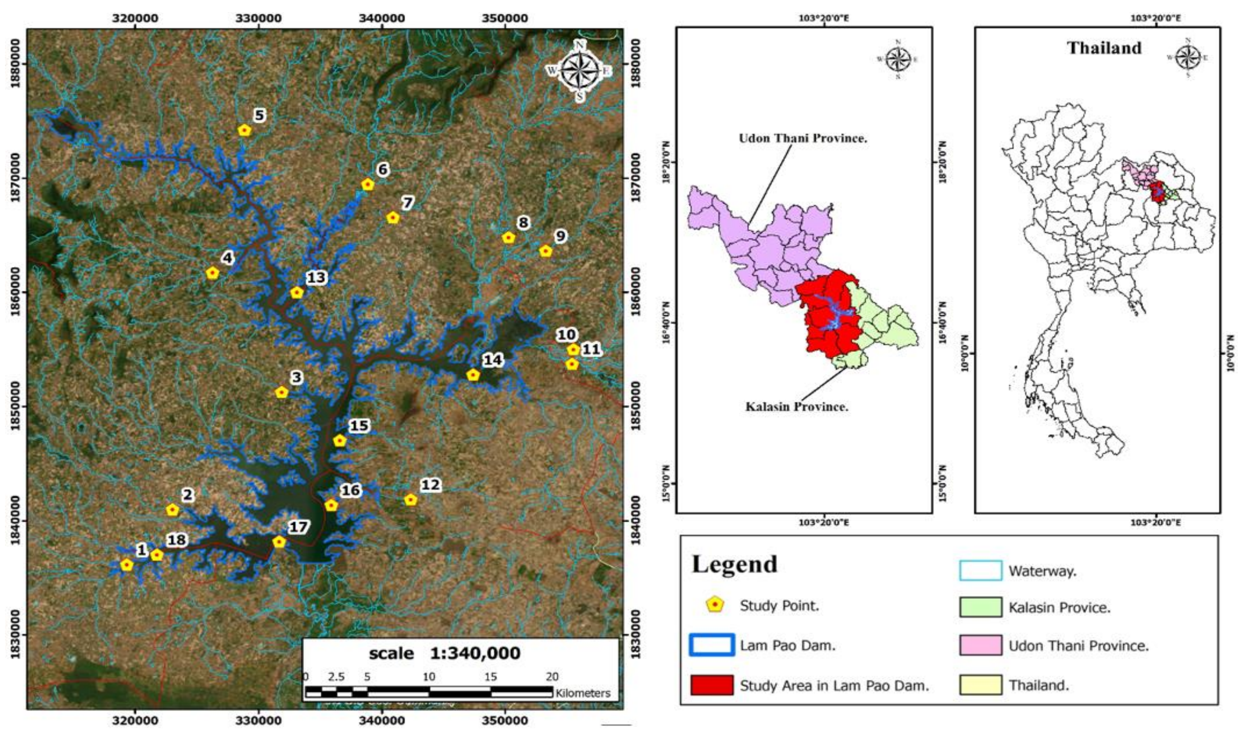


Fig. 1. The eighteen sampling stations (yellow dots) positioned within the Lam Pao Dam, Thailand

Table 1. Sampling stations in Lam Pao Dam

Sitecode	Sampling stations	Latitude	Longitude
1	Huai Mek, Huai Mek District, Kalasin Province	16°60'08.64"N	103°30'64.90"E
2	Huai Kham Pla Kang Nong Kung Si District Kalasin Province	16°64'47.04"N	103°34'06.93"E
3	Huai Kam Ka Kang, Nong Kung Si District, Kalasin Province	16°73'82.57"N	103°42'31.70"E
4	Huai Dong Mun, Tha Khan Tho District Kalasin Province	16°83'24.60"N	103°36'96.85"E
5	Huai Mun, Wang Sam Mo District, Udon Thani Province	16°94'54.14"N	103°39'29.17"E
6	Huai Lam Phan Khat, Wang Sam Mo District, Udon Thani Province	16°90'32.61"N	103°48'74.14"E
7	Huai Yang, Sam Chai District, Kalasin Province	16°87'72.80"N	103°50'67.36"E
8	Huai Sangka, Sam Chai District, Kalasin Province	16°86'20.50"N	103°59'47.99"E
9	Huai Nong Sim, Sam Chai District, Kalasin Province	16°85'15.51"N	103°62'33.81"E
10	Huai Kut Yao, Kham Muang District Kalasin Province	16°77'37.71"N	103°64'50.62"E
11	Huai Kloi, Somdet District, Kalasin Province	16°76'21.83"N	103°64'38.60"E
12	Huai Bong, Mueang Kalasin District, Kalasin Province	16°65'39.70"N	103°52'21.06"E
13	Ban Laem Thong, Wang Sam Mo District, Udon Thani Province	16°81'73.56"N	103°43.40.69"E
14	Ban Na Sinuan, Sahatsakhan District Kalasin Province	16°75'30.55"N	103°56'88.00"E
15	Ban Kham Khaen, Sahatsakhan District Kalasin Province	16°70'04.78"N	103°46'75.88"E
16	Ban Sukjai, Mueang District, Kalasin Province	16°64'90.07"N	103°46'14.94"E
17	Ban Sa-at Nathom, Mueang District, Kalasin Province	16°62'00.79"N	103°42'20.55"E
18	Ban Nong No, Nong Mek District, Kalasin Province	16°60'87.61"N	103°32'93.21"E

2.3 Analysis of microplastic accumulation in Asian clams

Three Asian clams were randomly selected from the frozen samples and allowed to thaw at room temperature. The meat was separated from the shells, then soaked in saltwater for 60 minutes to remove slime and impurities. After soaking, the clam meat was boiled for 5 minutes and ground into a uniform consistency using an electric grinder. The ground meat was then dried at 70°C for 24 hours.

The dried clam meat was placed in a beaker, and 50 milliliters of hydrogen peroxide solution (H_2O_2, 30%) was added per sample to digest organic matter. The mixture was stirred using a glass rod, followed by the addition of salt. The sample was stirred again and left to stand overnight. After 24 hours, the mixture was filtered using glass fiber filter paper No. 4 with a pore size of 20 micrometers. Finally, the filtered sample was placed on a glass plate and dried at 55°C for 4 hours. This methodology was adapted and modified from **(Sooksawat *et al.*, 2023)**.

3. Data analysis

Water, soil, and Asian Clam samples were examined using a stereo microscope to observe and record the number, size, shape, and color of detected microplastics.

Microplastic particles were randomly selected for polymer type identification using Fourier Transform Infrared Spectroscopy (FT-IR). This analysis was conducted using a PerkinElmer Spectrum Two FT-IR Spectrometer.

The number, type, and morphological characteristics of microplastics found in water, soil, and Asian Clams were then analyzed. For classification purposes, the microplastics were categorized into five size ranges: (1) greater than 150μm, (2) 100–500μm, (3) 501–1000μm, (4) 1000–5000μm, and (5) less than 5000μm.

4. Statistical analysis

Microsoft Excel was used for data recording and statistical analysis.

RESULTS

1. Microplastics in water at the Ingress area

1.1 Total number of microplastics in water

A total of 134 microplastic particles were detected in the water samples. The highest concentration was observed at Point 12 (16%), followed by Point 2 (13%), Point 5 (10%), Points 1, 3, 4, and 8 (7% each), Points 7 and 10 (7% each), Points 6 and 9 (6% each), and Point 11 (5%) (Fig. 2A).

1. 2 Size of microplastics in water

The most common size range of microplastics was 1000– 2500μm (39%), followed by 2500– 5000μm (24%), 500– 1000μm (21%), 150– 500μm (15%), and 0–150μm (1%) (Fig. 3A).

1.2 Morphological characteristics of microplastics in water

The majority of microplastics were fibrous in shape (79%), followed by fragments (19%), while foam and rod particles each accounted for 1% (Figs. 4A, 8).

1.3 Color of microplastics in water

Blue was the most commonly observed color (68%), followed by pink (7%), sky blue (4%), green and purple (4%), gray (3%), black, transparent, and red (2% each), and white, brown, and yellow (1% each) (Figs. 5A, 9).

2. Microplastics in soil at the Ingress area

2.1 Total number of microplastics in soil

A total of 156 microplastic particles per kilogram were detected in soil samples. The highest concentration occurred at Point 12 (26%), followed by Point 2 (13%), Point 6 (10%), Points 1, 3, 5, and 11 (8% each), Point 7 (7%), Points 8 and 9 (4% each), and Points 4 and 10 (2% each) (Fig. 2B).

2.2 Size of microplastics in soil

The most frequent size range of microplastics was 1000– 2500μm (42%), followed by 2500– 5000μm (26%), 500– 1000μm (20%), 150– 500μm (10%), and 0–150μm (2%) (Fig. 3B).

2.3 Morphological characteristics of microplastics in soil

Fibers accounted for the majority of particles (74%), followed by fragments (20%), foams (4%), and rods (2%) (Figs. 4B, 8).

2.4 Color of microplastics in soil

Blue was the dominant color (74%), followed by black (8%), sky blue (6%), and gray, pink, yellow, brown, white, and silver (2% each) (Figs. 5B, 9).

3. Microplastics in water, soil, and Asian clams in the habitat area

3.1 Total number of microplastics

3.1.1 Asian clams

The average number of microplastic particles in Asian clams was 6.9 particles per individual, with a standard average of 1.15 particles per individual. The highest concentration was observed at Point 16 (3.0 ± 2.75 particles per individual; 43%), followed by Points 17 and 18 (1.0 ± 4.17 particles per individual; 15% each), Point 15 (1.0 ± 4.17 particles; 14%), Point 14 (0.6 ± 4.45 particles; 9%), and Point 13 (0.3 ± 4.66 particles; 4%).

On a weight basis, the average number of microplastics was 16.6 particles per gram, with an average of 0.92 particles per gram. Point 16 again showed the highest concentration (6 particles per gram; 36%), followed by Points 15, 17, and 18 (3 particles per gram; 18% each), Point 14 (1 particle per gram; 6%), and Point 13 (0.6 particles per gram; 4%).

3.1.2 Water in the habitat area of Asian clams

A total of 106 microplastic particles per liter were found. Point 16 had the highest concentration (42%), followed by Point 17 (15%), Point 18 (14%), Point 15 (10%), and Points 13 and 14 (9% each).

3.1.3 Soil in the habitat area of Asian clams

A total of 76 microplastic particles per kilogram were detected in soil samples. The highest concentration was found at Point 16 (30%), followed by Point 17 (23%), Points 15 and 18 (17% each), Point 14 (9%), and Point 13 (4%).

3.2 Size of microplastics in the habitat area

3.2.1 Size of microplastics in Asian clams

The most common size range was 1000– 2500µm (56%), followed by 2500–5000µm (22%), 500– 1000µm (20%), and 150– 500µm (2%). No microplastics were found in the 0– 150µm range (Fig. 6A).

3.2.2 Size of microplastics in surface water

In surface water, the dominant size range was 500– 1000µm (33%), followed by 1000– 2500µm (31%), 150– 500µm (20%), 2500– 5000µm (14%), and 0– 150µm (2%) (Fig. 6B).

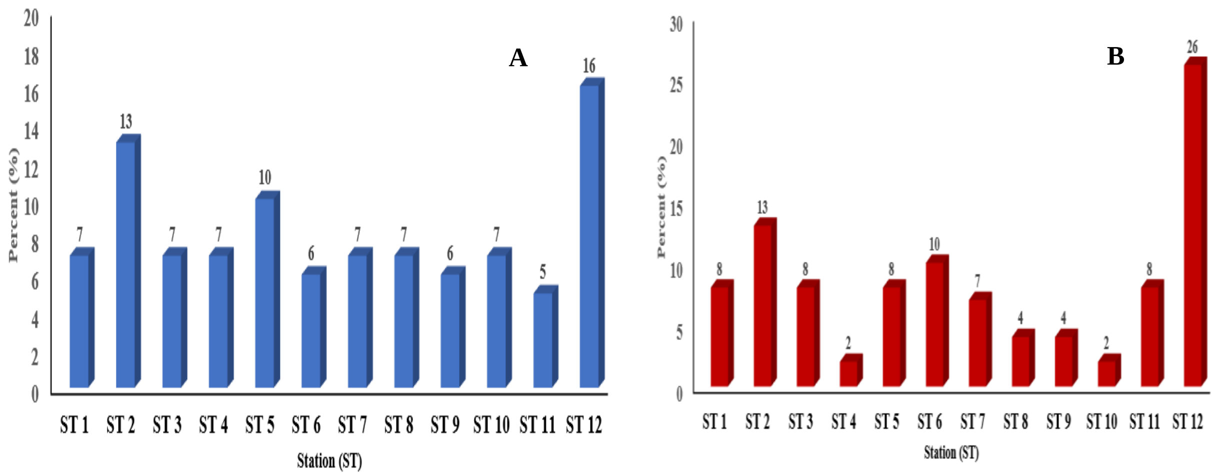


Fig. 2. The presence of microplastics at the ingress area: A) Total number of microplastics in water; B) Total number of microplastics in soil

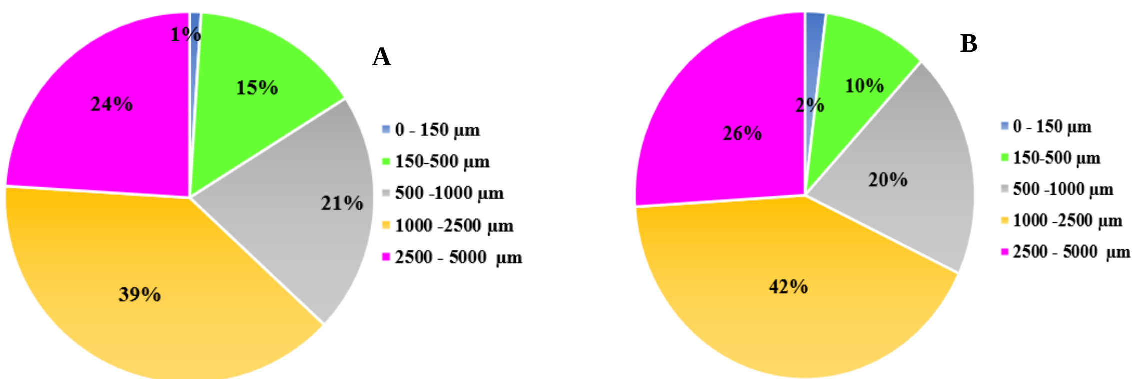


Fig. 3. The presence of microplastics at the ingress area: A) Size of microplastics in water; B) Size of microplastics in soil

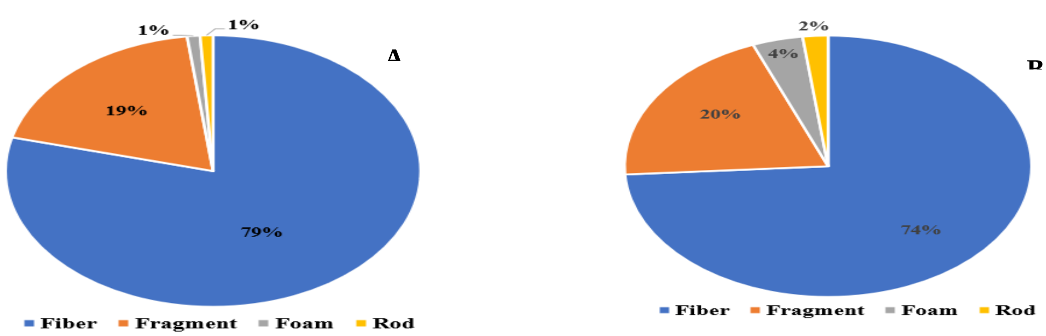


Fig. 4. The presence of microplastics at the ingress area: A) Morphological of microplastics in water; B) Morphological of microplastics in soil

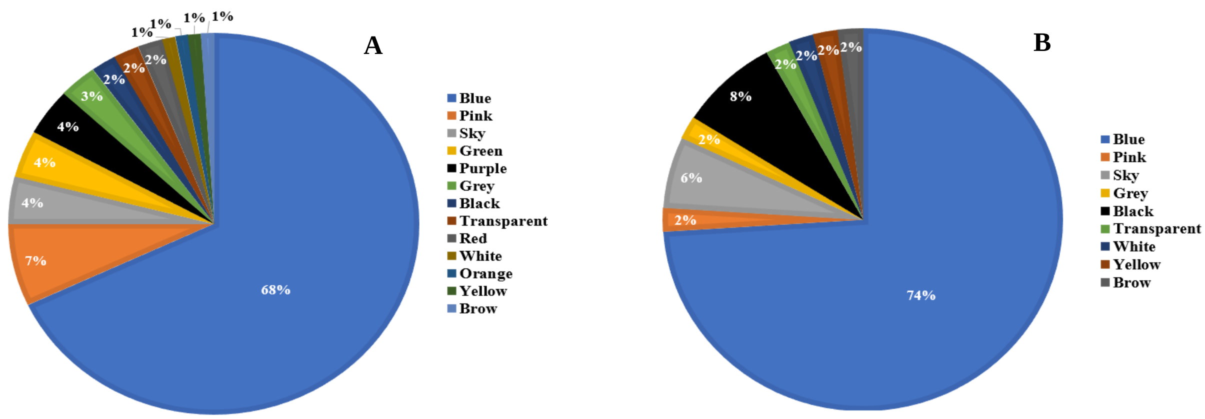


Fig. 5. The presence of microplastics at the ingress area: A) Color of microplastics in water; B) Color of microplastics in soil

3.2.3 Size of microplastics in soil in the habitat area of Asian clams

The most frequently detected size range of microplastics in soil was 1000–2500μm (36%), followed by 2500– 5000μm (30%), 500– 1000μm (26%), and 150–500μm (8%). No microplastics were detected in the 0– 150μm size range (Fig. 6C).

3.3 Morphological characteristics of microplastics in Asian clam, water, and soil samples (Fig. 8)

3.3.1 Morphology of microplastics in Asian clams

The majority of microplastics found in Asian clams were fiber-shaped (74%), followed by fragments (22%) and rods (4%) (Fig. 6D).

3.3.2 Morphology of microplastics in surface water

Fiber-shaped particles were most common in surface water (76%), followed by fragments (24%) (Fig. 6E).

3.3.3 Morphology of microplastics in soil

The most frequently observed shapes of microplastics in soil were fibers (75%), followed by fragments (21%) and rods (4%) (Fig. 6F).

3.4 Color of microplastics in Asian clam, water, and soil samples (Fig. 9)

3.4.1 Color of microplastics in Asian clams

Blue was the most prevalent color (56%), followed by transparent (15%), green (7%), gray, white, and purple (6% each), and pink and sky blue (2% each) (Fig. 7A).

3.4.2 Color of microplastics in surface water

The most common color in surface water samples was blue (64%), followed by pink (15%), sky blue, green, and transparent (4% each), black, gray, purple, and red (2% each), and white and orange (1% each) (Fig. 7B).

3.4.3 Color of microplastics in soil

In soil samples, blue was also the most dominant color (52%), followed by sky blue (12%), white and transparent (8% each), and black, gray, pink, brown, and purple (4% each) (Fig. 7C).

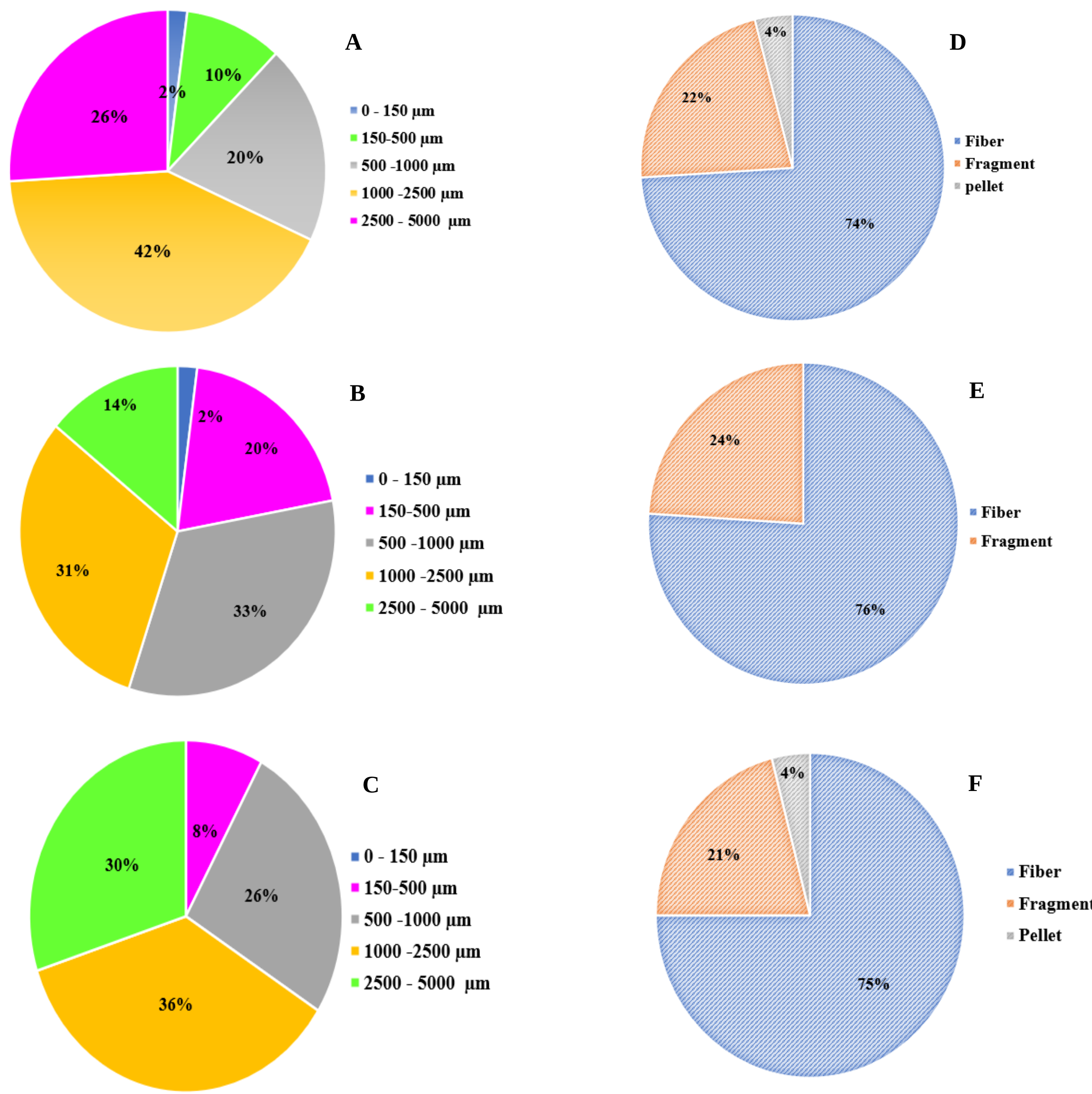


Fig. 6. 1) Size of microplastics in Asian clam (A), Water (B), and Soil; (C) Samples in the habitat area of Asian clams. 2) Morphological characteristics of microplastics in Asian clam (D), Water (E), and Soil; (F) Samples in the habitat area of Asian clams

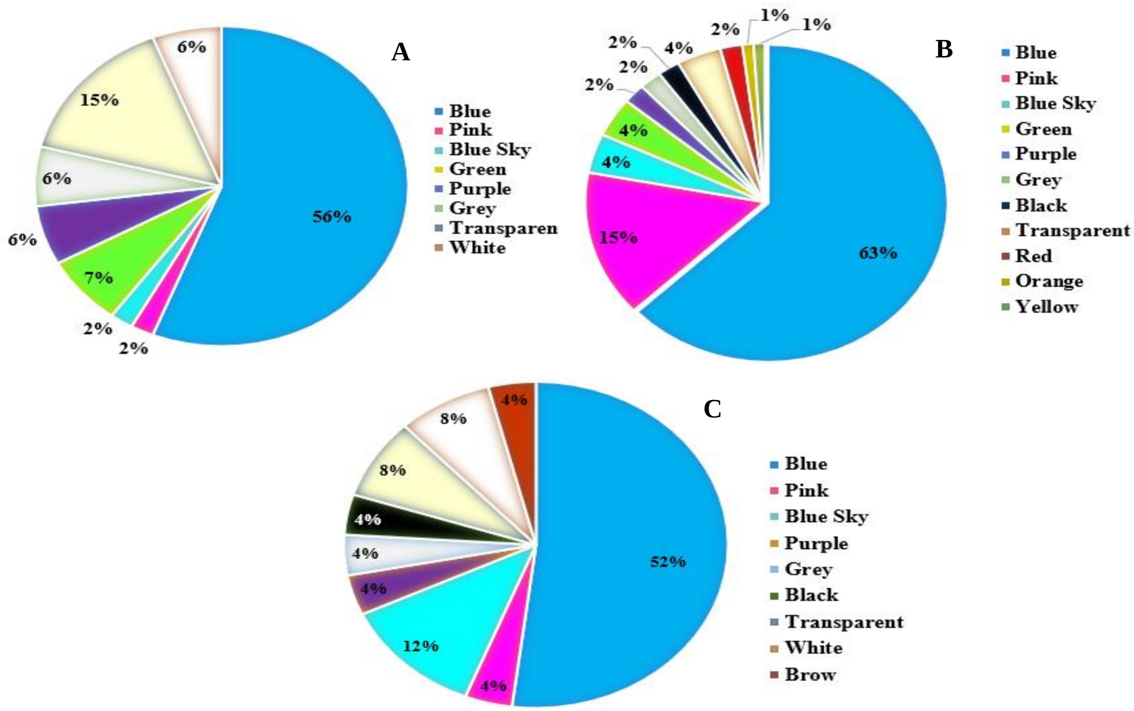
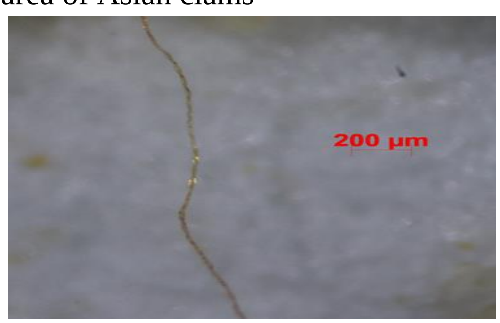
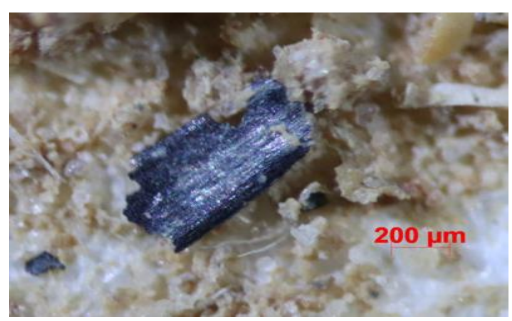
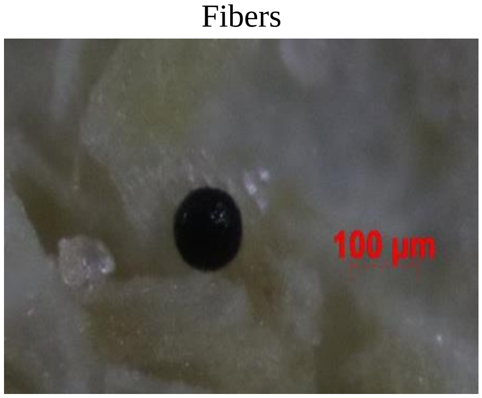


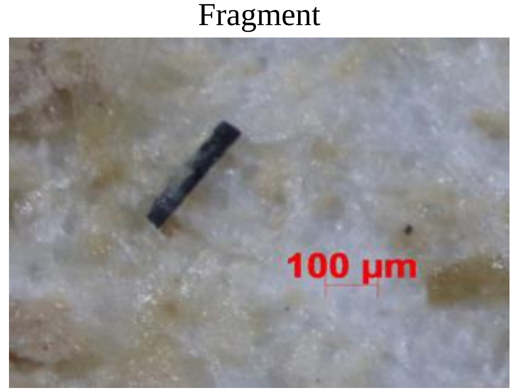
Fig. 7. Color of microplastics in Asian clams (A), Water (B), and Soil; (C) Samples in the habitat area of Asian clams





Fibers Fragment





Foams Rod

Fig. 8. Morphological characteristics of microplastics in the Lam Pao Dam, Thailand

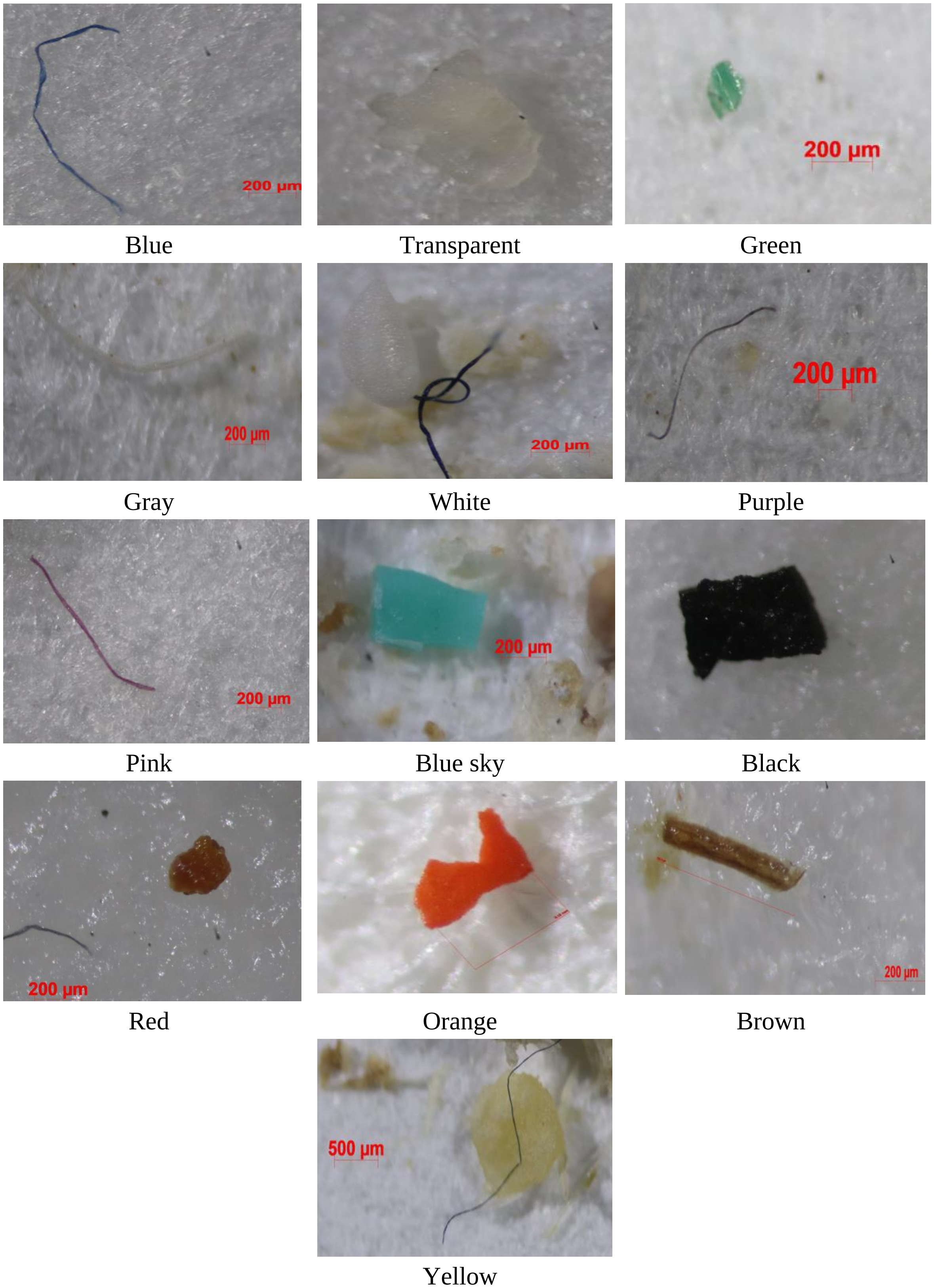


Fig. 9. Color of microplastics in the Lam Pao Dam, Thailand

4. Polymer types of microplastics

A total of 67 microplastic particles from water, soil, and Asian clam samples were randomly selected for polymer identification using Fourier Transform Infrared Spectroscopy (FT-IR). Among these, the most frequently identified polymer was Polyamide (PA), detected in 39 particles (58%), followed by Polyethylene (PE) in 19 particles (28%), High-Density Polyethylene (HDPE) in 5 particles (7%), and Polypropylene (PP) in 3 particles (5%) (Fig. 10).

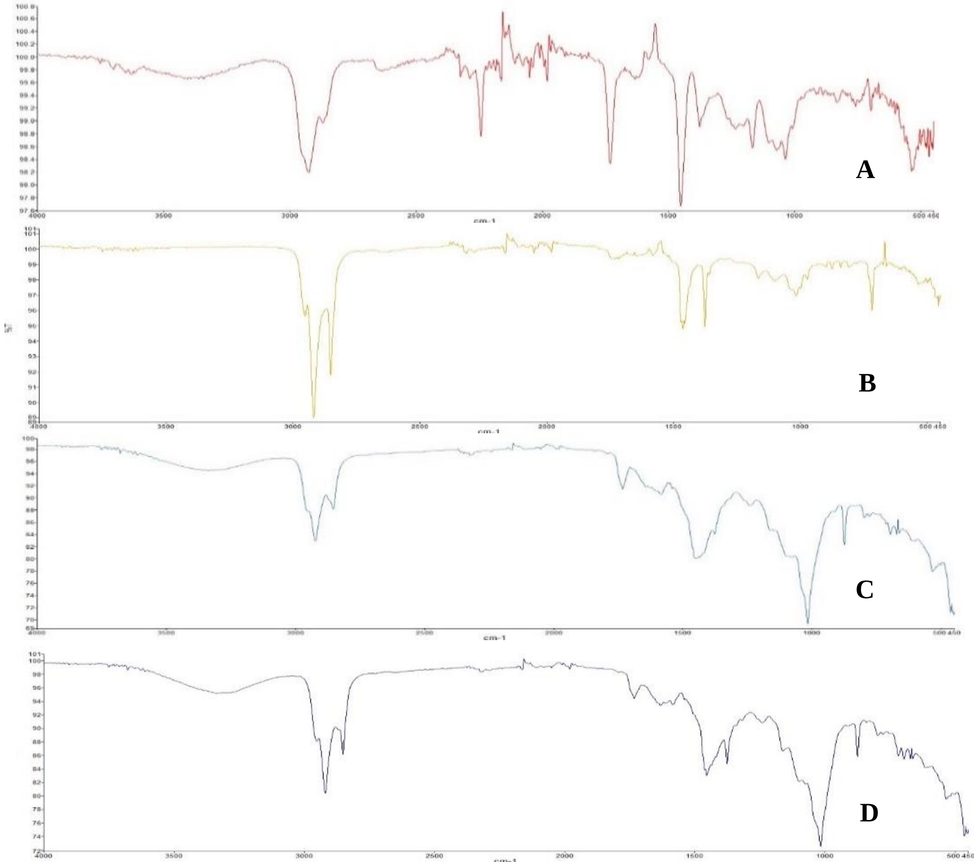


Fig. 10. Microplastic fragment polymer types analyzed using FTIR spectra; (A) Polyamide (PA), (B) High density polyethylene (HDPE), (C) Polyethylene (PE) and (D) Polypropylene (PP)

DISCUSSION

In the context of these observations, the results of this study on the accumulation of microplastics in surface water, soil, and Asian clams (*Corbicula* spp.) due to municipal wastewater in the Lam Pao Dam revealed a total of 473 microplastic particles across 12 sampling points along the water ingress channels. Specifically, microplastics were found in surface water at 134 particles per liter and in soil at 156 particles per kilogram. The highest concentration was recorded at Point 16, located near Ban Sukjai, accounting for 33% of the total contamination. Notably, the size and morphology of microplastics found in surface water and soil were consistent with those detected in the Asian clam samples, suggesting a direct relationship between environmental contamination and bioaccumulation in clams.

At Point 16, Asian clams exhibited the highest microplastic accumulation, with 3.0 ± 2.75 particles per individual (43%), equivalent to 6 particles per gram (36%). The most frequently observed microplastics in the clams were between 1000– 2500µm in size (56%), fiber-shaped (65%), and blue in color (48%). This localized contamination is likely attributed to the dam's location at the confluence of multiple water channels, where runoff and wastewater from residential areas—including Point 14 (Huai Bong), a densely populated area—converge. These conditions enhance microplastic accumulation, particularly in benthic filter feeders like clams.

These findings align with the study by **Su *et al.* (2018)**, which showed that microplastic contamination in freshwater clams varies in size, shape, and color depending on local human activities and sampling sites. Factors such as water flow and clam size also influence the level of microplastic accumulation **(Yuan *et al.*, 2019; Hoellein *et al.*, 2021; Delara *et al.*, 2025)**. The small size of microplastics—comparable to plankton and other suspended particulates—makes them easily ingestible by filter-feeding invertebrates like clams **(Vidal *et al.*, 2023)**. This leads to bioaccumulation and, ultimately, biomagnification in aquatic food webs **(Wright *et al.*, 2013; Noor *et al.*, 2025)**.

The predominance of fibrous blue microplastics is likely due to domestic activities such as laundry, where synthetic textile fibers are released into wastewater **(Li *et al.*, 2018; Tang *et al.*, 2020)**. However, these results contrast with findings from Bueng Boraphet wetland in Nakhon Sawan Province, where *Filopaludina martensi martensi* (Pond Snail) samples contained an average of 2.90 microplastic particles per kilogram of sediment, predominantly sized 501– 1000µm (54.80%) and sheet-shaped (56.05%). Seasonal differences were also observed, with transparent particles most common in the dry season (39.34%) and black particles in the rainy season (25.86%). The same species contained 0.34 pieces per gram (or 0.37 per individual), with the majority being 501–1000 µm, fiber-shaped (75.98%), and black in color (55.40%) **(Saowalak, 2020)**.

A comparative study in the Phong River, Khon Kaen Province, found 11.50 ± 16.80 microplastic particles per individual in *Filopaludina martensi* (Pond Snail), predominantly 1– 100µm in size (67.73%), with fibers (39.13%) and white particles (30.49%) being most common. In *Pomacea canaliculata* (Freshwater Snail), 26.33 ± 33.30 particles per individual were found, mostly fragments (72.78%) and black in color

(44.46%) **(Yasaka *et al.*, 2022)**. These findings differ from studies on *Anentome helena* (Assassin Snail) and *Pilsbryoconcha exilis compressa* (Clams) in the Khao Laem Dam area, where *A. helena* had 0.5 ± 1.0 microplastic particles per individual, mainly filamentous in shape (26.0%) and blue in color (54.8%). *P. exilis compressa* contained 2.5 ± 3.3 particles per individual, primarily 101– 200µm in size (38%), filamentous in shape (38.3%), and blue in color (64.5%) **(Sooksawat *et al.*, 2023)**.

Further, in the Mae Kha Canal, Chiang Mai Province, *F. martensi martensi* had an average of 0.87 ± 0.64 microplastic particles per individual, mainly 250– 500µm in size (36.56%), fiber-shaped (51.61%), and blue in color (36.56%) **(Bannajak *et al.*, 2023)**. Refer to Table (2) for a detailed summary.

Viewed holistically, this study provides insights into how freshwater mollusks—both univalves and bivalves—accumulate microplastics differently depending on seasonal variations and site-specific factors **(Hamdy *et al.*, 2024; Buwono *et al.*, 2025; Delara *et al.*, 2025)**. Land use and the nature of the waterbody—whether a stagnant reservoir or flowing river—also significantly affect aquatic ecosystems and microplastic accumulation.

In light of these findings, FT-IR analysis revealed that Polyamide (PA) was the most commonly detected polymer, accounting for 58% of identified microplastics. PA is widely used in textiles, sports equipment, fishing nets, electrical conduits, and food packaging **(Jonsson *et al.*, 2021)**. This predominance suggests that household and community activities are the main sources of microplastic pollution in the Lam Pao Dam area.

Asian clams, being benthic filter feeders, are exposed to microplastics from both sediment and suspended particles. The variation in polymer types identified via FT-IR across different species and locations highlights species-specific exposure pathways. For instance, *Theodoxus fluviatilis* contained polypropylene **(Akindele *et al.*, 2019)**, while *F. martensi martensi* contained both polypropylene and polyethylene **(Saowalak, 2020; Bannajak *et al.*, 2023)**. *P. canaliculata* contained polystyrene **(Yasaka *et al.*, 2022)**, *A. helena* contained polydimethylsiloxane (PDMS), and *P. exilis compressa* contained polyvinyl chloride (PVC) **(Sooksawat *et al.*, 2023)**. Other studies also reported polyethylene terephthalate (PET) in species such as *Cristaria plicata*, *Bellamya angularis*, and *Pomacea ampullacea* **(Delara *et al.*, 2025)**.

These comparisons (Table 2) illustrate how the types of polymers found as microplastic pollutants are closely linked to land use and human activity in each area. The nature and intensity of surrounding activities—such as residential wastewater discharge, textile washing, and industrial runoff—determine the composition and characteristics of microplastics contaminating the local aquatic environments.

Table 2. Comparison of microplastic accumulation in Asian clams of Lam Pao with other freshwater mollusks

Freshwater molluscs	**Dominate**			**Polymer type of MPs**	**Study areas**
	Size (μm)	**Color**	**Shape**		
Filopaludina martensi martensi	501 - 1,000	black	fiber	Prolypropylene	Bueng Boraphet Wetland, Thailand **(Neatsingsang, 2020)**
Pomacea canaliculata	1 - 100	black	fragment	Polyester (PES)	Nam Pong River, Thailand **(Yasaka *et al.*, 2022)**
Filopaludina martensi	1 - 100	white	fiber	Low-density polyethylene (LDPE)	Nam Pong River, Thailand **(Yasaka *et al.*, 2022)**
Anentome helena	1 - 100	blue	fiber	PDMS	Khwae Noi Basin, Thailand **(Sooksawat *et al.*, 2023)**
Pilsbryoconcha exilis compressa	101-200	blue	fiber	Polyvinyl Chloride (PVC)	Khwae Noi Basin, Thailand **(Sooksawat *et al.*, 2023)**
Filopaludina martensi martensi	250 - 500	blue	fiber	Polyethylene	Mae Kha Canal, Thailand **(Bannajak *et al.*, 2023)**
Corbicula spp.	1000 - 2500	blue	fiber	Polyamide (PA)	This study

CONCLUSION

Taking these observations into account, the Asian clam (*Corbicula* spp.) was found to accumulate microplastics at an average concentration of 1.15 pieces per individual and 0.92 pieces per gram. The highest accumulation was recorded at Point 16 (Ban Sukjai), where the predominant characteristics of microplastics were within the 1000– 2500μm size range, fibrous in shape, and blue in color. The accumulation patterns in Asian clams were consistent with the characteristics of microplastics found in both surface water and soil at their habitat, indicating a strong environmental correlation.

Based on the levels detected, this study concludes that Asian clams from the study area are currently safe for consumption and do not pose a significant health risk. Fourier Transform Infrared Spectroscopy (FT-IR) analysis identified Polyamide (PA) as the most prevalent polymer type, accounting for 58% of all microplastics detected. The dominance of PA suggests that the primary sources of microplastic contamination in Asian clams are related to surrounding community activities and land use. These include the use of textile products, sports equipment, nylon ropes, electrical components, conduit pipes, packaging materials, and waste from auto repair shops.

Point 12 (Huai Bong) was particularly noted for high levels of microplastic contamination in water, likely due to runoff from this densely populated area flowing into Lam Pao Dam and contributing to downstream microplastic accumulation.

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ETHICS STATEMENT

This research project has been approved by the Ethical Principles and Guidelines for the Use of Animals No. 51/2023 of Mahasarakham University, Thailand.

REFERENCES

Akindele, E. O.; Ehlers, S. M. and Koop, J. H. E. (2019). First empirical study of Freshwater microplastics in West Africa using gastropods from Nigeria as bioindicators. Limnologica., 78: 125708. DOI:10.1016/j.limno.2019.125708

Baldwin, A. K.; Spanjer, A. R.; Rosen, M. R. and Thom, T. (2023). Microplastics in Lake Mead National Recreation Area, USA: Occurrence and biological uptake. PLOS ONE., 1-20: DOI:10.1371/journal.pone.0228896

Bannajak, W.; Cheunbarn, S.; Cheunbarn, T.; Uttamang, P. and Srinaunsom, K. (2023). Microplastic contamination in water sediment and freshwater mollusc in Mae Kha Canal at Chiang Mai Province. Khon Kaen Agr. J., 51 (5): 878-891. DOI:10.14456/kaj.2023.66. [Thailand]

Barnes, D. K.; Galgani, F.; Thompson, R. C. and Barlaz, M. (2009). Accumulation and fragmentation of plastic debris in global environments. Philos. Trsoc. B., 364(1526): 1985-1998. DOI:10.1098/rstb.2008.0205

Barcelo, D. (2020). Microplastics analysis. MethodsX, 7: 10088. DOI:10.1016/j.mex. 2020.100884

Benson, A. J. and Williams, J.D. (2021). *Corbicula* spp. locations in the United States from 1964 to 2019: U.S. Geological Survey data release. DOI:10.5066/ P9JKHE3F.

Bodon, M.; López-Soriano, J.; Salgado, S. Q.; Nardi, G.; Niero, I.; Cianfanelli, S.; Mas, A. D.; Elvio, F.; Baldessin, F.; Turco, F.; Ercolini, P.; Baldaccini, G. N. and Costa, S. (2020). Unravelling the complexity of Corbicula clams invasion in Italy (Bivalvia: Cyrenidae). Boll. Malacol., 56: 127-171.

Buwono, N. R.; Samuel1, P. D.; Arifin1, N. B. and Lusiana, E. D. (2025). Contamination of microplastics in the gastropod *Sulcospira* sp. from Upstream of the Brantas River in Indonesia. Egypt. Aquat. Biol. Fish., 29(2): 1559 – 1575. DOI: 10.21608/ejabf.2025.420698

Delara, R. G. D.; Jumawan, J. C.; Burdeos, R. C. B.; Felicitas, G.; Inocente, S. A.T.; Banda, M. H. T.; Latayada, F. S.; Vales, T. P., Seronay, R. A. and Capangpangan, R. Y. (2025). Exploring Microplastic Contamination in Wetland Mollusks: Species-specific Findings from a Major Wetland Habitat. EnvironmentAsia 18(1): 1-12 DOI 10.14456/ea.2025.1

Eze, C. G.; Nwankwo, C. E.; Dey, S.; Sundaramurthy, S. and Okeke, E. S. (2024). Food chain microplastics contamination and impact on human health: a review. Environ. Chem. Lett., 22(4):1-39. DOI:10.1007/s10311-024-01734-2

Ghani, S. A. A.; Hassan, S. W. M.; Shreadah, M. A. and Shobier, A. H. (2024). Microplastics pollution in aquatic environment: A review of abundance, distribution, and composition in the Egyptian Coastal Waters. Egypt. Aquat. Biol. Fish., 28(2): 553-583. DOI: 10.21608/EJABF.2024.349839

Hamdy, N.; Osman, A. M.; Awad, H. and Shaaban, N. A. (2024). Monitoring of microplastics in the marine environment and their ecological risks; the coastline of Alexandria, Egypt as a case stud. Egypt. Aquat. Biol. Fish.,28(4): 221-242. DOI: 10.21608/ EJABF.2024.367795

Hoellein, T.; Rovegno, C.; Uhrin, A. V.; Johnson, E. and Herring, C. (2021). Microplastics in invasive freshwater mussels (*Dreissena* sp.): spatiotemporal variation and occurrence with chemical contaminants. Front Mar Sci., 8. DOI:10.3389/fmars. 2021.690401

Horton, A. A.; Svendsen, C.; Williams, R. J.; Spurgeon, D. J. and Lahive, E. (2017). Large microplastic particles in sediments of tributaries of the River Thames, UK–abundance, sources and methods for effective quantification. Mar. Pollut. Bull., 114 (1): 218-226. DOI:10.1016/j.marpolbul.2016.09.004

Kasamesiri, P.; Panchan, R. and Thaimuangphol, W. (2023). Spatial–temporal distribution and ecological risk assessment of microplastic pollution of inland fishing ground in the Ubolratana Reservoir, Thailand. Water, 15: 330. DOI:10.3390/w15020330

Khanjani, M.H, Sharifinia, M., Mohammadi, A.R. (2023). The impact of microplastics on bivalve mollusks: A bibliometric and scientific review. Mar. Pollut. Bull., 194: 115271. DOI: 10.1016/j.marpolbul.2023.115271

Kole, P. J.; Löhr, A. J.; Van Belleghem, F. and Ragas, A. (2017). Wear and tear of tyres: a stealthy source of microplastics in the environment. Int. J. Env. Res. Pub. He., 14:1265. DOI:10.3390/ijerph14101265

Lee, J-Y.; Chia, R.W.; Veerasingam, S.; Uddin, S.; Jeon, H-J.; Moon, H. A.; Cha, J. and Lee, J. A. (2024). Comprehensive review of urban microplastic pollution sources, environment and human health impacts, and regulatory efforts. Sci. Total. Environ., 946: 174296. DOI:10.1016/j.scitotenv.2024.174297

Lee, Y.; Cho, J.; Sohn, J. and Kim, C. (2023). Health effects of microplastic exposures:

current issues and perspectives in South Korea. Yonsei. Med. J., 64 (5): 301-308. DOI: 10.3349/ ymj.2023.0048

Li, J.; Liu, H. and Paul Chen, J. (2018). Microplastics in freshwater systems: A review on occurrence, environmental effects, and methods for microplastics detection. Water. Res., 137: 362-374. DOI:10.1016/j.watres.2017.12.056

Masura, J.; Baker, J.; Foster, G. and Arthur, C. (2015). Laboratory methods for the analysis of microplastics in the marine environment. NOAA Mar Debris Progr Natl. 1-39.

Noor, S.Y.; Riani E.; Hariyadi, S.; Butet, N. A. and Cordova, M.R. (2025). Abundance and characteristics of microplastics in surface waters of Banten Bay, Serang, Indonesia. Egypt. Aquat. Biol. Fish., 29(3): 61-79. DOI: 10.21608/ejabf.2025.425772

Office of Natural Resources and Environmental Policy and Planning (ONEP). (2008). Report on public consultation on the Draft List of Mollusk Species (Invertebrates). Ministry of Natural Resources and Environment, Thailand. [Thailand]

Pollution Control Department. (2021). Situation of municipal solid waste in Thailand, 2021: Decrease in municipal waste, Increase in infectious and hazardous waste. Pollution Control Department, Ministry of Natural Resources and Environment, Thailand. [Thailand]

Peng, G.; Zhu, B.; Yang, D.; Su, L.; Shi, H., and Li, D. (2017). Microplastics in sediments of the Changjiang Estuary, China. Environ. Pollut., 225: 283-290. DOI:10.1016/j.envpol. 2016.12.064

Royal Irrigation Department (2022).Documentation for Evaluating the Development of Quality Management in the Lam Pao Water Delivery and Maintenance Project, 2022. Ministry of Agriculture and Cooperatives, Thailand. [Thailand]

Saemi-Komsari, M.; Esmaeili, H. R.; Keshavarzi, B.; Abbasi, K.; Birami, F. A.; Nematollahi, M. J.; Tayefeh, F. H. and Busquets, R. (2022). Characterization of ingested MPs and their relation with growth parameters of endemic and invasive fish from a coastal wetland. Sci. Total. Environ., 860(3):160495. DOI:10.1016/j.scitotenv.2022.160495

Saowalak, P. (2020). Classification of microplastic in sediment and benthic fauna (Clams) in Bueng Boraphet Wetland, Nakon Sawan. Thesis M.S. in Environmental Science, Naresuan University. [Thailand]

Sooksawat, T.; Wattanakornsiri, A.; Kohkaew, R.; Page, L. M. and Tongnunui, S. (2023). Microplastic accumulation in local dominant shellfish from the Khwae Noi Basin in Western Thailand and its environmental factors. ScienceAsia, 49:1-10. DOI: 10.2306/scienceasia1513-1874.2023.030

Su, L.; Cai, H.; Kolandhasamy, P.; Wu, C.; Rochman, C. M. and Shi, H. (2018).

Using the Asian clam as an indicator of microplastic pollution in freshwater ecosystem. Environ Pollut., 234: 347-355. DOI:10.1016/j.envpol.2017.11.075

Tang, N.; Liu, X. and Xing, W. (2020). Microplastics in wastewater treatment plants of Wuhan, Central China: Abundance, removal, and potential source in household wastewater. Sci. Total. Environ., 745: 141026. DOI:10.1016/j.scitotenv. 2020.141026

Vidal, A.; Métais, I.; Latchere, O.; Guernic, A. L.; Gasperi, J. and Châtel A. (2023). Toxicity assessment of microplastics within the Loire River in the clam *Corbicula fluminea* exposed to environmentally relevant exposure conditions. Ecotoxicol., 32(9):1-16. DOI: 10.1007/s10646-023-02702-2

Xu, X.; Hou, Q.; Xue, Y.; Jian, Y. and Wang, L. (2018). Pollution characteristics and fate of microfibers in the wastewater from textile dyeing wastewater treatment plant. Water Sci. Technol., 78(10): 2046-2054. DOI:10.2166/wst.2018.476

Yasaka, S.; Pitaksanurat, S.; Laohasiriwong, W.; Neeratanaphan, L.; Jungoth, R.; Donprajum, T. and Taweetanawanit, P. (2022). Bioaccumulation of microplastics in fish and snails in the Nam Pong River, Khon Kaen, Thailand. EnvironmentAsia, 15(1):81-93. DOI 10.14456/ea.2022.8

Yadav, P. and Agwuocha, S. (2023). Effect of microplastic on aquatic animals & human health. J. Surv. Fish. Sci., 10 (2): 101-105.

Yuan, W.; Liu, X,; Wang, W.; Di, M. and Wang, J. (2019). Microplastic abundance, distribution and composition in water, sediments, and wild fish from Poyang Lake, China. Ecotoxicol. Environ. Saf., 170(15): 180-187. DOI:10.1016/ j.ecoenv.2018.11.126

Wright, S.L.; Thompson, R.C. and Galloway, T.S. (2013). The physical impacts of microplastics on marine organisms: A review. Environ. Pollute., 178: 438-492. DOI:10.1016/j.envpol.2013.02.031

Wu, C.; Zhang, K. and Xiong, X. (2018). Microplastic pollution in inland waters focusing on Asia. In book Freshwater microplastics. 85-99 p.