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RIVERINE MICROPLASTICS POLLUTION IN ASEAN COUNTRIES
- FROM SOURCES TO RIVERS -

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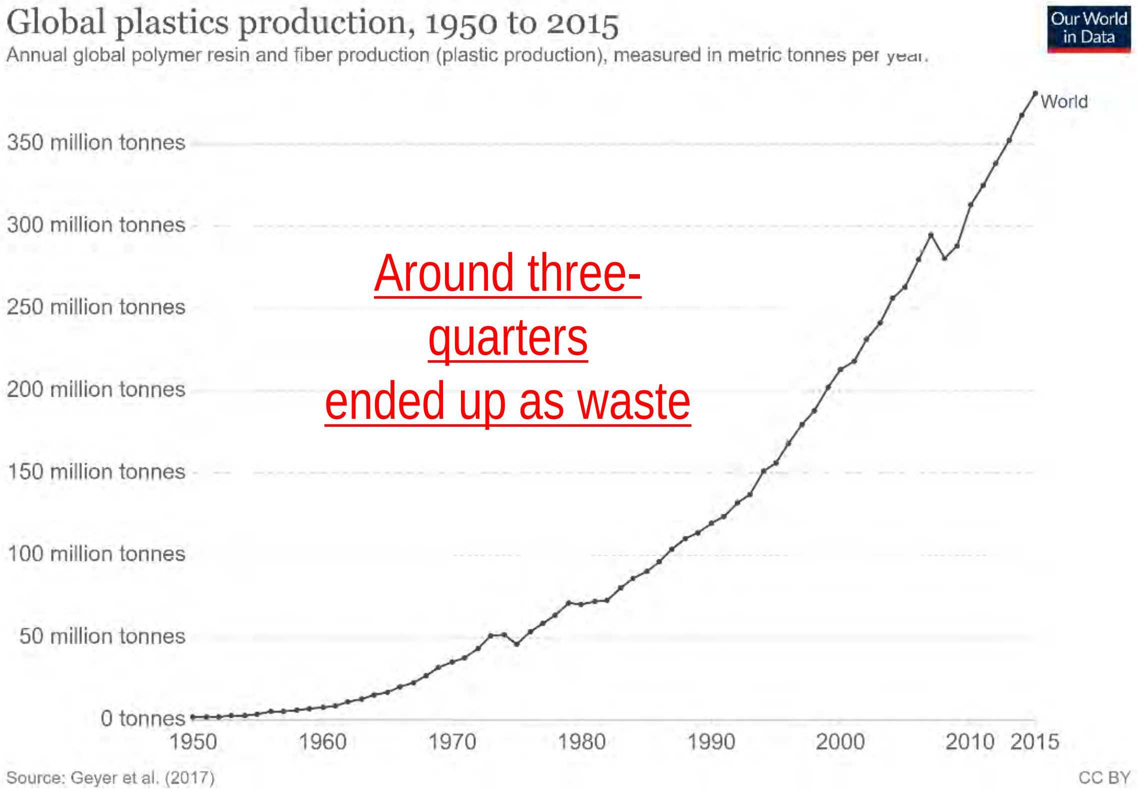
OUTLINE OF THE PRESENTATION

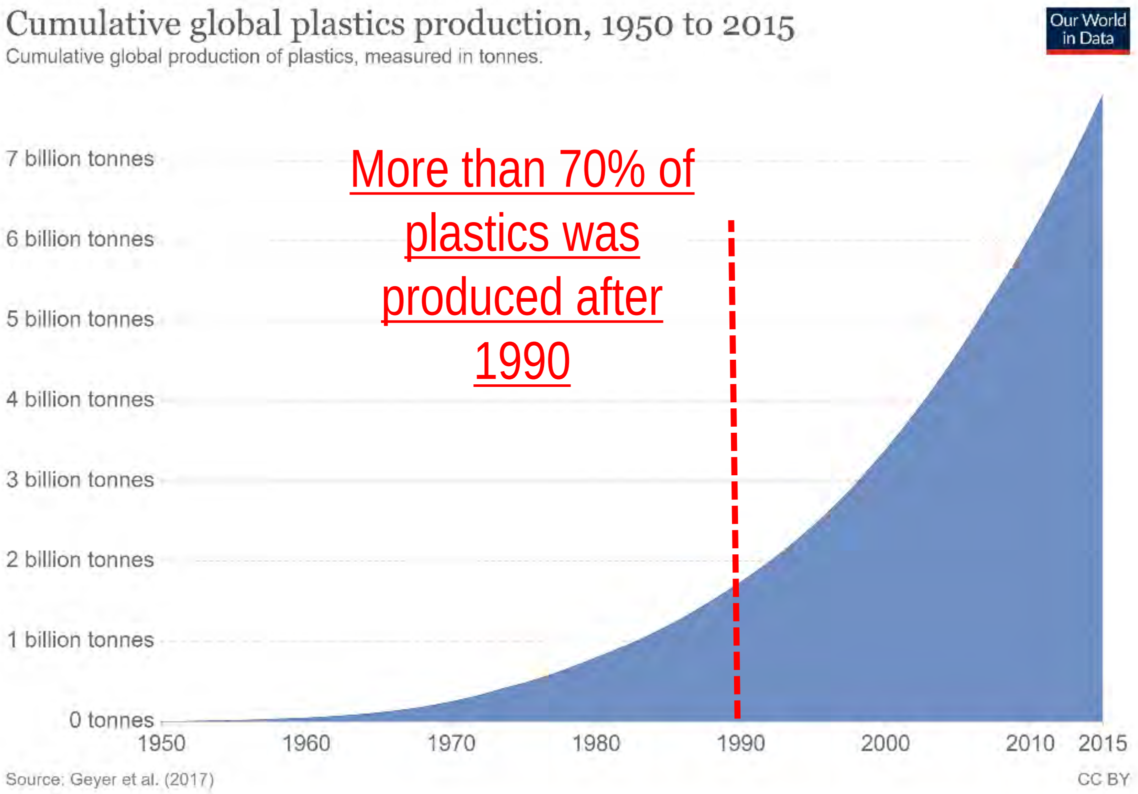
1. Background on plastic invention and plastics development in Asia & ASEAN region
2. Plastic production and its leakage to the environment
3. Microplastic occurrences, ingestion and its impacts on aquatic environments in ASEAN countries
4. Potential impacts of microplastics pollution on food chain and human health
5. Removal of microplastics from water/wastewater treatment plants
6. Circular plastic economy approach for closing the loop
7. Key recommendations for addressing riverine microplastics pollution

1. BACKGROUND ON PLASTIC INVENTION AND PLASTICS DEVELOPMENT IN ASIA

- ✓ In 1907, Leo Baekeland invented Bakelite, the first fully synthetic plastic, marking the beginning of the global plastics industry. However, rapid growth in global plastic production was not realized until the 1950s.
- ✓ During 1950-2000, annual production of plastics increased to about 200 million tonnes per year in 2000. The plastic production rate even increased more rapidly after 2000. **More than 70% of plastics was produced after 1990.**
- ✓ Plastic is a unique material which brings many benefits and convenience to our modern society nowadays. No one can deny.
- ✓ Due to mismanagement, we are "turning" plastics into "an emerging challenge/pollutant" to our environment and our world. Plastic pollution is having a negative impact on our ecosystem and human health
- ✓ In general, developed countries are generating more plastic waste per capita; but mismanaged plastic ratio discharged into the environment and finally end-up in the seas is much higher in developing countries, especially in Asia region.

2. PLASTIC PRODUCTION AND ITS LEAKAGES TO THE ENVIRONMENT IN ASEAN COUNTRIES



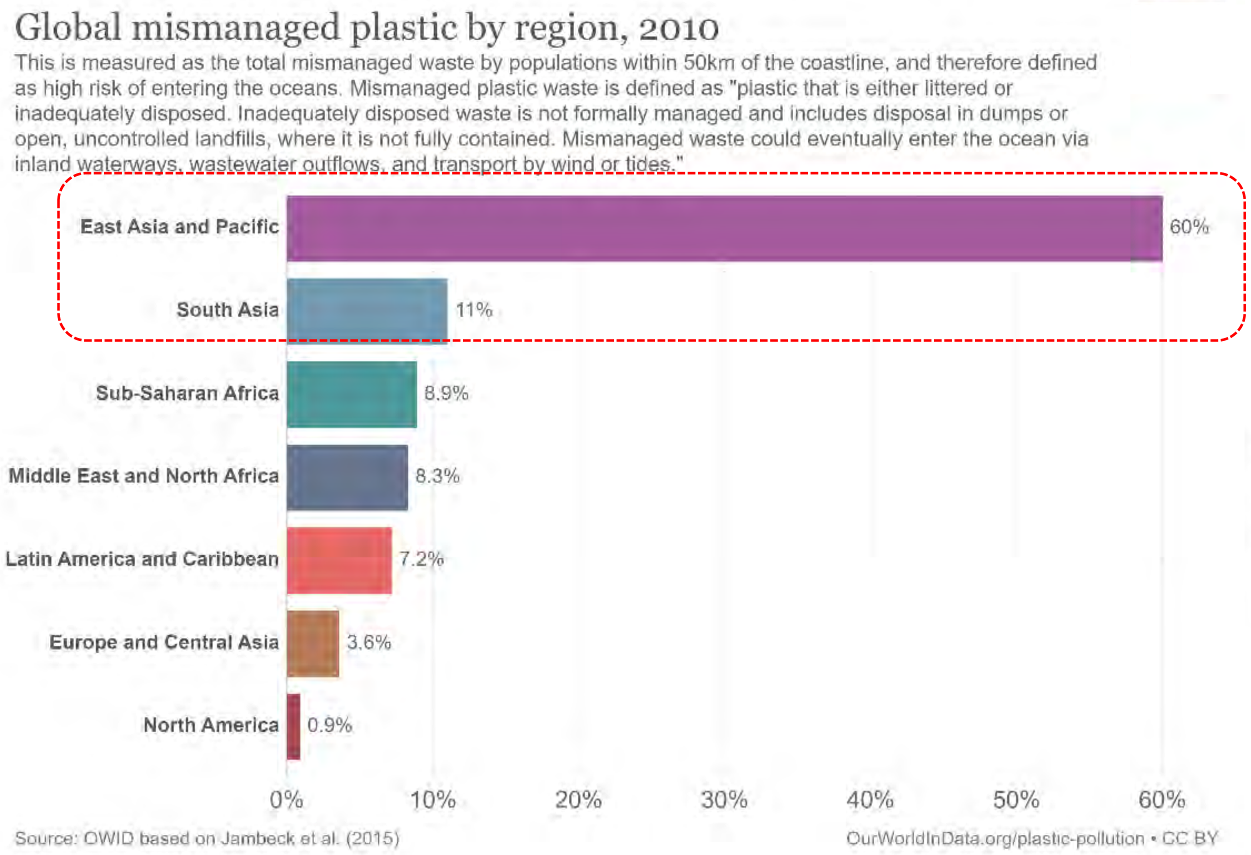


ASEAN Countries accounts for about 20% of global plastic production

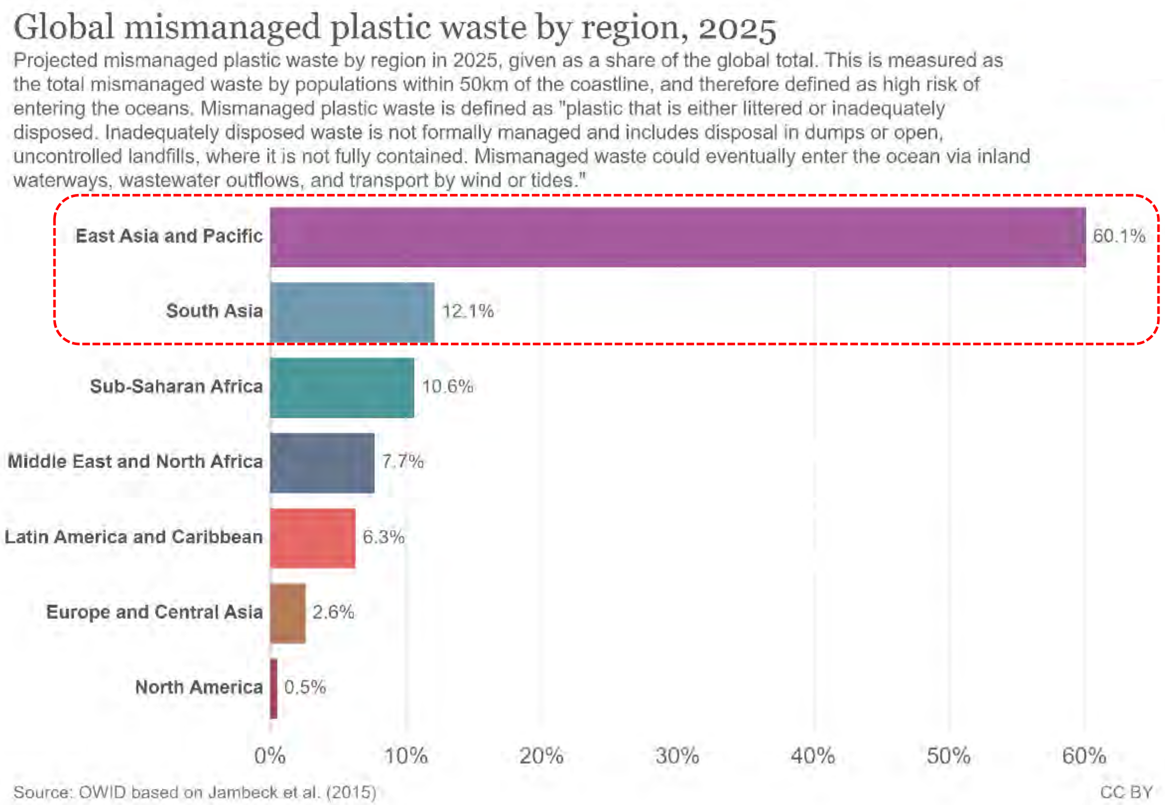
(Indonesia, Malaysia, the Philippines, Singapore, Thailand and Viet Nam have the largest growth in plastic production and consumption)

(Source: UN Environment, 2018)

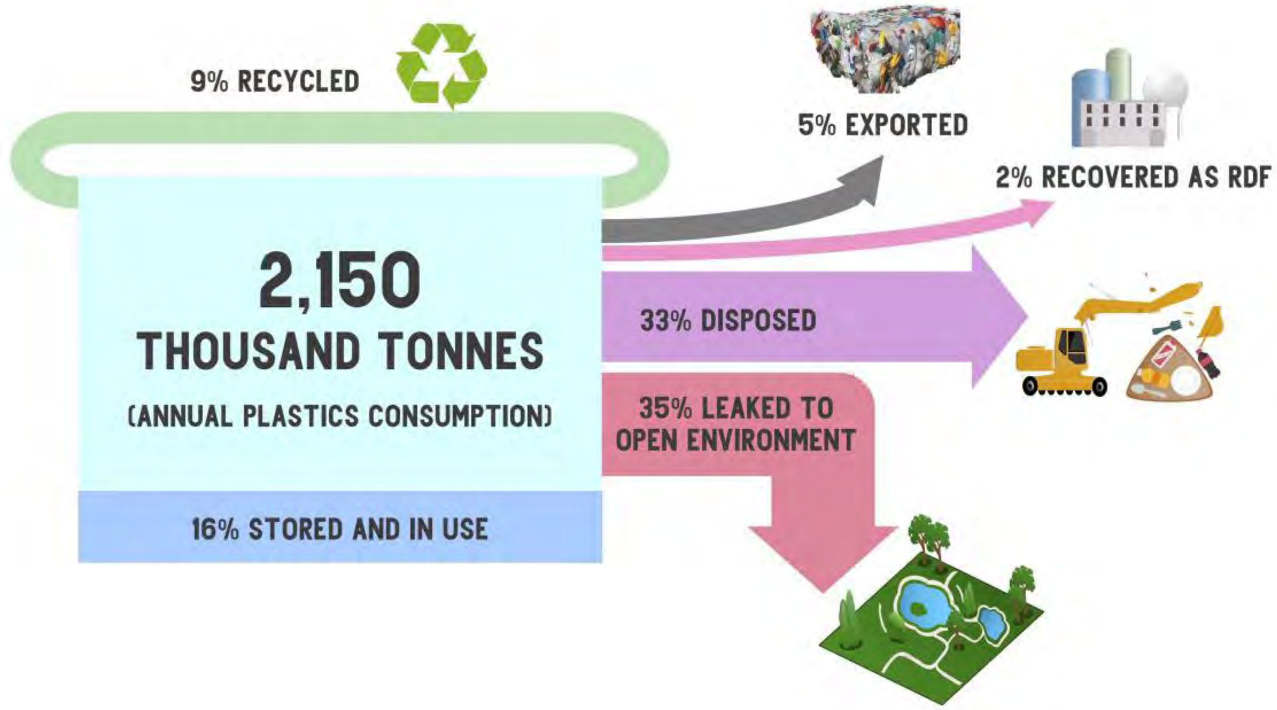
MORE THAN 70% OF GLOBAL MISMANAGED PLASTIC FROM ASIA



- ’`Takeaway food culture’, ‘e-commerce activities’ and ‘sachet economy’ are growing in the Southeast Asia region, leading to an increased use of plastics.
- Consumer preferences are also shifting from traditional fresh foods to packaged foods, while at the same time, shopping on digital platforms is on the rise
- Consequently, this convenience and versatility has resulted in an increase in plastic waste, with mismanaged plastic waste emerging as an environmental problem



Example of Plastic Flows in the Philippines

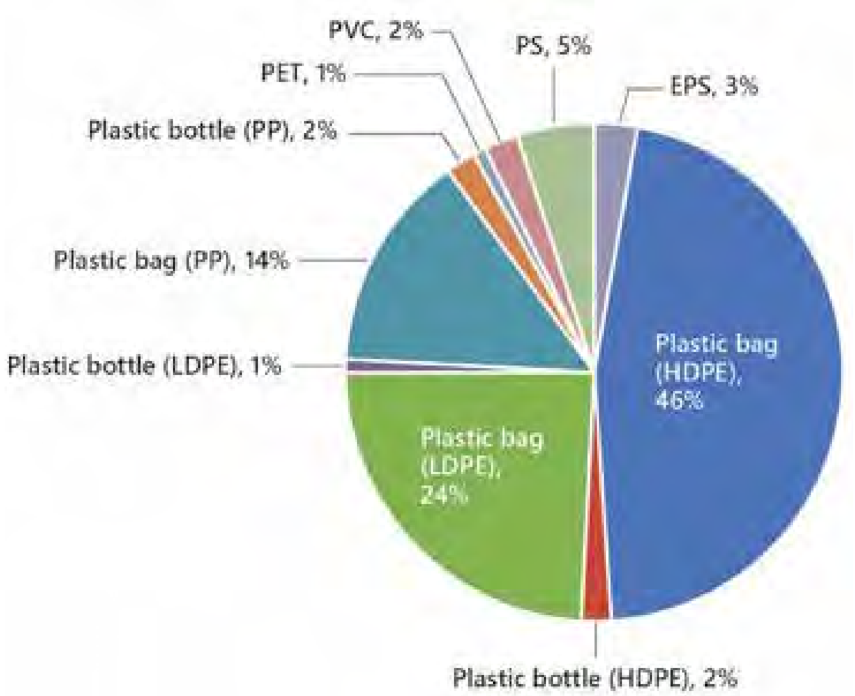


- ✓ The Philippines has been identified as the seventh largest contributor of mismanaged plastic wastes to the coastal environment globally.
- ✓ About 1.01 million tonnes of plastic wastes were calculated as mismanaged by the country in 2016.

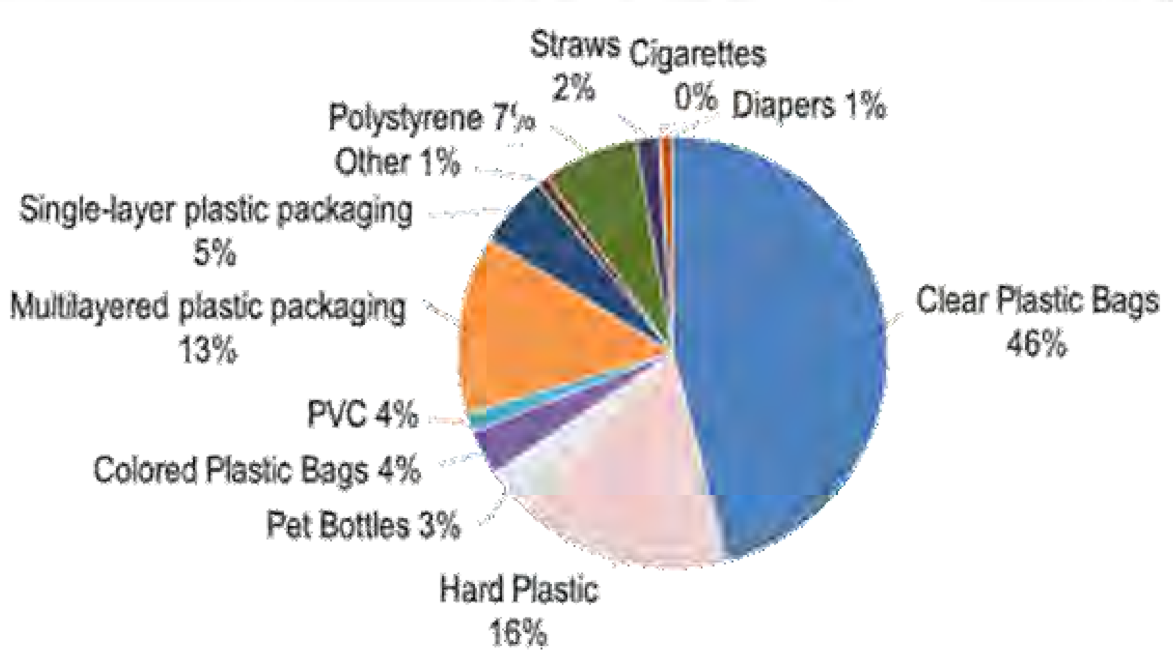
- ❑ More than 163 million plastic sachet packets, 48 million shopping bags (or roughly 17.5 billion pieces a year) and 45 million thin film bags daily.
- ❑ Out of the 2.1 million tonnes of plastics that are available for local consumption in 2019, about 7.1 hundred thousand tonnes or 33% are disposed to landfills and dumpsites, 3.5 hundred thousand tonnes or 16% are stored and in-use, and 1.9 hundred thousand tonnes or 9% are being recycled.
- ❑ Around 7.61 hundred thousand tonnes or 35% are leaked to the open environment as plastic wastes wherein majority of these are bottles, containers, and single-use plastics (SUPs) such as bags and sachets recycled.
- ❑ These plastic wastes may retain in land and storm drains, enter the waterbodies, and be burnt.

(Source: WWF Philippines and AMH Philippines, Inc., 2020)

EXAMPLE OF PLASTIC COMPOSITION IN MUNICIPAL SOLID WASTES IN ASEAN COUNTRIES



Beach clean-up activities conducted in 2017 identifying Thailand's top 10 marine debris



Vietnam Plastic Waste Characterization by Weight (kg)

(Source: PCD 2016, adopted from Wichai-utcha, N. & Chavalparit, O. (2019))

(Source: Vietnam Zero Waste Alliance, 2020)

HOW LONG DOES IT TAKE TO DECOMPOSE DIFFERENT SHORT-LIVED PLASTIC ITEMS?


Plastic bags (HDPE)
20 years


Drinking straws (PP)
200 years


Water bottles (PET)
450 years


Plastic toothbrush (PA)
500 years


Foamed plastic cup (XPS)
50 years

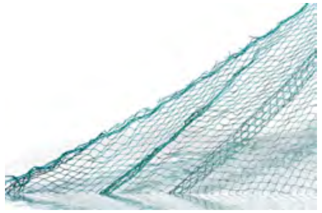

Disposal diaper (PP)
250 - 500 years


Bottle cap (PP)
100 - 500 years


Yogurt cups (PP)
100 - 500 years


Takeaway coffee cups
30 years


Cigarette butts (Cellulose acetate) 10-15 years

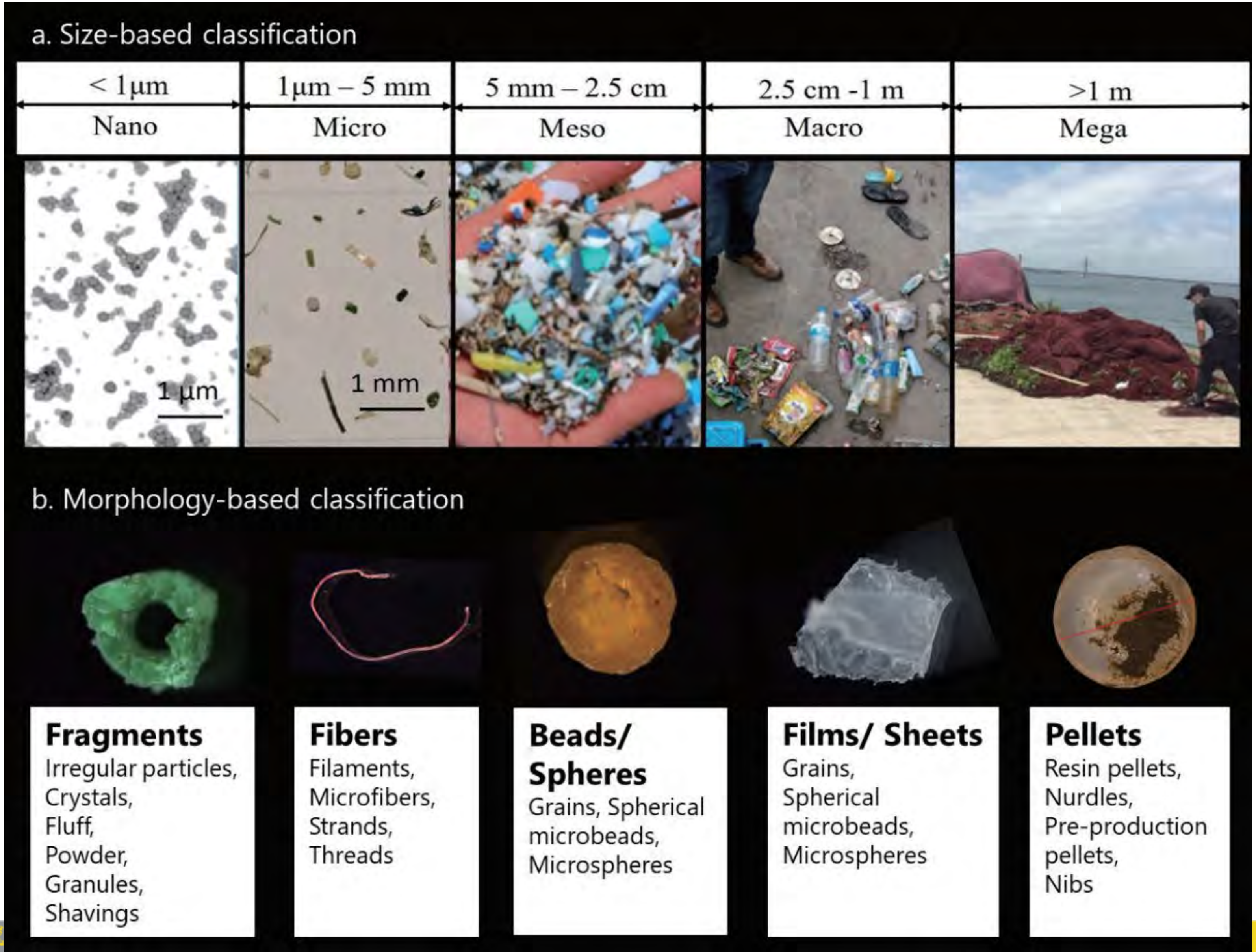

Monofilament fishing line/net (PA)
600 years


Nylon fabric (Polyamide fabric)
30-40 years

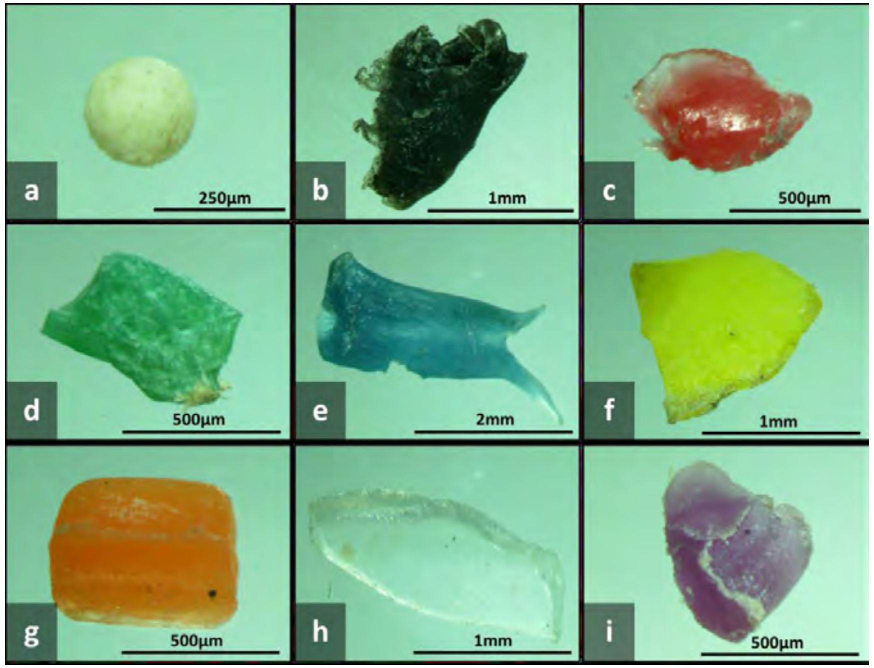

Polyester cloths
20-200 years

CHARACTERISTICS FOR CATEGORISING PLASTIC DEBRIS

Size, Shape & Color



c. Color classification: (a) White, (b) Black, (c) Red, (d) Green, (e) Blue, (f) Yellow, (g) Orange, (h) Transparent, and (i) Violet



CHARACTERISTICS FOR CATEGORISING PLASTIC DEBRIS

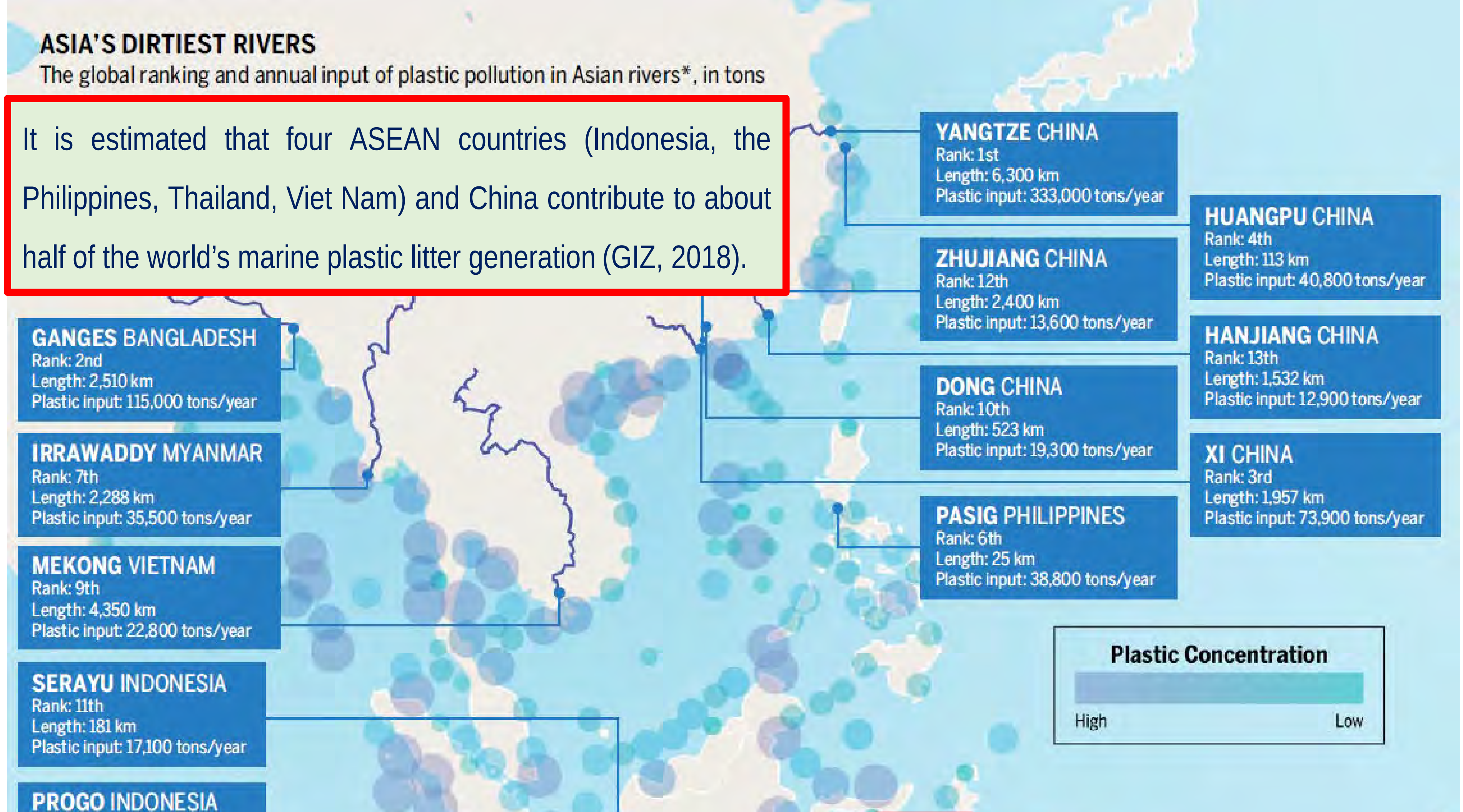
Polymer Type & Their Toxicity

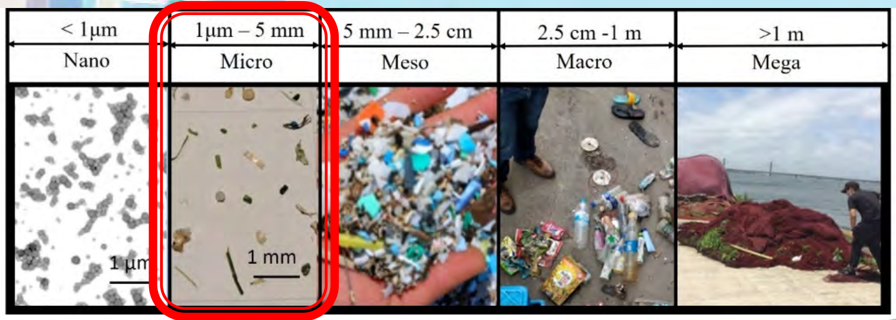
Polymer Name	POLYETHYLENE TEREPHTHALATE	HIGH-DENSITY POLYETHYLENE	POLYVINYL CHLORIDE	LOW-DENSITY POLYETHYLENE	POLYPROPYLENE	POLYSTYRENE	All other plastics, including acrylic, fiberglass, nylon, polycarbonate, and polylactic acid (a bioplastic)
Resin Identification Code	1	2	3	4	5	6	7
Abbreviation	PET or PETE	HDPE	PVC	LDPE	PP	PS	OTHER
Recyclable?	Commonly Recycled	Commonly Recycled	Sometimes Recycled	Sometimes Recycled	Occasionally Recycled	Commonly Recycled (but difficult to do)	Difficult to Recycle
Percentage Recycled Annually	36%	30-35%	<1%	6%	3%	34%	Low
How Long to Decompose Under Perfect Conditions	5-10 Years	100 Years	Never	500-1,000 Years	20-30 Years	50 Years	Majority of these plastics: never Polylactic acid: 6 months
Maximum Temperature	70°C (158°F)	120°C (248°F)	70°C (158°F)	80°C (176°F)	135°C (275°F)	90°C (194°F)	Polycarbonate: 135°C (275°F) Polyactic acid: 150°C (302°F)
Brittleness Temperature	-40°C (-40°F)	-100°C (-148°F)	-30°C (-22°F)	-100°C (-148 °F)	0°C (32°F)	-20°C (-4°F)	Polycarbonate: -135°C (-211°F) Polyactic acid: 60°C (140°F)
Toxicity Level							
Most Commonly Leached Toxin(s)	Antimony Oxide, Bromine, Diaszomethane, Lead Oxide, Nickel Ethylene Oxide, and Benzene	Chromium Oxide, Benzoyl Peroxide, Hexane, and Cyclohexane	Benzene, Carbon Tetrachloride, 1,2-Dichloroethane, Phthalates, Ethylene Oxide, Lead Chromate, Methyl Acrylate, Methanol, Phthalic Anhydride, Tetrahydrofuran, and Tribasic Lead Sulfate, Mercury, Cadmium, Bisphenol A (BPA)	Benzene, Chromium Oxide, Cumene Hydroperoxide, And Tert-butyl Hydroperoxide	Methanol, 2,6-di-tert-Butyl-4-Methyl Phenol, and Nickel Dibutyl Dithiocarbamate	Styrene, Ethylbenzene, Benzene, Ethylene, Carbon Tetrachloride, Polyvinyl Alcohol, Antimony Oxide, and Tert-butyl Hydroperoxide, Bensoquinone	BPA, BPS, as well as all other toxins mentioned

(Source: Bernau, 2020)

- ✓ *Over 80 percent of marine plastic litters comes from land-based sources through different pathways.*
- ✓ *Rivers are considered to be one of the major pathways for land-based plastic waste, mainly coming from single-use plastic items*

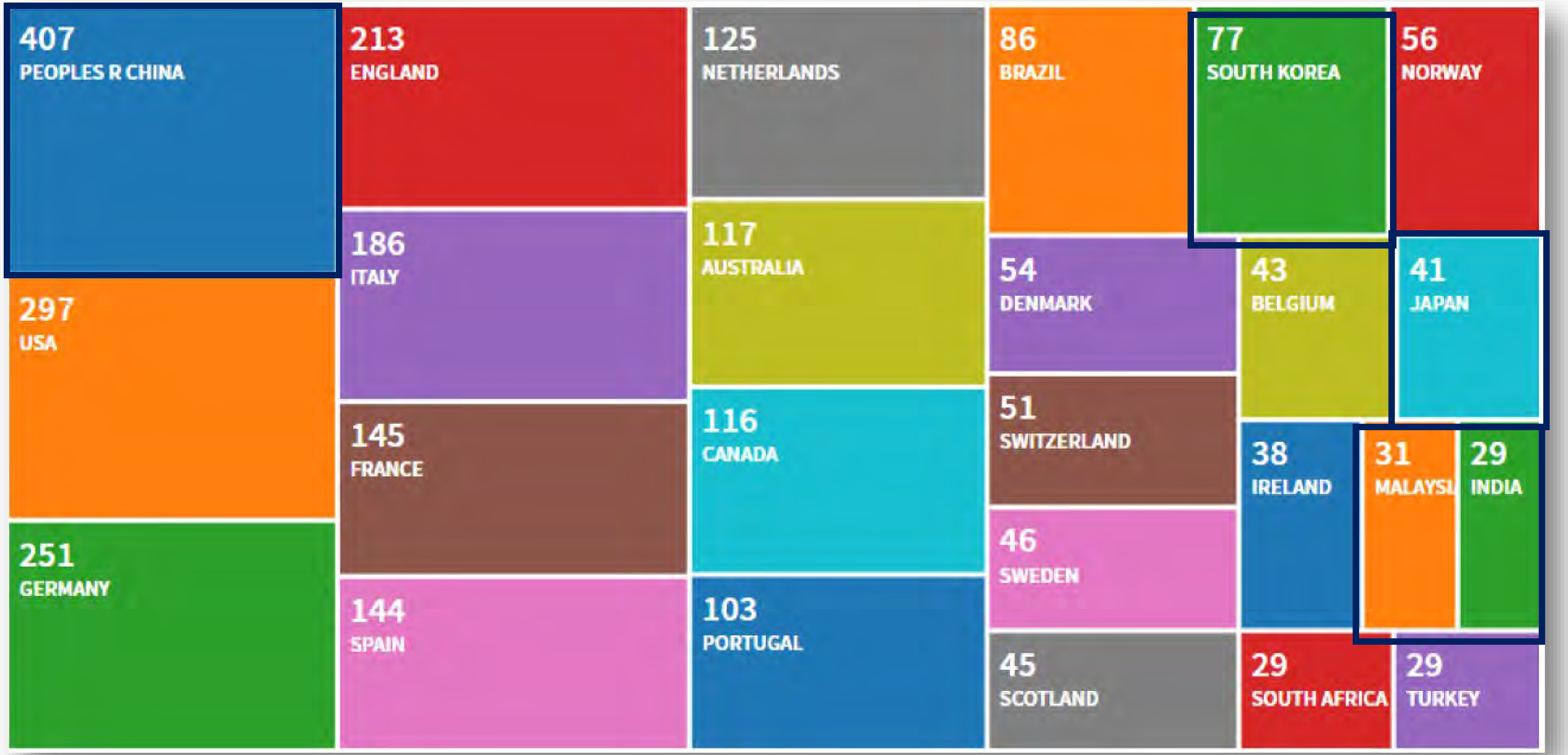
It is estimated that four ASEAN countries (Indonesia, the Philippines, Thailand, Viet Nam) and China contribute to about half of the world's marine plastic litter generation (GIZ, 2018).





GROWING INTERESTS ON THE MICROPLATICS RESEARCH IN THE PERIOD OF 2014-2019

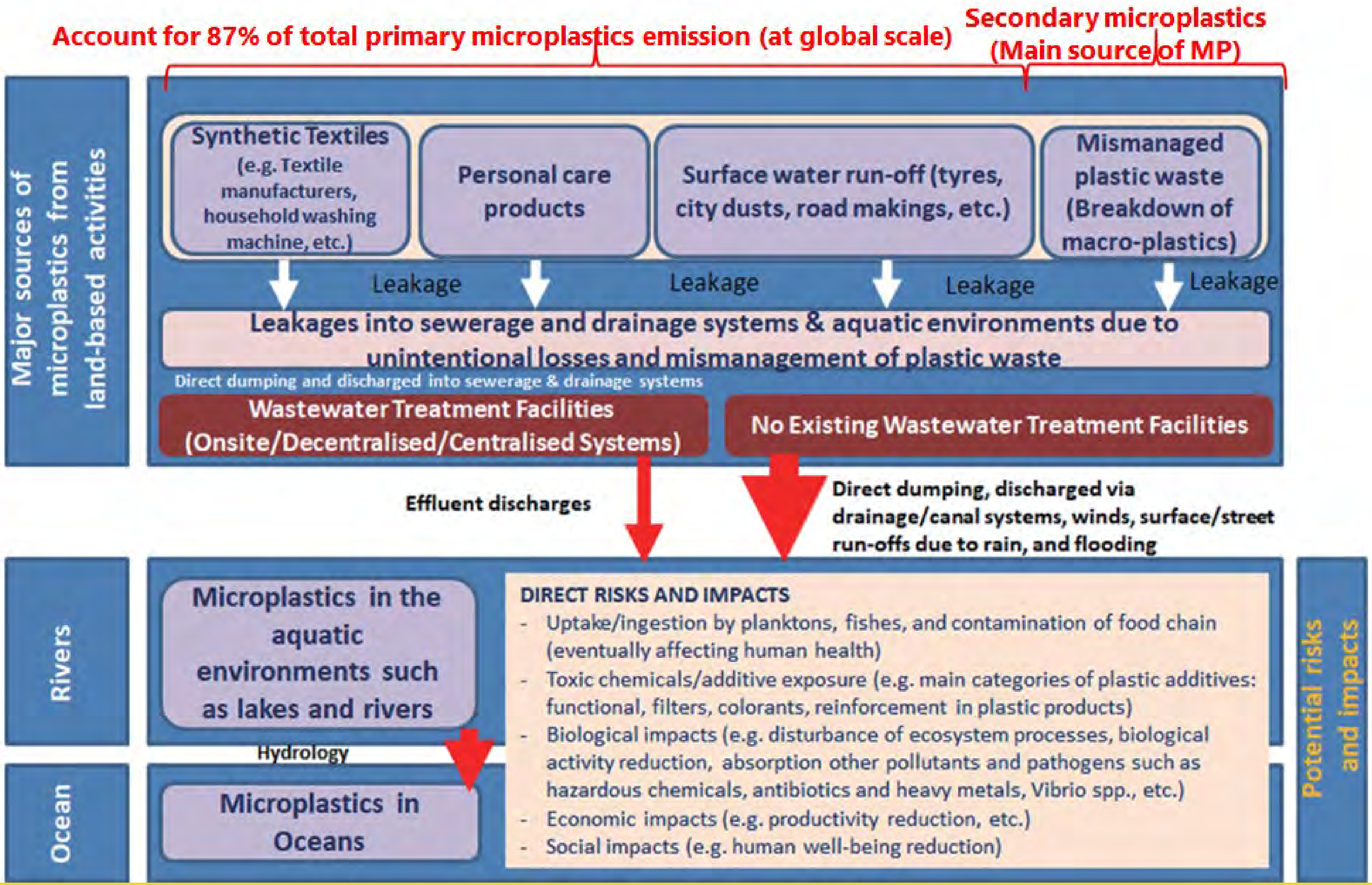
European countries account for 67% of all the published scientific articles



(Source: Vollertsen et al., 2019)

3. MICROPLASTIC OCCURENCES, INGESTIONS AND ITS IMPACTS ON AQUATIC ENVIRONMENTS IN ASEAN COUNTRIES

- ✓ Microplastics (MPs) are currently a great concern as they exist in water, sediments, fauna and even flora.
- ✓ MPs are divided into two categories, primary and secondary, based on their origin. Primary MPs (e.g. tire-wear particles, broken road markings, synthetic textile microfibres from cloth washing, microbeads from personal care products and land-based accidental pellet releases) enter the environment directly. Secondary MPs derive from the breakdown of macro-plastic pieces in the environment.
- ✓ These MPs originate from various sources and enter river systems through different pathways: road runoff, wastewater systems, wind movement, etc.



Study Area		Country	Target Size	Mean Abundance	References
Freshwater/ Marine Water	River	Indonesia	330 µm to 5 mm	11,535 particles/m3	Lestari et al. (2020)
	River	Indonesia	330 µm to 5 mm	9.66 particles/ m3	Lestari et al. (2020)
	Surface Water	Indonesia	125 µm to 5 mm	2.58x105 particles/km2	Ramadan and Sembiring (2019)
	Surface Water	Malaysia	<5 mm	0.41 particles/kg	Khalik et al. (2018)
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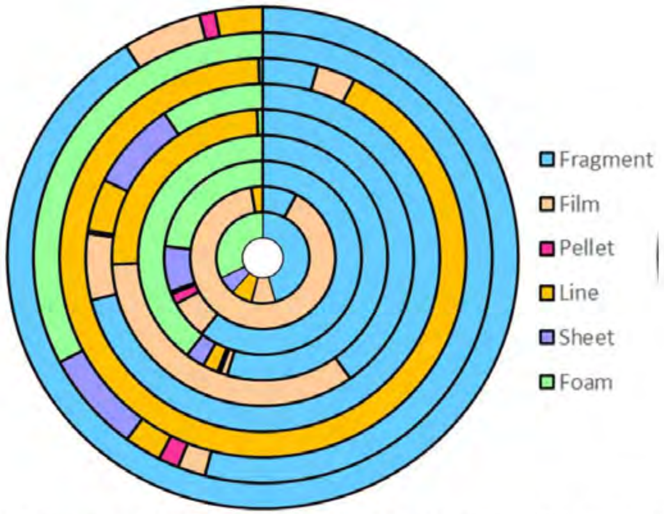
Sediment/ Soil	Beaches	Brunei	<5 mm	23 particles/m2
		Cambodia	1-5 mm	26,749 particles/kg
	Soil of Dumping Sites	Indonesia	1-5 mm	10,929 partic
		Vietnam	1-5 mm	20, partic
		Laos	1-5 mm	8, partic
	Sediment	Malaysia	<5 mm	2 partic
	Sediment	Malaysia	<5 mm	6 partic
	Beaches	Thailand	<4 mm	100 partic
	Beaches	Brunei	<5 mm	2 partic

Wastewater	Drinking Water Treatment Plant	Cambodia	6.5 µm to 5 mm	2,643 particles/L – Inlet 1,138 particles/L - Distribution Tank	Babel and Dork (2021)
	Wastewater	Indonesia	<50 µm to 5 mm	2.07 particles/L	Sucharitakul et al. (2021)
	Wastewater Treatment	Thailand	0.05 to 5	26.6 particles/L - Influent	Tadsuwan and Babel (2021)

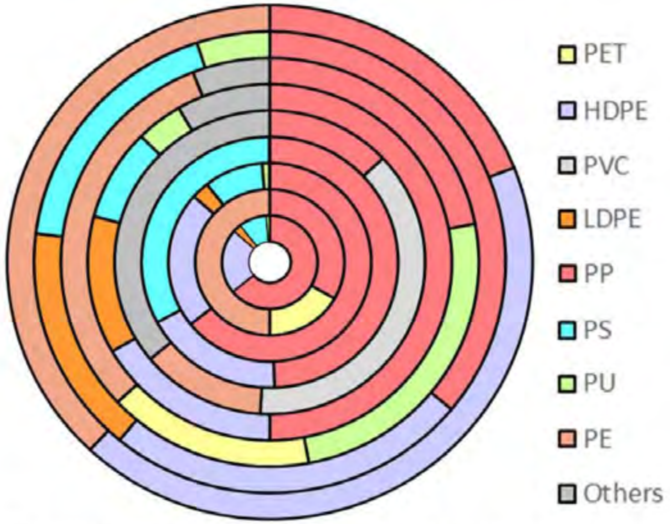
Marine Biota	Fishes and Bivalves	Indonesia	0.3- 5 mm	105.37 particles/ individual	Lestari et al. (2020)
	Kijing Shells	Indonesia	<5 mm	3.13 particles/ individual	Yuliati et al. (2021)
	Skipjack Tuna	Indonesia	<0.25-5 mm	4 particles/ individual	Andreas et al. (2021)
	Fishes	Malaysia	0.0043- 0.157 mm	1,610.50 particles/ individual	Ibrahim et al. (2017)
Others	Road Dust	Myanmar	0.10- 5 mm	136 particles/kg	Mon and Nakata et al. (2020)

CHARACTERISATION OF MICROPLASTICS FOUND IN MAJOR RIVERS AND CREEKS IN THE PHILIPPINES



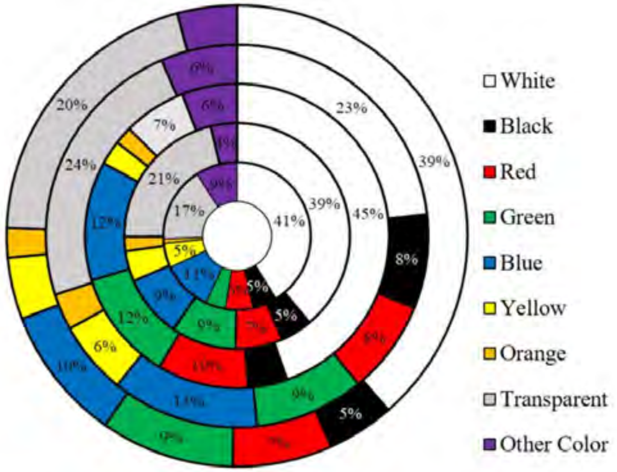
From innermost to outermost circle: (a) Cañas River (Osorio et al., 2021), (b) Makati Creeks (Lumongsod and Tanchuling et al., 2019), (c) Meycauayan (Osorio et al., 2021), (d) Parañaque (Osorio et al., 2021), (e) Pasig East (Adricula et al., 2019), (f) Pasig West (Osorio et al., 2021), (g) Sapang Bago (Bonifacio et al., 2019), (h) Tullahan (Osorio et al., 2021) and (i) Tunasan (Argota et al., 2018)

Distribution of microplastics according to **Shape** (Tanchuling and Osorio, 2021)



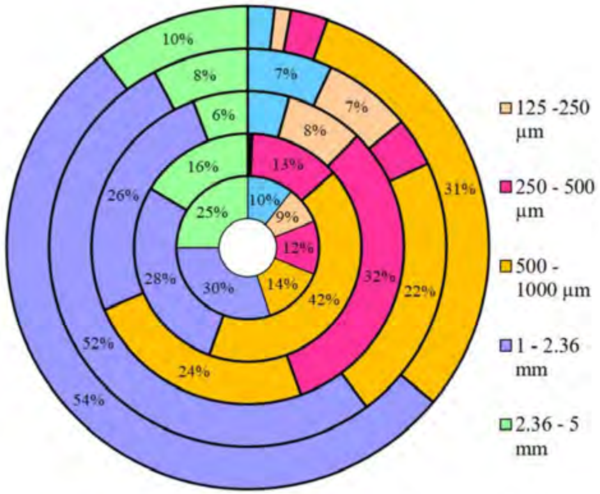
From innermost to outermost circle: (a) Cañas River (Osorio et al., 2021), (b) Makati Creeks (Lumongsod and Tanchuling et al., 2019), (c) Meycauayan (Osorio et al., 2021), (d) Parañaque (Osorio et al., 2021), (e) Pasig East (Adricula et al., 2019), (f) Pasig West (Osorio et al., 2021), (g) Sapang Bago (Bonifacio et al., 2019), (h) Tullahan (Osorio et al., 2021) and (i) Tunasan (Argota et al., 2018)

Distribution of microplastics according to **Polymer Type** (Tanchuling and Osorio, 2021)



From innermost to outermost circle: (a) Cañas River, (b) Meycauayan, (c) Parañaque, (d) Pasig, and (e) Tullahan

Distribution of microplastics according to **Color** (Osorio et al., 2021)

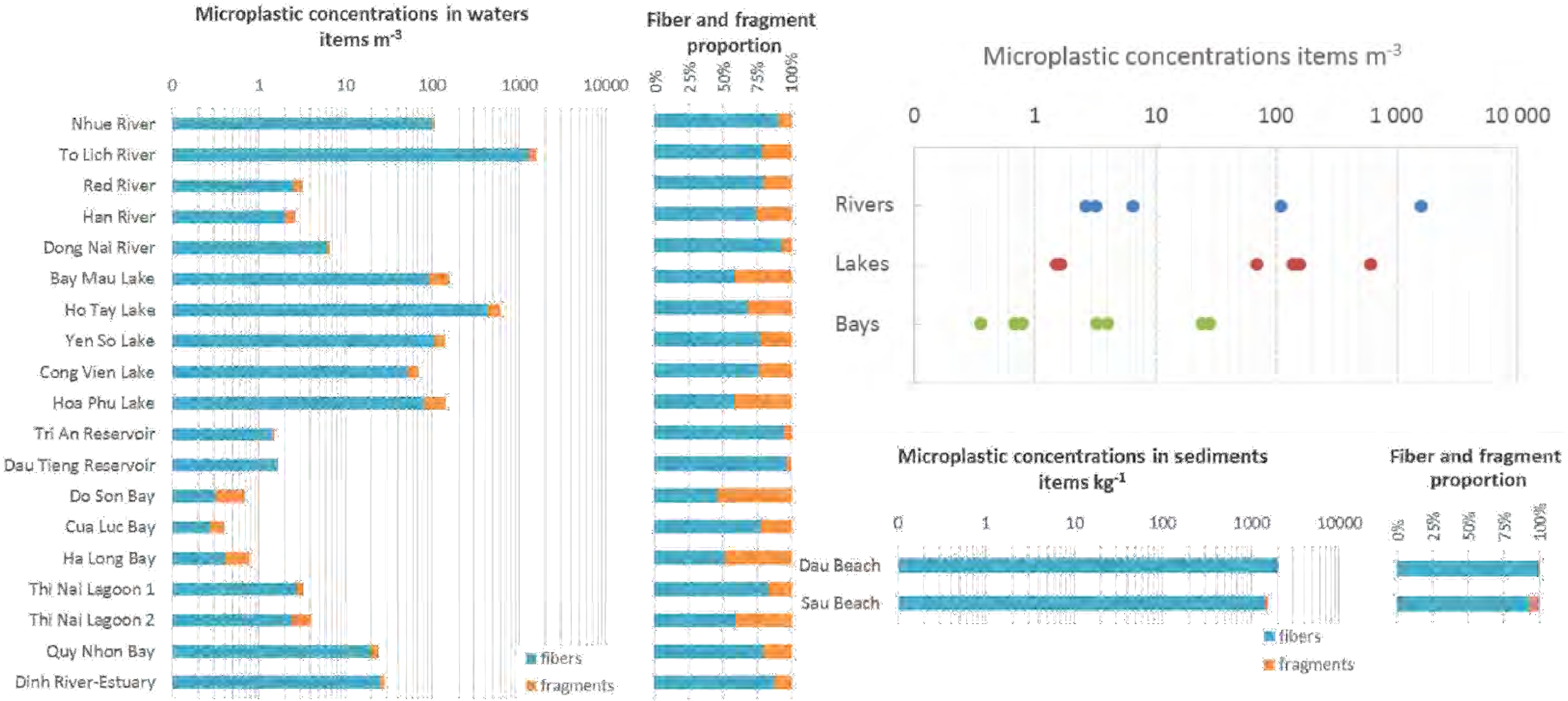


From innermost to outermost circle: (a) Cañas River, (b) Meycauayan, (c) Parañaque, (d) Pasig, and (e) Tullahan

Distribution of microplastics according to **Size** (Osorio et al., 2021)

- The abundance of microplastics: 1.32 particles/m^3 in Pasig River to as high as 57,665 particles/m^3 in Meycauayan River.
- The dominating occurrence of fragments and PP may originate from the degraded larger plastics that are mismanaged and leaked to the environment.

REPORTS ON THE OCCURRENCE OF MICROPLASTICS FROM RIVER & LAKE WATER IN VIETNAM



(Source: Strady et all., 2021)

4. POTENTIAL IMPACTS OF MICROPLASTICS POLLUTION ON FOOD CHAIN AND HUMAN HEALTH

- Microplastics can also be ingested by planktons at the bottom of the aquatic food chain allowing plastics to move to the next level of the aquatic food chain eventually affecting humans.

- A study carried out by the University of California, Davis, and Hasanuddin University in Indonesia, 76 fish samples across 11 different species were collected from markets in Makassar, Indonesia. The study revealed that, anthropogenic debris (plastic or fibrous material) was found in 28% of individual fish (in their guts) and in 55% of all species (Rochman et al., 2015).

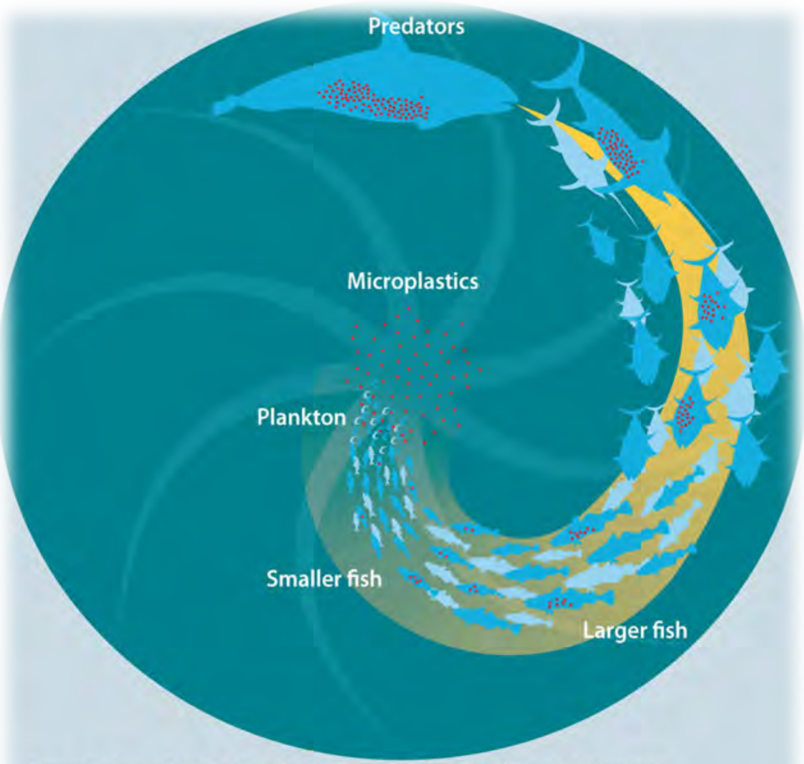
- In another study conducted in Japan, Tanaka and Takada (2016) also reported that microplastics was detected in the digestive tracts of 49 out of 64 Japanese anchovy (77%) sampled in Tokyo Bay. Among detected microplastics, polyethylene and polypropylene account for 52.0% and 43.3%, respectively. The results from this study also indicated that most of the detected plastics were fragments (86.0%), and 7.3% were beads or microbeads, which is similar to those found in facial cleansers.

4. POTENTIAL IMPACTS OF MICROPLASTICS POLLUTION ON FOOD CHAIN AND HUMAN HEALTH

By 2050, an estimated **99%** of seabirds will have ingested plastic

Marine litter harms over **600** marine species

15%
of species affected by ingestion & entanglement from marine litter are endangered



Source: Rochman, C., M., The Complex Mixture, Fate and Toxicity of Chemicals Associated with Plastic Debris in the Marine Environment, in Marine Anthropogenic Litter, 2015

Microplastics can contain toxic contaminants (e.g., bisphenol A, phthalate plasticizers, carcinogens, polybrominated flame retardants, and heavy metals), which are either derived from the plastic itself or absorbed from the surrounding environment. Ingestion of these toxic chemicals can cause a number of health problems, including cardiovascular disease, diabetes, and cancer.

(Source: Jambeck et al., 2015; UN Environment, 2018)

“Whales keep eating plastic and dying. This one’s stomach had 88 pounds of calcifying trash”

Plastic waste found in a whale’s stomach in the Philippines

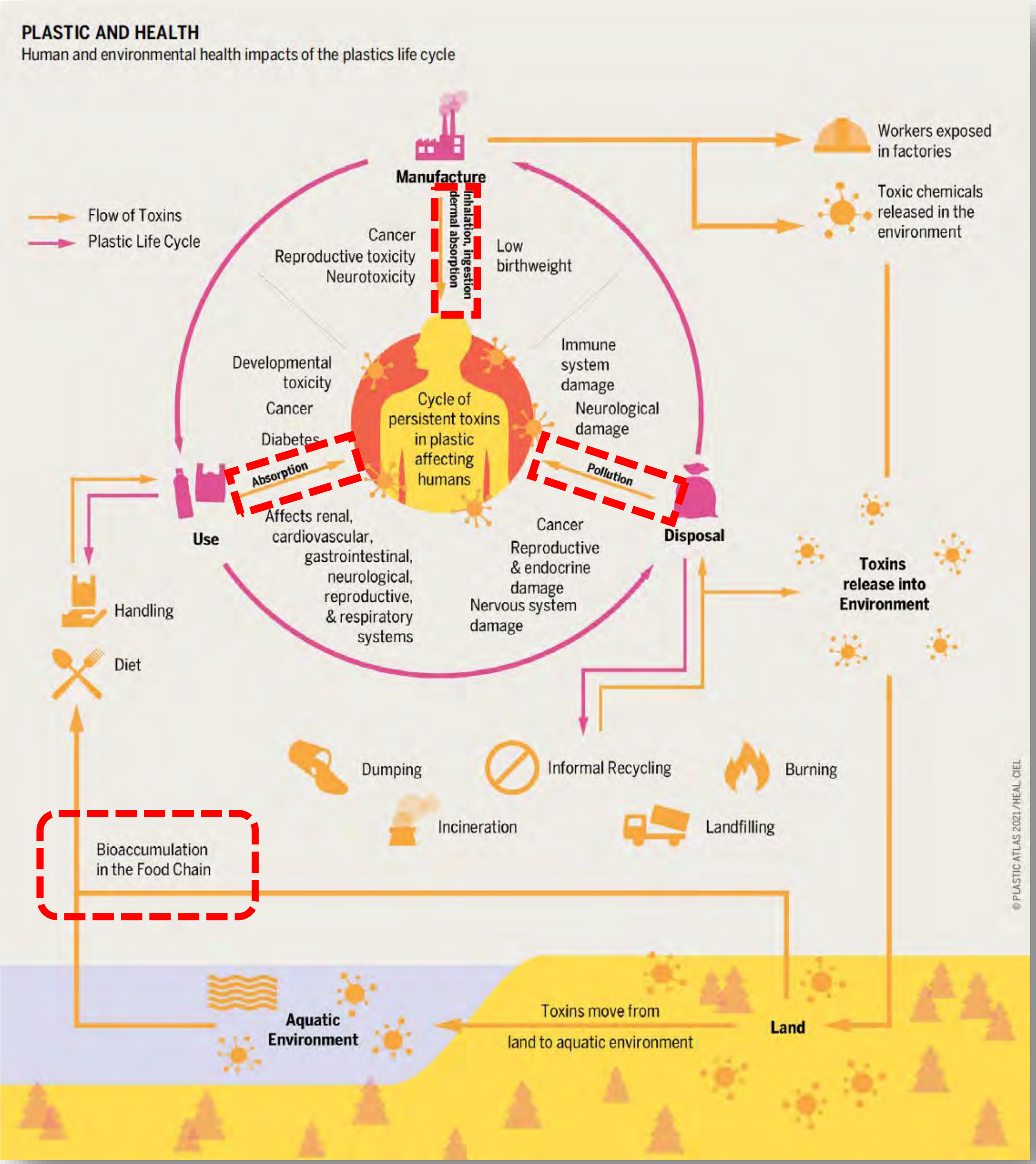
Source: https://www.washingtonpost.com/science/2019/03/18/whales-keep-eating-plastic-dying-this-ones-stomach-had-pounds-calcifying-trash/

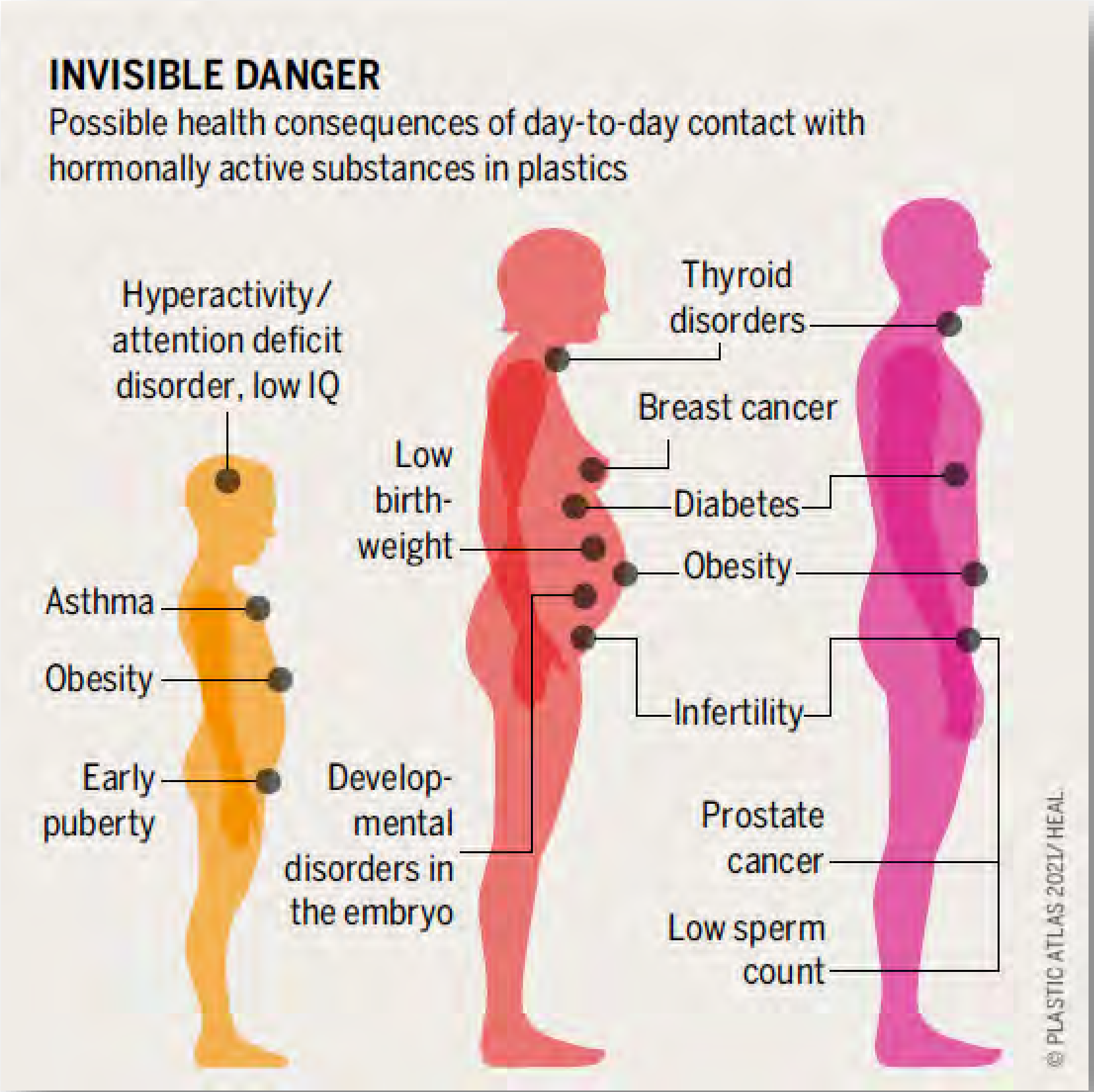
REPORTS ON THE OCCURRENCE OF MICROPLASTICS FROM SEAFOOD IN SOUTHEAST ASIA

Country	Sampling site	No. of species	No. of Sample	*Ingestion	Dominant				Referenc
					Shape	Colour	Size (mm)*	Polymer	
Indonesia	Bengkalis Waters, Riau	3 fish species	36	62.96 particle/fish	Film	White	0.1-0.5	NA	[9]
	Kodingareng Lompo Island	4 fish species	46	up to 40%	Line	Blue	NA	LDPE	[10]
	Citarum River downstream area	1 fish species (*Chanos chanos*)	6	1.33 ± 0.58 – 2.6 ± 2.23 particle/fish (gills & guts); 1.11 ± 0.84 -1.17 ± 0.98 particle/fish (tissue)	Fragment	Black	0.5-1.0	PP & PE	[7]
	Pantai Baron, Yogyakarta	4 fish species	80	78 97.5% (45.60 ± 44.31 particle/fish)	Fibre	Black	0.05-0.1	PA	[11]
	Pangandaran Bay	2 fish species	18	NA	Fragment	varied	varied		
	Talisayan Harbor, East Kalimantan	1 fish species (Stolephorus spp.)	15	366 ± 3.51 particle/fish	Film	NA	0.05-0.5		
	East Lombok Harbour, Lombok Island	1 fish species (Stolephorus spp.)	15	88 ± 2.89 particle/fish	Fibre	NA	0.05-0.6		
	Pantai Indah Kapuk	9 fish species	174	97.13%	Fibre	Transparent	0.06-0.08		
Malaysia	Klang River estuary	3 gastropod species	95	0.5 – 1.75 particle/g w.w	Fibre	Black	0.3-1.0		
	Skudai River, Johor	6 fish species	60	up to 100%	varied	Blue	varied		
	Seri Kembangan Market, Selangor	11 fish species	110	up to 100%	Fragment	NA	NA		

Country	Sampling site	No. of species	No. of Sample	*Ingestion	Dominant				Reference
					Shape	Colour	Size (mm)*	Polymer	
Malaysia	Setiu Wetlands, Terengganu	1 fish species (*Lates calcarifer*)	4	Total of 4498 particles	Line	Black	< 0.015	PA and PVA	[19]
	Setiu Wetland, Terengganu	1 bivalve species (*Scapharca cornea*)	NA	up to 557.98 particle/g d.w	Filament	Transparent	NA	PE and PA	[20]
Phillipines	Negros Oriental	1 fish species (*Siganus fuscescens*)	120	46.70%	Fibre	NA	1.8 ± 0.13	PP	[21]
	Sineguelasan Seafood Terminal	1 bivalve species (*Perna viridis*)	5	NA	varied	varied	< 1	NA	[22]
Thailand	Chi River	8 fish species	107	72.90%	Fibre	Blue	0.5	NA	[23]
	Gulf of Thailand	24 fish species	110	66.67%	Fibre and Fragment	Blue and Green	varied	NA	[24]
Vietnam	Tinh Gia, Thanh Hoa	1 bivalve species (*Perna viridis*)	5	0.29 ± 0.14 particle/g w.w	NA	NA	NA	PP	[25]
Singapore	Supermarkets	3 crustacean species (shrimps)	93	13 ± 1 to 7050 ± 418 particle/g w.w	Film and Sphere	Blue and Pink	NA	NA	[26]

(Source: Sarijan et al., 2021)





"Many of the chemicals in plastic have an effect on human health. The consequences may be both serious and long-term."

REPORT ON THE DETECTION OF MICROPLASTICS IN HUMAN PLACENTA

- ✓ A recent study reported that the presence of MPs in human placentas may lead to adverse pregnancy outcomes including preeclampsia and fetal growth restriction.

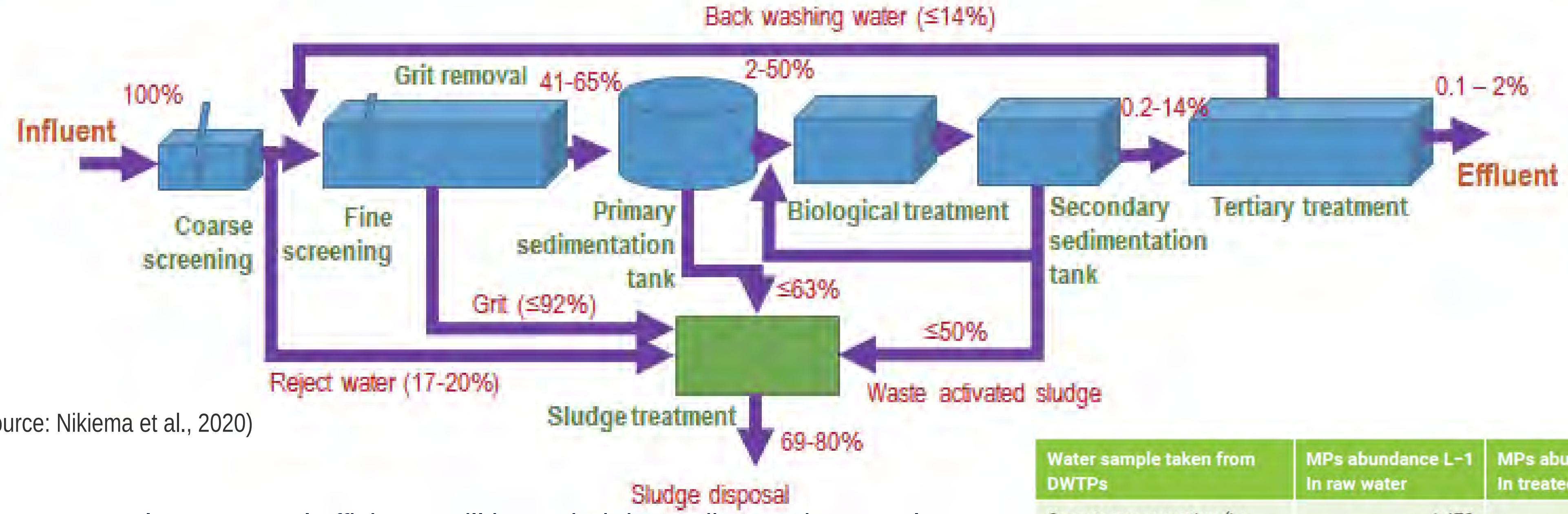
- ✓ This study observed the presence of microplastic fragments ranging from 5 to 10 µm in size, with spherical or irregular shape in placentas (5 in the fetal side, 4 in the maternal side and 3 in the chorioamniotic membranes), which are possibly used for manmade coatings, paints, adhesives, plasters, finger paints, polymers and cosmetics and personal care products.

"12 microplastic fragments (mostly 10 um in size), with spherical or irregular shapes were found in 4 placentas (5 in fetal side, 4 in the maternal side and 3 in the chorioamniotic membranes)"

(Source: Ragusa et al., 2021).

https://www.saindurenviro.com/evidence-of-microplastics-found-in-the-placentas-of-unborn-human-babies.html

AVERAGE MICROPLASTICS FLOW & FATE OF MICROPLASTICS AS THEY PASS THROUGH A TYPICAL WWTP AND DRINKING WATER TREATMENT PLANT



(Source: Nikiema et al., 2020)

Actual MP removal efficiency will be varied depending on the actual performance of WWTPs – Case Study in the Philippines (World Bank, 2021)

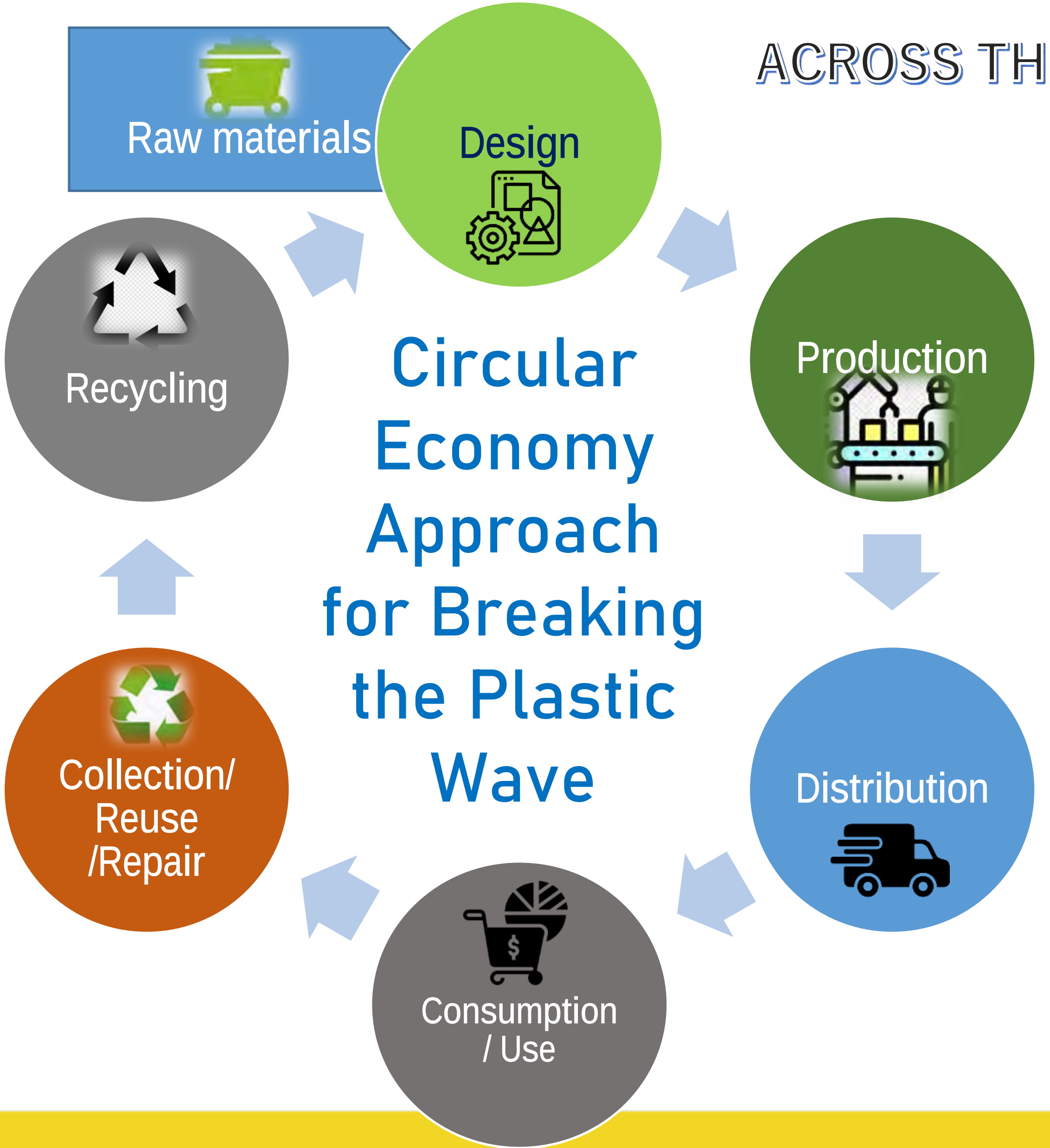
Facility	Actual Flowrate at Intake (10^6 L /day)	MP concentration in Influent (MP/m³)	MP concentration in Effluent (MP/m³)	Removal Efficiency (%)	MP discharged per day (10^6)
STP A	6.524	4370	1100	74.83	7.18
STP B	0.330	2500	140	94.40	0.05
STP C	10.4	1000	200	80.00	2.08
STP D	15.4	510	400	21.57	6.16
STP E	0.567	3860	760	80.31	4.31

Water sample taken from DWTPs	MPs abundance L−1 In raw water	MPs abundance L−1 In treated water	Size distribution (µm) <10 10-100 >100	Removal (per cent)
One-stage separation (i.e. sand filtration)	1,473	443	86, 13, 1 per cent	70
Two-stage separation (i.e. sedimentation + sand filtration) and filtration on granular activated carbon (GAC)	1,812	338	92, 8, 0 per cent	81
Two-stage separation (i.e. flotation + sand filtration) and GAC filtration	3,605	628	81, 17, 1 per cent	83

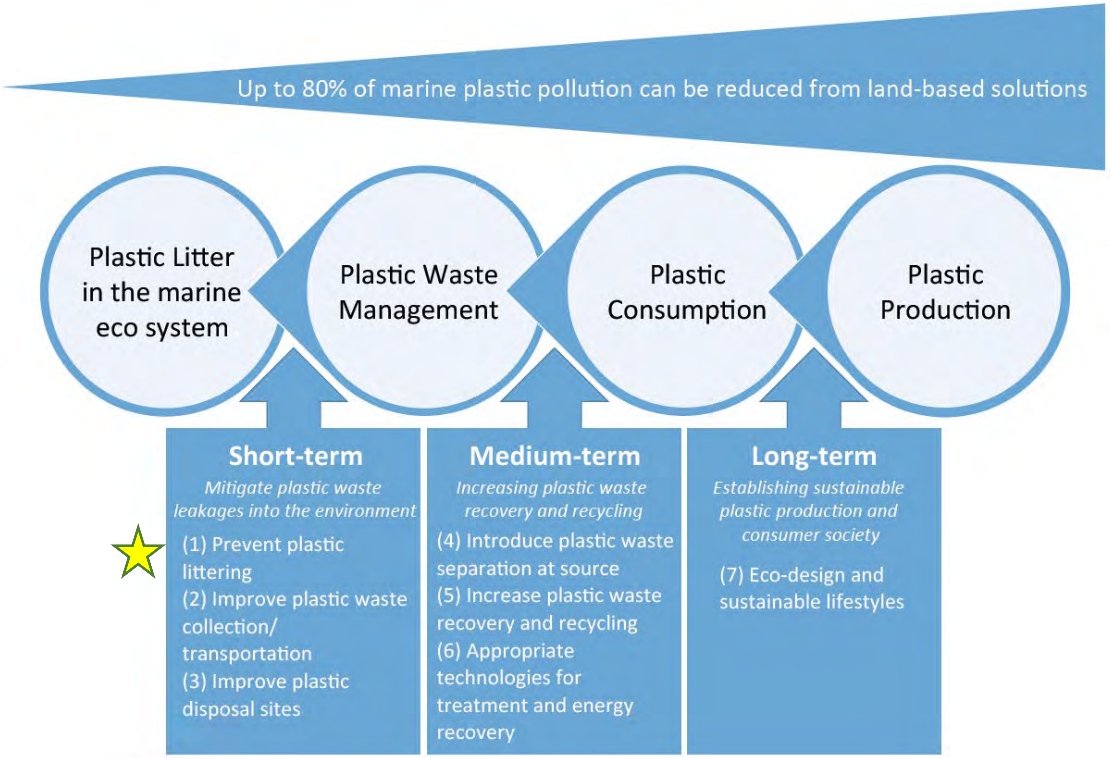
Note: Microplastics abundance is reported as an average (calculating the mean of minimum and maximum value).

Reference: Pivokonsky *et al.* (2018)

ACROSS THE PLASTICS VALUE CHAIN



STRATEGIC ACTIONS TO REDUCE MARINE PLASTIC WASTE FROM LAND-BASED SOURCES THROUGH SUSTAINABLE WASTE MANAGEMENT APPROACH



PREVENTION is always better than CLEANING UP
(Awareness raising, behavioural and lifestyle changes, EPR, economic incentives, bans, etc.)
Innovative Business Models for Plastic Recycling, considering the involvement of private sector through effective PPP models

(Source: Premakumara Jagath Dickella Gamaralalage & Kazunobu Onogawa, 2019)

4 Major Framework Components Identified under the ASEAN Regional Action Plan for Combating Marine Debris in the ASEAN Member States (2021-2025)

ASEAN Framework of Action on Marine Debris (2018)

ASEAN Regional Action Plan for Combating Marine Debris (2020)

G20 Osaka Blue Ocean Vision

National Marine Litter Action Plans from AMS

ELEMENTS OF THE WASTE VALUE CHAIN

FRAMEWORK COMPONENTS	Reducing inputs into the system	Enhancing collection and minimizing leakage	Creating value for waste reuse
Policy Support and Planning	2. Guiding principles for phasing out select single-use plastics 4. Best practice manual for development of minimum standards and technical requirements for plastic packaging and labeling 5. Regional stocktaking of green public procurement	1. Regional guidebook on financialmechanisms for investments in plastic waste management 6. Best practice manual for reducing, collection and treatment of sea-based litter	3. Regional guidebook on standards for responsible plastic waste trade, sorted plastic waste and recycled plastics
Research, Innovation and Capacity Building	8. Strengthen ASEAN regional knowledge network on marine plastics 9. Regional study on microplastics	7. Guidebook for common methodologies for assess-ment and monitoring of marine litter 10. Coordinate regional training programs on plastics and waste management	
Public Awareness, Education and Outreach	11. Behavioral change communication strategy playbook	12. Enhance regional awareness for consumers of labeling of plastics and packaging	
Private Sector Engagement		13. Establish a regional platform for EPR knowledge support and implementation support	14. Establish a regional platform to support innova-tion and investments in plastics and plastic waste management

(Source: ASEAN Secretariat, 2021)

Efforts Introduced at the National and City Level for Tackling both Riverine & Marine Plastic Pollution in ASEAN Countries

- At national and city level, great efforts are also underway to tackle both riverine and marine plastic pollution, with special attention on regulating or planning for the elimination of single-use plastic products and plastic packaging.

- For example, in October 2018, the Government of Malaysia released its Roadmap to Eliminate Single-use Plastics 2018 - 2030, announcing a policy to eliminate plastic straws and plastic bags by 2030.

- In Thailand, the Government announced a Roadmap on Plastic Waste Management 2018-2030, with the aim of reducing and halting the use of plastic and replacing it with environmentally-friendly materials. Accordingly, three plastic products, including plastic cap seals for water bottles, oxo-degradable plastics and plastic microbeads, would be banned in Thailand. The use of four other types of plastic, including plastic bags less than 36 microns in thickness, styrofoam food boxes, plastic straws and single-use plastic cups, will stop by 2022. By 2027, 100% of plastic waste will be reusable.

- Similarly, in Indonesia, the Philippines and Viet Nam, many actions have been taken by both central and local governments to reduce plastic pollution, mainly focusing on macro-plastic pollution in aquatic environments.

7. KEY RECOMMENDATIONS FOR ADDRESSING RIVERINE MICROPLASTICS POLLUTION IN ASEAN COUNTRIES

1. Install and optimise the performance of wastewater treatment facilities in ASEAN countries
2. Strictly control the discharge of wastewater containing microplastics into aquatic environments
3. Develop national quality standards related to microplastics pollutants (standards for both effluent and drinking water)
4. Properly manage plastic waste to avoid leakage into the water environment by improving municipal solid waste collection, treatment and management services
5. Reduce the use of single-use plastic products and replace them with alternative products
6. Introduce an appropriate policy approach of Extended Producer Responsibility to mitigate MP pollution, especially in aquatic environments.
7. Identifying alternative solutions (with a better design) to reduce leakages of MP from textiles, personal care products, and tire-wear particles emissions

ご清聴ありがとうございました。

Thank you very much for your attention.

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