XVIII World Water Congress
International Water Resources Association (IWRA)

Green economic development and ecological protection

Enhancing Plastic Pollution Monitoring and Control in the Yangtze River Basin

Organized by:

Asian Development Bank
Global Water Partnership

XVIII WORLD WATER CONGRESS
Water for All
Harmony between Humans and Nature

第18届世界水资源大会
水与万物:
人与自然和谐共生

Agenda

ASIAN DEVELOPMENT BANK · Global Water Partnership · XVIII World Water Congress, International Water Resources Association (IWRA)

Opening remarks and session overview Dr Au Shion Yee, Principal Water Resources Specialist, ADB	
Keynote **Prof. Richard Thompson**, University of Plymouth	
Session moderator **Ms. Xin SHEN,** Senior Project Officer, Natural Resources and Environment, ADB	
1. Efforts to address marine debris and plastic pollution management in Indonesia	**Ms. Anna Fink**, Senior Country Economist, Indonesia Resident Mission, ADB
2. Plastic pollution and its management strategies in the Yangtze	**Prof Lihui AN,** Chinese Research Academy of Environmental Science
3. Material flow analysis for quantification of the plastics pollution challenge.	**Prof. Wei ZHANG**, School of Ecology and Environment, Zhengzhou University
4. Effect of microplastics exposure on the microorganisms and aquatic plants in lakes and reservoirs.	**Dr. Xiong PAN**, Senior Engineer, Basin Water Environment Department, Changjiang River Scientific Research Institute, GWP China Yangtze River Partnership
5. Land-based plastic waste pollution and the pilot-city practice of 'No-Plastic-in-Nature' in the Yangtze River Basin	**Prof Chuanbin ZHOU,** Chinese Academy of Sciences
Panel Discussion and Q&A **Ms. Luca Jendrek,** Youth delegate for Europe at the World Water Council and IWRA Rapporteur.	

Plastic Pollution and Its Management Strategies in Yangtze River

Dr. Lihui AN 安立会
Chinese Research Academy of Environmental Sciences
Beijing, China

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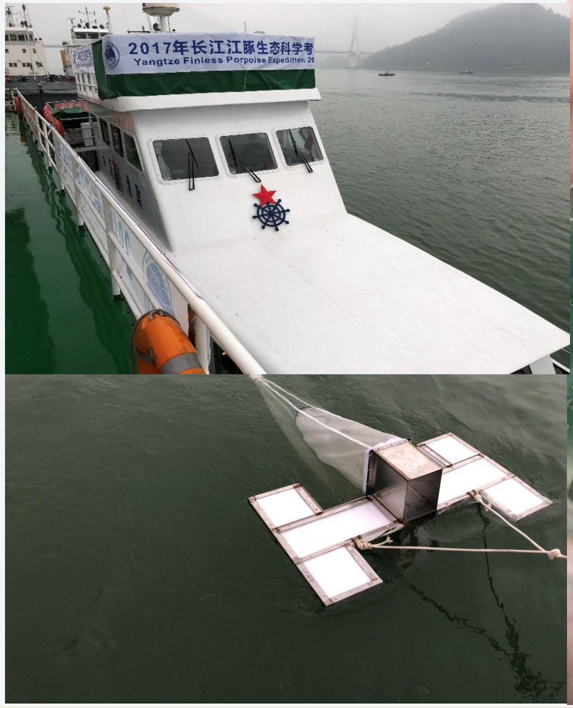
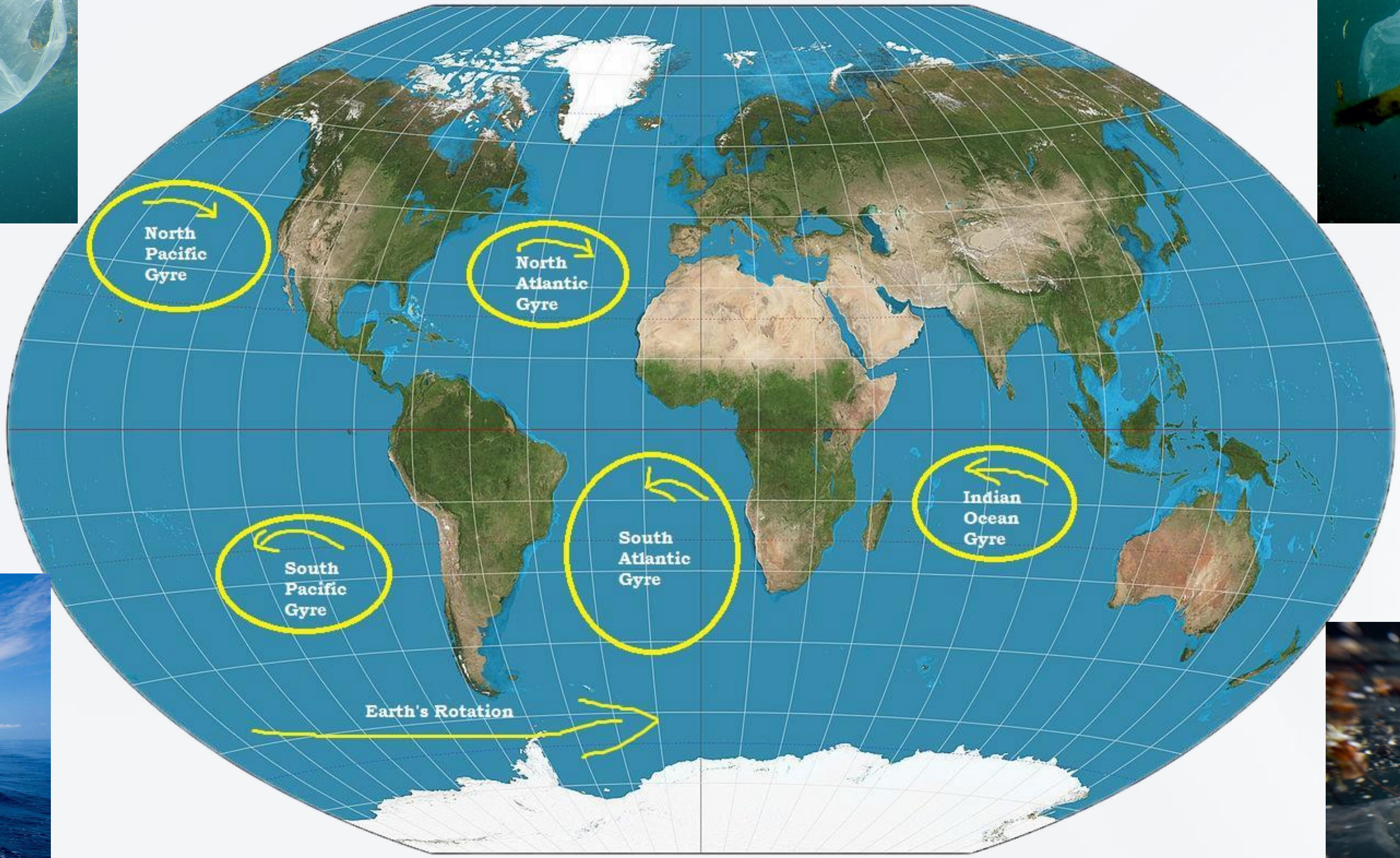
Contents

- Plastic pollution in Yangtze River
- Current management Strategies
- Next works

I. (Micro)Plastic Pollution in Yangtze River



(Micro)Plastic Pollution Is A Global Problem



Plastic Emissions From Rivers To Ocean

XVIII World Water Congress
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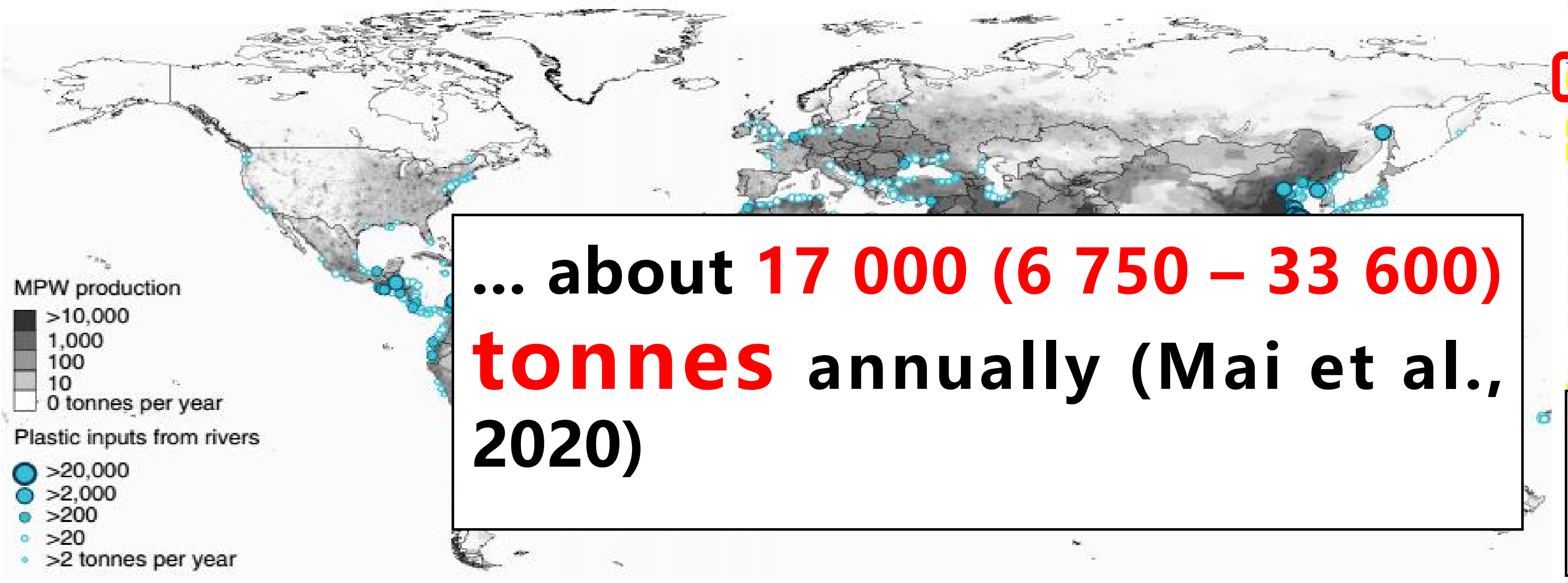


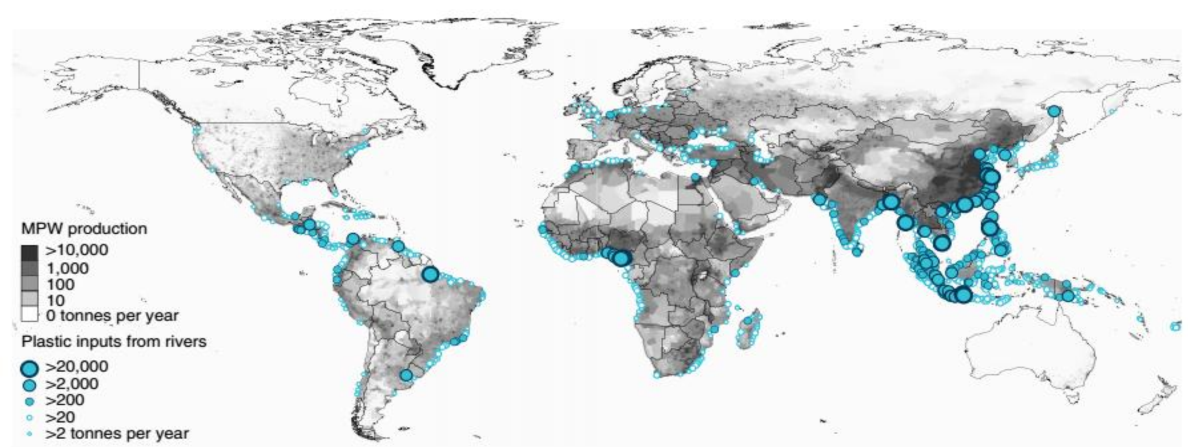
... about **17 000 (6 750 – 33 600) tonnes** annually (Mai et al., 2020)

Catchment	Country	Lower mass input estimate ($t\,yr^{-1}$)	Midpoint mass input estimate ($t\,yr^{-1}$)	Upper mass input estimate ($t\,yr^{-1}$)	Total catchment surface area (km^2)[21]	Yearly average discharge ($m^3\,s^{-1}$)[21]
Yangtze	China	3.10×10^5	3.33×10^5	4.80×10^5	1.91×10^6	1.58×10^4
Ganges	India, Bangladesh	1.05×10^5	1.15×10^5	1.72×10^5	1.57×10^6	2.08×10^4
Xi	China	6.46×10^4	7.39×10^4	1.14×10^5	3.89×10^5	5.53×10^3
Huangpu	China	3.35×10^4	4.08×10^4	6.73×10^4	2.62×10^4	4.04×10^2
Cross	Nigeria, Cameroon	3.38×10^4	4.03×10^4	6.5×10^4	2.38×10^3	2.40×10^2
Brantas	Indonesia	3.23×10^4	3.89×10^4	6.37×10^4	1.11×10^4	8.18×10^2
Amazon	Brazil, Peru, Columbia, Ecuador	3.22×10^4	3.89×10^4	6.38×10^4	5.91×10^6	1.40×10^5
Pasig	Philippines	3.21×10^4	3.88×10^4	6.37×10^4	4.07×10^3	2.07×10^2
Irrawaddy	Myanmar	2.97×10^4	3.53×10^4	5.69×10^4	3.77×10^5	5.49×10^3
Solo	Indonesia	2.65×10^4	3.25×10^4	5.41×10^4	1.58×10^4	7.46×10^2
Mekong	Thailand, Cambodia, Laos, China, Myanmar, Vietnam	1.88×10^4	2.28×10^4	3.76×10^4	7.74×10^5	6.01×10^3
Imo	Nigeria	1.75×10^4	2.15×10^4	3.61×10^4	7.92×10^3	2.79×10^2

Yangtze River .... an annual input of 0.33 (0.31 – 0.48) million tonnes

1.15 - 2.41 million tonnes of plastic waste currently enters the ocean every year from global rivers, with over 74% of emissions occurring between **May and October** (Lebreton et al., 2017)

Rivers Are Highway for Microplastics into Oceans ?



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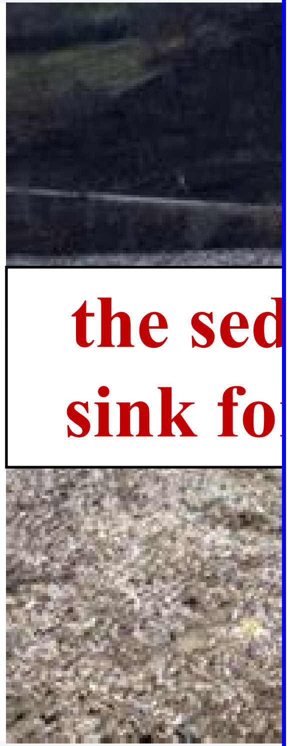

TOOLS OF THE TRADE

Understanding river plastic transport with tracers and GPS

Plastic pollution in the ocean has become a key concern because of its longevity and harmful effects on wildlife and, potentially, human health. A major fraction of marine plastic is believed to originate on land and is subsequently transported via rivers. However, relatively little is known about how plastic moves in rivers because most research has focused on estimating emission, rather than understanding transfer dynamics.

Tracers are a simple tool that can be used to improve understanding of riverine macroplastic transport. Using this technique, it is possible to determine how far plastic travels; where and what causes plastic debris to become trapped; the effect of river discharge, seasonal change in vegetation characteristics, plastic properties and other factors on plastic transport; and the residence time of plastic debris in storage. Tracers are items of plastic debris, such as single-use plastic bottles, that are introduced to rivers and their locations recorded over time. The number of tracers released and timescales before recovery vary with each experiment, but large sample sizes (>100 tracers) and long monitoring periods (months to years) allow variability and long-term transfer dynamics to be understood. The tracers can be tagged with paint or coloured tape to ensure that they are easy to identify, and to prevent littering, tracers are subsequently retrieved from boats, bridges or the riverbank using fishing nets. More sophisticated tracers contain GPS trackers, providing high temporal resolution data on tracer location. They are limited, however, by poor spatial accuracy (typically around 5 m) and relatively high procurement and running costs. Additionally, there is a trade-off between battery life and frequency of signal acquisition.

Tracer experiments show that macroplastic debris moves slowly and intermittently in rivers. Many items appear to be retained in freshwater systems and might never make it to the ocean. This information was initially surprising and it suggests that current estimates of riverine plastic flux to the ocean may have been overestimated. Elsewhere, tracer data can be used to inform numerical models that simulate the transport of plastic debris in rivers. The identification of accumulation hotspots can also allow mitigation efforts to be more focused and prioritized.

Robert Newbould
School of Geography, Geology and the Environment, University of Leicester, Leicester, UK
e-mail: ran14@leicester.ac.uk

Competing interests

… current estimates of riverine plastic flux to the ocean may have been overestimated (Newbould, 2021)

II. Current Management Strategies

English

MINISTRY OF ECOLOGY AND ENVIRONMENT
THE PEOPLE'S REPUBLIC OF CHINA

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Hot Keywords: Air pollution inspection clean heating

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China unveils 5-year plan to control plastic pollution

Source: China Daily 2021-09-23

Font Size:[S M L] [Print] [Close]

BEIJING -- China on Wednesday unveiled a plan on controlling plastic pollution over the next five years, aiming to effectively curb white pollution by 2025.

1. Implementation of National Actions

- Water Pollution Prevention and Control Action Plan (2015)
- Prevention and Control of Pollution from Ship and Ports Plan (2015-2020)
- Soil Pollution Prevention and Control Action Plan (2016)
- Release of the Opinions on Promoting the River Chief System in an All-Round Way (2016)
- Implementing Program for Prohibiting the Entry of Foreign Refuse to Promote the Reform of the Solid Waste Import Management System (2017)
- Three-year Action Plan For Rural Environment Governance (2018-2020)
- Implementation of the Plan for Pilot Development of Solid Waste-Free Cities (2019)
- Opinions on Further Strengthening Plastic Pollution Control (2020)
- Notice on Solidly Promoting Plastic Pollution Control (2020)
- 14th Five-Year Plan for Plastic Pollution Control Action (2021-2025)
- … …

14th Five-Year Plan for Plastic Pollution Control Action

(2021-2025)

Measures for **sources** of pollution	Targets for 2025	● **Significantly reduce single-use plastic usage** in key businesses, including retailing, e-commerce, food delivery, home delivery and hotels ● **Ban secondary packaging** for e-commerce home delivery in principle ● **Increase the use of recyclable** home delivery packaging to 10 million packages
	Details of measures	● **Promote** eco-design of plastic products — develop necessary standards for single-use and other plastics, optimize their designs and improve their recyclability ● **Continue** to take measures to reduce single-use plastic usage ● **Promote** substitutes for plastic products — consider the environmental impact of materials such as bamboo, wood, paper and biodegradable plastic, as well as develop necessary standards for products
Measures for **collection, disposal and recycling**	Targets for 2025	● **Establish** a system for the collection, transportation and disposal of household waste in cities at the prefectural level2 or above to significantly improve the efficiency of plastic waste collection and transportation ● **Increase** the national capacity for urban household waste disposal to about 800,000 tons per day to significantly reduce plastic waste dumped in landfills ● **Increase t**he collection rate of agricultural films to 85% to prevent an increase of agricultural films that are not collected and left on farmland
	Details of measures	● **Increase** the recycling rate of plastic waste as the separate collection of waste is adopted more widely across China ● **Develop** plastic waste collection and disposal systems in rural areas ● **Promote** plastic waste recycling ● **Promote** construction of waste incineration plants across the country to enhance the capacity to render plastic waste harmless

Domestic Waste Classification System in Chongqing City

A Small Plastic Waste Recycling Plant

Abandoned woven bags
(polypropylene，PP)

20 000 tonnes/year

2. Implementation of the Regional Actions

- Clearance Action in Yangtze River Basin (2018)
  - In 2018, 150 inspection groups inspected the waste dumping specially along Yangtze River, 1308 problems about solid waste dumping were found and amended
- Yangtze River Protection Law (2021)
- 14th Five-Year Plan for Implementation of Plastic Pollution Control in Yangtze River Economic Belt (2021)
- Action plan to further advance the ecological and environmental protection and restoration of the Yangtze River basin (2022)

Cleaning floating waste in Yangtze River

重庆市发展和改革委员会
fzggw.cq.gov.cn

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[索引号]	11500000009276150N/2022-00290
[发文字号]	渝发改资环〔2022〕850号
[主题分类]	环境监测、保护与治理
[发布机构]	市发展改革委
[成文日期]	2022-07-08
[体裁分类]	其他公文
[发布日期]	2022-07-08

关于开展重庆市江河水域清漂专项行动的通知

3. Establishing the National Joint Research Center of Yangtze River Eco-Environment Protection and Restoration

- **269** research institutions , universities, colleges, ...
- More than **5000** scientists
- **58** cities along Yangtze river

4. Joint Actions for Controlling Plastic Pollution in Yangtze River

Governments

NGOs

Citizens

Enterprise

III. Next Plan

- **To further implement the national and local actions on plastic waste control and management, such as cleaning floating wastes in rivers**
- **To strengthen scientific & technological support for preventing plastic wastes and microplastics into rivers from sources**
- **To strengthen school-community collaboration**
- **To strengthen cooperations with all stakeholders, including international and regional cooperations**
- **… …**

ThankS

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Beijing, China | September 11-15, 2023

Material flow analysis for quantification of the plastics pollution challenge

Reporter: Dr. ***Wei Zhang***

Date: 2023/9/12

- *Ecology and Environment, Zhengzhou University*
- *Yellow River Institute for Ecological Protection & Regional Coordinated Development, Zhengzhou University* http://www7.zzu.edu.cn/yellowriver/
- *Henan International Joint Laboratory of Water Cycle Simulation and Environmental Protection* http://www7.zzu.edu.cn/wrwer/

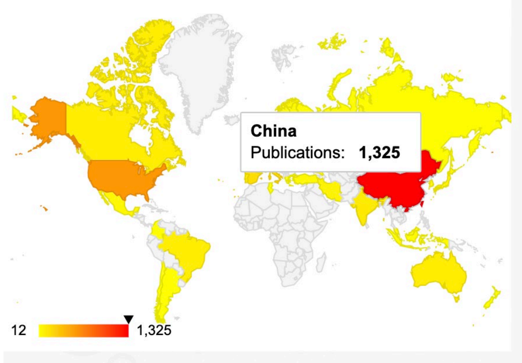
(1) Hotspot： *Microplastics in the environment*

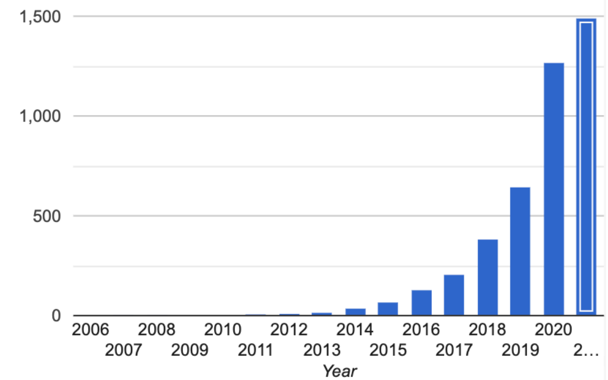
OCEANS

Microplastics in the seas

Concern is rising about widespread contamination of the marine environment by microplastics

By **Kara Lavender Law[1]** *and* **Richard C. Thompson[2]**





Widely observed in rivers worldwide

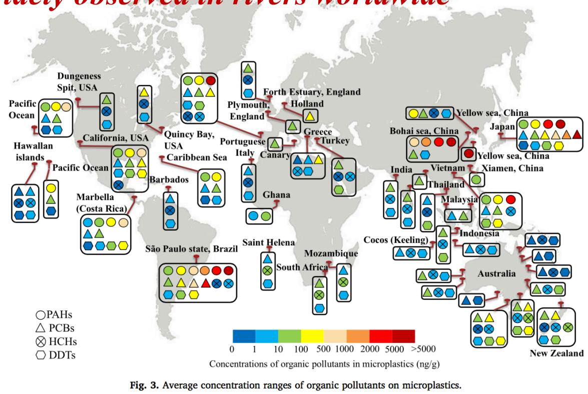
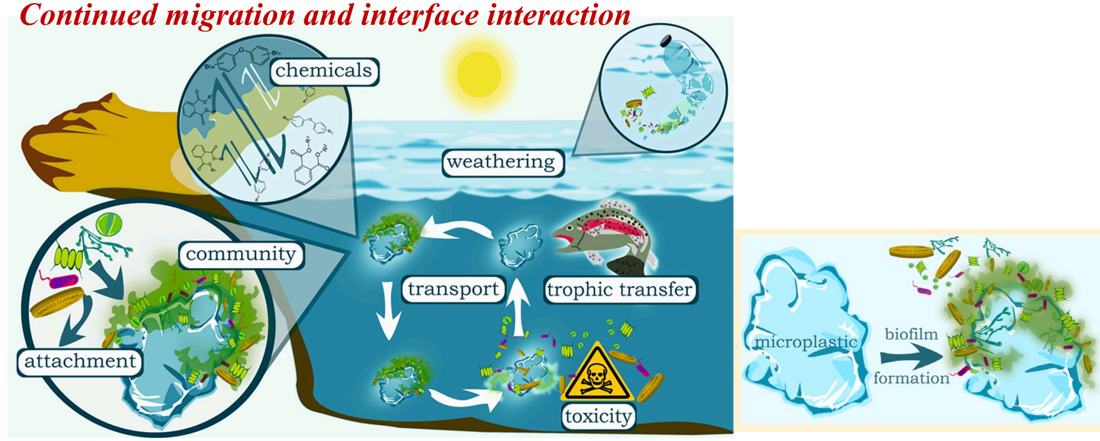


Fig. 3. Average concentration ranges of organic pollutants on microplastics.

Continued migration and interface interaction



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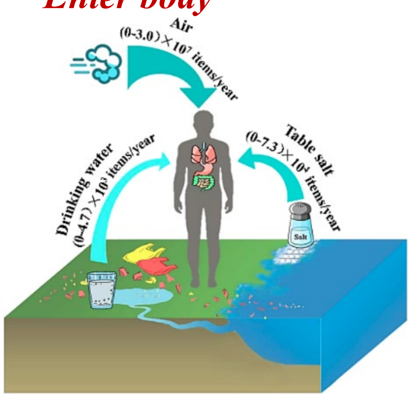
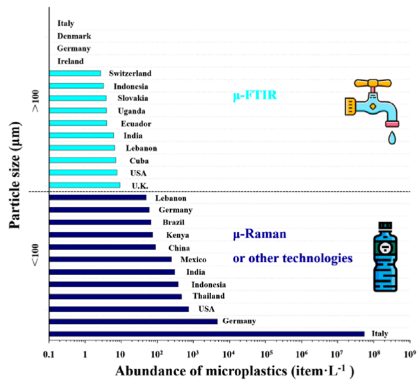
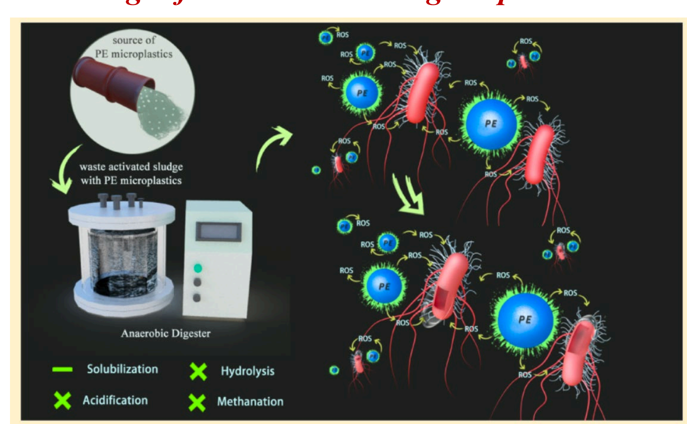




Driving influence other biological processes



Cited from: *Science* 2014, 345(6193): 144-145

Environ. Sci. Technol. Lett. 2017, 47258-267

Environ. Sci. Technol 2020, 54, 3740−3751

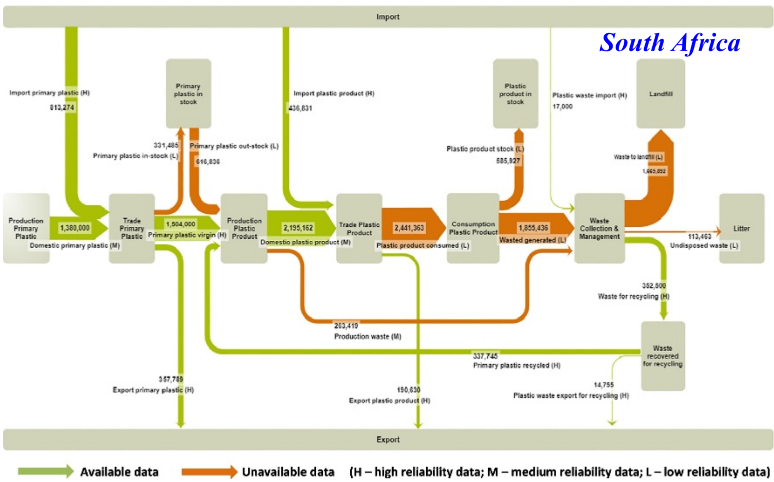
Marine Pollution Bulletin 2019, 142: 1-14

(2) Analysis： *Material Flow Analysis(MFA) -macro perspective*

Around 28 peer review studies have been published around this topic in total: MFA → *Law of conservation of mass*

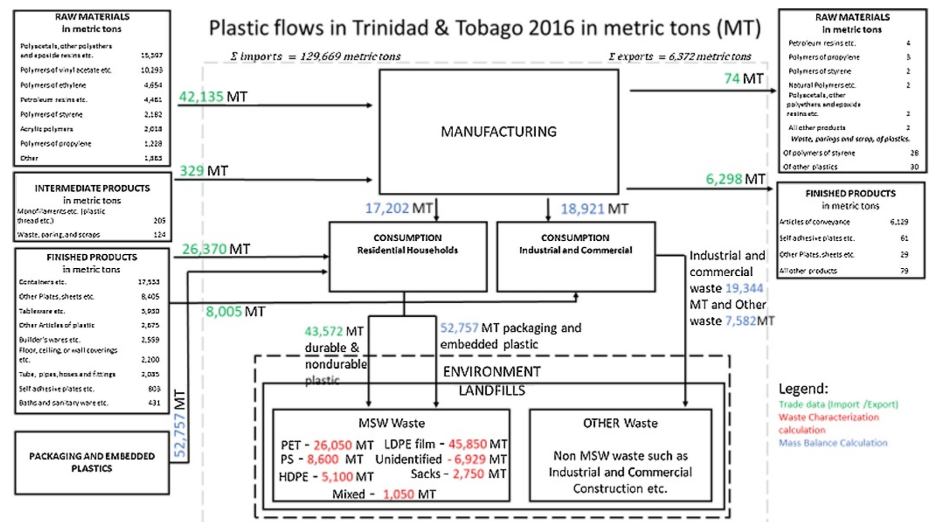
$$\sum M_{stock} = \sum M_{production} + \sum M_{import} - \sum M_{consumption} - \sum M_{export}$$

South Africa



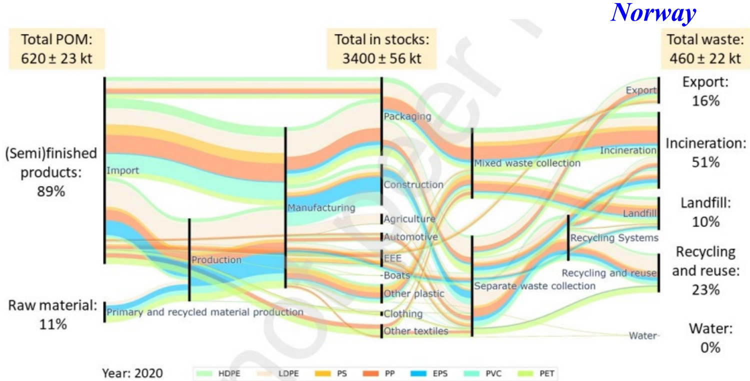
PPE through the supply chain during COVID-19 is relatively smaller compared to the total national plastic

Trinidad and Tobago



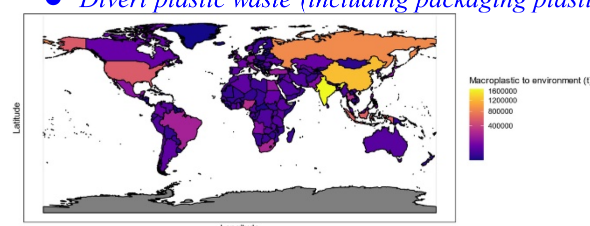
48% of the landfilled plastic comes from plastic packaging for imported products

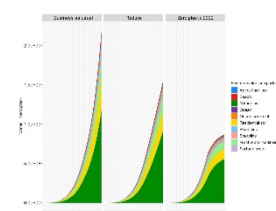
Norway

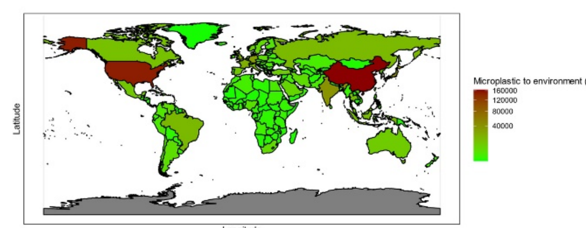


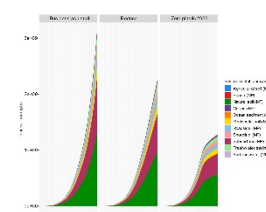
- *~50% of plastic waste is incinerated, ~15% exported, and ~10% landfilled*
- *increase by 65%, 140%, and 90%, respectively by 2050*

- *Divert plastic waste (including packaging plastic) for use*







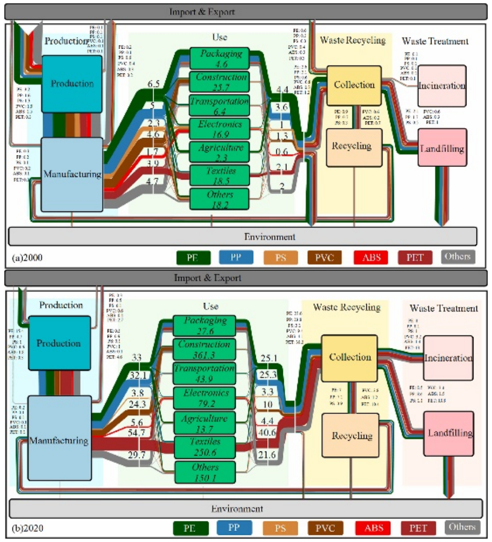


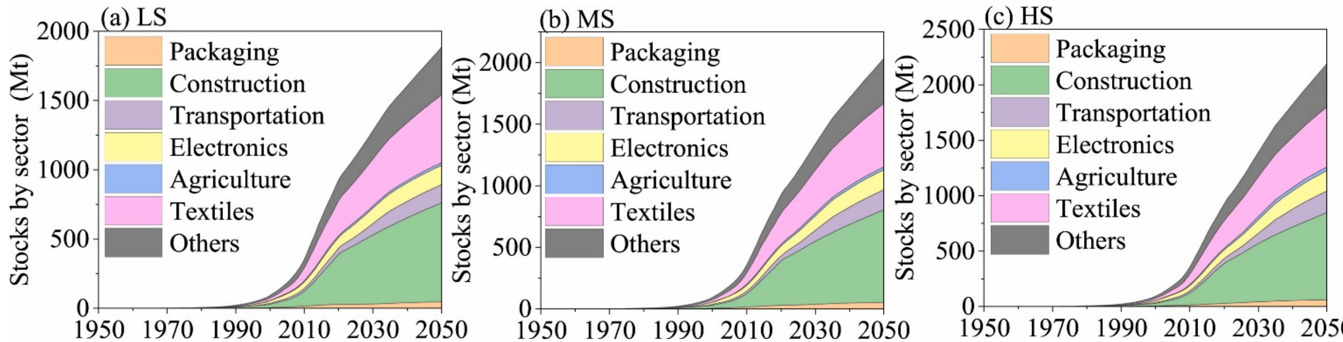
At least 2.15 and at most 5.3 gigatonnes of environmental plastics in 2050

- ***2017, 9.5 megatonnes***

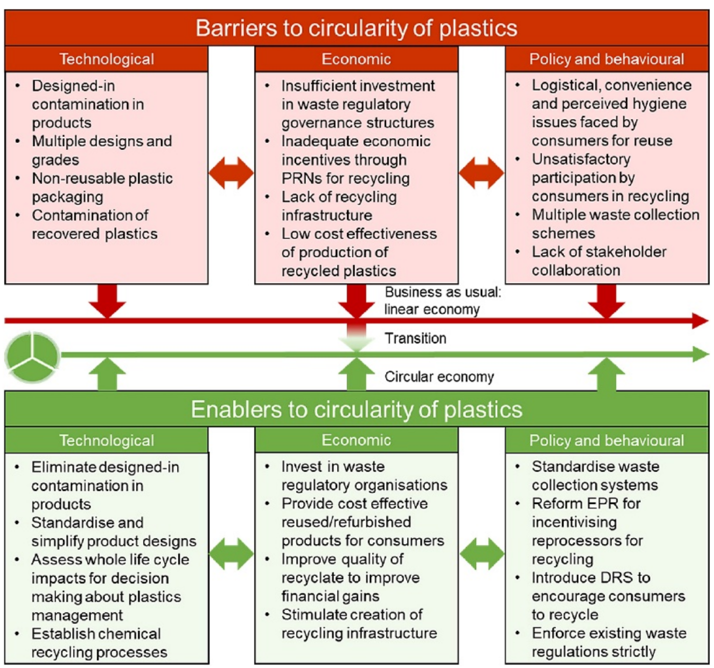
Cited from: *Science of The Total Environment* 2021, 790: 148190
Science of The Total Environment 2023, 875: 162644
SSRN 4263852 *Resources, Conservation and Recycling* 2019, 150: 1044336

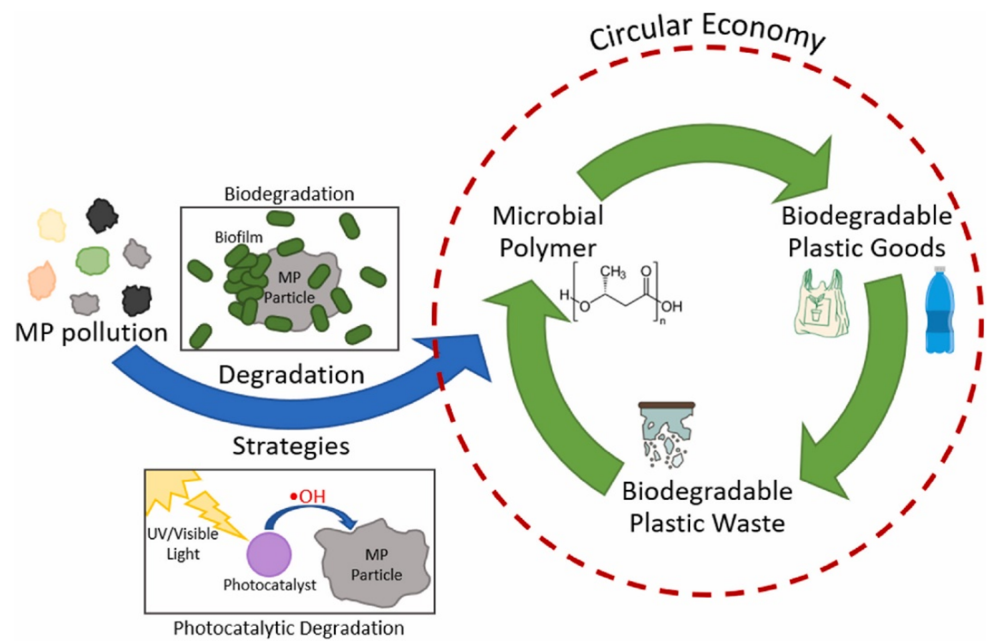
(2) Analysis： *Material flow analysis -macro perspective*





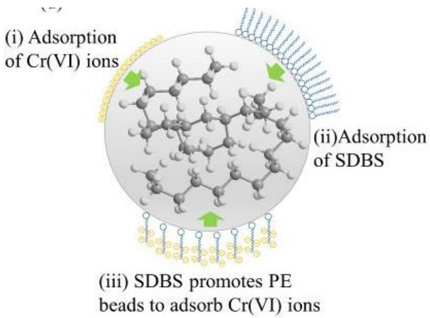
- *In-use stock of plastics reached 926.5 Mt in 2020*
- *24.7% of waste plastics were recycled from 1950 to 2020*
- *Secondary plastics could supply 49.1% of plastic demand by 2050*

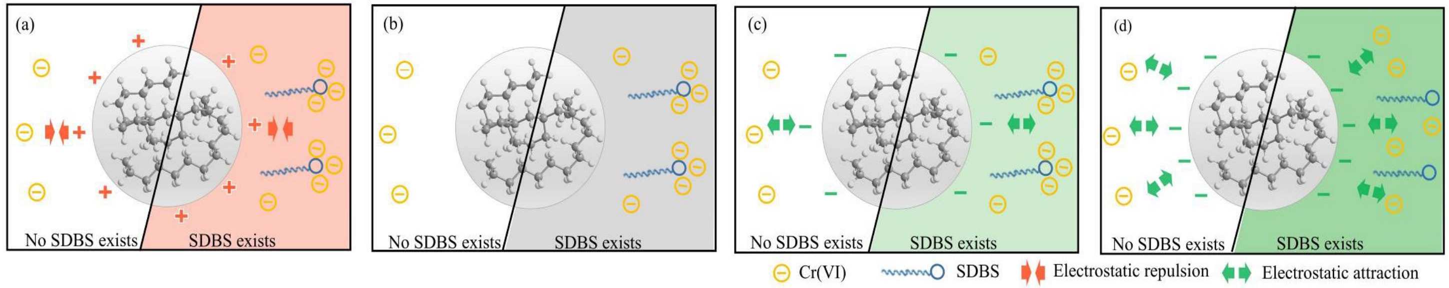


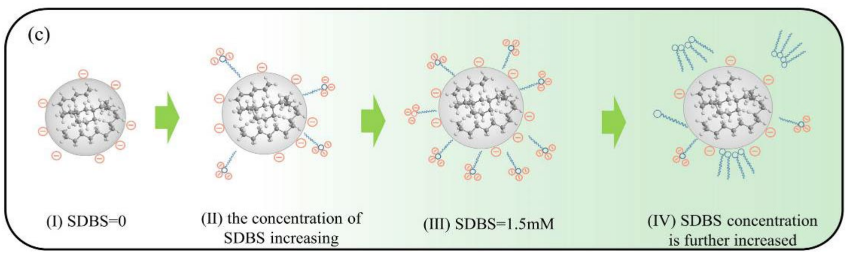


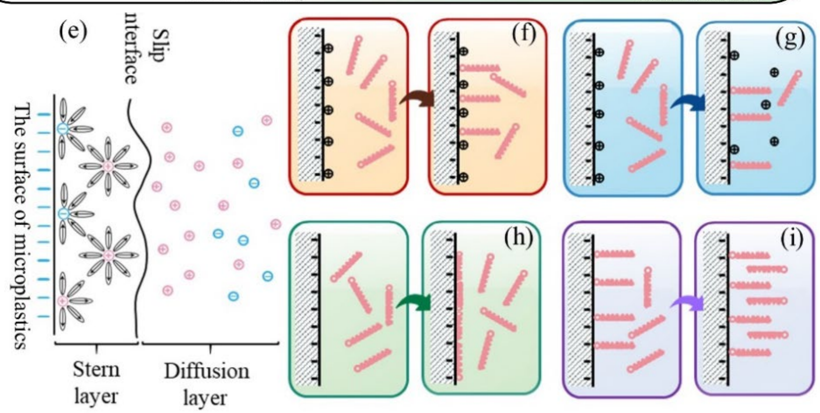
Cited from: *Journal of Cleaner Production* 2021,327: 129492 *Environmental Pollution* 2022, 315: 120334 *Resources, Conservation and Recycling* 2022, 179: 106085

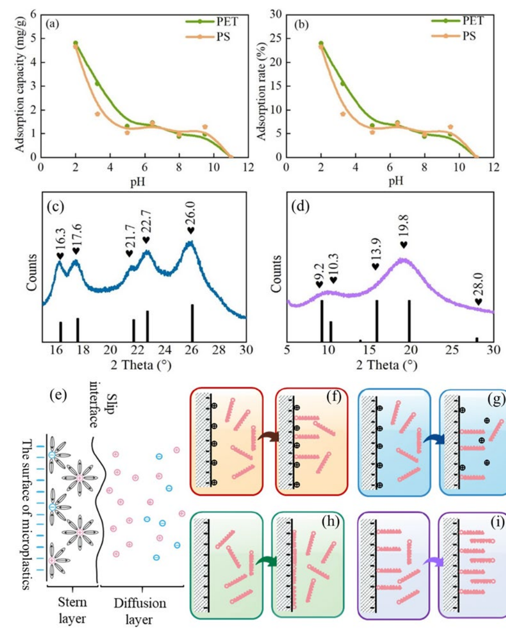
(3) Analysis ： Material flow analysis -micro perspective









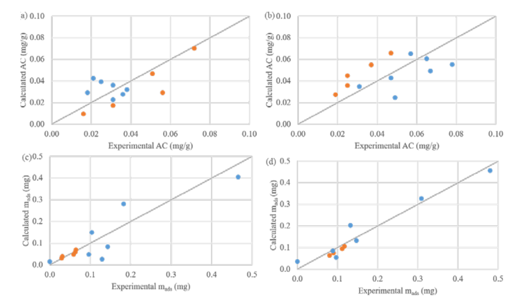


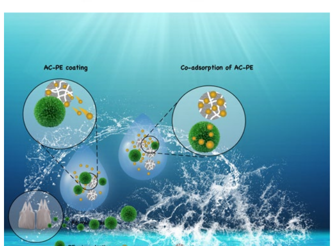
$$q_e = K_{eq} \cdot C_{eq} \cdot \left(\frac{-1+\sqrt{1+8K_{eq}C_{eq} \cdot q_{tot}}}{4K_{eq}C_{eq}} \right)^2$$

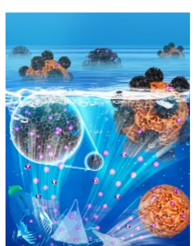
$$q_{tot} \propto A \rightarrow q_{tot} \propto \frac{m}{\rho} \cdot \frac{6}{d} \rightarrow q_{tot} = B \cdot \frac{6}{\rho} \cdot \frac{m}{d} = B' \cdot \frac{m}{d} = B' \cdot \frac{C_{MP}V}{d}$$

$$q_e = \frac{B'}{2} \cdot \frac{C_{MP}V}{d^m}$$

$$m_{ads} = B'' \cdot \left(C_{liq,1}\right)^{1/n} \cdot \frac{C_{MP}V}{d^m} \cdot \exp(-\alpha \cdot pH)$$

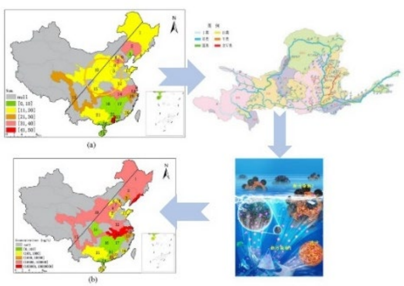


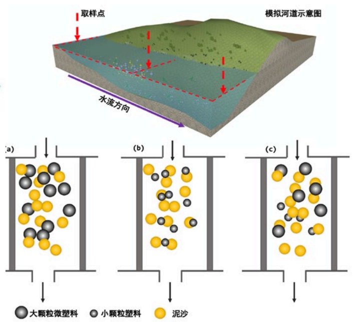


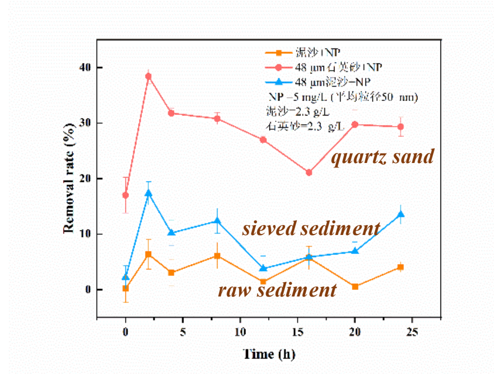


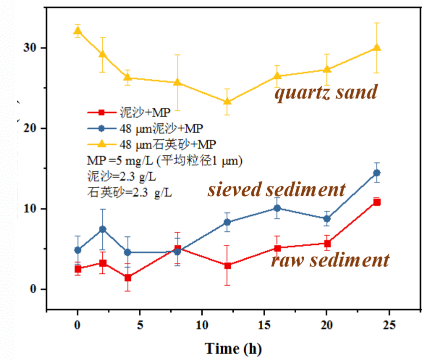
Environmental Research 2021, 197:111057
Environmental Pollution 2020, 257:113440
Toxics. 2021, 9, 139. ***Editor's Choice Article***
Toxics. 2022, 10(2): 70 ***Hot Article***

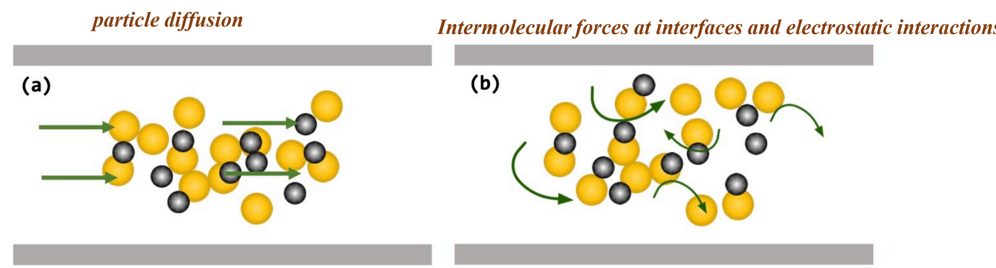
(4) Microplastics in Yellow River ： micro perspective

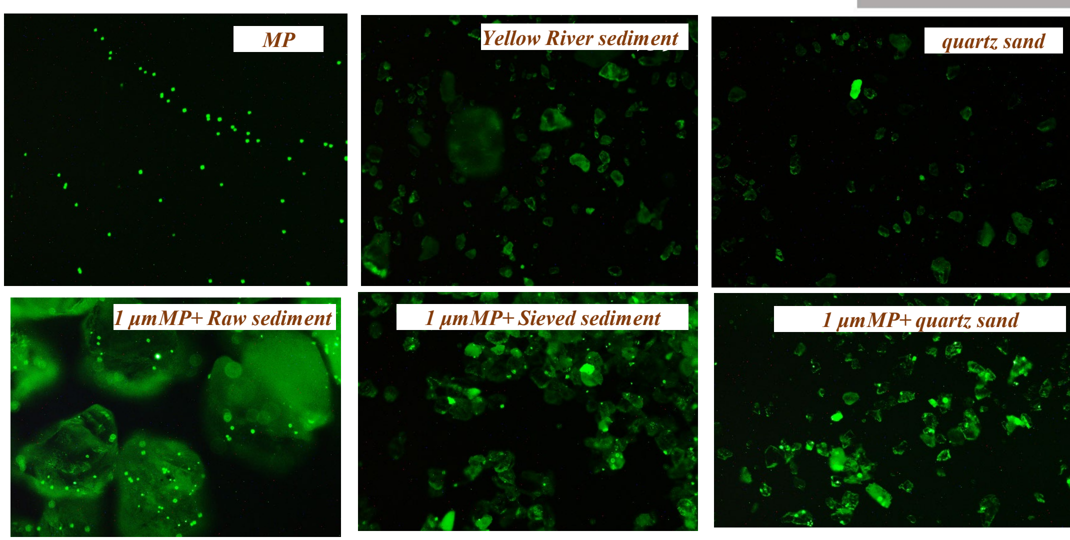


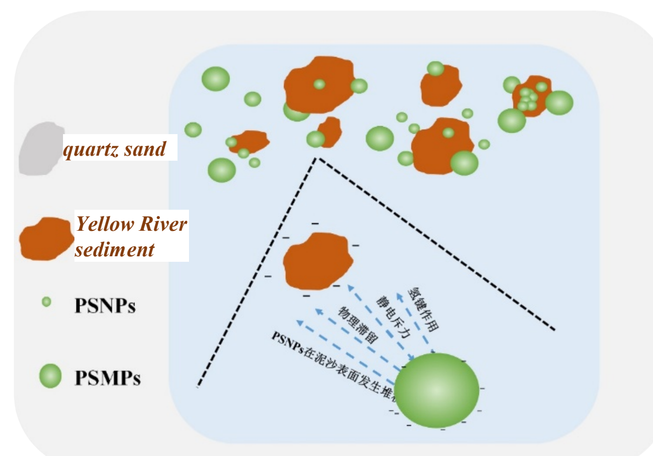












(5) Conclusions

- *From the **MFA** routes, the emissions of plastic have been consistently increasing.*
- *Through calculation and estimation, at most* **5.3 gigatonnes** *of environmental plastics in 2050.*
- *To incorporate plastic into the **circular economy** process and achieve its recycling.*
- *Plastics could **interact with various pollutants** at interfaces, thereby increasing their toxicity.*
- *The plastics would also collide and aggregate at the sediment interface, thereby increasing **the transportation of plastics**.*

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International Water Resources Association (IWRA)
Beijing, China | September 11-15, 2023

Acknowledgments

国家自然科学基金委员会
NSFC

- ***China Association for Science and Technology Young Talent (2022)***
- ***RIE Young Scientist Award (2023)***
- *Henan Province Youth Talent Cultivation Project (2023)*
- *Henan Province Young Backbone Teacher Support Project (2021)*
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- *National Postdoctoral Science Foundation (2018M632799)*
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CRSRI

Global Water Partnership
China Yangtze River

XVIII
World Water Congress
International Water Resources Association(IWRA)
Beijing, China | September 11-15, 2023

Effect of microplastics exposure on the microorganisms and aquatic plants in lakes and reservoirs

Reporter：Xiong PAN

Basin Water Environmental Research Department,

Changjiang River Scientific Research Institute

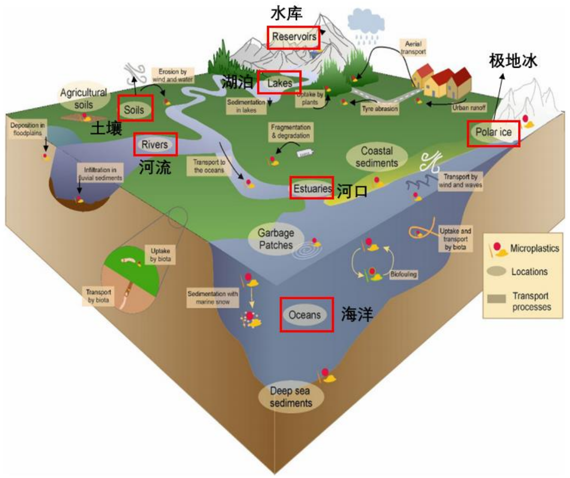
Sep 2023

CONTENTS

1 Research Background and Significance

1.1 Overview of microplastics (MPs)

- **Definition: plastic particles less than 5 mm in diameter** **(Thompson et al., Science, 2004)**
- **graphically referred to as PM 2.5 in water: United Nations Environment Programme identified MPs as a significant emerging pollutant**



until 2023

Studies have confirmed the presence of microplastics in **human lungs, liver, spleen, kidney tissue and even placenta**

Primary MPs

small-particle plastics specially produced for various applications

Secondary MPs

large quantities of plastic waste formed by physical, chemical, and biological processes

1.2 Hazards of microplastics

- **MPs' direct toxicity**

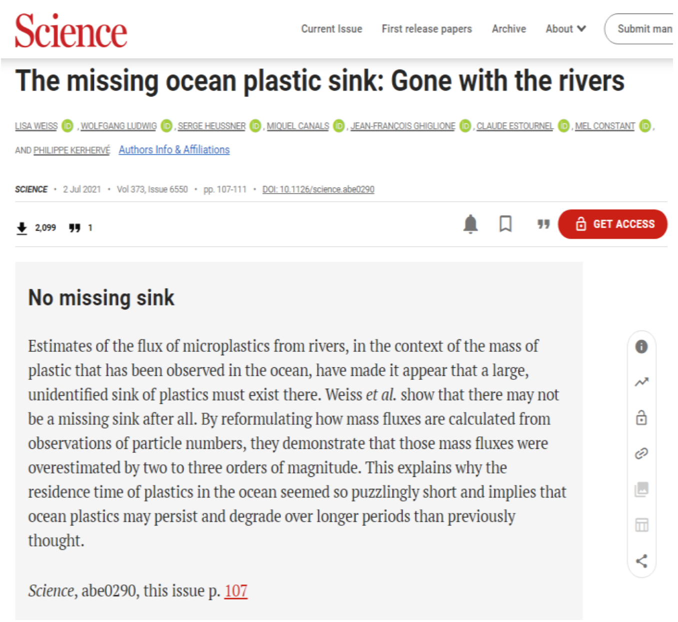
Digestive System, Reproductive System, Photosynthetic System

- **Indirect release of toxic substances**

enter the food chain and accumulate in living organisms

- **Adsorbed toxic substances**

transport chemical pollutants, such as heavy metals and POPs


Science
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The missing ocean plastic sink: Gone with the rivers

LISA WEISS, WOLFGANG LUDWIG, SERGE HEUSSNER, MIQUEL CANALS, JEAN-FRANÇOIS GHIGLIONE, CLAUDE ESTOURNEL, MEL CONSTANT, AND PHILIPPE KERHERVÉ Authors Info & Affiliations

SCIENCE • 2 Jul 2021 • Vol 373, Issue 6550 • pp. 107-111 • DOI: 10.1126/science.abe0290

2,099 1 GET ACCESS

No missing sink

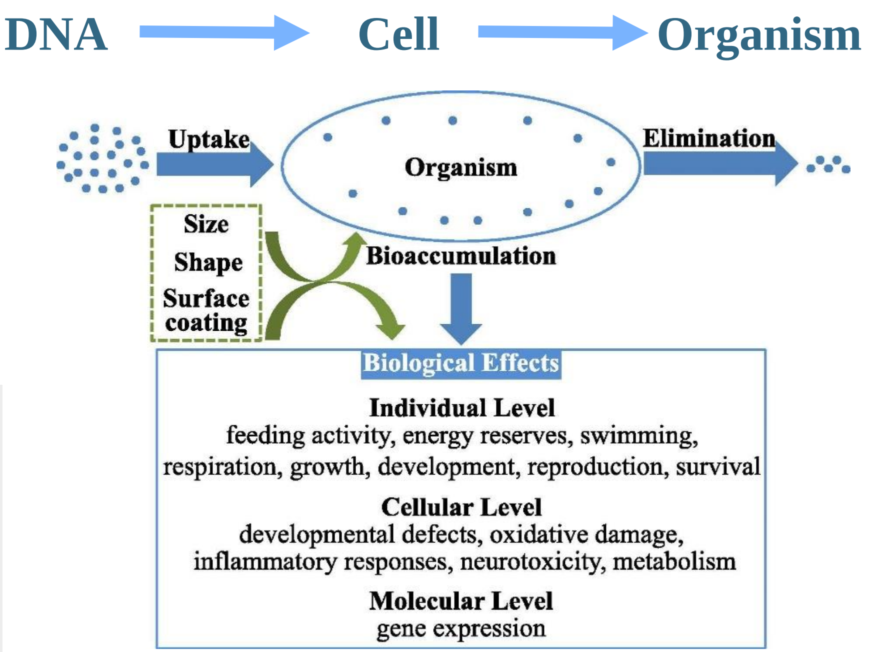
Estimates of the flux of microplastics from rivers, in the context of the mass of plastic that has been observed in the ocean, have made it appear that a large, unidentified sink of plastics must exist there. Weiss *et al.* show that there may not be a missing sink after all. By reformulating how mass fluxes are calculated from observations of particle numbers, they demonstrate that those mass fluxes were overestimated by two to three orders of magnitude. This explains why the residence time of plastics in the ocean seemed so puzzlingly short and implies that ocean plastics may persist and degrade over longer periods than previously thought.

Science, abe0290, this issue p. 107

Mechanical injury, Inflammatory response

Growth, Development, Metabolism

Oxidative stress, Exercise capacity

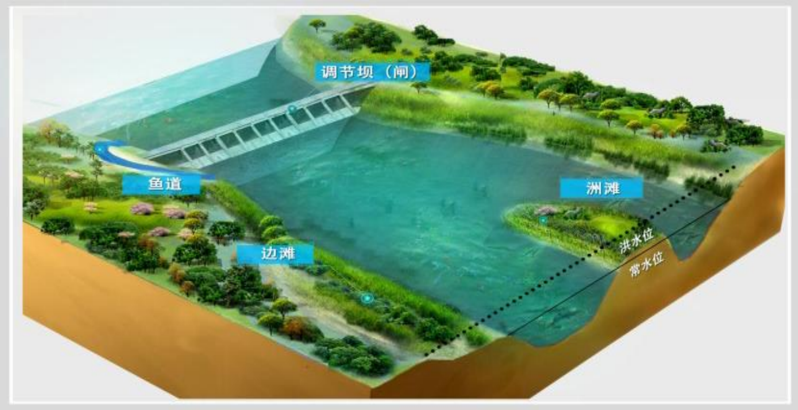


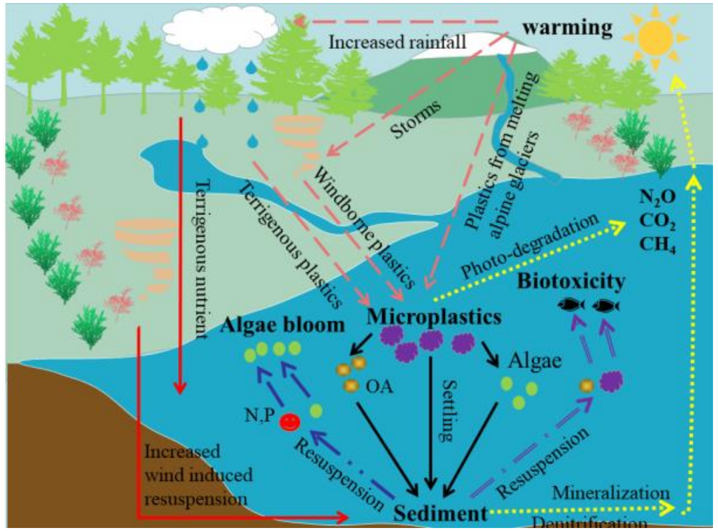
◆ **The source and distribution of MPs are incredibly diverse:** In 2015, Jambeck estimated that between 4.8 and 12.7 million tonnes of plastic waste enter the ocean annually, with most entering via freshwater rivers.

1.3 MPs pollution in basin water environment

■ **Studying MPs in freshwater is a hot environmental science topic**

- **MPs in rivers, lakes and reservoirs** have been the subject of extensive investigation.
- **Transport** of MPs in rivers, lakes, and reservoirs is closely related to their **hydrological characteristics**.
- MPs may also inhibit the growth of aquatic plants, inhibit the activity of microorganisms, and influence aquatic ecosystems' material and energy cycles**. Indeed, the relevant processes and mechanisms remain obscure**.





(Zhang et al., 2020, STOTEN 135979)

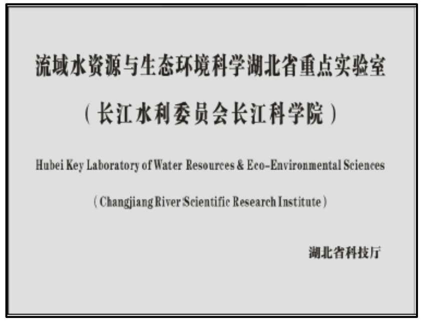
1 Research Background and Significance

1.4 Our proposed research works

Due to the need for plastic pollution control in the water environment of the Yangtze River Economic Belt and the development orientation of our research institute, we will focus on the following areas of research：

- Occurrence and Transport Characteristics of MPs in Lake or Reservoir
- Effects of MPs Pollution on Water Ecology and Environment
- Ecological Risk Assessment and Control Countermeasures of MPs Pollution in Basin Water Environment

Research Team

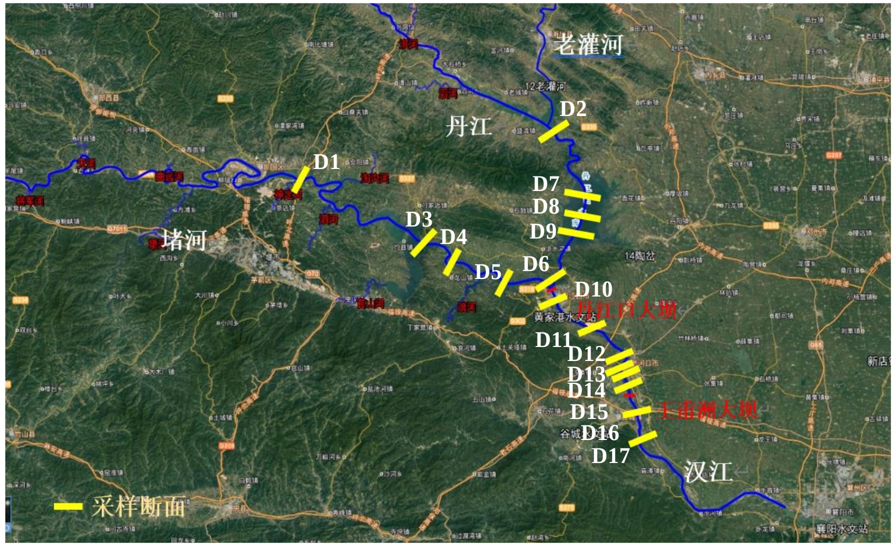


CONTENTS

3 Effects on Microbial Community and Function

3.1 Field Investigation

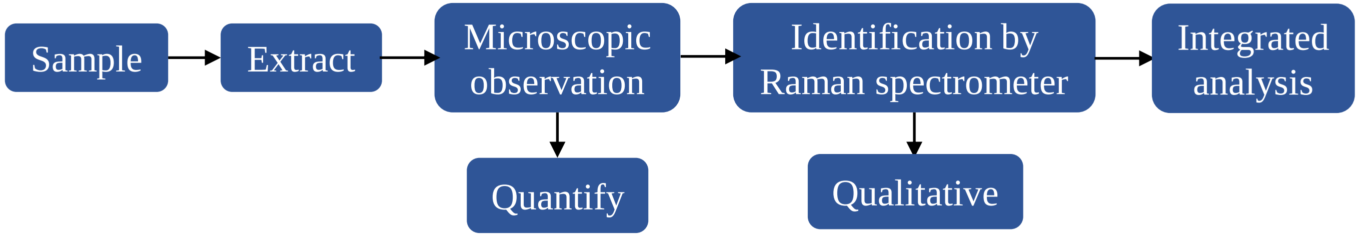
- **Survey Object**: A typical channel reservoir
- **Sampling**: 9 sampling sections at the reservoir's entrance, middle and front (D1~D9), collected surface sediment samples
- **Survey Content**: The occurrence characteristics of MPs, the microbial community structure and functional characteristics, the physical and chemical properties of sediments
- **Time**： August 2021
- **MPs analytical method:** Dual density separation method
- **Microbiological analytical method:** High-throughput sequencing of the 16SrDNA gene, Functional gene chips



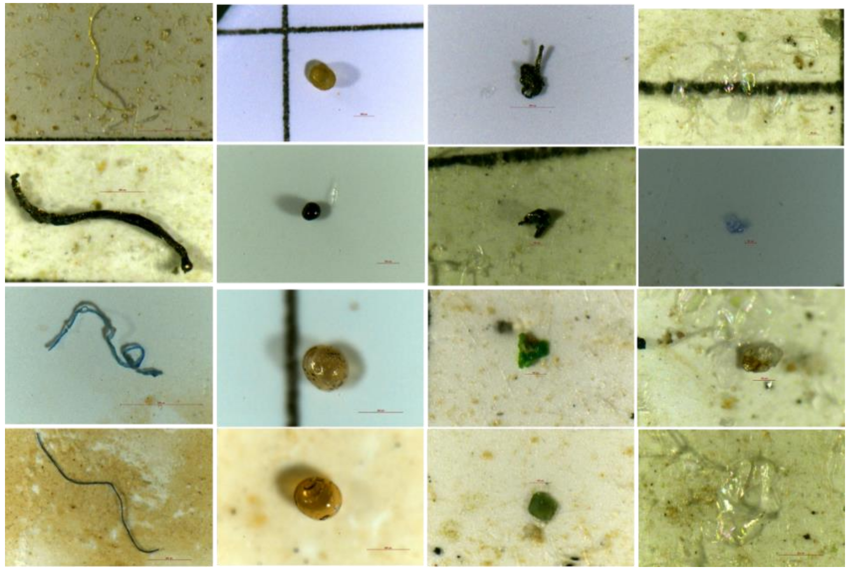
Survey sampling points

3 Effects on Microbial Community and Function

3.1 Field Investigation



The investigation and testing workflow of MPs



Typical microplastics in reservoir sediments

Microplastics testing equipment

Microscopic Raman Spectrometer

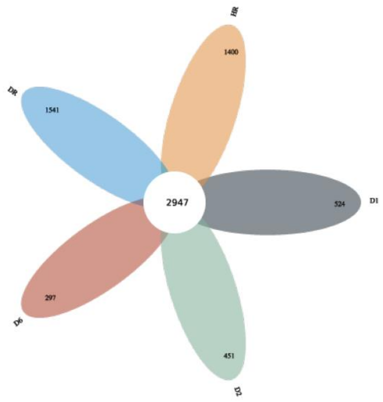
The main colors of microplastics are red, yellow, white, green, blue, purple, pink, grey, black, transparent and others.

Spherical, thin films, fragments and fibers are the main shapes.

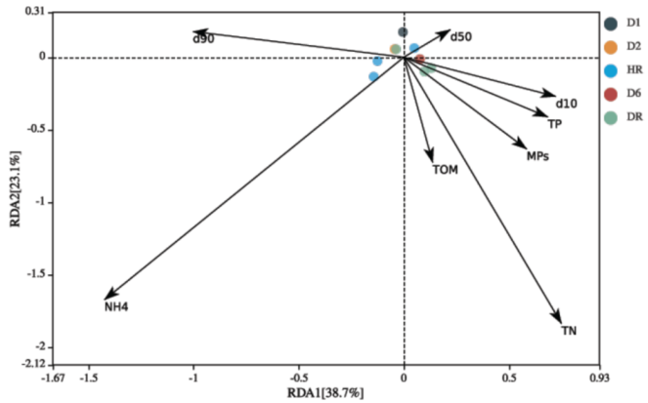
3 Effects on Microbial Community and Function

3.2 Microbial Community

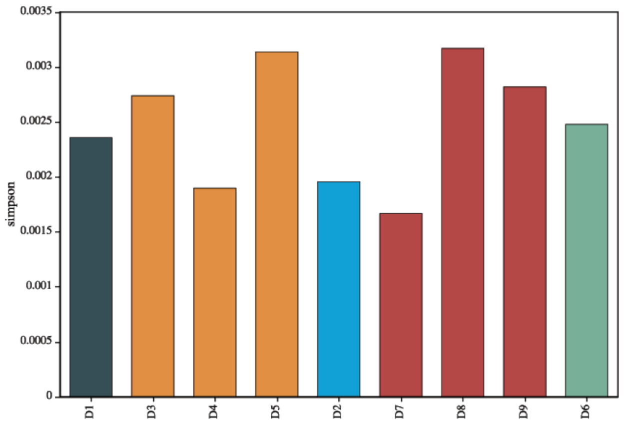
- **53** phyla of bacterial communities were found, with Proteobacteria, Bacteroidetes, Verrucomicrobacteria and Nitrobacteria being the dominant phyla.
- More microbial species in reservoirs, especially in areas with slower water flow, and the fewest near dams.
- **Microbial diversity and abundance were greater** in regions **where microplastics were abundant**. Environmental factors, such as the content of TN and TP, sediment particle size, and microplastic abundance, **may account for 61.8%** of the variance of the microbial community.



Venn diagram of common or endemic species



Redundancy analysis

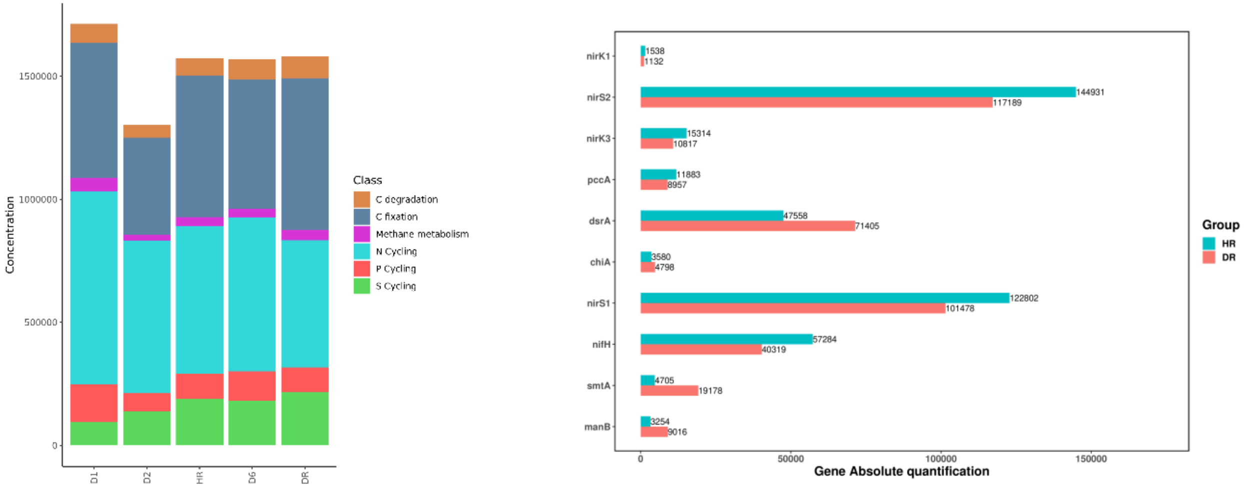


Microbial alpha diversity index statistics

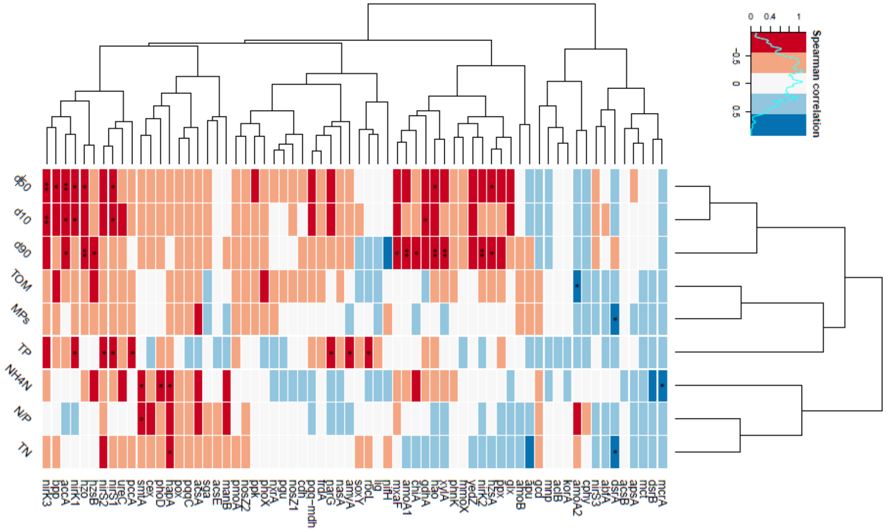
3 Effects on Microbial Community and Function

3.3 Microbial Function

- In regions with **fast water flow**, **N and P** cycling functional genes were **abundant and active**, whereas C and S cycling functional genes were scarce and inactive
- Functional genes C, N, P, and S expression activities in **coarse sediment particles** were **low**.
- In regions with **a high abundance of microplastics** in the reservoir, the functional activity of the **C and N** cycles was **low**, while the functional activity of the S cycle was strong.



Abundance comparison of functional genes of C, N, P and S



Correlation analysis of functional gene abundance and environmental factors

CONTENTS

4 Effects on Aquatic Plant Growth

4.1 Transport and accumulation of sMPs

- **Experimental Methods**: Microcosms
- **Tracer and quantification**: europium-labeled PS
- **Treatments**: ck, 1000 nm PS, 100 nm PS
- **Concentration**: 0.1 g/kg, 1 g/kg
- **Observing targets**:

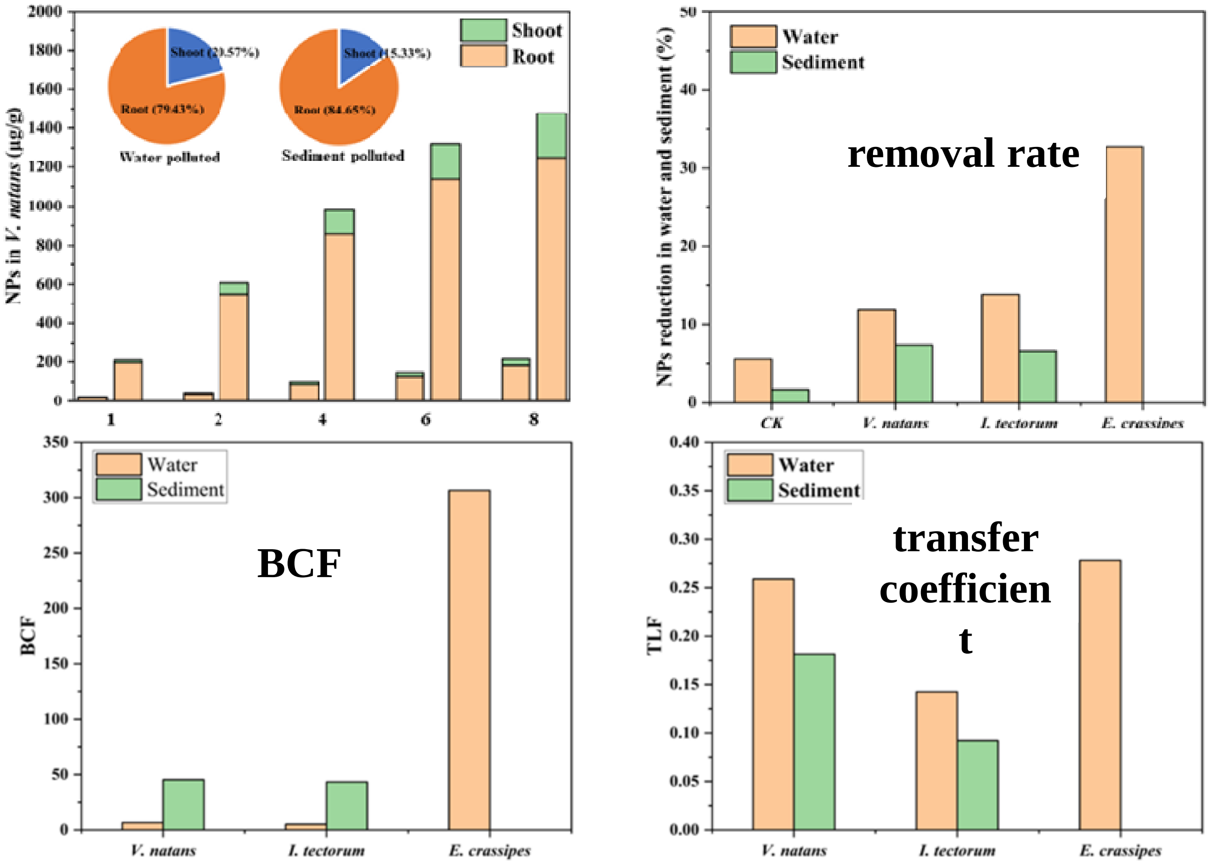
1) **Sediment**: oxidation-reduction potential (ORP), pH
2) **Water**: DO, conductivity, pH, ORP
3) **Chlorophyll fluorescence characteristics**: Fv/Fm, Y(II), qn, qp, qL, ETR
4) **Photosynthetic pigment content**: chlorophyll a, b, c
5) **Biomass**: plant length, fresh weight, tillering

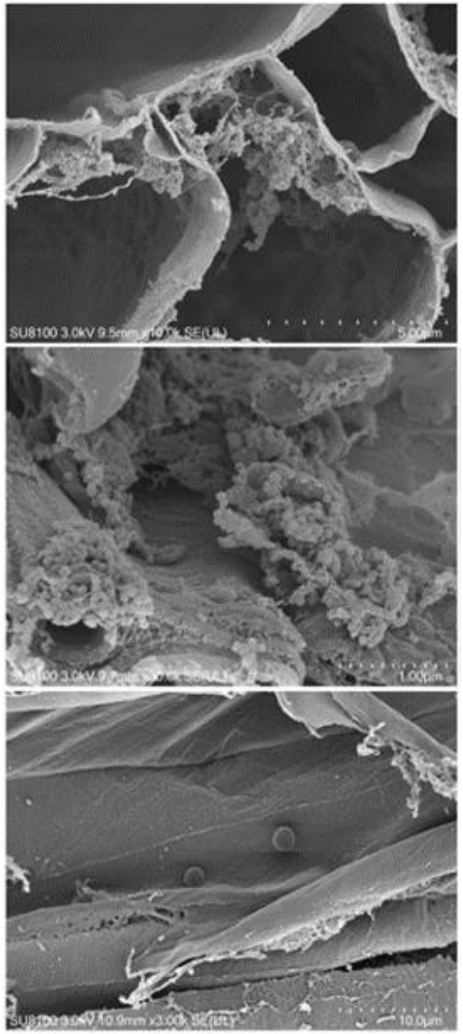
***V.denseserrulata*+Sediments+sMPs** (PS)

4 Effects on Aquatic Plant Growth

4.1 Transport and accumulation of sMPs

- Root is the main organ where sMPs accumulated the most
- 7 to 12 percent of the sMPs consumed by *V.denseserrulata*
- Root of *V. denseserrulata* contained a small number of 100-nm plastic particles but none of 1000-nm plastic particles





100 nm PS root

100 nm PS leaf

1000 nm PS root

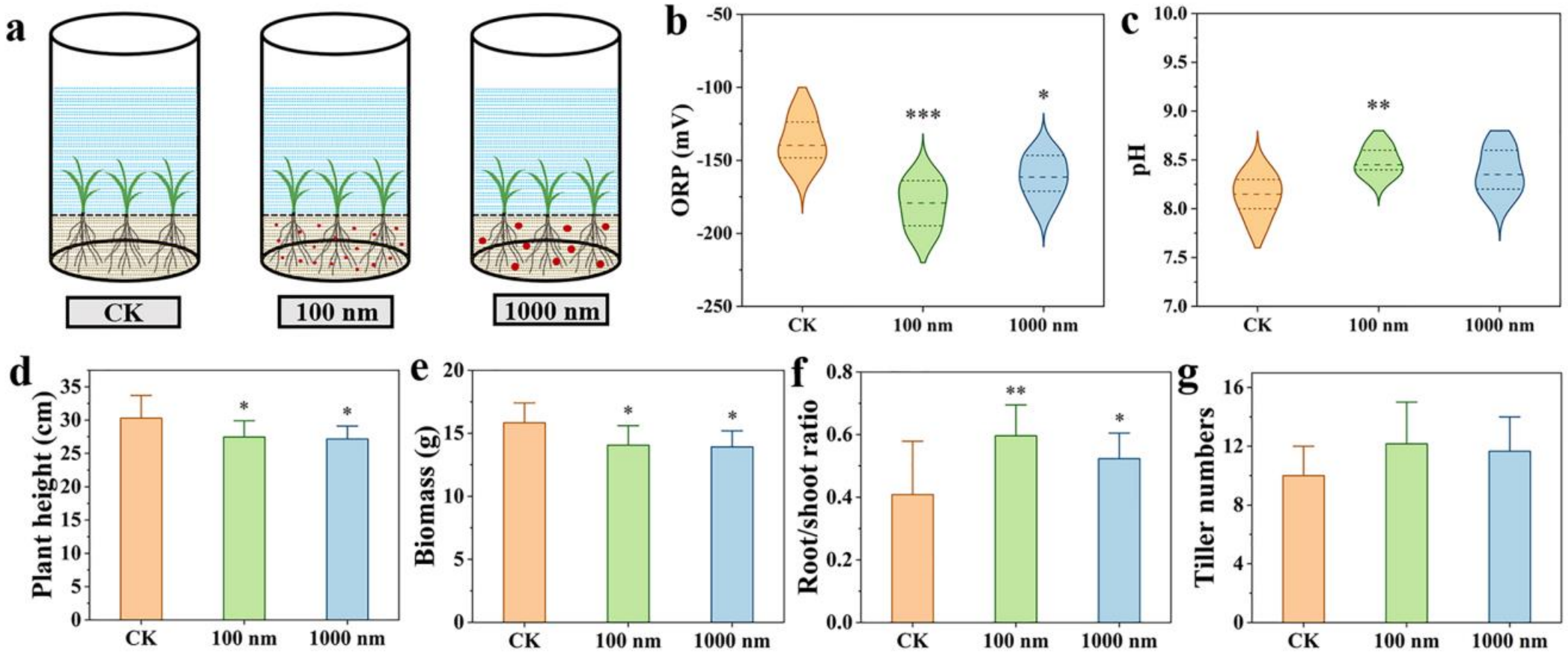
V.denseserrulata

4 Effects on Aquatic Plant Growth

长江科学院 CHANGJIANG RIVER SCIENTIFIC RESEARCH INSTITUTE

Global Water Partnership China Yangtze River

4.2 Effects of sMPs on sediment properties and plant growth



- sMPs (PS) significantly reduced the ORP and increased the pH of sediments. 100-nm particles had a more significant effect on plant growth than 1000-nm particles.
- A dose-response experiment (0-1000 μg/g) showed that the growth of *V.denseserrulata* in wet sediment was not affected until the dose reached 1000 μg/g (i.e.,0.1% w/w).
- The observed effect dosage of 0.1%w/w sMPs significantly suppressed plant height and biomass by 19.2-22.3% and 10.8-15.8%, respectively.

CONTENTS

4 Conclusion and Future Work

4.1 Conclusion

- The dam operation increased the microbial diversity of surface sediments. Furthermore, the carbon, nitrogen, phosphorus, and sulphur cycle activity of the microbial flora in the reservoir sediment coarsening and microplastic accumulation areas was relatively low.
- Bitter grass could inhale nanoscale PS plastic, which would be more concentrated in the root. It significantly inhibited the height and biomass of bitter grass, decreased sediment ORP values, and increased sediment pH.

4 Conclusion and Future Work

4.2 Future Work

- It is intended to conduct further study on the occurrence characteristics of microplastics from different sources in the basin and analyze the microplastic sources in the lake and reservoir. .
- to conduct a study on the influence of hydrological changes on MPs' transport behaviour under river damming conditions
- to identify the water ecological and environmental effects of microplastic pollution; and propose countermeasures and measures for controlling such pollution in lakes and reservoirs

This ends the presentation
Thank you

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Land-based plastic waste pollution and the pilot-city practice of No-Plastic-in-Nature in the Yangtze River Basin

Chuanbin Zhou
Research Center for Eco-Environmental Sciences,
Chinese Academy of Sciences

XVIII
WORLD WATER CONGRESS
Water for All
Harmony between Humans and Nature

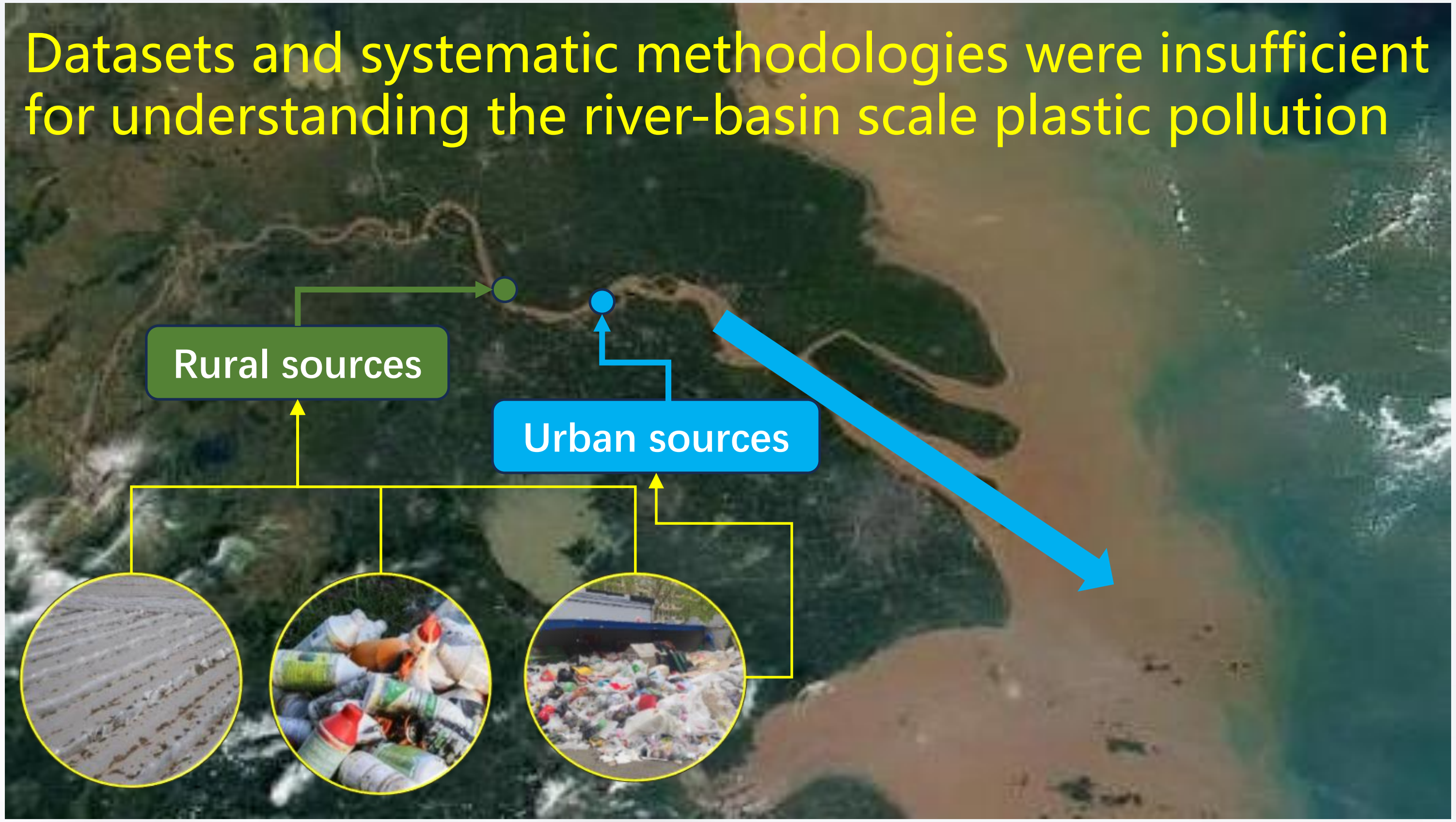
第18届
世界水资源大会
水与万物:
人与自然和谐共生

Content

- Background
- Land-based plastic waste pollution
- Practice of No-Plastic-in-Nature

Background

- Plastic pollution resulted in irreversible impacts on marine and terrestrial ecosystems
- The very first step is understand land-based plastic waste emission and pollution (UNEP, 2021)
- Yangtse River was considered as one of the largest plastic-waste generator into ocean?



Plastic waste generation from land

⇩

Plastic leakage to rivers & lakes — Rain, runoff, wind...

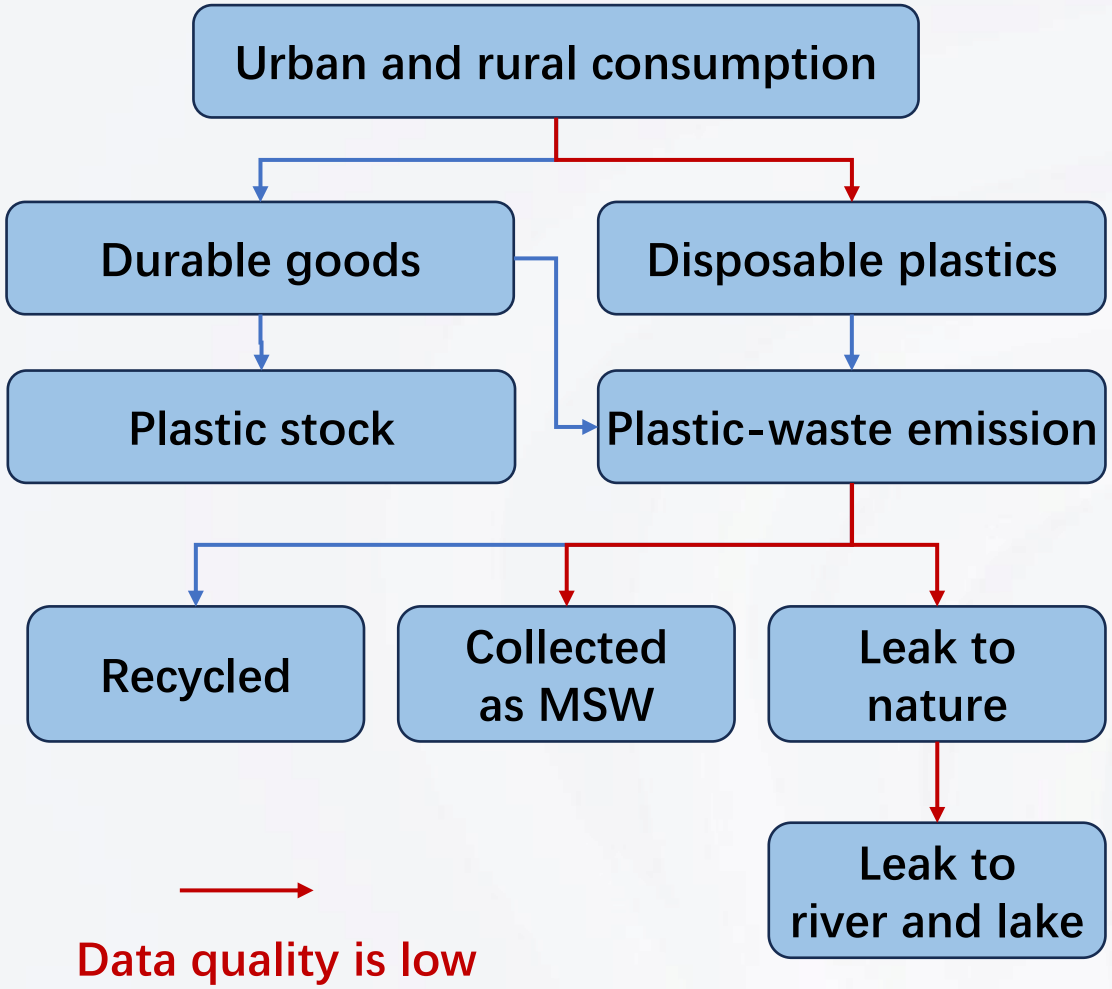
⇩

Plastic emissions to ocean — River and coastal clean...

Estimate land-based plastic waste pollution

Research Objectives

- Establish a Land-based plastic waste flow model, and a database covering the whole life-cycle of plastic waste management system
- Find the key sectors and the hotspots of land-based plastic waste management system



Estimate land-based plastic waste pollution

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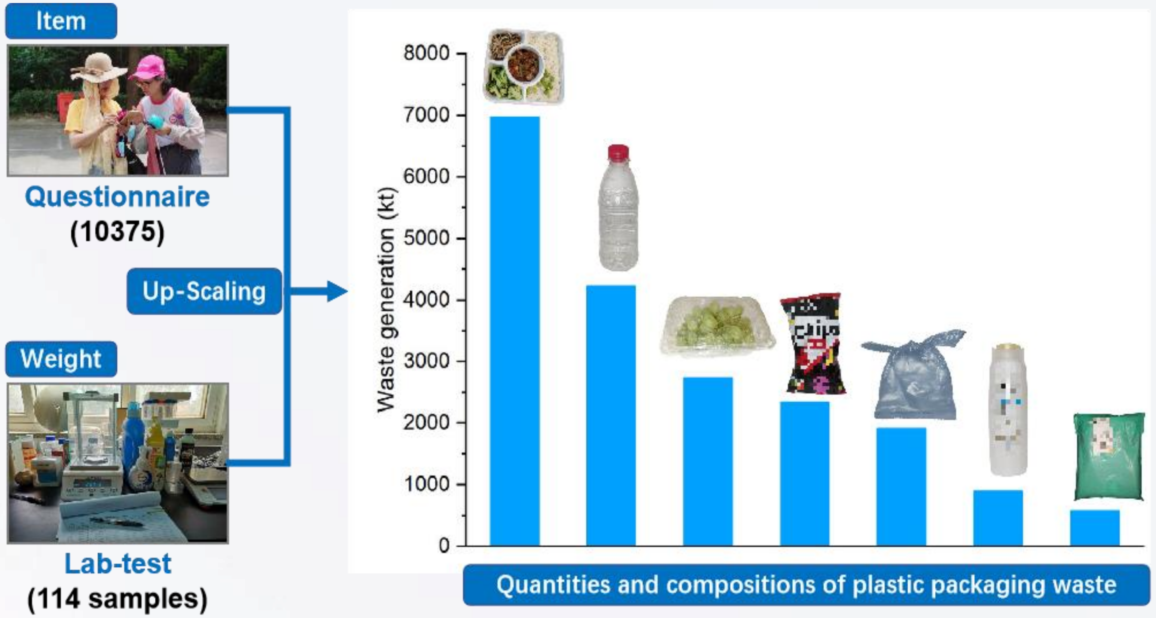
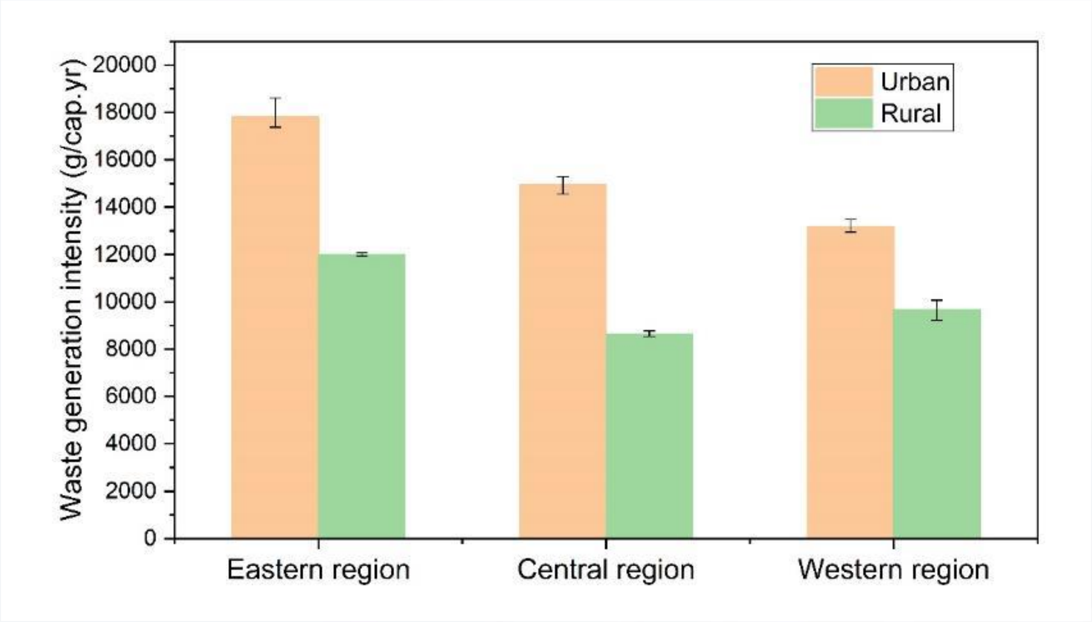
Estimate the disposable plastics in provincial-level

- **Per capita plastic waste generation rate: 8.5 ~ 18.6 kg/cap.yr**
- **Significantly higher generation intensities in cities compared to rural areas**



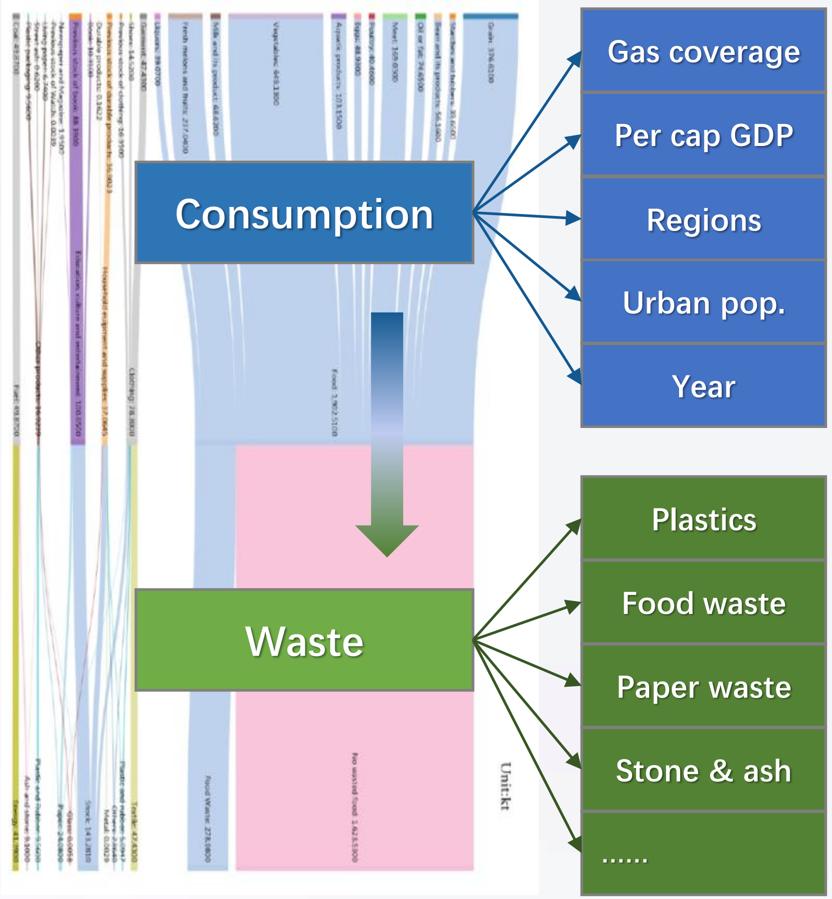


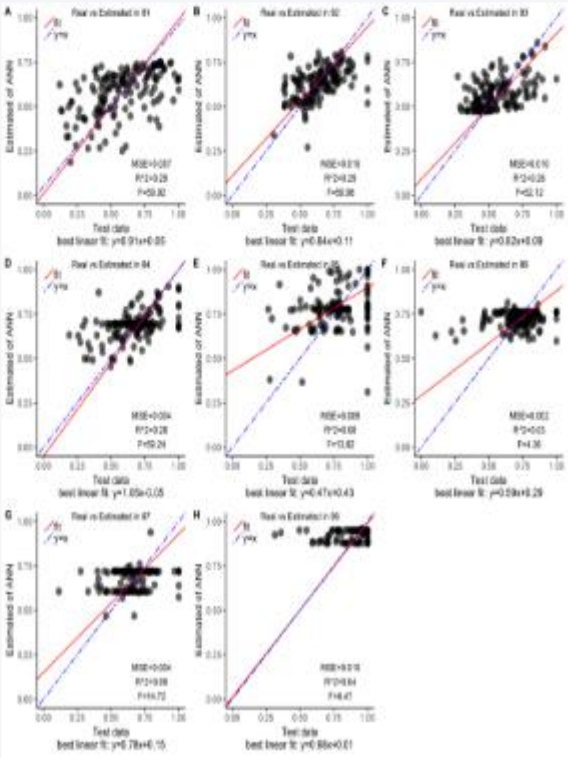
(Zhang et al., 2023, Resource, Conservation & Recycling)

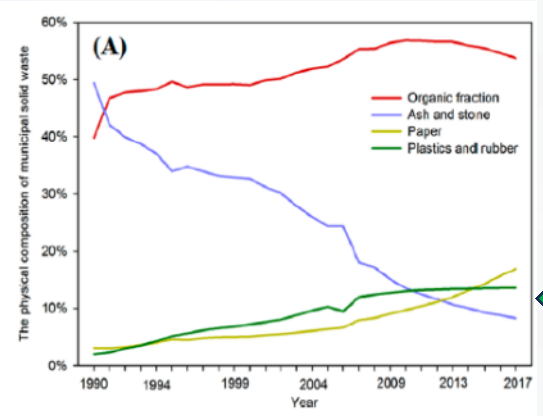
Estimate land-based plastic waste pollution

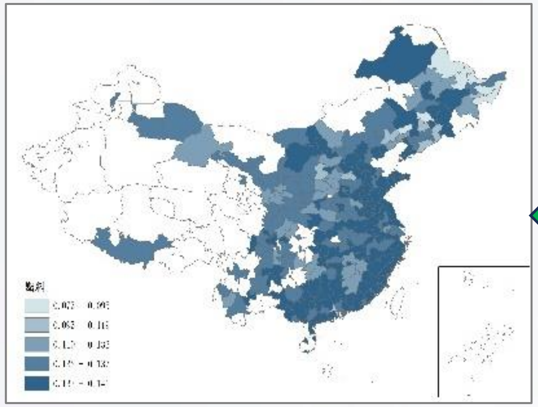
Estimate the plastic-waste disposed in controlled MSW treatment facilities

- 135 city-level waste composition data → BPNN modeling → city-level disposed plastics









(Ma et al., 2023, Environmental Science & Technology)

Estimate land-based plastic waste pollution

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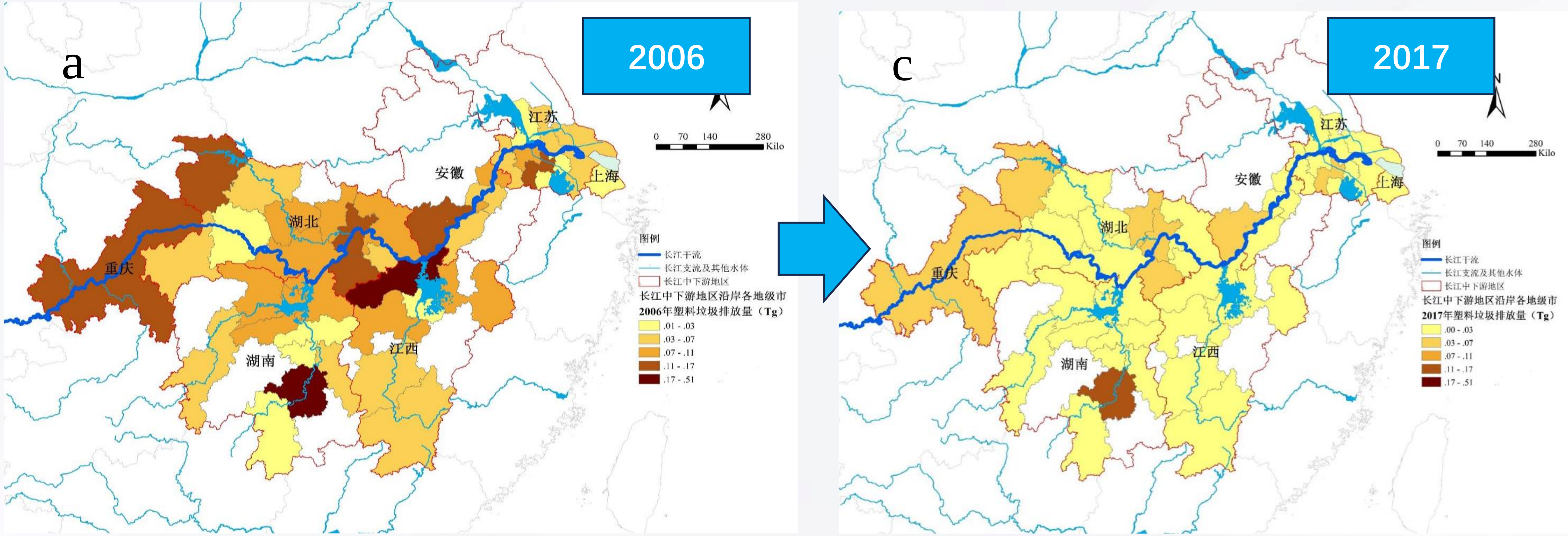
Upscaling the plastic pollution data in Yangtse Rive basin area

- **From 2006-2017, the nature-leakage of plastic waste decreased by 79% (77 kt in 2017)**
- **Hotspot: 1) rural areas in middle stream (~49%); 2) agriculture film, food package, …**



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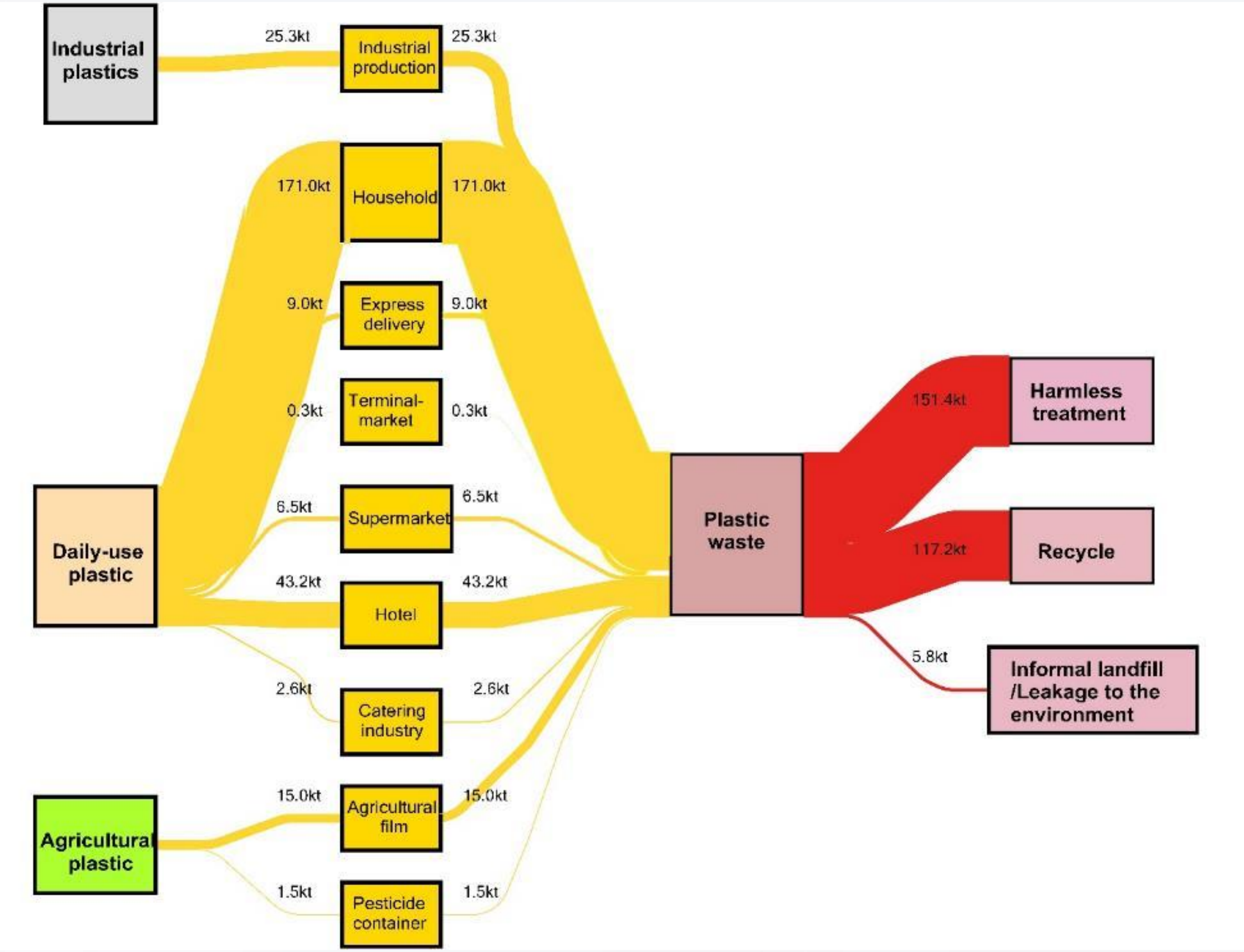
2020: WWF selected Yangzhou as the No-Plastic-in-Nature Pilot-City

- **Set the boundary and the monitoring indicators of the pilot area**

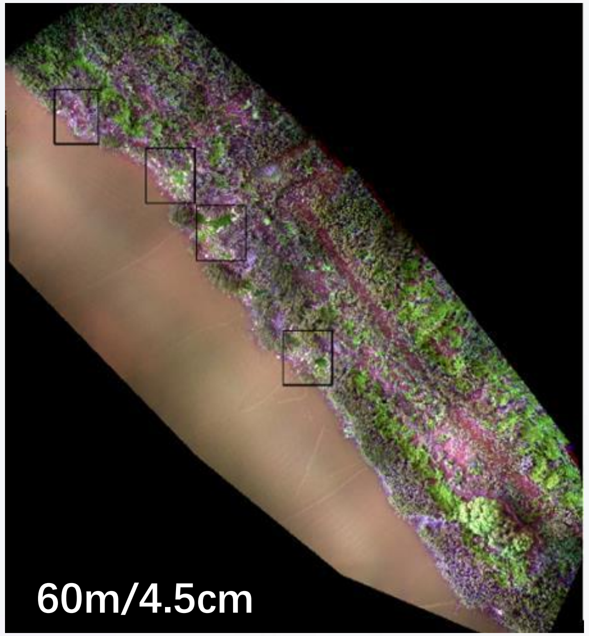
No-plastic in Nature Pilot Area in Yangtse River Reserve of Yangzhou City (WWF-UN Habitat)

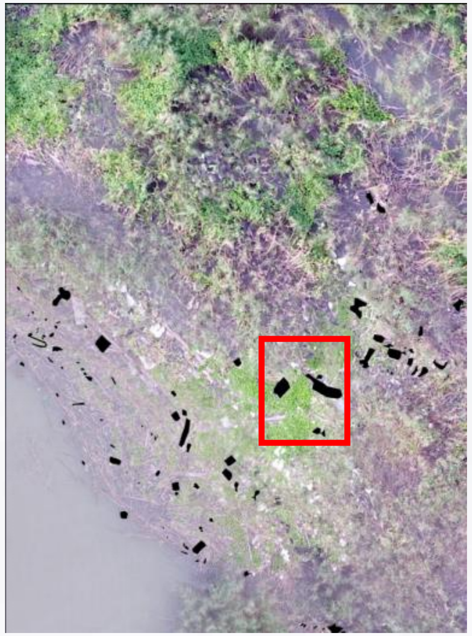
criterion	Indicators		Units
Waste reduction	1	Per capita plastic package use	kg/cap.yr
	2	Decrease of disposable plastic use	%
	3	Non-degradable plastic bag use	kg/cap.yr
Recycling	4	Recycling rate of plastic waste	%
	5	Recycling rate of plastic mulching	t/yr
	6	Recycling rate of express plastic waste	t/yr
Reducing nature leakage	7	Plastic waste controlled treatment rate	%
	8	Plastic waste in river bank	kg/ha
Culture	9	Public participation in NP program	Pop.
	10	Environmental education events	times

Practices for No-Plastic-in-Nature Pilot-City in Yangzhou



- **Material flow analysis of plastic waste in Yangzhou City**
- **Recycling rate: 42.7%**
- **Uncontrolled treatment rate: 2%**

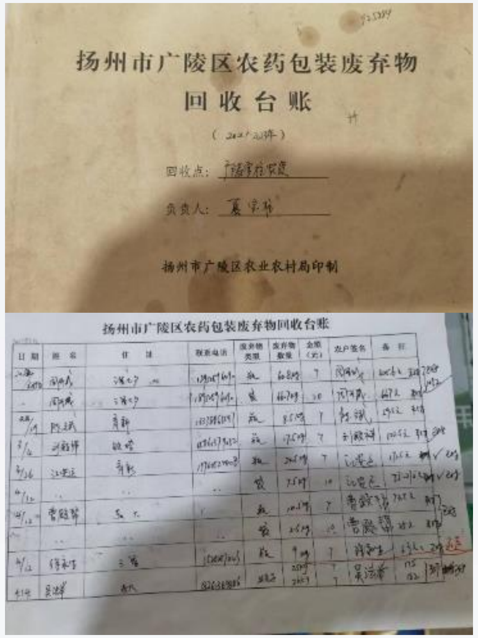




Practice of No-Plastic-in-Nature Pilot-City

Practices for No-Plastic-in-Nature Pilot-City in Yangzhou

- Established 87 recycling station for agriculture plastic mulching film (RR-90.5%)
- Set 1457 recycling node in Supply & Marketing Cooperative networks
- Recycling 2000 tons of fishing nets and gear (forbid fishing policy of Yangtse River)
- Upgrading the source-separation system (60 recycling center, 4 centralized facilities)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回收台账
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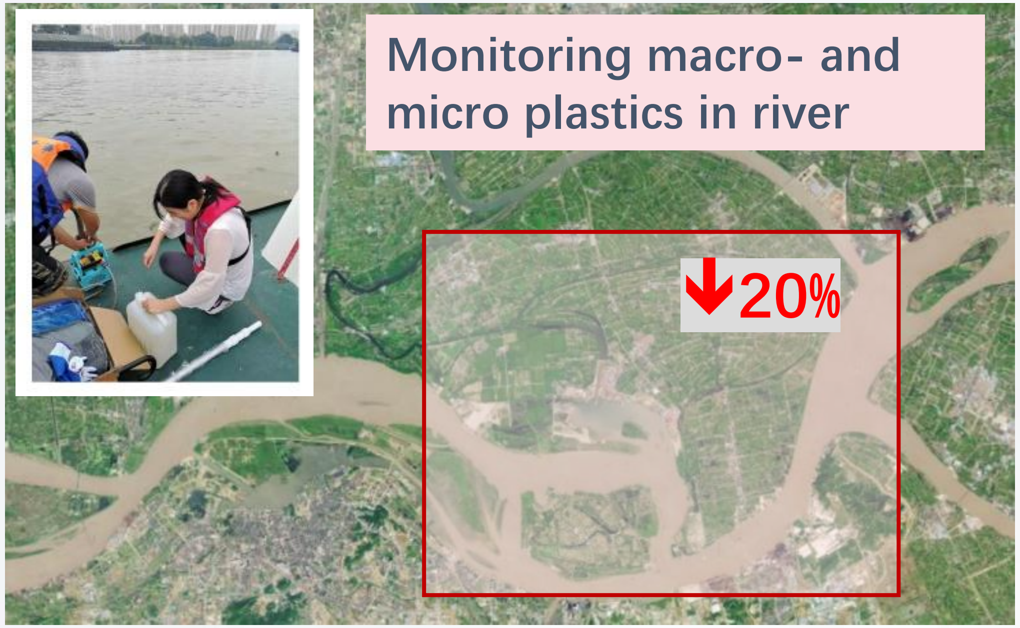

Thanks for your attention!

cbzhou@rcees.ac.cn

Plastic waste Generation and Migration in Yangtze River Basin
2019

Carbon footprint analysis of clothing enterprise (ANTA) and recycling tech.
2020

EPR for two-big (fast moving products and express delivery)
2021

Action Plan of mitigation plastic pollution in Yangtze Delta Area
2022