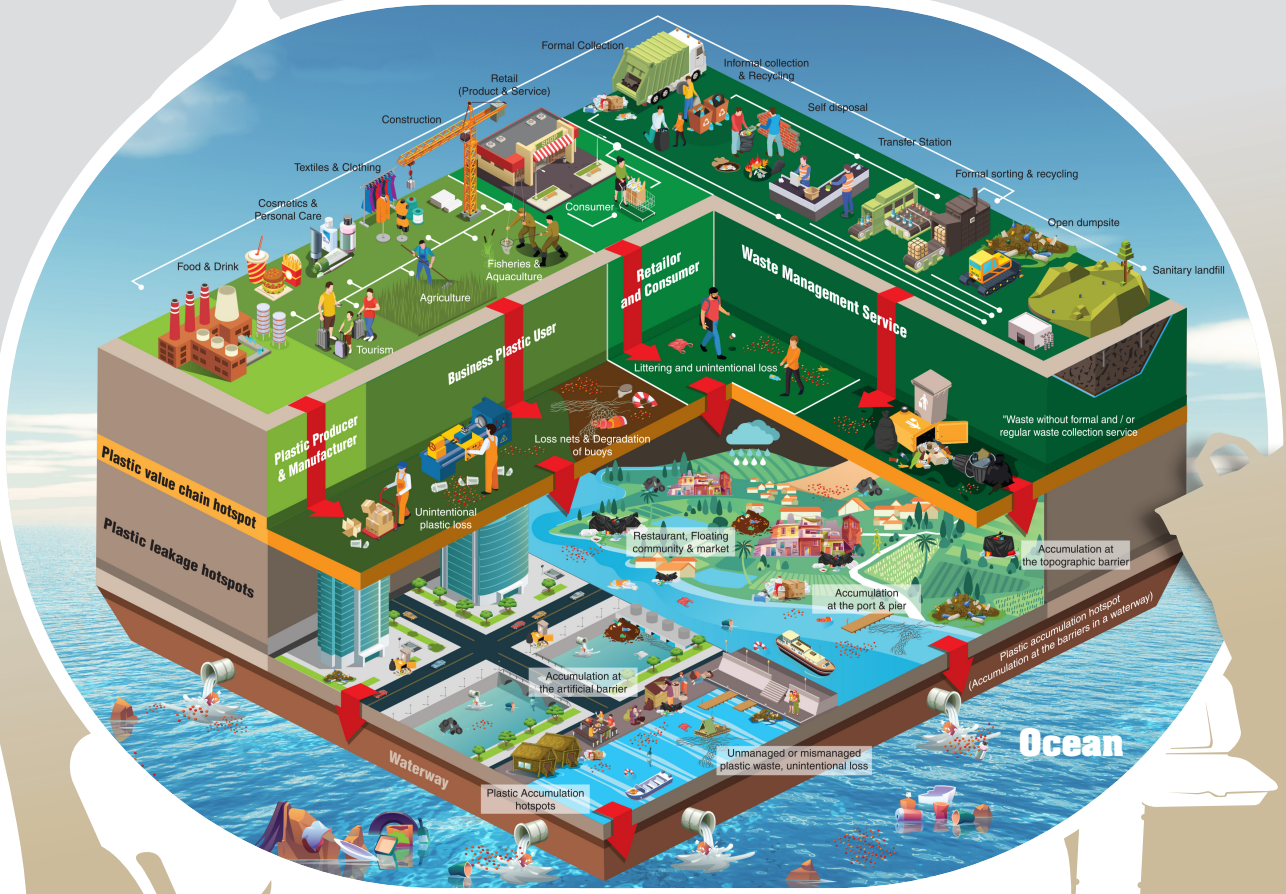
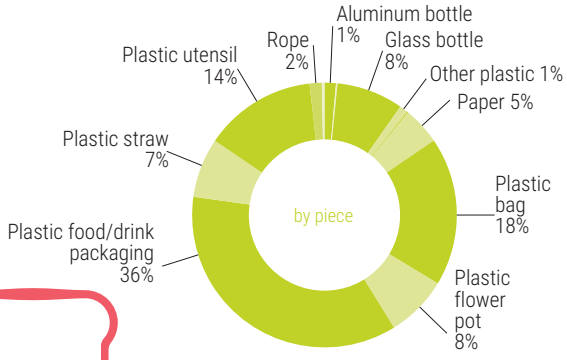
Counter MEASURE FOR PLASTIC FREE RIVERS

Plastic Leakage Assessment and Monitoring in River Basins in Asia



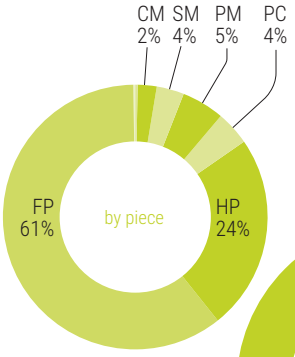
Possible countermeasures for retailers and consumers from the findings of the plastic application hotspots

A Findings from plastic application hotspots in the Mekong region and India



Clean-up The clean-up activity at Chiang Rai River Beach was conducted in September 2019. **Plastic food/drink packaging** and **plastic bags** were the major items identified.

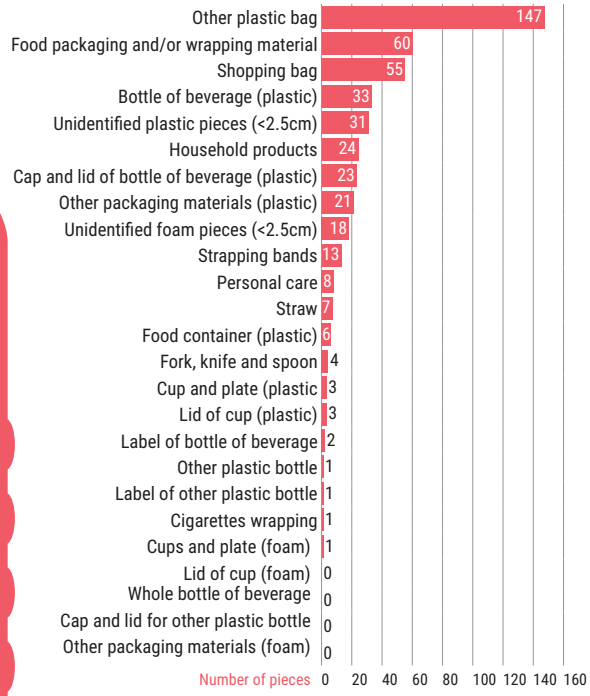
Sampling from the Mekong River The highest number of the plastic product type was **FP** (**food packaging**) with over a thousand items found from the Mekong River. **HP** (**household products**) was the second largest.



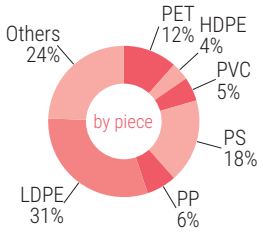
Mekong Region
Chiang Rai

Clean-up
The clean-up event was organized in October 2019 on the riverbank of the Mun river, Ubon Ratchathani. The plastic waste composition was 57%. Of the plastic types collected, **food packaging** and/or **wrapping materials**, **shopping bags**, **beverage bottles**, **household products** and **beverage bottle caps** and **lids** were the most common products.

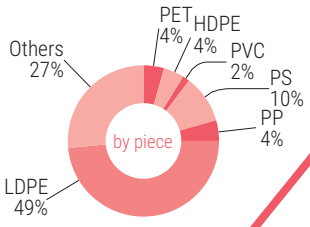
Sampling from the Mekong River
The major plastic product types collected from two sites at the Mekong River were **plastic (shopping) bags**, **plastic food wrappers**, **PET bottles** and **plastic foam packaging**. In terms of plastic resin types collected, LDPE, Others, PS and PET (in order of prevalence) were most common.



Khong Chiam district

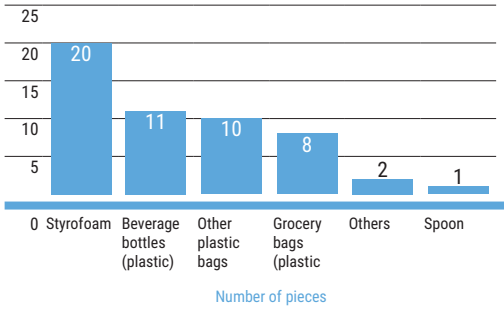


Phosai district



Mekong Region
Ubon Ratchathani

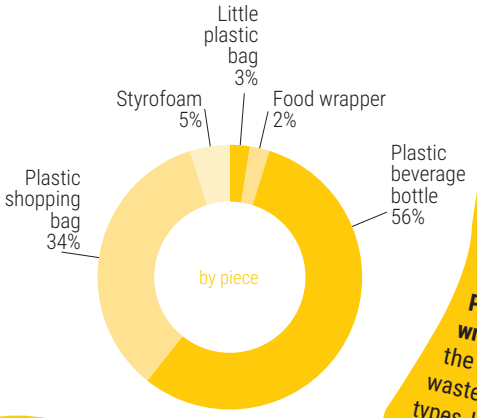
Mekong Region
Can Tho



Artificial barrier A waste audit was conducted at two artificial barriers in Can Tho city. **Styroform**, **beverage bottles**, and other **plastic bags** were the most common items collected.

Sampling from the Mekong River A sampling survey was conducted in the Mekong River by using net traps. The result of the plastic waste audit showed that "**other plastic bags**" and "**take out/away container** (**Styroform**)" are found in the largest numbers, followed by "**food wrappers**" and "**plastic shopping bags**".

The major plastic items leaked to the environment were identified as plastic food packaging, plastic beverage bottles and plastic (shopping) bags.

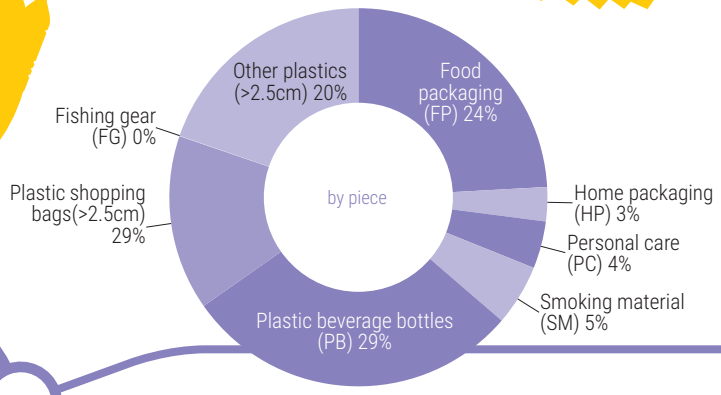


Artificial barrier The team identified the seven artificial barriers in the canals and tributaries of the Mekong River. The most common waste types are **plastic beverage bottles** and **plastic shopping bags**, which are common products used by local people in their daily consumption.

Sampling from the Mekong River 43kg of plastic waste was collected in total for 7 days by both net traps and boat collection from the Mekong River. **Plastic shopping bags, plastic food wrappers** and **plastic bottle caps** are the most common types of plastic waste collected. Regarding plastic resin types, LPDE was the largest (57%) followed by PP (13%) and HDPE (10%)

Other plastic bags **687**	Food wrappers (candy, chips, etc.) **419**
Grocery bags (plastic) **1002**	Bottle caps (plastic) **381**
Straws/ chopstick wrap (plastic) **267**	
Drinking water bottle (plastic) 200-350ml **274**	Straws/stirrers **225**

Mekong Region
Vientiane

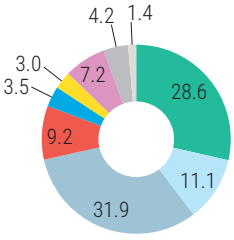


Artificial barrier
Visual inspection was conducted at artificial barriers in Phnom Penh. The majority of waste collected was **plastic beverage bottles, food/ home packaging**, and **plastic shopping bags**.

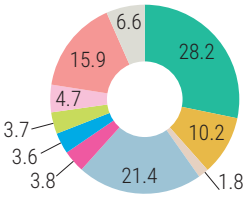
Mekong Region
Phnom Penh

Total plastic count (%) in:

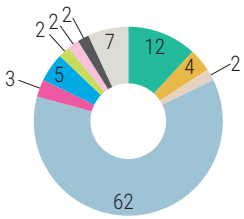
Haridwar



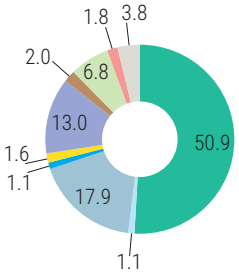
Prayagraj



Agra



Mumbai



India

- Multi-layer large and medium size for snacks, chips, nambeen, biscuits, etc.
- Hard plastic such as HDPE, pipes, HDPE bottle, HDPE tubes, tray, PVC, etc.
- Polythene bags (colored, white, black)
- Disposable paper cups coated with plastic film
- Packaging used for water, milk, etc.
- Bottle plastic caps
- Garment/textile packaging materials
- Silver foil disposable plates and bowls with plastic lamination
- Monolayer plastic packaging used for food, detergent, etc
- Synthetic woven bags used for cement packaging, etc
- Disposable plastic cups/glasses
- Ritual material
- Plastic sheets and other thicker plastic bags (color, white, black)
- Tobacco, pan masala sachet/wrappers
- Shopping bags
- Footwear
- Beverage bottles (plastic) including PET bottles
- Thermacoal and other trash
- Others

Plastic waste composition results at four cities during the clean-up activities

Possible countermeasures for retailers and consumers from the findings of the plastic application hotspots

B Possible Countermeasures

Plastic food packaging, plastic beverage bottles and plastic (shopping) bags are identified as the main types of plastic leaked into the environment.

These items are possibly littered by consumers and households living in communities where collection services are inadequate.

From the findings, the following countermeasures can be considered by retailers and consumers

- Refuse to use plastic bags (use own bag)
- Choose non/less plastic products
- Reuse plastic bags
- Promote the plastic levy
- Conduct a my/eco bag campaign and programme

Common countermeasures

- Promote awareness and education for the private sector, schools and communities
- Conduct stop littering campaigns and programmes
- Promote green procurement
- Initiate take-back scheme
- Promote source separation and recycling

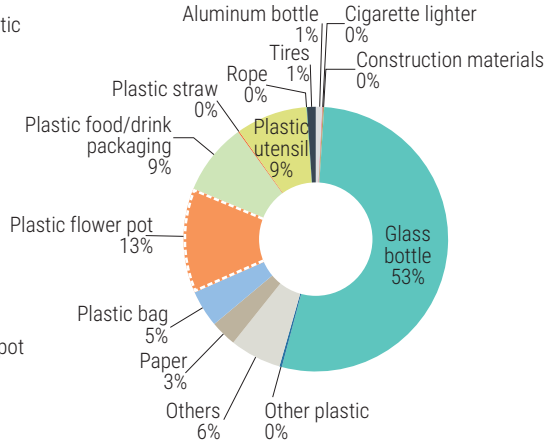
Common countermeasures are identified according to the findings mentioned in the left table and the figure.
In addition, some specific and local countermeasures are also identified.

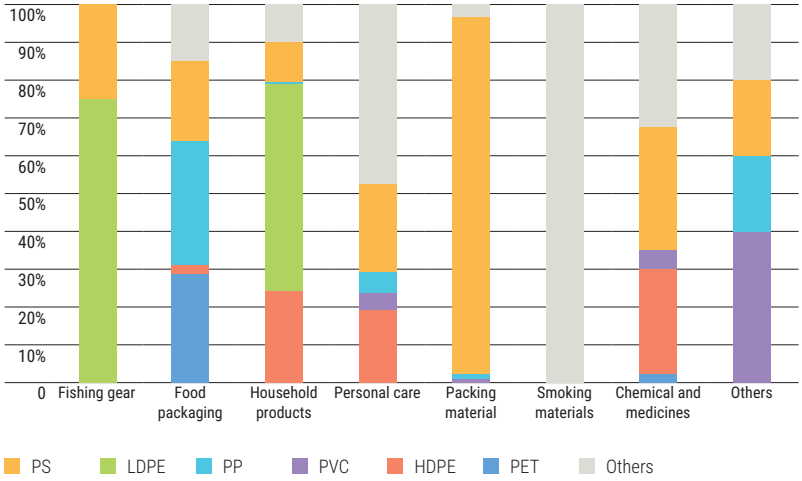
Specific countermeasures

Clean-up
- Major plastic items collected were similar.
- Plastic flowerpots were identified as one of the major items.
- The flower festival is a popular cultural event in the region.
- A specific intervention to manage the flowerpot waste during the event is necessary - for organizers and participants.

By number (84% for plastic items)

By weight (42% for plastic items)



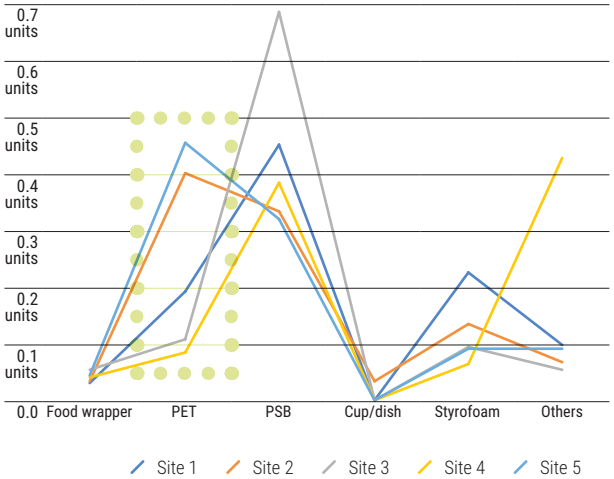


Sampling from the Mekong River
- Fishing gear (FM) and packaging material (PM) were the most prevalent in terms of categories - dominated by LDPE and PS, respectively.
- Single layer material should be chosen by retailers and consumers to increase recycling potential.
- Awareness-raising is needed to promote single layer products for recycling.

Chiang Rai

Artificial barrier
- At artificial barriers in Chiang Rai, there was a wide variation in the amount of "PET" items found.
- This may be due to local reasons, such as the recycling market or community behavioral patterns in Chiang Rai.
- An additional survey is required in the identified sites where PET leakage is lowest and highest.

by piece



Ubon Ratchathani

(*Sampling from the Mekong River*)
- Strapping bands and fishing ropes were also identified.
- This may be caused by local activities, including fisheries and aquaculture.
- Specific interventions are necessary to manage the waste generated from fisheries and aquaculture.

2 Possible countermeasures for retailer, consumer and waste management services from the findings from illegal dumpsites/littering spots

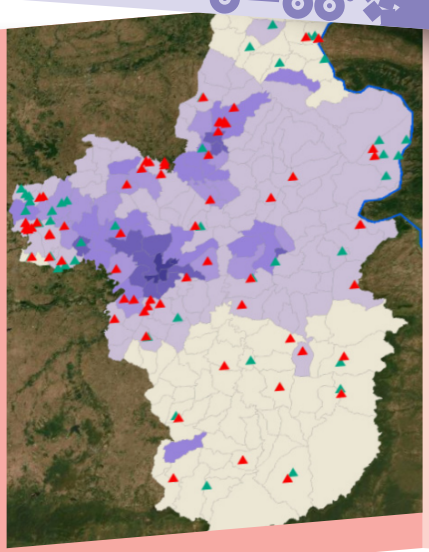
A Findings from illegal dumpsite/littering spots in the Mekong region and India

Illegal dumpsites/littering spots scattered around the project cities in the Lower Mekong region and India were identified by a mobile phone application tool developed by the CounterMEASURE project and by field reconnaissance.

The following findings were identified through a comparison between the Illegal dumpsite/littering spot location map, and other maps such as plastic leakage density, slum area, waste collection rate, watershed and road network by the CounterMEASURE GIS platform.

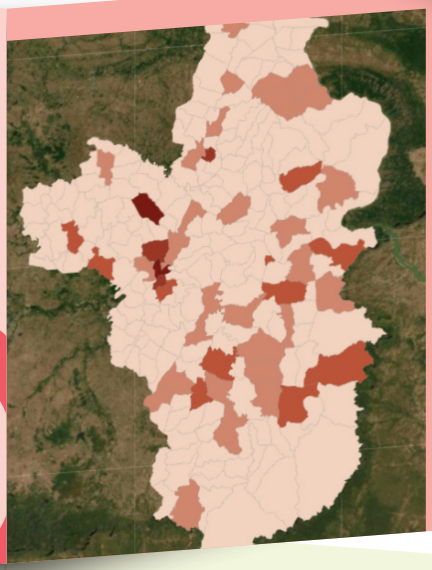
Phnom Penh

- (*Illegal dumping site and slum area, Phnom Penh*)
- Merged the illegal dumpsite map with the slum map.
- Identified well-matched areas highlighted by red dotted circle



(*left*)
Disposal site/illegal dumping sites with plastic leakage density map

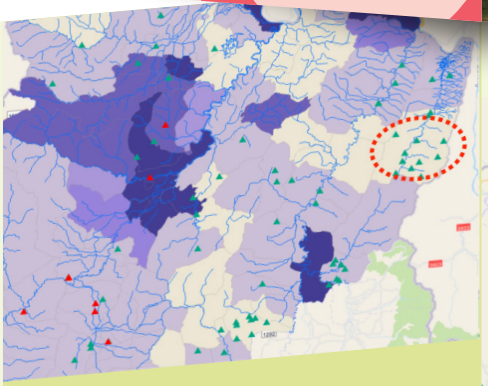
(*right*)
Waste generation
(Deeper color is higher.)

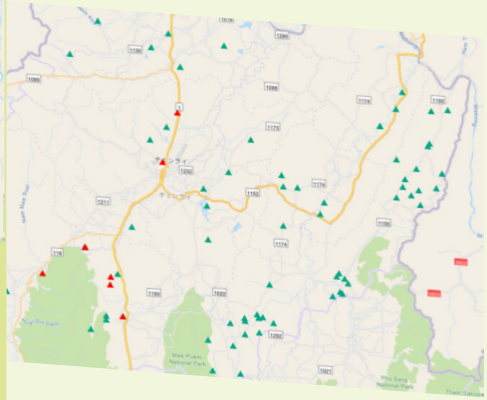


Ubon Ratchathani

(*Illegal dumping sites, road networks, watersheds, and plastic leakage density, Chiang Rai*)

- Identified illegal dumping sites along the roads.
- (*Correlated between illegal dumping site locations with lower plastic leakage density*)
- Identified the open dumpsite cluster in the specific watershed area close to the Mekong River.





Chiang Rai

B Possible Countermeasures

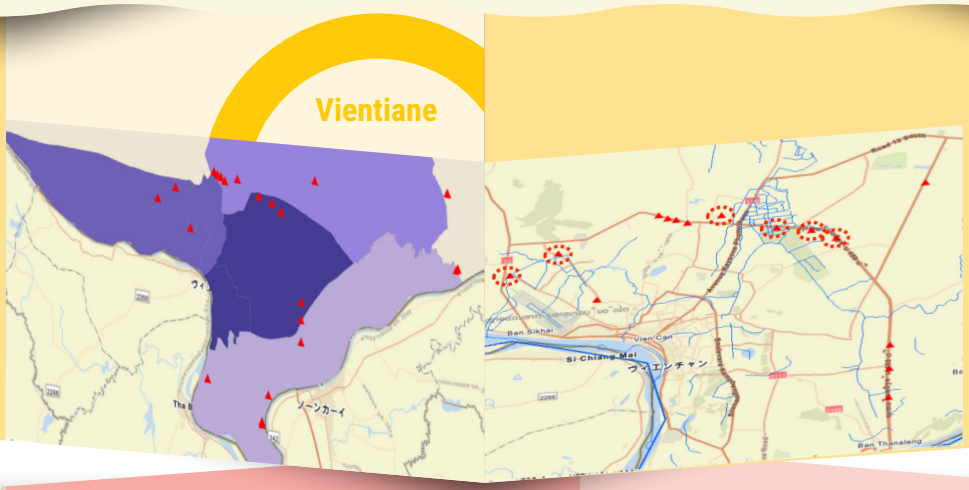
Common countermeasures are identified according to the comparison between illegal dumping sites and other layers:

- Clean-up activities for illegal dumpsites which have been identified close to waterways, around upstream tributaries of the Mekong River and the open dumpsite cluster alongside tributaries close to the Mekong River.
- Awareness-raising for communities close to illegal dumping sites.
- Install a signboard to prevent littering along the roadsides.
- Conduct an awareness campaign for the communities along the road networks.
- Improve waste collection services in the areas where illegal dumping sites are scattered and along the roadsides.
- Improve the operation and management of disposal sites, and rehabilitate open dumpsites.
- Develop further survey plans to seek the causes for the formation of existing illegal dumping sites (hypothesis: littering from communities in lower waste collection service areas and littering from transport passing along the road on the way towards disposal sites).
- Develop further survey plan such as a perception survey to identify the individual plastic leakage source

Vientiane

(*Illegal dumping, and Road network and Plastic leakage density, Vientiane*)

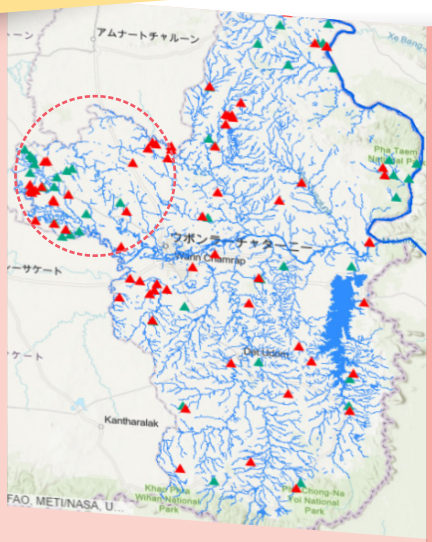
+ Identified illegal dumping sites along the main roads
+ Identified specific illegal dumpsites located close to the waterways
+ Not being correlated between illegal dumpsite locations with plastic leakage density map



Ubon Ratchathani

Illegal dumping site, and waste collection rate, plastic leakage density map and watershed, Ubon Ratchathani, left)

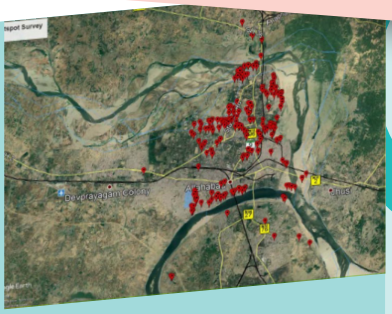
+ Not being correlated between illegal dumping site locations with plastic leakage density map (rather a negative correlation)
+ Seemed to be correlated, dumping site locations with lower waste amount areas (usually no collection services provided)
+ Scattered illegal dumping sites close to the waterways
+ Concentrated dumping sites at the upstream of the Mun River which is the tributary of the Mekong River

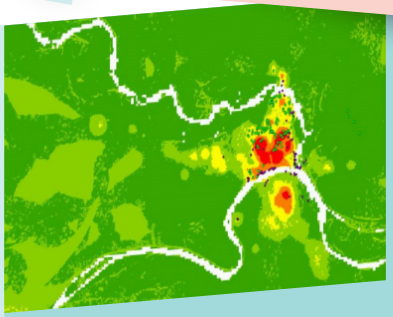


Prayagraj, India

Illegal dumping site and plastic leakage density, Prayagraj

+ Well-matched dumping sites with the vulnerable area





3 Possible countermeasures for Waste Management Practices from findings of plastic accumulation at the waterway

A Findings from plastic accumulation at the waterway in the Mekong region

- Plastic accumulation at the artificial barrier in waterways was studied by visual inspection survey with the mobile phone application developed by CounterMEASURE project.
- 18 barriers in Phnom Penh, 5 barriers in Chiang Rai, and 7 barriers in Vientiane were inspected
- Major plastic items accumulated at the barriers in general (See PPT No.1)
- Plastic food package, Plastic shopping bag, Plastic beverage bottle
- Correlation is considerable between the location of the artificial barriers and illegal dumping sites.
- The amount of plastic accumulation at artificial barriers located in a rural area is relatively larger than the one in an urban area.

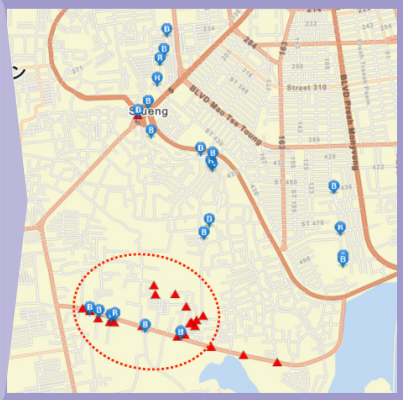
Visual inspection




No.		ITEM	DETAIL	RESULT
1	**Artificial barriers: Stueng Meanchey, Meanchey, Phnom Penh**			
	1-1	Frequency of cleaning of accumulated wastes	Who, When, How, & last date of cleaning	No one Clean up
	1-2	Estimate total amount of accumulated wastes	20 liter plastic bag method	15
	1-3	Identify type of accumulated plastic wastes		
	1)	Food Packaging (FP)	Rough counting (piece)	110
	2)	Home Packaging (HP)	Rough counting (piece)	20
	3)	Personal Care (PC)	Rough counting (piece)	30
	4)	Smoking Material (SM)	Rough counting (piece)	40
	5)	Plastic Beverage Bottles (PB)	Rough counting (piece)	60
	6)	Plastic Shopping Bags (more than 2.5 cm)	Rough counting (piece)	2
	7)	Fishing Gear (FG)	Rough counting (piece)	0
	8)	Other specific plastic if any (more than 2.5 cm)	Rough counting (piece)	300
	1-4	Take photos with GPS	Panoramic & Foreground Photos X: 489582.2E Y: 1276025N	

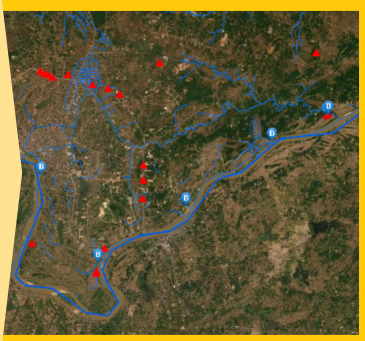
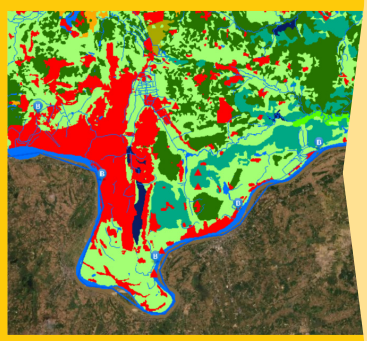
Phnom Penh

- 18 barriers were inspected visually by using mobile phone app.
- The total amount of accumulated waste along the artificial barriers was estimated as 96,600 liters.
- Accumulation at some barriers may be linked with illegal dumping sites nearby the barriers. (left figure circled)
- There were 4 locations filled up by large amounts of garbage, estimated about 4,000, 10,000, 32,000 and 40,000 liters respectively, which seems to be caused by dumping and littering from nearby or upstream communities. (photo)
- Majority of waste composition were plastic bags, PET, Styrofoam, plastic bottle. (See pages 1)
- The community along waterways were requested to have more awareness, knowledge as for waste management




Vientiane

- There are 7 inspected artificial barriers (circle) with hydrological information.
- The yellow colored circle shows the top three areas with larger amounts of waste accumulated barriers among those of 7 sites.
- **Those sites located close to the Mekong may cause plastic pollution.**

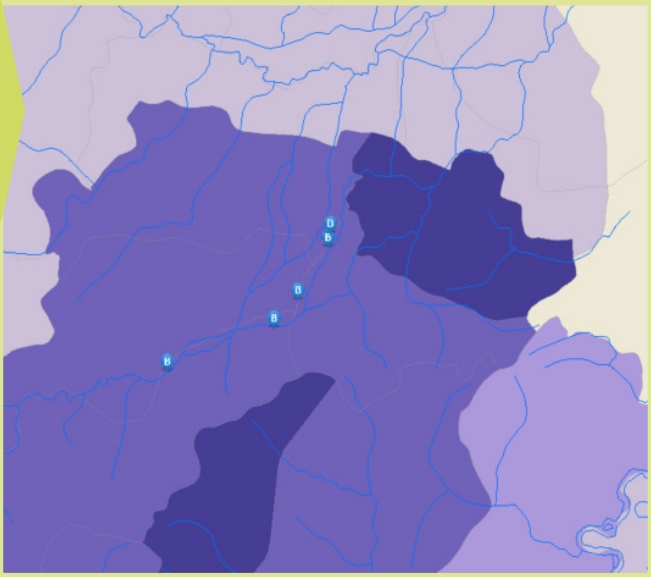
- This is the map merging the artificial barriers locations with the land use map.
- The red and green colors show “Urban or Building-up” and “forestry or rice paddy” areas, respectively.
- The relatively higher amount of accumulated waste barriers are located mainly in the forestry or rice field areas rather than the urban areas.

B Possible Countermeasures

Common countermeasures are identified by visual inspection survey results together with other layers of GIS platform.

- Clean-up activities targeting for areas with larger accumulated amounts at the artificial barriers must be urgent and the priority action to be taken.
- Regular monitoring and clean-up and at the artificial barrier are also necessary to be taken by authorities and nearby communities.
- Illegal dumping sites/littering spots are linked with accumulation at the artificial barriers in some areas. In those areas, the action needs to be taken in consideration of both sites in an effective way and efficient manner.
- Relatively larger amount of accumulation at the artificial barriers seem to be located at a rural area rather than an urban area, which means the waste collection service status may be affected. The waste management should be improved in such areas.
- In Phnom Penh, there seems to be correlation between the illegal dumping site and the accumulation at the artificial barrier, as well as a slum and a floating community on the river. The awareness activity and improvement of waste management service must be required urgently in those identified areas and communities.
- Improvement of waste collection services, and awareness campaign and programmes targeting the communities along the waterways and rivers must be considered in general.
- Installation of the barrier at the waterway, specifically for waste trapping, could be one option for countermeasures.
- As the next step, it would be effective to develop the plan for the additional survey focusing on the large accumulation barriers, to elaborate the pathways and more suitable countermeasures.
- 3Rs countermeasures including source separation, take-back scheme, development of local recycling system, and other alternative options like thermal recycling, can be considered for identified plastic items such as plastic food packages, plastic shopping bag, plastic beverage bottle, in line with local text.

- 5 barriers (weirs) were inspected.
- The accumulation was not so large with the average number of 37 pieces (above photo).
- All 5 barriers are located in the area analyzed as the “high” plastic leakage density area.
- **Plastic accumulation at the artificial barriers in this area seems not to be influenced by high plastic leakage density area.**



4 Achievement & Challenges on CounterMEASURE Approach

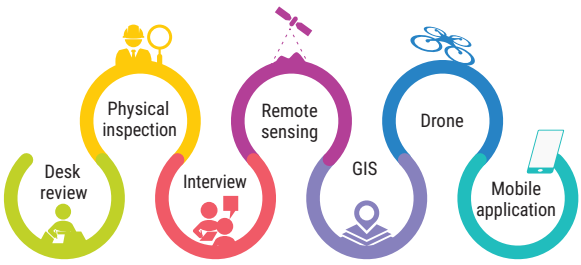
A Secondary Data Collection

The table below shows the accessibility of secondary data collection (%) from the global data and open sources responsible for the Geoinformatics Center, Asia Institute of Technology, and the local source responsible for partners in Chiang Rai, Vientiane, Ubon Ratchathani, Phnom Penh and Can Tho. The collection rate was calculated by the number of project sites accessible for the target data divided by the total number of project sites (5 sites). 100% means all project sites are accessible for the target data, and 0% means all no sites are accessible for the target data. The data less than 50% is highlighted in black. Notable are the collection rate such as Slum Spot, Flow Observation, Rainfall runoff data, Temporal Change of Riverbanks, Plastic manufacturer, Waste collection points, and Wastewater facility, which are less than 20%

Data Valuable		Collection rate (%)
Demographic information		
1.1	Population	100
1.2	**Population Growth Rate**	**40**
1.3	**Floating Population**	**40**
1.4	Household	100
1.5	**Slum Spot** (if any)	**20**
Topographic/Basin characteristics information		
2.1	River networks: Mainstream and Tributary of rivers	100
2.2	Digital Elevation Model (DEM)	100
2.3	**Flow Observation**	**20**
2.4	**Rainfall runoff data**	**20**
2.5	**Temporal Change of Riverbanks**	**0**
2.6	Flood Hazard Map	80
Infrastructure		
3.1	Industrial area/Economic zone/Factory location	80
3.2	Tourism area	80
3.3	Other Point of Interests	100
3.4	Road network	100
3.5	**Building footprint**	**60**
Land use information		
3.1	Administration	100
3.2	Land use land cover	100
3.3	**Plastic manufacturer**	**20**
3.4	Agriculture	60
3.5	**Fishery and Aquaculture**	**40**
3.6	**Waste collection points**	**20**
3.7	Intermediate treatment facility (transfer station, recycling facility, junkshop)	100
3.8	Illegal dump	100
3.9	Disposal site (dumpsite)	100
3.10	**Wastewater facility**	**20**
Satellite imagery		
4.1	Optical imagery	100
4.2	Nighttime light imagery	100

Data Valuable		Collection rate (%)
Waste Composition (Plastic type if possible)		100
Waste generation		
2-1	Household waste	60
2-2	Commercial waste	60
2-3	Market waste	60
2-4	Public area cleansing	60
2-5	**Industrial waste**	**40**
Waste collection		
3-1	Formal Collection	100
3-2	Informal Collection (Junkshop, waste picker)	60
3-3	**Open burning**	**40**
3-4	**Burry (HH or Communal pit)**	**40**
3-5	Littering/dumping	100
Intermediate treatment		
4-1	Transfer station (t/d)	60
4-2	Recycling Facility	60
4-3	Others (if any:)	60
Final Disposal		
5-1	Open dump site	100
5-2	Sanitary disposal site	100

Data collection



Methodology check-list including IoT options

Data visualization

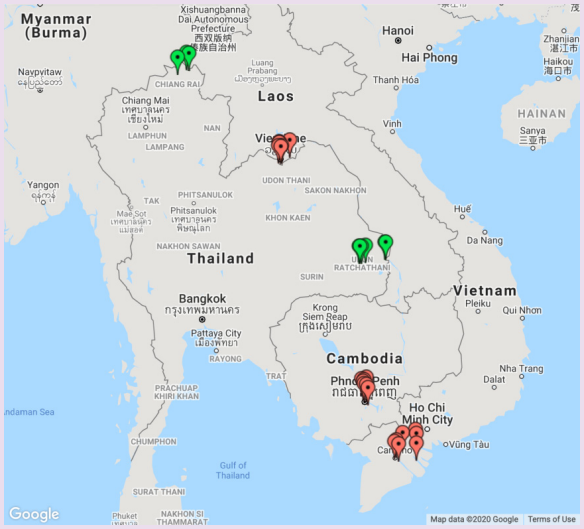
Plastic leakage scenario

Leakage scenario including data

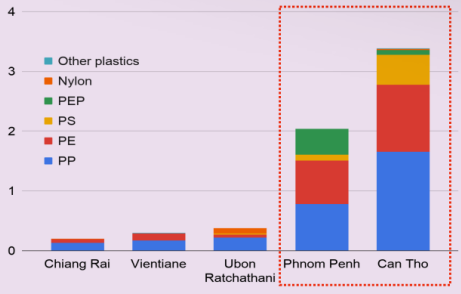
B Mekong River Basin (Micro)

Findings

- 449 of the 570 solids collected/extracted from the 33 survey points in the Mekong River Basin were analyzed by Pirika Inc.
- The following pie-chart is plastic resin type composition at the 33 survey points in the Mekong River basin.
- The average **number of microplastics per m³ in each pilot site is shown in the below figure** (left).
- The survey revealed the prevalence of microplastics in the Mekong River basin as follows;
  - > The most common component in all regions was PP.
  - > Small amounts of plastic pieces were also found in Chiang Rai, Vientiane and Ubon Ratchathani.
  - > The amount per volume has a positive linear with the river flow from up to down stream.
  - > The increase in values between Ubon Ratchathani and Phnom Penh, and between Phnom Penh and Can Tho were remarkable. It is highly likely that there are large plastic leakages between each city.

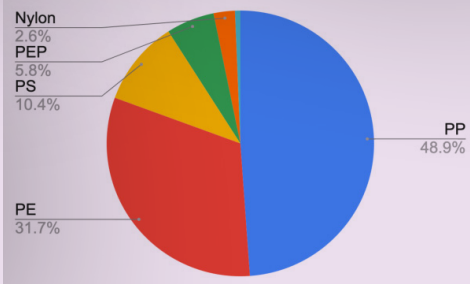


Left
Figure *Microplastic sampling points in the Mekong Basin*

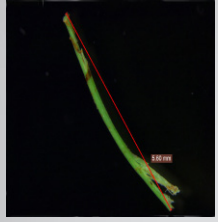


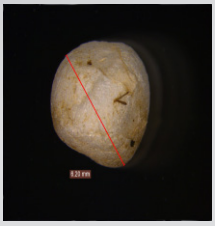
Left
Figure *Plastic resin type composition*

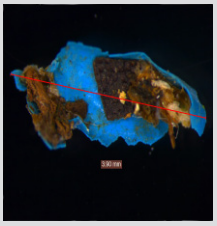
Right
Figure *Average number of microplastics (per m³)*



Some materials were identified with high probability such as 10.7% for artificial turf (green color, made of either PE, PP or PEP, left photo), 8.6% for food trays and containers, and styrofoam (white, elastic and made of PS, middle photo), and also blue tarpaulin (right photo).







4 Achievement & Challenges on CounterMEASURE Approach

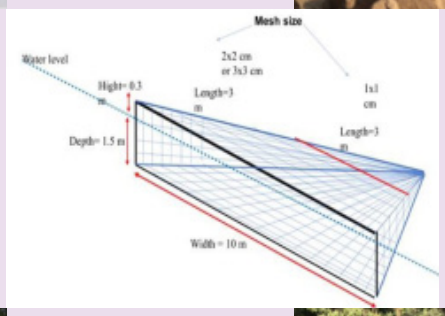
C Findings from plastic (Macro/Micro) discharge in the Mekong River Basin

- The CounterMEASURE project tried the following sampling methods at the Mekong River
  - > Accumulation at the pier, net trap installation, boat collection
- Total amount of plastic discharge by accumulated
  - > Ubon Ratchathani: 2g/h (upstream) and 7g/h (downstream)
  - > Vientiane: 47g/h (small net), 92.2g/h (large net) and 939g/h (boat collection)
  - > Chiang Rai: 308g/h (net + collection at the pier)
- Need to develop the standard and common method for the sampling survey in the Mekong River among stakeholders
- Pros & Cons with recommendation of the plastic sampling method in the Mekong river

	Pier	*Net trap*	*Boat*
			
Pros	Easier sampling, good for regular monitoring	Possible for 24hrs collection, adjust collection	Easier collection, good for short time sampling
Cons	Location bias, only existing specific sites along the Mekong	Difficulty of installation (current, depth and fishery, shipping route	Costly, collection bias (influenced to the estimation)

Recommendations

★★★ ★★ ★



The Way Forward

- Develop the equation for quantification of macro-plastic flux in the Mekong River
- Suggestion from the CounterMEASURE results
  1. Develop the waste flow (within a geographical boundary i.e. city or well-defined watershed
  2. Identify daily amount of mismanaged plastic waste (DMPW) to the environment (kg/d) by waste flow
  3. Identify the Plastic flux speed (PFS) at the specific time and point in the river by sampling survey (kg/h). This would be good to collect at two points in the main stretch of the river (one upstream and the other downstream) within a geographical boundary.
  4. Calculate the plastic flux density (kg/m3)
  5. Identify the river discharge (m3/h) at the sampling point
  6. Calculate the daily amount of plastic flux (kg/d) and identify the plastic leakage rate (%, PLR = DPF/DMPW) from waste generation to the river in the targeted city/town or river-basin
- Organize the study group on the plastic pollution assessment and monitoring in the Mekong River
- Collaborate with existing monitoring programmes and activities such as Fish Abundance and Diversity Monitoring (FADM) and the water quality monitoring for macro- and micro- plastic monitoring in the Mekong River in collaboration with the Mekong River Commission (MRC)

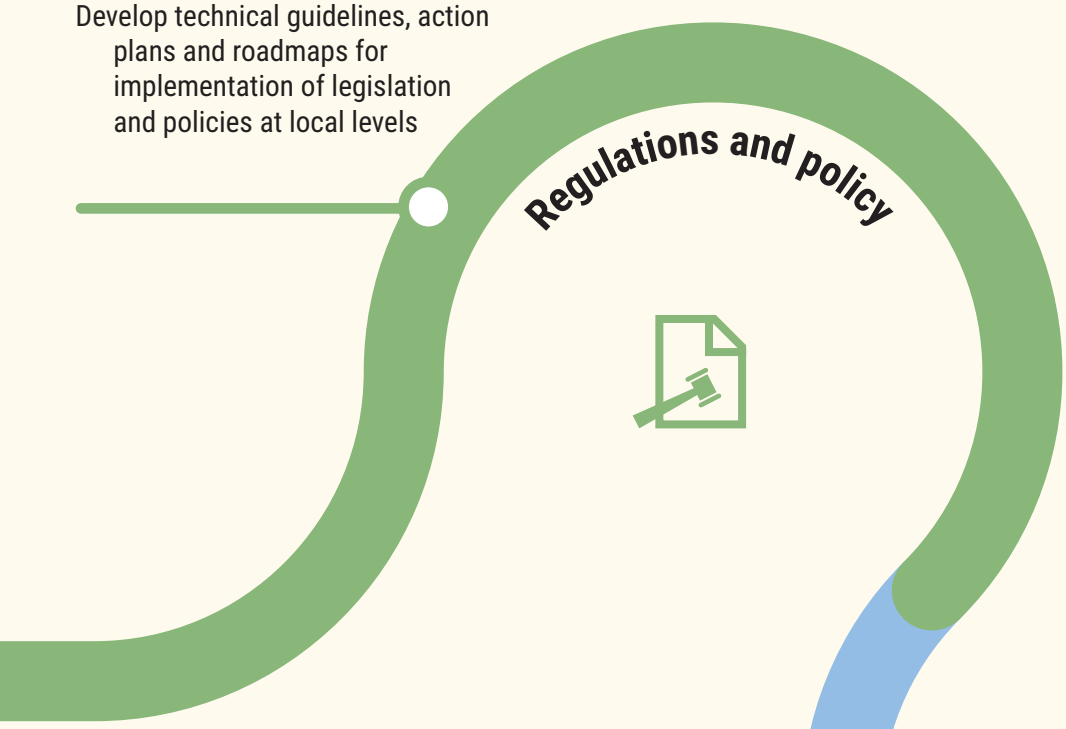
Policy and practice recommendation

Accelerate the development of enhanced evidence-based policy making with strong stakeholder engagement, partnership and consensus-building

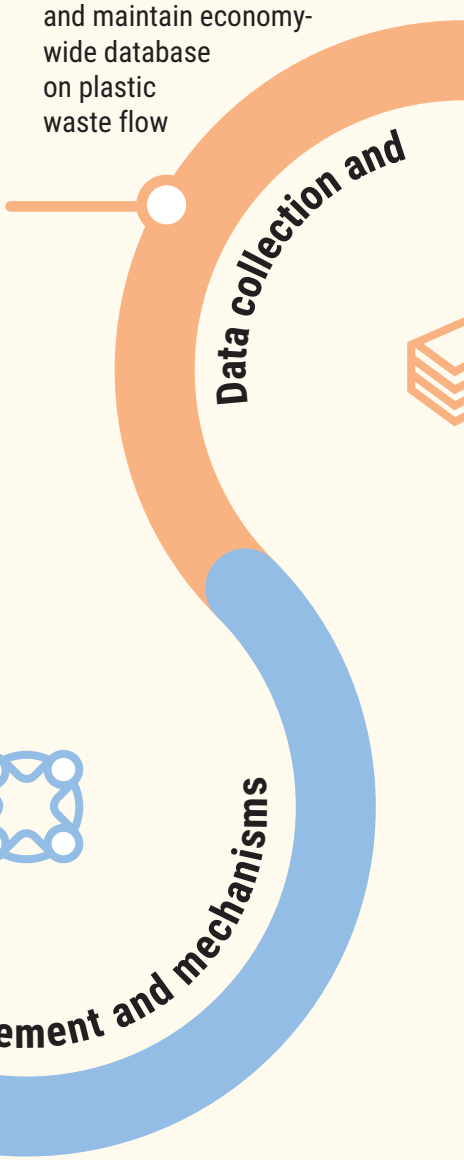
Prioritise and promote plastic waste management policies from general municipal solid management policies, with strong functional decentralize functions to subnational waste management authorities

Promote policy instruments to discourage the production and use of certain low value, hard to manage plastic items

Develop technical guidelines, action plans and roadmaps for implementation of legislation and policies at local levels



Develop attainable indicators on plastic waste management and maintain economy-wide database on plastic waste flow



Promote cross-sectoral and interdisciplinary approach between state institutions and actors in the implementation of legislation and policies

Facilitate inter- and intra-institutional dialogue to promote ownership of, and participation in plastic waste and leakage assessment and management

Develop and enhance mechanisms for improved coordination between central and subnational levels

Strengthen administrative capacities for implementation of plastic waste management policies at municipal/local levels

Develop and implement policies on monitoring, data collection, reporting, and information system at local levels

knowledge building

Promote inclusive communication and consensus building on the prevention of plastic leakage of key plastic types identified at plastic application hotspots

Promote effective communication and dialogue on policies and policy objectives on plastic waste management at local level

Awareness raising and capacity building

Close gaps between institutional and investment needs and opportunities by exploring innovative transparent funding models, including PPP models

Promote full fiscal decentralization to support the implementation of environmental policies and programmes at local level

Promote capacity building to monitor and manage plastic pollution at local level

Human resource and financing

Counter MEASURE FOR PLASTIC FREE RIVERS

UN environment