



# Marine Debris: Impact and Innovative Solutions

by **Dida Migfar Ridha**

**Director of Coastal and Marine Degradation and Pollution Control,  
Ministry of Environment and Forestry, Republic of Indonesia**

## Outline

1. Marine Environment
2. Marine Debris on Reference Beaches
3. Impacts of Marine Debris on Ecosystem
4. Initiatives and Innovative Solution to Address the Challenge of Marine Debris
5. Conclusion

# 1. Marine Environment

## The Global Ocean From decline to recovery

Sustainable ocean

### Drivers of decline

**Rising Demand for Resources**  
Minerals and energy  
Genetic materials  
Living marine resources



**Technological Advances**  
Deep sea access and exploitation  
Vessels (distance and depth)  
Increased (over)extraction  
Destructive fishing and other activities



**Decline of Fish Stocks (both an effect and driver)**  
Overfishing  
Overcapacity  
Subsidies



**Climate Change, Biodiversity and Habitat Loss**  
Climate change  
Acidification  
Pollution



**Weak High Seas Governance**  
Patchwork/sectoral/incomplete governance  
Weak compliance and lack of enforcement  
New and emerging uses



Degraded, unproductive and exploited ocean

### Drivers of recovery



**Creating a High Seas Regeneration Zone**  
Free from industrial fishing  
If sufficient action is taken and ocean decline continues within 5 years, according to what the Global Ocean Accountability Board reports  
With the exception of areas where RFMO action is effective  
Could be revoked if Commission's proposals for action are implemented  
Fish stocks replenished and equitably and sustainably shared, for present and future generations



**Global Ocean Accountability Board – Monitoring progress toward a healthy ocean**  
Independent  
To benchmark progress made towards achieving the Commission's proposals for action  
Sharing of this information with the global public



**Offshore Oil and Gas – Establishing binding international safety standards and liability**  
Binding safety and environmental standards  
Universal liability provisions  
Response-preparedness and capacity building



**Plastics – Keeping them out of the ocean**  
Coordination between governments, private sector and civil society:  
Land-based pollution sources  
Sea-based (i.e. fish aggregation devices) pollution sources



**Illegal, Unreported and Unregulated Fishing – Closing ocean ports and markets**  
IMO mandatory numbers to all high seas fishing vessels  
Banning at-sea transshipment  
Ratification and implementation of international fisheries treaties  
Remove flags, deny port entry, cut market access of catch from illegal vessels  
Collaboration between Port States, RFMOs and industry: a global information-sharing platform  
Retailers to commit to sustainable seafood sourcing and traceability  
Civil society organisations as independent performance watchdogs



**No More Overfishing – Ending harmful high seas subsidies**  
Full transparency of fisheries subsidies  
Distinguishing fisheries subsidies that are most harmful  
Immediately capping and phasing-out, within 5 years, high seas fuel subsidies



**Governing the High Seas – Promoting care and recovery**  
UNCLOS implementing agreement on high seas marine biological diversity  
Universal ratification and prompt implementation of existing agreements  
Regular independent assessment of RFMOs to improve their performance  
UN Special Representative for the Ocean  
Regional Ocean Management Organisations  
National ocean envoys or ministers

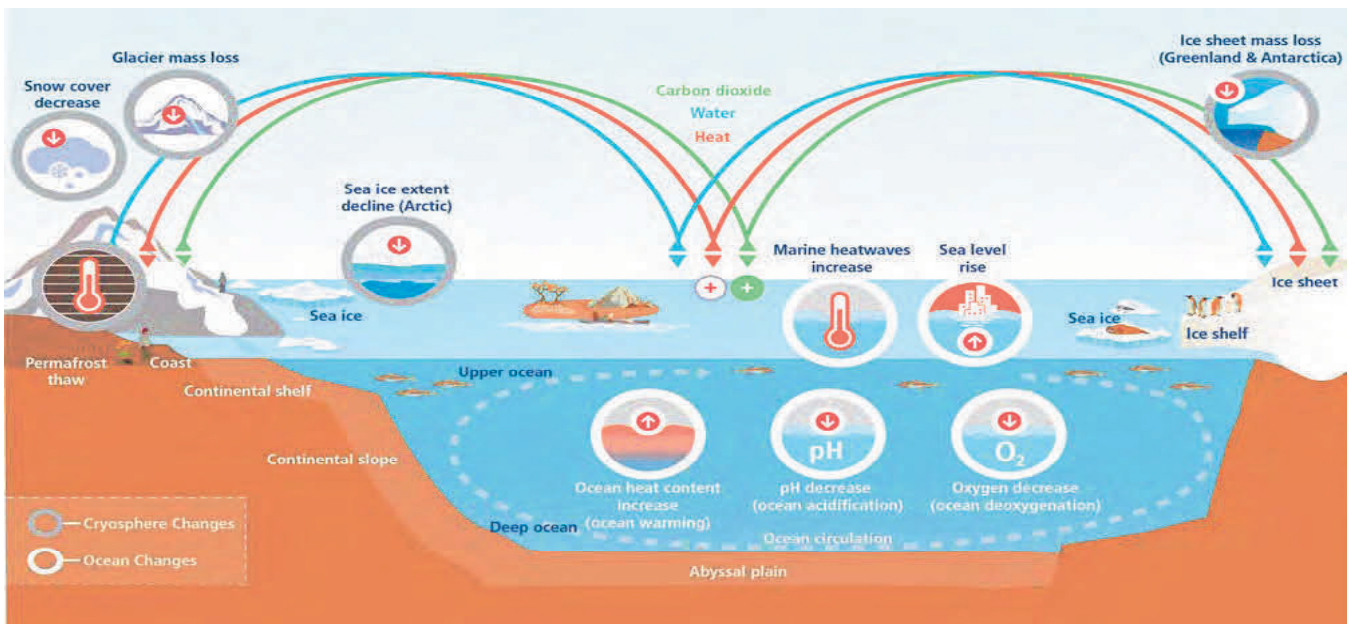


**UN Sustainable Development Goal for the Ocean – Putting a healthy living ocean at the heart of development**  
Detailed targets  
Specific indicators  
Ocean in the UN post-2015 development agenda

Global Ocean Commission

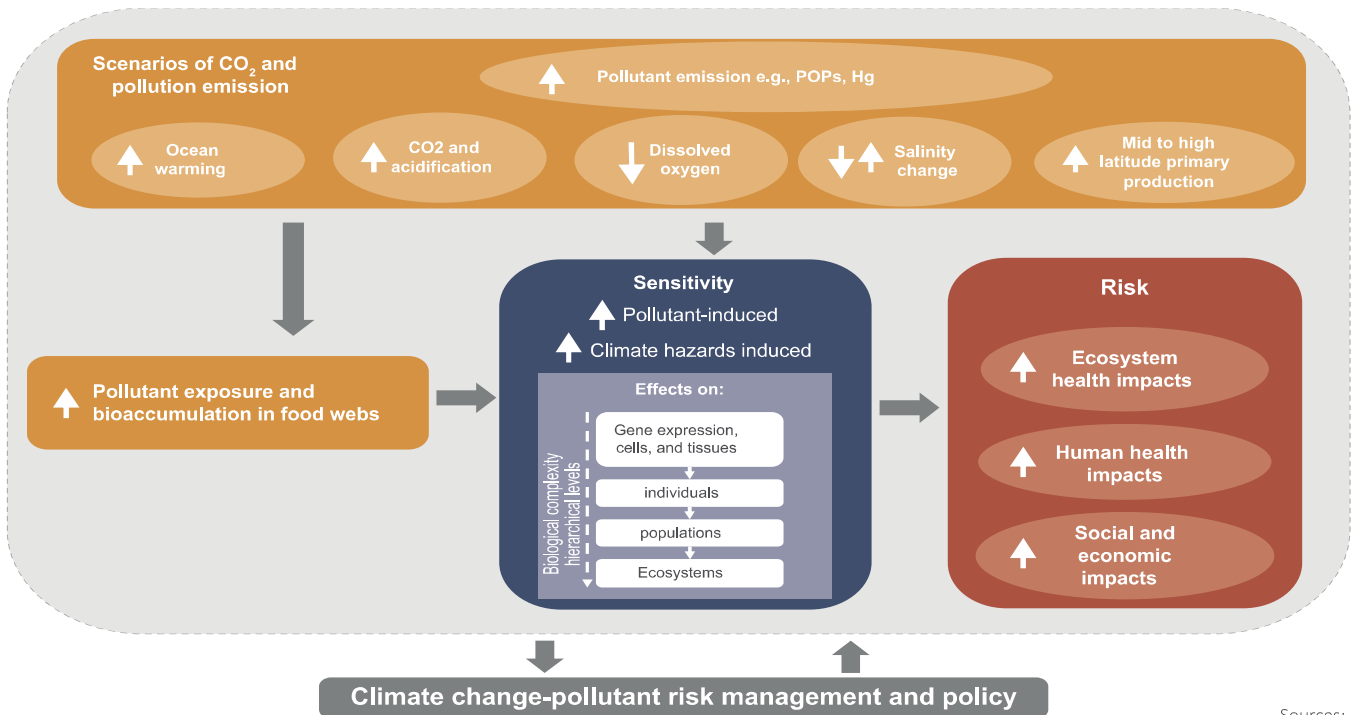
# Marine Environment

❖ Key components and changes of the ocean and cryosphere, and their linkages in the earth system



Sources: IPCC Special Report on Climate Change, Oceans and Cryosphere (SROCC, 2019)

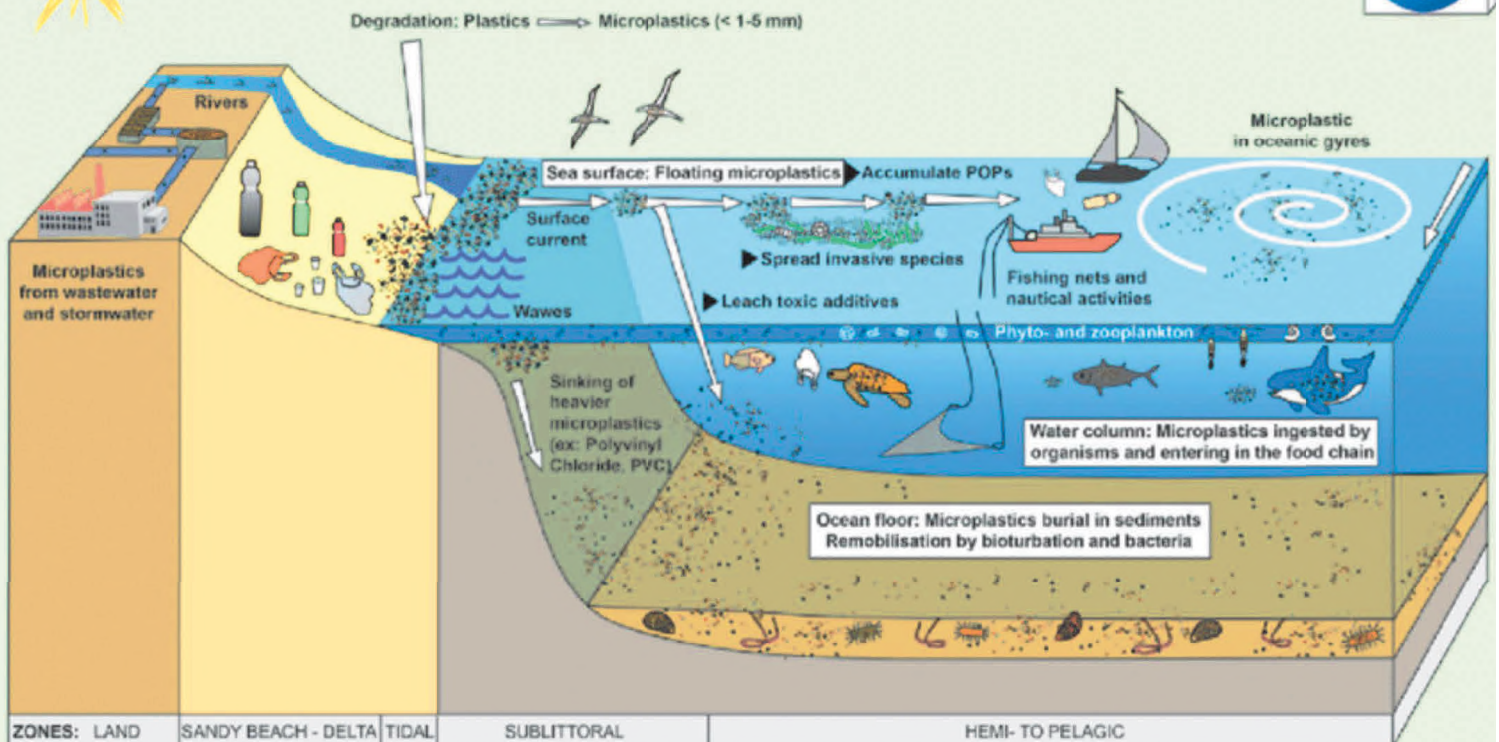
# Marine Environment



Sources:  
IPCC Special Report on Climate Change,  
Oceans and Cryosphere (SROCC, 2019)

# Marine Environment

## Microplastics in the oceans



## 2. Marine Debris on Reference Beaches

Main category	Sub-category - examples	Main category	Sub-category - examples
Plastic	Bottle < 2 litre	Wood - machined	Crates
	Bottle, drum > 2 litre		Fish boxes
	Cigarette lighter		Wood < 0.5 m
	Fishing net		
	Buoy	Metal	Bottle cap
	Foamed plastic buoy		Aerosol can
	Foamed plastic packaging		Drink can
			Food can
Rubber	Boots		Electrical appliance
	Balloon		
	Tyre	Glass	Light bulb
	Bottle		
Cloth	Clothing		
	Sacking	Ceramics	Tile
	Furnishing		Pot
Paper/cardboard	Bags	Sanitary	Condom
	Cardboard sheet		Cotton bud stick
	Cigarette packet		Tampon and applicator
	Newspaper and magazines		
			Medical waste
			Medicine container

Sources: Joint Group of Expert on the Scientific Aspects of Marine Environment Protection (GESAMP), 2019

99

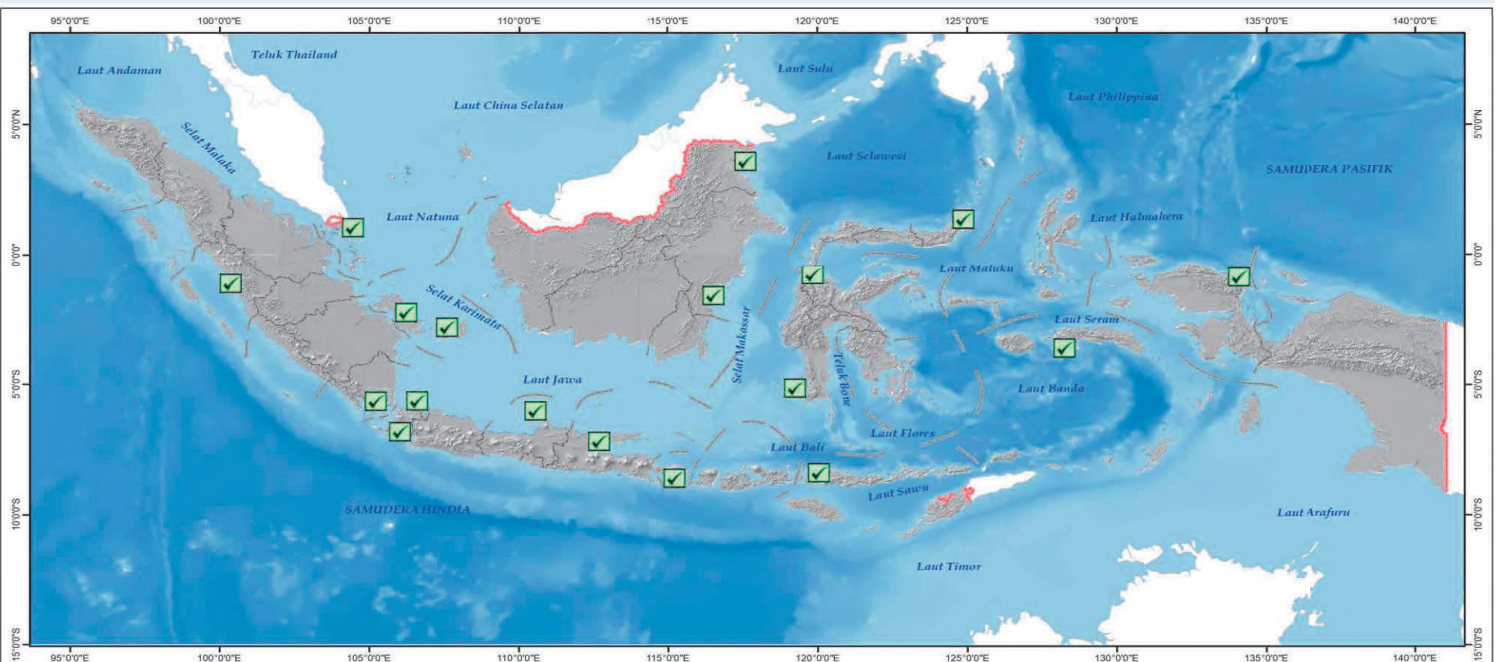


**GESAMP**  
Joint Group of Experts on the  
Scientific Aspects of Marine  
Environmental Protection

### GUIDELINES FOR THE MONITORING AND ASSESSMENT OF PLASTIC LITTER IN THE OCEAN



## Marine Debris on Reference Beaches



PETA LOKASI KEGIATAN SAMPLING SAMPAH LAUT 2017



0 195 390 780 Km

**Legenda:**

Lokasi Sampling



Direktorat Pengendalian Pencemaran dan Kerusakan Peleisir dan Laut  
Direktorat Jenderal Pengendalian Pencemaran dan Kerusakan Lingkungan  
Kementerian Lingkungan Hidup dan Kehutanan

# Marine Debris on Reference Beaches



Pemantauan Sampah Laut di Kabupaten Bintan



Sampah Negara Asing yang Ditemukan



Pemantauan Sampah Laut di Kabupaten Lombok Utara



Pemantauan Sampah Laut di Kabupaten Tangerang



Pemantauan Sampah Laut di Kabupaten Belitung Timur



Pemantauan Sampah Laut di Kabupaten Banyuwangi



Pemantauan Sampah Laut di Kota Ambon



Pemantauan Sampah Laut di Kota Gorontalo



Pemantauan Sampah Laut di Kabupaten Sukabumi



Pemantauan Sampah Laut di Kabupaten Tangerang



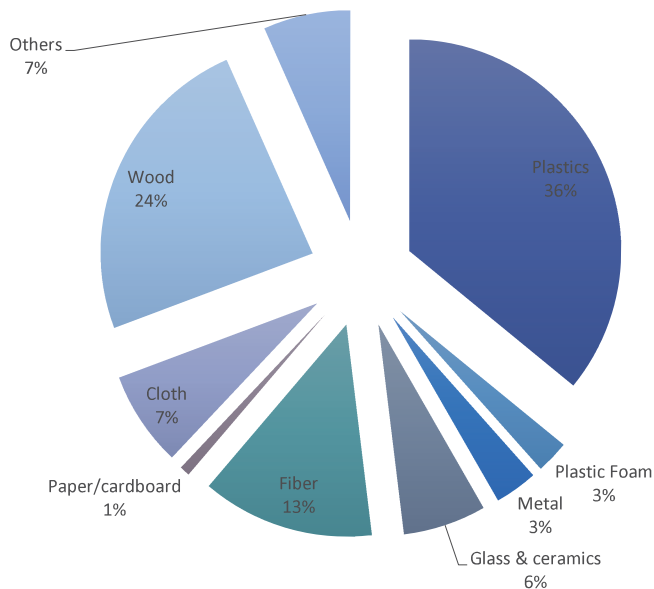
Pemantauan Sampah Laut di Kota Makassar



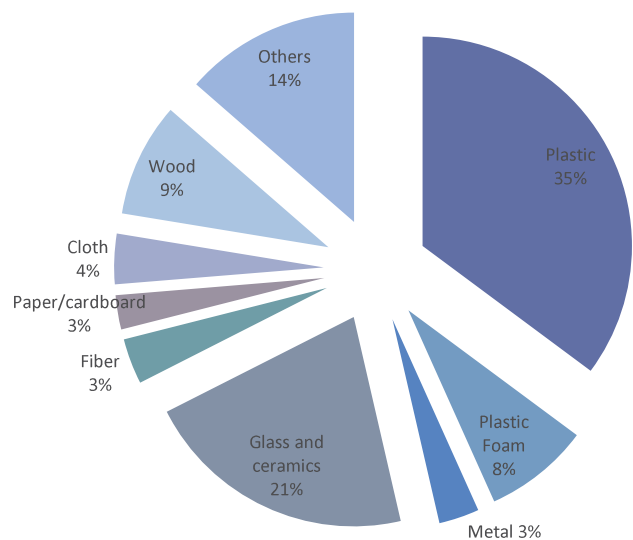
Pemantauan Sampah Laut di Kota Manokwari

# Marine Debris on Reference Beaches

Composition of Marine Litter, 2019



Density of Marine Litter 2019



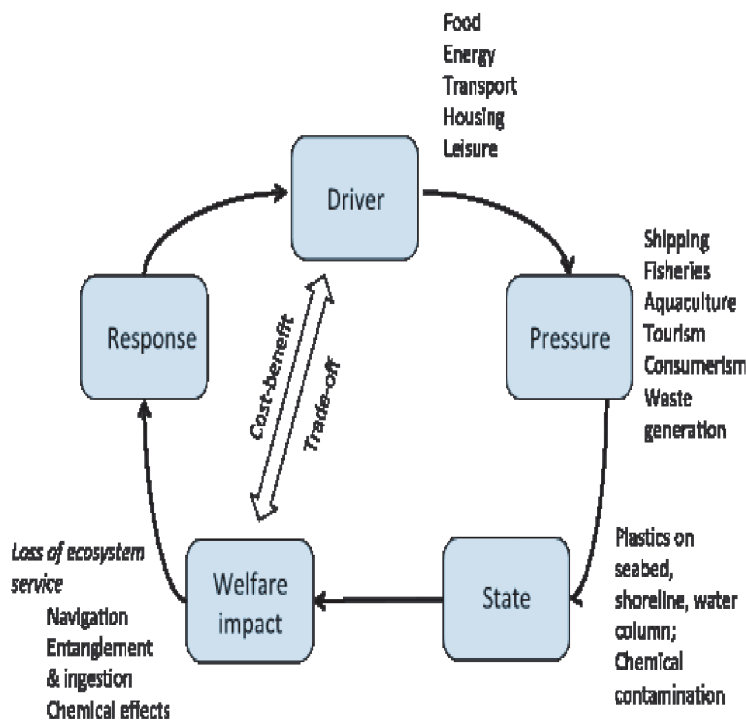
# Marine Debris on Reference Beaches

Category	KEPULAUAN SERIBU, JAKARTA	Category	BANTUL, YOGYAKARTA	Category	MANADO, SULAWESI UTARA
Glass & Ceramics	32.93%	Rubber	61.56%	Plastic	40.63%
Plastic	20.73%	Plastic	27.06%	Glass & Ceramics	17.35%
Rubber	19.67%	Glass & Ceramics	8.48%	Cloth	15.41%
Wood	16.34%	Wood	2.25%	Metal	11.87%
Foamed plastic	6.26%	Foamed plastic	0.47%	Rubber	5.91%
Others	2.33%	Cloth	0.14%	Others	4.67%
Cloth	1.19%	Others	0.04%	Foamed plastic	1.87%
Metal	0.56%	Metal	0.00%	Paper/cardboard	1.65%
Paper/cardboard	0.00%	Paper/cardboard	0.00%	Wood	0.64%

# Marine Debris on Reference Beaches



# 3. Impacts of Marine Debris on Ecosystem



DPSIR/DPSWR model as applied to the generation and potential impacts of marine litter.

- The marine debris is known to be harmful to organisms and to human health
- The presence of marine debris in this list highlights its importance as a factor considered to contribute toward biodiversity loss, underscoring the need for greater understanding of the impacts of such debris and the potential measures to facilitate mitigation and management.
- Marine debris can impact biodiversity in a number of ways, namely through entanglement in, or ingestion of, debris items by individuals, through facilitation of the transport of organisms via rafting on marine debris, through the provision of new habitat for colonization, and through effects at an ecosystem level.

## Impacts of Marine Debris on Ecosystem: Microplastics exposure in marine organisms

Marine species	Plastic particle exposure and effect	Reference
Blue mussel <i>M. edulis</i> to crab <i>C. maenas</i>	Transition 0.5 µm PS from mussel to crab by trophic transfer	Farrell & Nelson 2013
Blue mussel <i>M. edulis</i>	Translocation to hemolymph of mussel after ingestion; 3–9.6 µm, into blood cells including macrophages 0–80 µm. Transfer into cells	Browne et al. 2008; von Moos et al. 2012; Höher et al. 2012; von Moos et al. 2012
Blue mussel <i>M. edulis</i>	Exposure to 10, 30 90 µm MPs Indications for selective uptake of 10 µm MPs Reduced clearance rate	Van Cauwenberghe et al. 2012b, 2013a
Zooplankton & mysid shrimp	Neomysis integer Ingestion, trophic transfer of fluorescent 10 µm PS from zooplankton to mesozooplankton Trophic transfer	Setälä et al. 2014
Shore crab <i>Carcinus maenas</i>	Uptake via gills of 8–10 µm PS and ingestion. Retention in foregut Watts et al. 2014 Echinoderm larvae Active capture and ingestion, 20 µm	Hart 1991
Lancet fish copepod	Polystyrene beads 0.05–25 µm Unrestricted intake of polystyrene beads, max 100 µm	Ruppert et al. 2000
Centropages typicus	Microbeads 10–70 µm, selective ingestion of 59–65 µm	Wilson 1973

Sources: Joint Group of Expert on the Scientific Aspects of Marine Environment Protection (GESAMP), 2015

# Impacts of Marine Debris on Ecosystem



Waste Technology (WasTech)

Journal homepage: <http://ejournal.undip.ac.id/index.php/wastech>

An International Journal

## Daily Accumulation and Impacts of Marine Litter on The Shores of Selayar Island Coast, South Sulawesi

Roni Hermawan<sup>1</sup>, Ario Damar<sup>2</sup>, Sigid Hariyadi<sup>2</sup>

<sup>1</sup>Post-graduate Student of Coastal and Marine Resources Management, FPIK-IPB, 16680, Bogor

<sup>2</sup>Department of Aquatic Resources Management, FPIK-IPB, 16680, Bogor

e-mail: [hermawanrooney@gmail.com](mailto:hermawanrooney@gmail.com)

**Abstract** - West coast of Selayar facing solid marine litter during west monsoon period December until March, marine litter come from floating litter, carried by sea surface current and deposited along the west coast. Marine litter deposited on the west coast affected social, economic and ecological. This study aims to determine type, weight, density and distribution of marine litter; the impact of litter on water quality; the impact of economic, social and environmental ecosystems. Retrieved data using line transect at 7 observation points. Litter size were observed ( $> 2.5$  cm) or macro litter. Floating litter and daily increasing of litters were also analyzed. Inorganic waste density is  $14.3 \pm 2.97$  items/m<sup>2</sup> for the number of pieces and  $564.8 \pm 196.1$  g/m<sup>2</sup> for waste weight. Daily accumulation was about  $1445 \pm 1743$  g/m/day, the number of pieces  $14.3 \pm 8$  item/m/day, cubication  $0.0187 \pm 0.019$  m<sup>3</sup>/m/day. The impacts on seagrass and biota such as broken leaves, crushed and organism rafting on floating litter some types of coral such as *Favia fragum*, types of crustaceans such as *Balanus. sp.*, *Lepas. sp.*, *Dosima. sp.* which affect the bio-diversity.

**Keywords** - marine litter, Selayar island, management, impact, ecology.

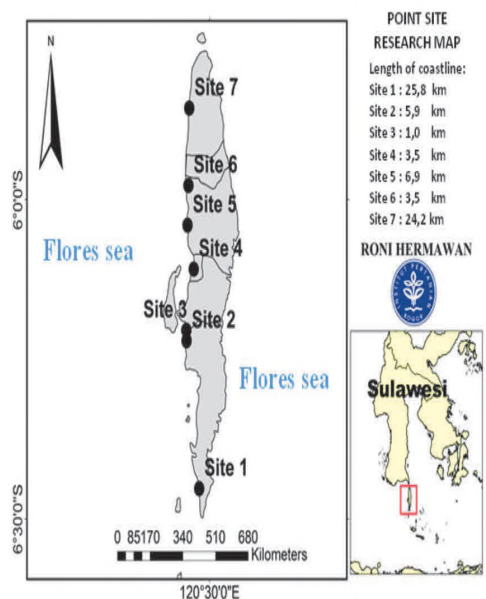
Submission: March 2, 2017

Correction: April 12, 2017

Accepted: April 20, 2017

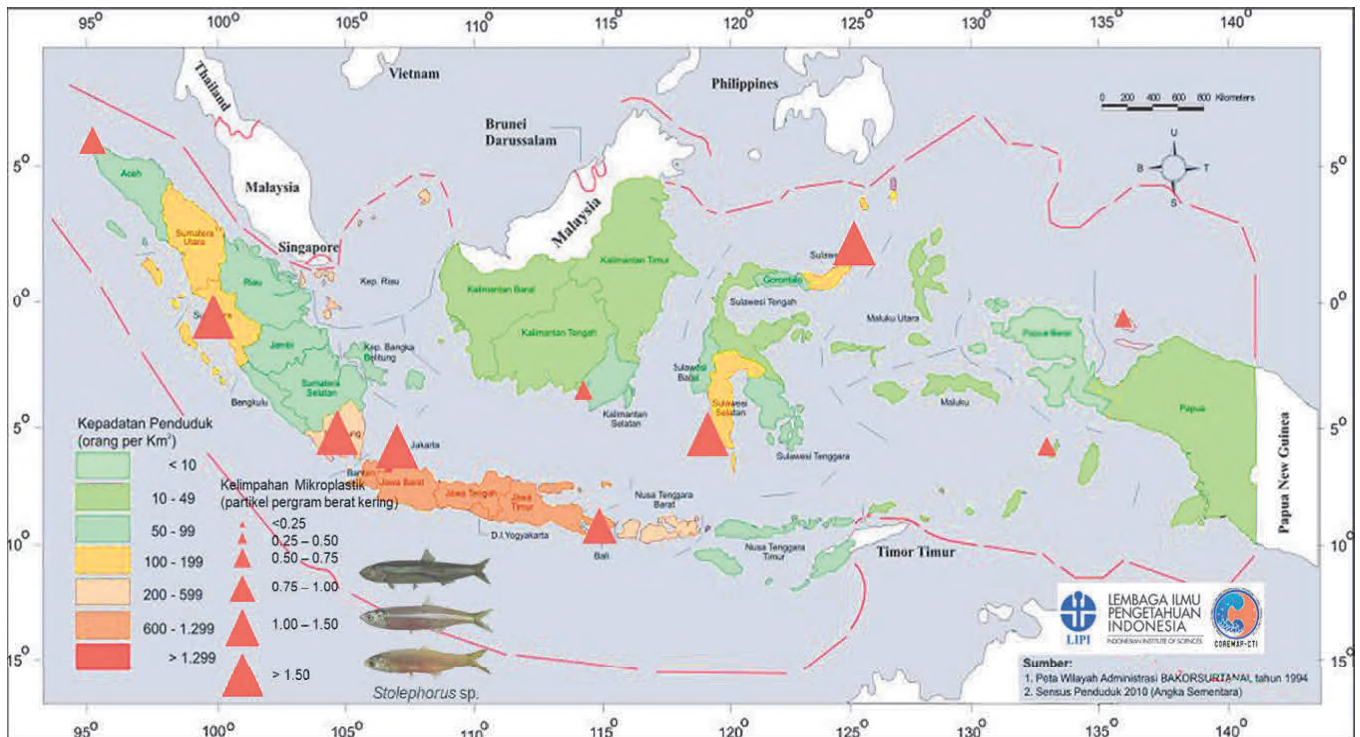
## Impacts of Marine Debris on Ecosystem

- Impact on the ecology in the waters especially in the intertidal, the impact arising from floating litter that stranded in the intertidal area.
- Litter piled up on the beach, covering the seagrass and organism, covered by plastic wrap, timber and glass bottles.
- Plastic wrappers and timber lots in the area found on the intertidal. Some of timbers and floating materials were sinks in the intertidal area.
- During low tide floating materials were covered and piled up on vegetation or organism.
- Impact on seagrass and organism that are covered and piled up such as broken leaves, tissue abrasion causing partial or mortality.
- Effectuated and broken seagrass leaves become litter and washed away by water current to the beach.
- The damaged seagrass leaves and accumulate along the coast, on observations at sites 1, 2 and 4 of seagrass leaves litter weight about 2.68 to 23.6 kgs.

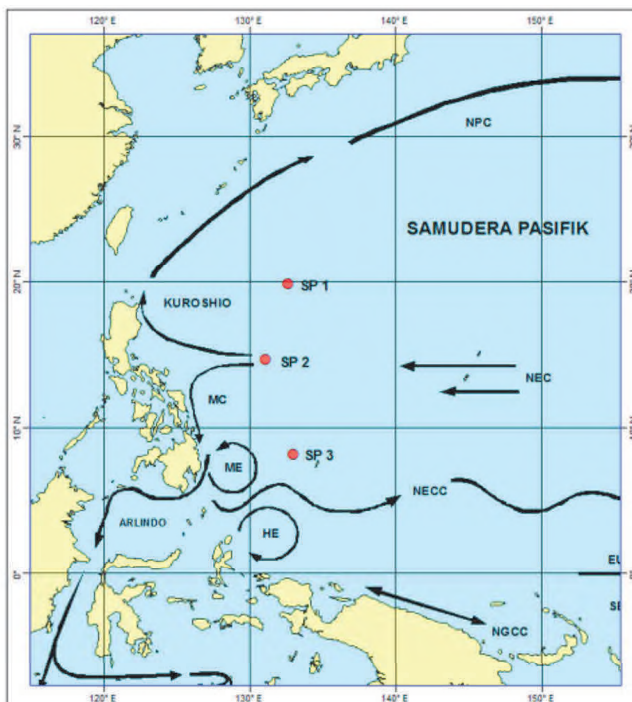




# Impacts of Marine Debris on Ecosystem: Microplastics exposure



# Impacts of Marine Debris on Ecosystem: Microplastics Tracking



## Microplastic tracking from Pacific garbage to Northern Indonesia Sea

Agung Ramos<sup>1</sup>; Noir P Purba<sup>1,2</sup>; Ibnu Faizal<sup>2</sup>; Yeni Mulyani<sup>1</sup>; Mega L. Syamsuddin<sup>1</sup>

<sup>1</sup> Marine Science Program, Universitas Padjadjaran km. 21 UBR 40600, West Java  
<sup>2</sup> Marine Research Laboratory (MEAL), Universitas Padjadjaran km. 21 UBR 40600, West Java

- Simulation of the trajectory of microplastic particles for 1 year showed that the microplastic waste sourced from Great Pacific Garbage Patch did not reach the northern waters of Indonesia.
- With the widespread of research in marine debris, the impact of marine debris would be impacted into tourism, fisherman activities, local income especially in east Indonesia with the high diversity of fish and ecosystem.

## 4. Initiatives and Innovative Solution

- Initiatives involved stakeholders: marine litter

<b>Reuse, Reduce, Recycle (3Rs)</b>	01	Waste Bank
	02	Waste Management Facility-3Rs Recycling Center
	03	Creative Recycled Products
	04	Plastic Bottle-Paid Bus
	05	City Initiatives to Limit the Use of Plastic Bags
	06	Waste to Energy
Alternative of products	07	Alternative to Plastic Bags
	08	Seaweed-Based Packaging
	09	Eco-friendly Water Bottles

<b>Clean-up</b>	10	Beach Clean-up
	11	Ocean Clean-up
	12	River Clean-up
	13	Waste Management at National Parks
	14	Mountain Clean-up Operation (Sapu Jagad)
<b>Monitoring and Research</b>	15	Marine Litter Monitoring
	16	Marine Litter Tracking Models
	17	Coastal Clean-up Registry System
	18	Regional Capacity Center for Clean Seas (RC3S)

## Initiatives and Innovative Solution

- Initiatives and Innovative of Local Community: Waste Bank



Picture : Fahmi Hidayat



The main source of national waste generation comes from household activities, which is 36% from total waste generated. The waste management approach must also be based on community participation, therefore building waste bank facilities is important to raise public awareness in applying the 3Rs principle (reduce, reuse, recycle). In so doing, the community could be encourage to sort and process their waste independently.

The waste bank facilities have been operated in 31 provinces and 218 districts / cities with 8036 plants in total all across Indonesia. Waste banks have positive impact for the environment, social, and economy. In addition to reducing the number of waste piled up in landfills or drifted in the environment, there are also job opportunities and new sources of income from doing this initiative.

# Initiatives and Innovative Solution

- Initiatives and Innovative of Local Government: Plastic Bottle-Paid Bus



Bus Suroboyo: Plastic Bottle-Paid Bus



Suroboyo Bus is a bus rapid transit service in the city of Surabaya which fares paid using plastic waste. This bus can carry as many as 67 people at maximum. The plastic waste collected will then be deposited to the Waste Bank to be recycled into more useful materials.

Suroboyo Bus Passengers are required to pay using plastic waste. For a one-way trip, each passenger must exchange 10 plastic mineral water cups, or 5 medium-sized plastic water bottles, or 3 large plastic bottles.

#### Contact Person:

Surabaya City Government  
Telephone: (031) 5312144

# Initiatives and Innovative Solution

- Initiatives and Innovative of Local Government: Clean-up



In addressing pollution caused by garbage around the Thousand Islands, the Government of Jakarta together with the Environmental Agency of the Thousand Islands provide waste transporting vessels operates around the islands.

At the moment, there are already 13 vessels in function to collect and transport garbage in Jakarta waters as well as islands in the Thousand Islands Regency.

#### Narahubung:

Jakarta Environmental Agency, Head of Integrated Service Unit  
of Water Bodies  
Telephone: (021) 8092744

# Initiatives and Innovative Solution

- Initiatives and Innovative of Private Sector: Waste to energy

## Best Practices Innovative Approaches

### Reduce, Reuse, Recycle (3Rs)

#### 5 | City Initiatives to Limit the Use of Plastic Bags



Single Used Plastic Prohibition

Since June 1<sup>st</sup>, 2016, the city of Banjarmasin has begun to ban plastic bags in modern retailers and became the first city in Indonesia to implement such policy. Until now, regency / city governments that have a plastic bag pro

- 1.
- 2.
- 3.

# Initiatives and Innovative Solution

## Indonesia COASTAL CLEAN-UP by *DITJEN PPKL*



# Initiatives and Innovative Solution

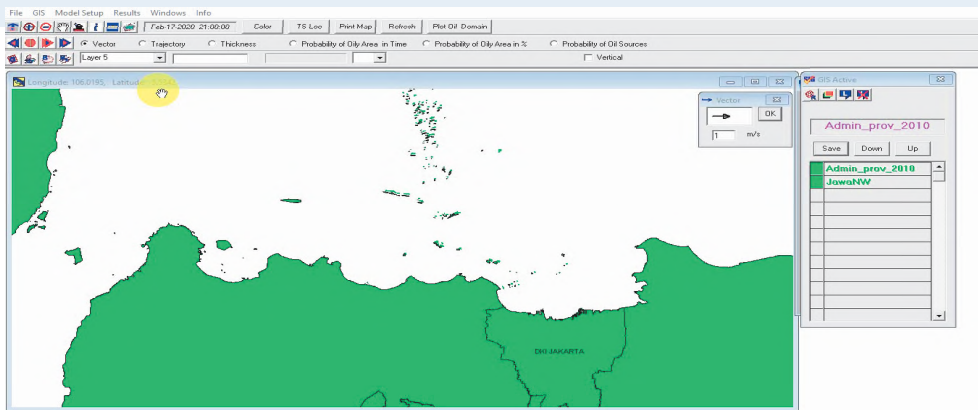
## Trash Boom, River Air Kemiri - Labuan Bajo

KOORDINAT LOKASI : -8.498244,119.879952



Collaboration MoEF with Local Government of Manggarai Barat

# Trajectory for Marine Litter Monitoring

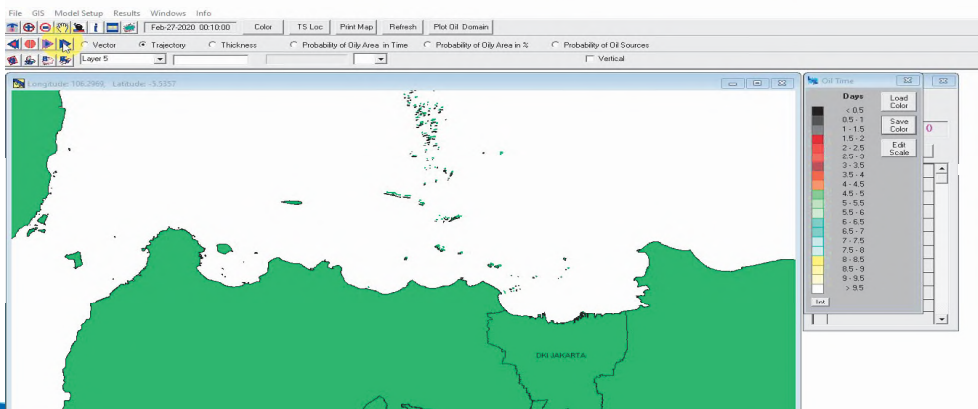


Flow data based on hydrodynamic modeling using BMKG data

The vector magnitude shows the direction and speed of the current

The movement of waste is based on the flow pattern, describes the distribution direction

Trajectory can be seen deposited garbage on the beach



# #Regional Capacity Center for Clean Seas (RC3S)

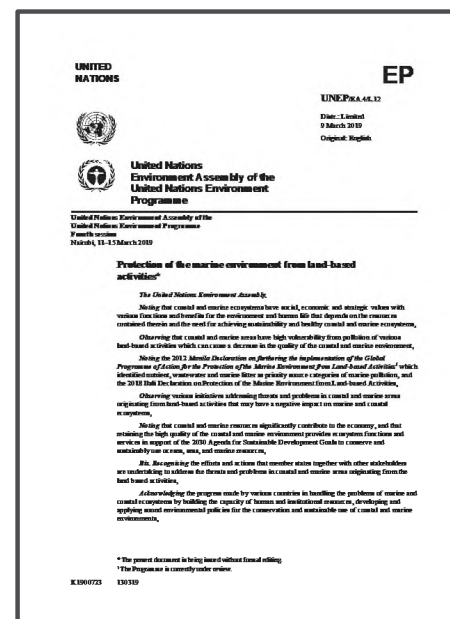
- The Fourth Intergovernmental Review Meeting on the Implementation of the GPA for the Protection of the Marine Environment from Land-Based Activities (IGR-4) in Bali from October 31 to November 1, 2018
- IGR-4 successfully agreed on **Bali Declaration** on the Protection of the Marine Environment from Land-Based Activities.



## Regional Capacity Center for Clean Seas

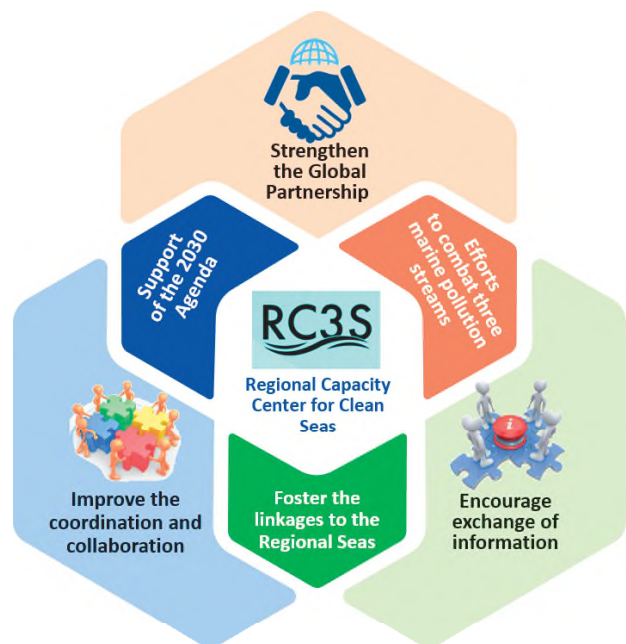
### UNEP/EA.4/L.12: Resolution on Protection of the marine environment from land-based activities

- Enhance the mainstreaming of the protection of coastal and marine ecosystems in policies particularly caused by increased nutrient, wastewater, marine litter and microplastics;
- Enhance capacity-building, know-how, lessons learned, knowledge sharing through collaboration and partnerships;
- Improve the coordination, engagement and support of the work with member states and foster the linkages to the Regional Seas, other relevant platforms and international initiatives;
- Encourage exchange of information, practical experience and scientific and technical expertise cooperative and collaborative action and partnership
- Invite member states to take initiative at both national and regional levels



# Regional Capacity Center for Clean Seas

- To assure the commitment of the Bali Declaration adopted at the fourth session of the Intergovernmental Review Meeting (IGR-4).
- To foster linkages to the Regional Seas, other platforms and international initiatives, and build further on the resolution on Protection of the marine environment from land-based activities adopted at the Fourth session of UNEA (UNEP/EA.4/L.12).
- RC3S is to be a hub for strengthening capacity building in the field of protection of the marine environment from land-based activities, in particular nutrients, waste water and marine litter/microplastics.



## Regional Capacity Center for Clean Seas

### Functions of RC3S:

- Enhance the capacities to prevent pollution of the marine environment;
- Establish, maintain and disseminate information;
- Provide a framework for exchange of information, experiences, tools, legal and policy frameworks;
- Assist countries, on requests, in the development of their national capabilities to address marine pollution;
- Compile and disseminate experiences, approaches, tools, guidance and any other practical information
- Raise awareness among stakeholders
- Communicate the work of the centre widely;
- Mobilize financial and other support.

The functions of RC3S is to deliver public values as follows,



# Regional Capacity Center for Clean Seas

- Enhance the capacities to prevent pollution:  
Training of Trainers (ToT) Monitoring and Assessment of Marine Plastic Litter and Microplastics, joint collaboration UN & COBSEA Secretariat, Bali, September, 9 - 13 2019 attended by 8 countries in East Asia



# Regional Capacity Center for Clean Seas

- Provide a framework for exchange of information, experiences and tools :  
Asian Regional Workshop on Data and Information Management Large Marine Ecosystems, December 3 - 5 2019, collaboration with PEMSEA Resources Facility





# Regional Capacity Center for Clean Seas

- Provide a framework for exchange of information, experiences and tools :  
Forum Researchers and Practitioners - Surabaya, July 24 – 26, 2019



# Regional Capacity Center for Clean Seas

- Raise awareness among stakeholders:  
Beach Clean-up in Bali, to take place on November 15, 2019, collaboration with United Nations Information Centre (UNIC) and AWMUN



*The Beach Clean-up coincide with the Asia World Model United Nations (AWMUN) involving 1000 delegates coming from all over the Asian Region and beyond.*

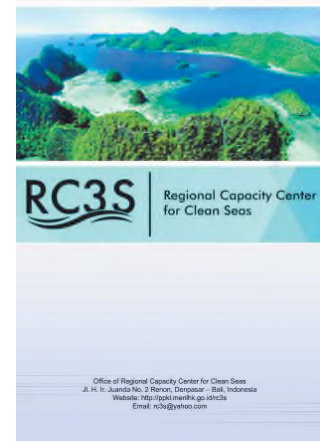
# Regional Capacity Center for Clean Seas

- Raise awareness among stakeholders

RC3S has published documents/publications



Booklet  
*Best Practice*  
Innovative  
Solutions to  
Combat Marine  
Litter




Booklet  
Regional Capacity Centre  
for Clean Seas

## 5. Conclusion

- Marine debris represents a significant additional and escalating anthropogenic factor affecting marine habitats and biodiversity.
- The consequences of marine debris on species and individuals may also have indirect effects on trophic interactions and on assemblages, something which will be particularly important where a keystone species is affected.
- Marine debris should be acknowledged as a major additional driver contributing to the degradation of marine environments. Strategies for prevention at source, have been identified as being key to minimizing further increases in marine debris and its associated impacts.
- Control of sources of marine debris is an issue which can benefit from a broadly based framework approach focused on prevention.
- There are numerous policies, programs and instruments which have been successfully used to Address the Challenge of Marine Debris. These measures can be effectively used in reducing debris at points of origin and in improved life cycle management.




Ministry of Environment and Forestry  
Directorate General of Environmental Pollution and Degradation Control

 Main Office  
Gedung Manggala Wanabakti Blok I Lt. 2  
Jl. Jenderal Gatot Subroto - Jakarta 10270  
Po Box 6505, Indonesia

 021-5730191  
021-5705086

 [www.menlhk.go.id](http://www.menlhk.go.id)  
[www.pptl.menlhk.co.id](http://www.pptl.menlhk.co.id)

Directorate General of Environmental Pollution and  
Degradation Control  
Jl. D.I. Panjaitan Kav. 24 Kebon Nanas Jakarta Timur  
Cedung B Lantai 4 - Indonesia 13410

 021-8520886  
021-8580105