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The Ocean Plastic Crisis – Mapping Source to Sea

Source Identification as a Solution

An OpenOceans Global White Paper



Kuta Beach, Bali Indonesia, Image Credit: [Shutterstock // Maxim Blinkov](#)

Plastic is ubiquitous in environments throughout the world. The ocean is no exception. While public perception imagines marine plastic concentrated in the deep ocean in garbage patches trapped in the ocean gyres, 75% of ocean plastic is actually on beaches and shorelines. With this knowledge,

- It is important to map the locations where ocean plastic accumulates,
- If plastic is located on a beach, the source of that plastic (i.e., the geographic pathway by which it reached any given shoreline) can often be identified, and
- When the source can be identified, solutions can be implemented to stem the flow of plastic to the ocean.

Plastic Pathways to the Ocean

Plastic can only reach the ocean and its shorelines through four pathways:

1. **Rivers**, which are the source of most ocean plastic,
2. **Local litter**, blown or washed directly onto a beach from local land sources,
3. **Fishing gear** and other maritime debris, or
4. **From a distant location via ocean currents** that first reach the ocean from one of the first three sources.

OpenOceans Global seeks to:

- **Identify and map** where plastic accumulates in significant amounts on beaches around the world,
- **Connect the people** struggling with plastic debris on those shorelines with each other and global experts, and
- **Provide them with access the best solutions** to stop or significantly reduce the flow of plastic before it reaches the ocean.

A Global Problem with Local Impact

Public knowledge of the geographical source of the plastic is critical to understanding and implementing the best solutions. Visualization and documentation are important tools for local leaders to understand the scope of the problem. Often, the ocean plastic crisis is seen as a global problem that can only be solved globally. While this is true to an extent, solutions require stemming the flow of plastic from-and-to local sources before it reaches the ocean.

All plastic debris is ultimately local, so local solutions must be implemented to solve the crisis. OpenOceans Global is curating a set of solutions by category that can be assessed for application at each location where accumulations of plastic on shorelines are found.

Mapping the Flow from Source to Sea

One category of solutions involves forensics. Once the location of an accumulation of plastic debris is documented, the pathway it traveled must be determined. OpenOceans Global is mapping and documenting beaches that regularly accumulate plastic. Once documented, the pathway taking plastic to that beach must be determined. From the Galapagos to the Bahamas, researchers have been working to develop forensic strategies to identify the pathways by which plastic accumulates on local shorelines. This is the first step in finding solutions. OpenOceans Global is curating solutions and making them available for use where ocean plastic pollution is a problem.

Approaches to Shutting Off the Flow

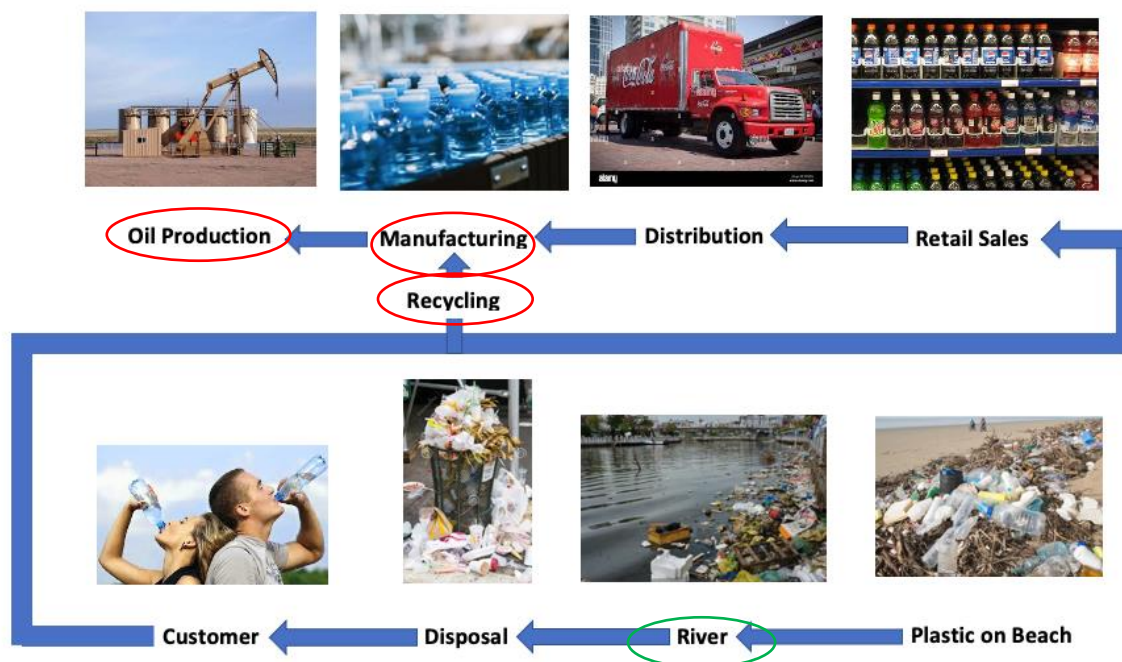
Internationally, there have been two major approaches to addressing the ocean plastic crisis and shutting off the flow.

- **Eliminating plastic.** The first is focused on the upstream end of the plastic supply chain – eliminating the production of single-use plastic, suppressing the creation of virgin plastic resin, and eliminating much of the flow of plastic through the supply chain.
- **Circularity.** The second focuses on the midstream of the supply chain and places a priority on circularity – recycling plastic waste by taking it out of the waste stream or intercepting it before it arrives there.

These important long-term approaches effectively seek to implement the difficult task of changing and restructuring the entire supply chain currently supported by plastic production.

- **Stemming the flow.** A third approach on the downstream end of the supply chain must be implemented to stop the flow of plastic to the ocean. This strategy is where OpenOceans Global's work begins. The end of the supply chain is on a beach, and **Open Oceans Global employs a reverse supply chain model** and provides access to the tools to search upstream to identify the best places to stop the flow.

Ocean Plastic Reverse Supply Chain



Where can the plastic be stopped?

The red circles indicate where the primary focus internationally has been placed on stopping the flow of plastic. While this critical work needs to continue at an urgent pace, OpenOceans Global believes another emphasis should be placed on the green circle, representing the places closest to where most plastic reaches the sea – rivers, local litter, and fishing gear.

This third strategy is important because, even as the United Nations works to complete an actionable and binding international plastic treaty by 2024, it is likely that:

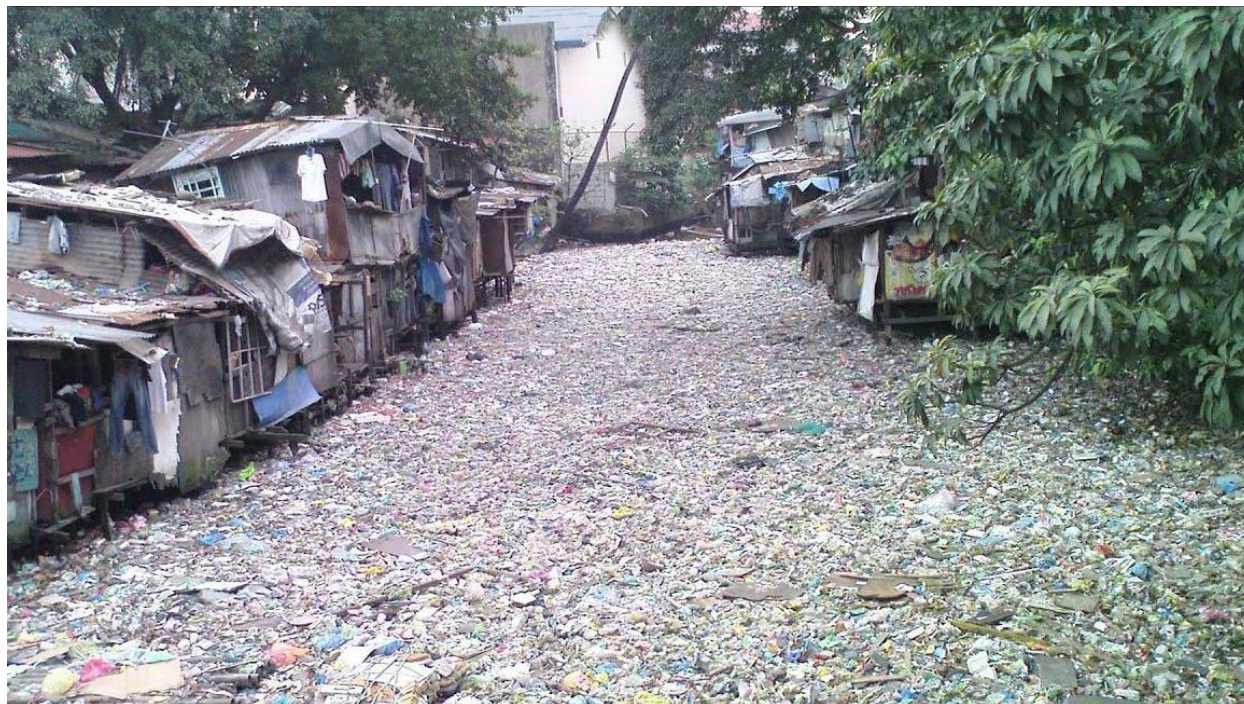
- The global changes envisioned by the UN will not be agreed upon in short order,
- They will not be implemented and enforced universally, and
- Investment by governments and industry will not be sufficient to stem the flow at the upper end of the supply chain.

11 Million Metric Tons Soon to Become 29 MT

Until the first two approaches are fully implemented, plastic will continue to flow into the ocean. The Pew Charitable Trust estimates that 11 million metric tons of plastic go into the ocean every year and will increase to 29 million tons by 2040 under current practices. Pew also developed a list of strategies to be implemented that, if fully funded and universally applied, will reduce 78% of the plastic flowing into the ocean. That means five million metric tons of plastic will still flow into the ocean each year, even if Pew's strategies are fully funded and universally implemented. This is truly a crisis that makes the OpenOceans Global strategy critical.

70% of Ocean Plastic Comes from Five Countries

Knowing the countries where the majority of plastic reaches the ocean is important to implementing this third solution. While the U.S. and other developed nations are leaders in the production and use of plastic, they aren't the primary sources of marine plastic to the sea. The U.S. directly contributes less than 1% of plastic to the world's oceans. One percent of 11 million tons is more than 100,000 metric tons, still a significant amount, and the U.S. must continue to reduce the plastic it does contribute to the ocean. However, five countries in Asia contribute as much as 70% of plastic to the world's oceans, and ten countries contribute up to 84%, according to the best data available.



The Pasig River is the most plastic-polluting river in the world. Image Credit: [Gulf News](#) and [Asian Development Bank](#)

To reduce the growing amount of plastic in the ocean, there must be an international focus on the places where the most plastic reaches the sea, even as changes in supply chains and in-country work continue in the richer, developed nations. One reputable study estimates that 36% of all river-borne ocean plastic comes from the Philippines. Another says the Philippines contributes 15%. No matter the actual number, placing a collaborative international priority on the Philippines, China, India, Malaysia, Indonesia, and Brazil (which all contribute more than 5%) would go a long way to reduce the amount of plastic reaching the ocean while testing and implementing the best solutions to achieve that end.

Three primary studies inform our understanding of the ocean plastic crisis.

- Florida State University's Center for Ocean-Atmospheric Prediction Studies, has produced the "Global Model for Monitoring Marine Litter," which has been adopted by the United Nations Global Partnership on Marine Litter. <https://www.coaps.fsu.edu/our-expertise/global-model-for-marine-litter>

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- The Ocean Cleanup has produced “River Plastic Emissions to the World’s Oceans,” which analyzes the emissions of plastic from the world’s rivers into the sea. <https://theoceancleanup.com/sources/>
- The Pew Charitable Trust’s “Breaking the Plastic Wave” is a comprehensive overview of the ocean plastic problem and its solutions. <https://www.pewtrusts.org/en/research-and-analysis/articles/2020/07/23/breaking-the-plastic-wave-top-findings>

Key data and OpenOceans Global’s analysis of that data can be found below. It is important to recognize that variations in the absolute amount of plastic contributed can be attributed to different assumptions. For instance, the Ocean Cleanup data only looks at river-borne plastic from the 1,000 rivers that contribute the most. The total from those rivers is one million metric tons. Other estimates are based on country totals using models that make assumptions about the amount of mismanaged waste in each country and how much of it reaches the ocean. No matter the absolute numbers, the scale of the numbers is consistent in pointing to the countries that provide the most plastic pollution to the ocean.

Florida State University - Top 10 Countries Contributing Plastic to the Ocean

Country Name	Tons Exported	Ends in the Ocean	Ends in the beach	% Exported to the Ocean	% Top 5 and Next 5	% Top 10
China	3,185,508	501,877	2,683,631	19.26%		
Philippines	2,642,449	947,189	1,695,260	15.98%		
India	1,521,591	555,144	966,447	9.20%		
Brazil	940,540	300,874	639,665	5.69%		
Indonesia	926,209	327,189	599,020	5.60%	55.72%	
Vietnam	656,644	172,188	484,457	3.97%		
Malaysia	546,318	213,562	332,756	3.30%		
Turkey	519,066	164,625	354,441	3.14%		
Nigeria	502,546	5,705	496,841	3.04%		
Bangladesh	452,158	136,404	315,755	2.73%	16.18%	
Totals	16,539,443	4,710,314	11,829,136		71.91%	71.91%
Total %		28.48%	71.52%			

Ocean Cleanup - Top 10 Countries Contributing River-Borne Plastic to the Ocean

Country	MT/Year	% River-Borne Plastic	% Top 5 and Next 5	% Top 10
Philippines	360,000	36.00%		
India	130,000	13.00%		
Malaysia	73,000	7.30%		
China	71,000	7.10%		
Indonesia	56,000	5.60%	69.00%	
Myanmar	40,000	4.00%		
Brazil	38,000	3.80%		
Vietnam	28,000	2.80%		
Bangladesh	25,000	2.50%		
Thailand	23,000	2.30%	15.40%	
Total Top 10	844,000	84.40%	84.40%	84.40%

Conclusion

The ocean plastic crisis has implications not only for marine life and the environment but also for human health, climate change, and how we approach the future. Since 75% of ocean plastic is on beaches and other shorelines, stopping the flow of plastic from reaching beaches will also stop most of the flow from reaching coastal waters and the deep ocean. Plastic that doesn't reach the ocean won't become marine microplastic, and the chemicals of concern found in plastic won't become part of the marine ecosystem.

As a final note, there would not be an ocean plastic crisis if there was universal waste management like that found in much of the developed world. There would still be too much plastic, and the initiatives underway to address that plastic would still be needed, but the ocean would have far less plastic.

Mapping Plastic-Fouled Beaches

- To view beaches on the Ocean Plastic Map go to: <https://www.openoceans.org/Plastic-Trash>
- To add a beach where plastic regularly accumulates, go to the OpenOceans Global website. <https://www.openoceans.org/trash-survey>

Here, you can provide a photo, locate the beach on a map, and provide background information.

Curating the Best Solutions

- To view the current list of solutions or add a solution to be considered for addition to the OpenOceans Global website go to: <https://www.openoceans.org/solutions>

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