

International Law Instruments To Address The Plastic Soup

Luisa Cortat Simonetti Goncalves

Michael Gerbert Faure

Repository Citation

Luisa Cortat Simonetti Goncalves and Michael Gerbert Faure, *International Law Instruments To Address The Plastic Soup*, 43 Wm. & Mary Env'tl. L. & Pol'y Rev. 871 (2019), <https://scholarship.law.wm.edu/wmelpr/vol43/iss3/6>

INTERNATIONAL LAW INSTRUMENTS TO ADDRESS THE PLASTIC SOUP

LUISA CORTAT SIMONETTI GONCALVES* & MICHAEL GERBERT FAURE**

ABSTRACT

The problem of plastic pollution in the oceans has been increasingly evident after 1997, when the great concentrations of plastics in the oceans were initially publicized. Still, there is a substantial lack of scientific data and research about the sources of plastic pollution, destinations and consequences to nature and human life. The only certainty is that the amount of plastic that ends up in the ocean is alarming and likely will not decrease anytime soon because of its durability and large range of use. Estimates show that, each year, at least 8 million tons of plastics leak into the ocean and, if no action is taken, this is expected to double by 2030, and quadruple by 2050. As a result, by 2050 there would be more plastic than fish in the ocean. This Article focuses on international legal pathways to face such a problem. It constitutes the basis for further research that aims at constructing a legal framework to adequately face the problem of plastic pollution of the oceans. In order to do so, the first step is to unveil the already existing international instruments—both hard and soft law. It is indispensable to accomplish this intermediate step because a great part of such pollution is in international waters, where the only legal regulations and remedies applicable are those from public international law. Solely through this state-of-the-art approach is it possible to analyze critically its possibilities and limitations, as well as to suggest how to proceed. Therefore, this Article first analyzes whether the international instruments deal with the plastic soup issue, both from the *ex ante* and from the *ex post* perspectives. After showing that the current efforts are not compatible with the current harms and threats of plastic pollution of the oceans, we suggest possible pathways and approaches to surpass the obstacles and to start facing the problem of plastic pollution of the oceans.

* PhD candidate at Maastricht University, with scholarship from CAPES, and at Vitoria Law School (FDV). Master—with scholarship from FAPES—and bachelor degrees at Law from FDV, with academic semester at Coimbra University. Postgraduate in Economics and Environment at Federal University of Parana. Bachelor in Physics from Federal University of Espirito Santo. Law lecturer and consultant. luisacs@gmail.com.

** Professor of comparative and international environmental law, Maastricht University and Professor of comparative private law and economics at Erasmus School of Law, Rotterdam, both in The Netherlands.

INTRODUCTION	873
I. OVERVIEW OF THE PLASTIC SOUP PROBLEM	876
A. <i>What Are the Plastic Sources?</i>	876
B. <i>Where Is Plastic Going in the Oceans?</i>	880
C. <i>Consequences for Nature and Human Health</i>	882
D. <i>Technical Solutions</i>	885
II. INSTRUMENTS UNDER HARD LAW	892
A. <i>United Nations Convention on the Law of the Sea</i> . . .	893
B. <i>The Convention on the Prevention of Marine Pollution</i> <i>by Dumping of Wastes and Other Matter (1972</i> <i>London Dumping Convention) and London Protocol</i> <i>(2006)</i>	898
C. <i>International Convention for the Prevention of Pollution</i> <i>from Ships—Annex V</i>	900
D. <i>Convention on Biological Diversity and the Jakarta</i> <i>Mandate</i>	901
E. <i>Convention on the Conservation of Migratory Species of</i> <i>Wild Animals</i>	903
F. <i>Summary</i>	904
III. INSTRUMENTS UNDER SOFT LAW	905
A. <i>Agenda 21 and the Johannesburg Plan of</i> <i>Implementation</i>	906
B. <i>Global Programme of Action for the Protection of the</i> <i>Marine Environment from Land-Based Activities and</i> <i>Related International Instruments</i>	911
C. <i>FAO Code of Conduct for Responsible Fisheries</i> . . .	916
D. <i>Sustainable Development Goals</i>	917
E. <i>Summary</i>	923
IV. INTERNATIONAL INSTRUMENTS AND THE PLASTIC SOUP	924
A. <i>Ex Ante Perspective</i>	925
B. <i>Ex Post Perspective: Perceptions and Lessons</i> <i>Learned</i>	931
1. <i>Technical Solutions</i>	931
2. <i>A Law and Economics Approach</i>	934
a. <i>Creating Property Rights?</i>	936
b. <i>Application of the Coase Theorem?</i> ..	938
c. <i>Taxation?</i>	939
d. <i>Liability Rules?</i>	940
e. <i>Funding?</i>	941
3. <i>Implementation</i>	943
CONCLUSION	945

INTRODUCTION

In 1997, the sailor-man Charles Moore took a shortcut when traveling between Hawaii and California and reported to major news outlets and interview programs about the Great Pacific Garbage Patch.¹ Recent studies have described the plastic soup as twice the size of Texas.² Since then, the problem of plastic pollution in the oceans has increasingly gained visibility.³

Although there is still much to learn about the plastic sources, destinations, and consequences to nature and human health, the only certainty is that the amount of plastic that ends up in the ocean is alarming and likely will not decrease anytime soon because of its durability and wide range of use.⁴ “The great variety of polymers, their excellent properties, low price and versatility lead to the growth of single-use disposable plastics. This was the result of direct outgrowth of chemical industries developed during World War II and quickly polymer items became symbolic of the convenience of modern day living.”⁵

Each year, at least 8 million tons of plastics leak into the ocean and, if no action is taken, this is expected to double by 2030 and will quadruple by 2050.⁶ With that, it is estimated is that by 2050 there will be more plastic than fish in the oceans.⁷ Besides, plastics production increased worldwide from 15 million tons in 1964 to 311 million tons in 2014.⁸

¹ Richard Grant, *Drowning in plastic: The Great Pacific Garbage Patch is twice the size of France*, THE TELEGRAPH (Apr. 24, 2009), <https://www.telegraph.co.uk/news/earth/environment/5208645/Drowning-in-plastic-The-Great-Pacific-Garbage-Patch-is-twice-the-size-of-France.html> [https://perma.cc/7VMD-DG6U].

² Marian Liu, *Great Pacific Garbage Patch Now Three Times the Size of France*, CNN (Mar. 23, 2018), <https://www.cnn.com/2018/03/23/world/plastic-great-pacific-garbage-patch-intl/index.html> [https://perma.cc/4ES2-HFXJ].

³ See *id.* (noting that the UN and scientific community have taken notice).

⁴ Grant, *supra* note 1.

⁵ ATHANASIOS VALAVANIDIS & THOMAS VLACHOGIANNI, MICROPLASTICS IN THE MARINE ENVIRONMENT: UBIQUITOUS AND PERSISTENT POLLUTION PROBLEM IN THE WORLD OCEANS THREATENING MARINE BIOTA (June 25, 2014), https://www.researchgate.net/publication/263477975_MICROPLASTICS_IN_THE_MARINE_ENVIRONMENT_Ubiqutous_and_Persistent_Pollution_Problem_in_the_World_Oceans_Threatening_Marine_Biota [https://perma.cc/N8ZM-B4DL].

⁶ ELLEN MACARTHUR FOUNDATION, THE NEW PLASTICS ECONOMY: RETHINKING THE FUTURE OF PLASTICS & CATALYSING ACTION 24 (2016), https://www.ellenmacarthurfoundation.org/assets/downloads/EllenMacArthurFoundation_TheNewPlasticsEconomy_Pages.pdf [https://perma.cc/D2DJ-AK9D].

⁷ *Id.*

⁸ *Id.*

The large visible objects are just a sign of a much bigger problem.⁹ Several natural interactions such as sunlight, wave action, and mechanical abrasion make those larger pieces slowly break up into smaller ones.¹⁰ Since the decomposition of many plastics can take almost 400 years or even more, virtually every piece of plastic ever produced is still around.¹¹

“Plastic can be found on every beach in the world. Microplastics are found at 5,000 metres depth, and plastic bottles have been found at depths of 3,500 meters. It’s actually ‘raining’ plastic in the ocean. Scientists are still far from mapping all the plastic pollution in the oceans.”¹² All this plastic together forms the so-called plastic soup in the seas and oceans.¹³

There is no doubt about the fact that plastic pollution is a problem caused by human activity on Earth.¹⁴ The major issue in this case is the manner by which to address this problem. This Article will analyze the already existing international instruments to face the problem of plastic pollution of the oceans—both hard and soft law. The choice of such approach is, in large part, due to the fact that this specific pollution is located in international waters, where the only legal regulations and remedies applicable are those from public international law.¹⁵ Solely through this state-of-the-art approach is it possible to analyze critically the laws, possibilities, and limitations, as well as to formulate suggestions on how to proceed with effective remedies.

Therefore, this Article aims to evaluate the extent to which those instruments of public international law deal with the plastic soup issue, from both the *ex ante*¹⁶ and from the *ex post*¹⁷ perspectives. Of course,

⁹ *The Trash Vortex*, GREENPEACE, <https://www.greenpeace.org/archive-international/en/campaigns/oceans/pollution/trash-vortex/> [<https://perma.cc/GG7L-443G>] (last visited Apr. 3, 2019).

¹⁰ *Id.*

¹¹ Mike Wright et al., *The stark truth about how long your plastic footprint will last on the planet*, THE TELEGRAPH (Jan. 10, 2018), <https://www.telegraph.co.uk/news/2018/01/10/stark-truth-long-plastic-footprint-will-last-planet/> [<https://perma.cc/WCX4-YWKP>].

¹² *What is plastic soup? Gyres and Hotspots*, PLASTIC SOUP FOUNDATION, <https://www.plasticsoupfoundation.org/en/files/what-is-plastic-soup/> [<https://perma.cc/T2RX-WM84>] (last visited Apr. 3, 2019).

¹³ *Id.*

¹⁴ *See id.*

¹⁵ *See, e.g., Oceans and the Law of the Sea*, UNITED NATIONS, <http://www.un.org/en/sections/issues-depth/oceans-and-law-sea/> [<https://perma.cc/4E9D-AJNB>] (last visited Apr. 3, 2019) (describing the United Nations Convention on the Law of the Sea).

¹⁶ Meaning the stages before the plastic reaches the oceans: production, consumption, and disposal/final destination.

¹⁷ Meaning the stage after the plastic is already in the oceans: recovery.

international instruments and their complex contexts often bring up several positive and several negative aspects. All of them will be taken into account to evaluate the relative effectiveness of international laws regarding the plastic soup problem, according to the available academic literature.

Achieving this goal is essential to assess the role of international law and, consequently, the importance of alternative, private, pathways. As discussed in the conclusions of this study, an approach based on private governance will, so we argue, be indispensable to enable effective solutions. As far as international law is concerned, we focus on treaties as well as on soft law instruments. We do not, however, discuss principles applicable to the relationships between states, such as the “no harm” principle, as these are not directly applicable to this topic.¹⁸ The plastic soup is, after all, not related to wrongful behavior of one particular state or other states, but rather harm to the environment that occurs in a legal “no-man’s-land.”

There are no international instruments specifically dealing with the plastic pollution problem.¹⁹ However, this, by itself, does not inhibit us from formulating any conclusions. There are a number of international instruments that have, at least potentially, some relevance for the plastic soup problem.²⁰ Those instruments will be examined within the scope of this Article. The question that will particularly be addressed is the extent to which certain international instruments are able to address the plastic soup problem.

The description of each instrument provides a brief summary of the specific convention and an explanation about how it can relate to plastic pollution of the oceans. Finally, each description also includes a concise analysis about enforceability and progress, based on the academic literature available. The same approach will be used to address hard law and soft law.

We start the Article with an overview of the plastic soup problem (Part I), which allows an assessment of the problem, including its main challenges and possibilities. The remainder of the Article is devoted to analyzing whether international law currently facilitates the possible technical solutions or whether particular changes are needed to implement those solutions. We first address to what extent the plastic soup problem

¹⁸ These principles should be considered when inserting provisions into international instruments and when a court—either national or international—is to decide on a case.

¹⁹ See, e.g., UNITED NATIONS, *supra* note 15 (not specifically addressing plastics).

²⁰ See, e.g., *id.* (describing how the United Nations protects biodiversity).

is addressed in international hard law instruments (Part II), then we move to soft law instruments (Part III). After having discussed the limits of both kinds of instruments, Part IV addresses the role of international law instruments in remedying the plastic soup problem. This Article concludes in the last section.

I. OVERVIEW OF THE PLASTIC SOUP PROBLEM

Here we present a brief overview of the main information available on the plastic pollution sources, destinations, and consequences. However, mainly because of differences in time and methodology, and sometimes because of lack of transparency in data, there is still some inconsistency in the numbers. Still, this overview shows the gravity of the situation and enables a starting point to reflect on the main problems and potential pathways.

A. *What Are the Plastic Sources?*

Since plastic's first appearance in the format we know, a great diversity of various kinds of polymers—with an enormous range of applications—was developed,²¹ and we know all of them as plastic. According to PlasticsEurope (Association of Plastics Manufacturers), there are fourteen types, each with different characteristics, compositions, and applications.²² Such variety, by itself, poses an incredible challenge regarding solutions.²³

The yearly production of plastics in 2013 was around 299 million tons, of which about 10–20 million ended up in the sea.²⁴ According to the United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution, about 80% of plastics come from land.²⁵ The remainder

²¹ See *Types of Plastic*, PLASTICSEUROPE, <https://www.plasticseurope.org/en/about-plastics/what-are-plastics/how-plastics-are-made> [<https://perma.cc/SB53-HRBY>] (last visited Apr. 3, 2019).

²² *Id.*

²³ For example, a unique technical approach is virtually impossible. When developing new materials or techniques for recycling, and so on, there is a need to consider all of that variety.

²⁴ *Global Plastic Production Rises, Recycling Lags*, WORLDWATCH INSTITUTE (Jan. 28, 2015), <http://www.worldwatch.org/global-plastic-production-rises-recycling-lags-0> [<https://perma.cc/ZZZ2-AKLK>].

²⁵ SEBA B. SHEAVLY, SIXTH MEETING OF THE UN OPEN-ENDED INFORMAL CONSULTATIVE

come from ships and the fishing industry.²⁶ For instance, “cargo ships are increasingly carrying packing cases using small plastic pellets as stuffing, which are dispersed across the oceans when drum-loads or even container loads are lost at sea.”²⁷

There are four major categories of sources of plastic pollution: (i) “[t]ourism related litter at the coast”; (ii) “[s]ewage-related debris”; (iii) “[f]ishing related debris”; and (iv) “[w]astes from ships and boats.”²⁸ However, as indicated, most of the plastic waste in the regional seas and oceans come from land-based sources:

Plastic is blown off the streets and garbage dumps, from garbage trucks and freight trains, to end up in streams, rivers, gullies, and, ultimately, in the sea. The tides draw it out to sea, where the currents catch it and transport it to the vortex and there it rotates like in a toilet that is never flushed.²⁹

Among all the applications of plastics, packaging is the greatest, representing 26% of the total volume of plastic used.³⁰ Nevertheless, it is also clear that other sources, such as electronic waste, electrical equipment, and vehicles, are becoming very significant.³¹

Regarding the geographical sources, the numbers vary from region to region and studies get outdated fast due to the continuous increase of plastic production and pollution.³² Even so, it is possible to obtain an idea of the whole picture and understand why there is a consensus around the gravity of the situation.

Obviously, the most important source of plastic pollution is the production of plastic itself. In 2012, European countries produced 45.9

PROCESSES ON OCEANS & THE LAW OF THE SEA 4 (June 6–10, 2005), http://www.un.org/depts/los/consultative_process/documents/6_sheavly.pdf [<https://perma.cc/T299-9SAB>].

²⁶ *Id.* at 2.

²⁷ GREENPEACE, *supra* note 9.

²⁸ GREENPEACE, PLASTIC DEBRIS IN THE WORLD’S OCEANS 6, http://www.greenpeace.org/international/Global/international/planet-2/report/2007/8/plastic_ocean_report.pdf [<https://perma.cc/4NF7-FNWK>] (last visited Apr. 3, 2019).

²⁹ Peter Haffner, *Eine Ahnung von Apokalypse*, NZZ FOLIO (July 2009), <https://folio.nzz.ch/2009/juli/eine-ahnung-von-apokalypse> [<https://perma.cc/5KNF-KUEQ>].

³⁰ ELLEN MACARTHUR FOUNDATION, *supra* note 6, at 17.

³¹ Jefferson Hopewell et al., *Plastics Recycling: Challenges and Opportunities*, 364 PHIL. TRANSACTIONS ROYAL SOC. LONDON 2115, 2115 (2009).

³² *Id.*

megatons of polymer, of which 40% consisted of packaging, 22% appliances, furniture, sport, health etc., 20% building and construction, 8% automobile, and 5% electrical and electronic equipment.³³ The use of plastic materials in Western Europe reached about 100kg per capita per year in 2005.³⁴ North America reached the same amount, whereas in Asian countries it was 20kg per capita per year.³⁵

Yet, as mentioned above, the great variety of polymers, their properties and versatility, together with the low price, allow for the continued growth of plastic production and use.³⁶ Worse, it leads to the growth of single-use disposable plastics.³⁷ Approximately 50% of plastics are used for single-use disposable applications, such as packaging, agricultural films, and disposable consumer items.³⁸ “Only between 20 and 25% is usable in long-term infrastructure such as pipes, cable coatings, and structural materials”; the remainder is used for “durable consumer applications with intermediate lifespan such as in electronic goods, furniture, vehicles, etc.”³⁹

This increase in addition to low quantities of reuse or recycling, leads to the need for great amounts of virgin feedstocks.⁴⁰ For instance, packaging alone meant a global annual production of 78 million tons in 2013,⁴¹ from which 98% was derived from virgin feedstocks,⁴² and 32% escaped the collection system.⁴³ If we take the more specific case of polyethylene terephthalate (“PET”) bottles—the second largest category of plastic packaging used globally—“just 14% of this plastic packaging is recycled globally, whilst a third of it escapes collection entirely, leaving it to pollute streets, beaches, and oceans.”⁴⁴

³³ VALAVANIDIS & VLACHOGIANNI, *supra* note 5, at 3.

³⁴ See P.C.H. HOLLMAN ET AL., MICROPLASTICS IN THE AQUATIC FOOD CHAIN: SOURCES, MEASUREMENT, OCCURRENCE AND POTENTIAL HEALTH RISKS 8 (2013), <http://edepot.wur.nl/260490> [<https://perma.cc/47QT-MB3J>].

³⁵ *Id.*

³⁶ Hopewell et al. *supra* note 31, at 2115.

³⁷ *See id.*

³⁸ *Id.*

³⁹ *Id.*

⁴⁰ ELLEN MACARTHUR FOUNDATION, *supra* note 6, at 17.

⁴¹ *Id.* at 27.

⁴² *Id.*

⁴³ *Id.* at 15.

⁴⁴ GREENPEACE, BOTTLING IT: THE FAILURE OF MAJOR SOFT DRINK COMPANIES TO ADDRESS OCEAN PLASTIC POLLUTION 3, https://storage.googleapis.com/gpuk-static/legacy/Bottling-It_FINAL.pdf [<https://perma.cc/BJ5Y-RM4T>] (last visited Apr. 3, 2019).

That explains why packaging and PET bottles are among the most fought-over sources of plastic pollution. However, there are also other great efforts to fight pollution from straws,⁴⁵ laundry,⁴⁶ and cosmetics.⁴⁷

Regarding geographical sources, there is still a gap in academic research. A recent study⁴⁸ showed, however, that ten rivers are responsible for 88 to 95% of the plastic going into the oceans.⁴⁹ Out of those ten, eight are in Asia.⁵⁰ Even considering the complexity in the data on plastic pollution in the oceans and its causes, the data reveal another important aspect to the international debates: the North-South tension.⁵¹ Although a discussion of this issue is not within the scope of this Article, we highlight it as an aspect that will have to be considered regardless of the path chosen to fight plastic pollution of the oceans.

⁴⁵ See *Top Reasons to Go Plastic Straw Free*, STRAW FREE, https://strawfree.org/top_reasons_to_go_straw_free/ [<https://perma.cc/753Q-8A9X>] (last visited Apr. 3, 2019). Even where there are recycling initiatives, straws usually are thrown out together with the rest of the trash. This means that straws end up in landfills, where wind easily blows them away and they reach the oceans. Moreover, huge numbers of plastic straws are used. In the United States alone, people use 500 million plastic straws every day. *Id.*

⁴⁶ See *Ocean Clean Wash*, PLASTIC SOUP FOUNDATION, <https://www.plasticsoupfoundation.org/en/psf-in-action/ocean-clean-wash/> [<https://perma.cc/W6UP-A4Q9>] (last visited Apr. 3, 2019). Laundering releases millions of tiny synthetic fibers into the water, and due to their small size, most get by traditional water treatment plants, so all of us inadvertently contribute to this rapidly growing environmental problem. *Id.*

⁴⁷ See H.A. LESLIE, REVIEW OF MICROPLASTICS IN COSMETICS: SCIENTIFIC BACKGROUND ON A POTENTIAL SOURCE OF PLASTIC PARTICULATE MARINE LITTER TO SUPPORT DECISION-MAKING 17 (2014), https://science.vu.nl/en/Images/Plastic_ingredients_in_Cosmetics_07-2014_FINAL_tcm296-409859.pdf [<https://perma.cc/MZN2-K3CM>]. At least thirty different types of polymers appear in the European Union Cosmetic Ingredient “CosIng” Database, and they have all kinds of properties useful for the industry, such as bulking, viscosity controlling, hair fixatives, abrasives, and so on. These are tiny particles of plastics, which are released into washing water and end up directly in the oceans because they slip undetected through the water treatment plants. *Id.*

⁴⁸ See Christian Schmidt et al., *Export of Plastic Debris by Rivers into the Sea*, 51 ENVTL. SCI. & TECH. 12246 (2017).

⁴⁹ *Id.*

⁵⁰ *Id.* at 12250 (“Of the 10 catchments delivering the highest loads [of plastics] to the ocean, 8 are located in Asia, with mostly middle-income countries such as China . . . where high rates of MMPW [mismanaged plastic waste] generation prevail.”).

⁵¹ See *Mismanaged plastic waste*, OUR WORLD IN DATA, <https://ourworldindata.org/plastic-pollution#mismanaged-plastic-waste> [<https://perma.cc/K5FP-RDA8>] (last visited Apr. 3, 2019); *Mismanaged plastic by region*, OUR WORLD IN DATA, <https://ourworldindata.org/plastic-pollution#mismanaged-plastic-by-region> [<https://perma.cc/VUM7-FVMM>] (last visited Apr. 3, 2019). See also Jeffrey J. Minneti, *Environmental Governance and the Global South*, 43 WM. & MARY ENVTL. L. & POL’Y REV. 83, 85 n. 9 (2018) and accompanying text (discussing the differences between global North and global South contribution to environmental degradation and the corresponding political tension stemming from regulation of global South actors).

B. Where Is Plastic Going in the Oceans?

As with waste in general, plastics that go out of use can be recycled, incinerated, or end up in landfills or in nature. Because the focus of this Article is the plastic soup, its aim is to describe the destination of plastics on the high seas,⁵² thus allowing a perception of the kind, amount, and paths of such pollution.⁵³

The most known destination of plastic waste in the ocean is the North Pacific Gyre.⁵⁴ This concentration of garbage in the North Pacific is due to the vortex created there by ocean currents.⁵⁵ It consists of a subtropical gyre that covers a large area of the Pacific, in which water circulates clockwise in a slow spiral and that pushes any floating material into its center.⁵⁶ The winds and the rotation of the Earth and the ocean currents in the high-pressure zone of the North Pacific Gyre form this enormous vortex that attracts flotsam from the coasts of Japan and China, as well as from the Pacific coast of Mexico, the United States, and Canada.⁵⁷ This means that something entering into the sea at the beach in San Francisco is carried by the California, North Equatorial, and Kuroshio currents until it lands in the garbage patch one year later.⁵⁸

Nonetheless, there are four other vortexes where plastic concentrates because of circulating ocean currents: the South Pacific, the Indian Ocean, the North Atlantic, and the South Atlantic Gyres.⁵⁹ They are in subtropical areas, above and below the Equator, and all of them have higher concentrations of plastic rubbish compared to other parts of the oceans.⁶⁰ In the North Atlantic Gyre, 20,328 pieces of plastic were found per square

⁵² As an example, see generally S. Galgani et al., *Distribution and Abundance of Debris on the Continental Shelf of the North-Western Mediterranean*, 30 MARINE POLLUTION BULLETIN 713 (1995). There are hotspots in other waters as well. These include the Mediterranean Sea, the Black Sea, and the Baltic Sea. Heavy plastic pollution can be observed, *inter alia*, in bays lined with large cities, bays into which plastic floats and remains, river mouths, coastlines where industries are situated, and places or islands where different ocean currents congregate. Shipping lanes and fishing areas are other zones where high concentrations of debris are found. *Id.*

⁵³ *Id.*

⁵⁴ See generally GREENPEACE, *supra* note 9.

⁵⁵ *Id.*

⁵⁶ *Id.*

⁵⁷ Haffner, *supra* note 29.

⁵⁸ *Id.*

⁵⁹ PLASTIC SOUP FOUNDATION, *supra* note 12.

⁶⁰ *Id.*

kilometer, compared to the North Pacific Gyre, where 334,271 pieces per square kilometer were found.⁶¹

Other than that, marine litter is distributed along water columns, seabeds, and beaches and shores.⁶² In the water column, more litter is transported horizontally and vertically with most of it floating on, or close to, the water surface—90% are light plastics or related polymer items.⁶³ Of the heavier components 70% go to the seabed, 15% deposit on beaches and shores worldwide, and the other 15% float in the ocean.⁶⁴

Speaking about a more general framework, a comparison between studies shows that plastic pollution affects the Pacific and Atlantic Oceans equally.⁶⁵ In the meantime, a North-South analysis shows that the South Atlantic and Southern Ocean values are lower than those reported from the North Pacific Ocean, except around the United Kingdom.⁶⁶ Densities of floating debris are also lower in the North Atlantic compared with equivalent values for the North Pacific and Caribbean Atlantic.⁶⁷ Finally, there is a trend of a tropics-to-poles decrease at a 3 items/km² rate, such that the lowest quantities of plastics are found towards the poles.⁶⁸

A large review of the literature from 1990 to 2005 allows for a comparison between regions.⁶⁹ Analyzing the data, despite the time difference of when the studies were held, it is possible to confirm the general statement that debris distribution is ubiquitous around the world, and that latitude plays an important role in the density of plastic pollution.⁷⁰ Specially, floating debris tends to move towards mid-latitudes, meaning higher concentrations in those areas in comparison to areas near the poles.⁷¹

⁶¹ *Id.*

⁶² *Marine Litter*, UNITED NATIONS ENV'T PROGRAMME (2005), https://www.un.org/depts/los/consultative_process/documents/6_guchte.pdf [<https://perma.cc/H46Y-QKMY>].

⁶³ *Id.*

⁶⁴ *Id.*

⁶⁵ D. Barnes & P. Milner, *Drifting Plastic and its Consequences for Sessile Organism Dispersal in the Atlantic Ocean*, 146 *MARINE BIOLOGY* 815, 822 (2005).

⁶⁶ *Id.*

⁶⁷ *Id.*

⁶⁸ *Id.*; still, plastics are found in the Arctic ice, for example. See, e.g., Matthew Taylor, *Record levels of plastic discovered in Arctic sea ice*, *THE GUARDIAN* (Apr. 24, 2018), <https://www.theguardian.com/environment/2018/apr/24/recordlevels-of-plastic-discovered-in-arctic-sea-ice> [<https://perma.cc/SZ8D-BXG3>].

⁶⁹ See generally GREENPEACE, *supra* note 28, at 23.

⁷⁰ *Id.*

⁷¹ *Id.*

Nonetheless, the volume at the north gyres, and especially at the North Pacific, are larger.⁷² This occurs, presumably, because of the North Pacific's vast area and because of the large inputs of plastic waste from the coastlines of Asia and the United States.⁷³ Other factors that influence the type and amount of debris present include proximity to urban centers, industrial centers, and recreational areas.⁷⁴

Lastly, a recent study highlights a major concern: although the numbers are already alarming, they may be underestimating the real scenario.⁷⁵ Van Sebille and others⁷⁶ explain that the data standardization that is most commonly used may lead to a miscalculation.⁷⁷ This, together with variation in data collection, sample analysis, count-to-mass conversions, and model designs, lead to their conclusions that indicate there are much larger amounts of plastics debris in the oceans than what has been calculated before.⁷⁸

C. *Consequences for Nature and Human Health*

The consequences of all that pollution are innumerable, starting with visible debris, especially with plastics that end up in the shore or with the floating pollution, which already damages human health and the natural environment.⁷⁹ Then, plastics have a direct influence on animal health and impact the food chain, ranging from plankton to human consumption.⁸⁰

Among the specific dangers to marine life, there are the threats of entanglement, ingestion, destruction or smothering of the seabed (including coral reefs and sea-grasses), and transportation of invasive species.⁸¹ Species encounter marine litter through ingestion (32.61%), entanglement (23.88%), colonization (38.73%), coverage (2.5%), and other (2.28%), and reports already show 2,249 species affected.⁸²

⁷² Erik van Sebille et al., *A Global Inventory of Small Floating Plastic Debris*, 10 ENVTL. RES. LETTER 1240006 at 9 (2015).

⁷³ *Id.*

⁷⁴ SHEAVLY, *supra* note 25, at 1.

⁷⁵ van Sebille et al., *supra* note 72, at 9–10.

⁷⁶ *See generally id.*

⁷⁷ *Id.*

⁷⁸ *Id.*

⁷⁹ Andrew Dilevics, *How Ocean Pollution Affects Humans*, PLANET AID (Mar. 24, 2016), <http://www.planetaid.org/blog/how-ocean-pollution-affects-humans> [<https://perma.cc/8CDL-SE2B>].

⁸⁰ *Id.*

⁸¹ *Marine Litter*, *supra* note 62.

⁸² Mine B. Tekman et al., *2,249 species are affected by litter (1,188 publications)*, LITTER-BASE, http://litterbase.awi.de/interaction_graph [<https://perma.cc/FPZ3-HQ8M>] (last visited Apr. 3, 2019).

The effects harm all kinds of aquatic animals. Seabirds are the second most affected, representing 18.45% of all affected species.⁸³ According to a United Nations Environment Programme (“UNEP”) report, a million seabirds die every year because they mistake plastic for food.⁸⁴ All kinds of waste are found inside dead animals around the world, and they usually starve to death with a stomach full of plastic.⁸⁵ Moreover, hundreds of thousands of marine mammals and turtles die in fishing nets or grow up crippled.⁸⁶ One of the most famous cases was of “Mae West,” a turtle whose shell was constricted at the middle by a plastic ring.⁸⁷

Another serious consequence perpetrated by plastic pollution is the spread of toxic materials.⁸⁸ For example, plastic acts like a sponge for polychlorinated biphenyls (“PCBs”) and other toxins.⁸⁹ PCBs were banned during the 1970s, “after the appearance of hermaphrodite fish and after polar bears showed the damage they cause to animals’ hormonal balance.”⁹⁰ Still, plastic produced before this time will continue to contaminate the oceans.⁹¹

A study from 2005⁹²—or, in other words, just over three decades after the ban of PCBs—determined that, although heterogeneous, plastic pellets are highly contaminated by PCBs, even in remote areas.⁹³ Similarly, a study from 2013⁹⁴ demonstrated that, even though heterogeneous, there is still much contamination by polycyclic aromatic hydrocarbons (“PAHs”) within plastic pellets.⁹⁵

Aggravating the problem, more than one third of lantern fish have plastic particles contaminated with toxins in their stomachs.⁹⁶ This happens because this fish eats zooplankton, but, in their haste, the fish snap at

⁸³ *Id.*

⁸⁴ Haffner, *supra* note 29.

⁸⁵ *Id.*

⁸⁶ *Id.*

⁸⁷ *Id.*

⁸⁸ *Id.*

⁸⁹ *Id.*

⁹⁰ Haffner, *supra* note 29.

⁹¹ *Id.*

⁹² See S. Endo et al., *Concentration of Polychlorinated Biphenyls (PCBs) in Beached Resin Pellets: Variability Among Individual Particles and Regional Differences*, 50 MARINE POLLUTION BULLETIN 1103, 1103–14 (2005).

⁹³ *Id.*

⁹⁴ Mara Fisner et al., *Polycyclic aromatic hydrocarbons (PAHs) in plastic pellets: Variability in the concentration and composition at different sediment depths in a sandy beach*, 70 MARINE POLLUTION BULLETIN 219, 219–26 (2013).

⁹⁵ *Id.*

⁹⁶ Haffner, *supra* note 29.

everything they see, including microplastics.⁹⁷ Such a discovery shows the threat to the food chain.⁹⁸ At one point in time lantern fish were the most widespread fish in the ocean and the main food of tuna, swordfish, and dolphinfish.⁹⁹ The accumulation in the food chain makes plastic, pollution, and toxins land on our plates, the consequences of which are still unknown.¹⁰⁰

Therefore, even though the effects of the plastic soup are easier to identify in animals than in humans, there are many concerns regarding human health and safety. There are the immediate risks, especially because items such as medical waste, rope, and fishing line impose a direct risk to those enjoying or working on beaches and in the ocean.¹⁰¹ In addition, discarded syringes, condoms, and tampon applicators create serious water quality problems.¹⁰² Floating debris may also entangle swimmers, divers, and snorkelers.¹⁰³ Furthermore, medical and hygiene plastic debris often carry invisible pathogens, such as streptococci, fecal coliform, and other bacterial contamination, which can result in infectious hepatitis, diarrhea, bacillary dysentery, skin rashes, typhoid, and cholera.¹⁰⁴ More recently, scientists from Orb Media also found out that microplastics are even in tap water around the world.¹⁰⁵

So far, we have described the consequences of plastic waste ending up in the oceans. At the other end of the spectrum, there is the matter of the feedstocks: a major problem, since over 90% of the plastic produced derives from virgin fossil fuel feedstocks.¹⁰⁶ This represents approximately 6% of global oil consumption.¹⁰⁷ Just to make plastic bottles, every year we use 17 billion barrels of oil, which would be enough to fuel 1 million cars.¹⁰⁸ This is to say that the environmental impacts go further than the pollution caused by plastics themselves. In this example, the environmental harm related to plastics results from oil exploitation.

⁹⁷ *Id.*

⁹⁸ *Id.*

⁹⁹ *Id.*

¹⁰⁰ *Id.*

¹⁰¹ See Haffner, *supra* note 29.

¹⁰² *Id.*

¹⁰³ SHEAVLY, *supra* note 25, at 1.

¹⁰⁴ *Id.* at 3.

¹⁰⁵ Damian Carrington, *Plastic fibres found in tap water around the world, study reveals*, THE GUARDIAN (Sept. 5, 2017), <https://www.theguardian.com/environment/2017/sep/06/plastic-fibres-found-tap-water-around-world-study-reveals> [<https://perma.cc/3THB-EX6B>].

¹⁰⁶ ELLEN MACARTHUR FOUNDATION, *supra* note 6, at 12.

¹⁰⁷ *Id.*

¹⁰⁸ Plastic Pollution Coalition, *Open Your Eyes*, YOUTUBE (Mar. 28, 2016), <https://www.youtube.com/watch?v=9znvqIkIM-A> [<https://perma.cc/XK3J-M4U6>] (last visited Apr. 3, 2019).

As the manufacture of plastics also requires energy, its production is responsible for the consumption of a similarly large additional quantity of fossil fuels.¹⁰⁹ Consequently, there are implications for other environmental issues, such as global warming, and implications for marine life directly related to oil extraction.¹¹⁰ As this is not the focus of this Article, it will not be elaborated upon, but it has to be accounted for when referring to consequences of plastics to human health and marine life.

D. *Technical Solutions*

When the subject is solving environmental issues, some approaches are common ground, such as public awareness and the “6R’s” that attempt to create a circular economy.¹¹¹ In any of those, innovation is essential. We will present some examples of current initiatives. For all of the technical solutions, a starting point is obviously that there should be an awareness of the plastic pollution problem; otherwise, incentives to develop solutions will fail as well.¹¹² We will now review the “6R’s” as potential solutions to the plastic problem, and relate them to available—or under-developed—technology.

The first of the six “R’s” is repair, which extends the life of a product by repairing its parts.¹¹³ The second “R” is recondition, by which the life of a product is extended by significantly overhauling it.¹¹⁴ With the third “R,” remanufacture, the old products serve as base for new ones.¹¹⁵ All three can help diminish the amount of plastic that needs to be discarded, the majority of which end up in the oceans.¹¹⁶

Then, there is the fourth “R,” reuse.¹¹⁷ In that sense, a movement that is continuously growing is focused on refusing single-use plastics.¹¹⁸ For example, the Plastic Pollution Coalition “is a growing global alliance of individuals, organizations, businesses, and policymakers working toward a world free of plastic pollution and its toxic impact on humans, animals,

¹⁰⁹ Hopewell et al., *supra* note 31, at 2115.

¹¹⁰ *Id.* at 2120–21.

¹¹¹ MARK ANTHONY CAMILLERI, CORPORATE SUSTAINABILITY, SOCIAL RESPONSIBILITY AND ENVIRONMENTAL MANAGEMENT 177 (2017).

¹¹² *Id.* at 176.

¹¹³ *See id.* at 177.

¹¹⁴ *Id.*

¹¹⁵ *Id.*

¹¹⁶ *See id.*

¹¹⁷ CAMILLERI, *supra* note 111, at 177.

¹¹⁸ *See* PLASTIC POLLUTION COALITION, <http://www.plasticpollutioncoalition.org/> [<https://perma.cc/46PN-GJWF>] (last visited Apr. 3, 2019).

and the environment.”¹¹⁹ There are more than one hundred suggestions for living a plastic-free life, usually related to changing daily habits.¹²⁰

Among those changes, we highlight not using plastic straws and bringing your own bag because they lead to the fifth “R,” reducing.¹²¹ Discussed below are two initiatives that are trying to help solve the plastic problem which are closely related to the plastic-free movement. However, it is important to remember that there are other initiatives, from the more general, such as Costa Rica aiming to eliminate single-use plastics by 2021,¹²² to others with specific targets, such as the United Kingdom starting a ban on microplastics in cosmetic products.¹²³

The first of the two movements mentioned above is Be Straw Free. It started in 2011 when a nine-year-old asked for a soda in a restaurant and it came with a straw.¹²⁴ Indignant with the waste of plastic, Milo Cress not only refused his straw, but also went to the restaurants of his city and asked them not to give straws unless customers asked for them.¹²⁵ The campaign has shown some results: it reached Walt Disney World’s Animal Kingdom and the food concession areas of the Smithsonian Institution museums.¹²⁶ Even a managing director for plastics markets at the American Chemistry Council said in a *National Geographic* article that the group would attempt to eliminate plastic straws, although a spokesperson said they would not be able to comment.¹²⁷ However, the movement grew quickly in 2015, when a video showing the removal of a straw from a turtle’s nose went viral on YouTube.¹²⁸

¹¹⁹ *Id.*

¹²⁰ See generally BETH TERRY, PLASTIC-FREE: HOW I KICKED THE PLASTIC HABIT AND HOW YOU CAN TOO (2015).

¹²¹ CAMILLERI, *supra* note 111, at 177.

¹²² Kristine Lofgren, *Costa Rica aims to become the first country to ban all single-use plastics*, INHABITAT (Aug. 7, 2017), <https://inhabitat.com/costa-rica-aims-to-become-the-first-country-to-ban-all-single-use-plastics/> [<https://perma.cc/QH7W-KYRD>].

¹²³ Ian Johnston, *Microbeads Ban: Government to outlaw microplastics in cosmetic products*, THE INDEPENDENT (July 21, 2017), <https://www.independent.co.uk/environment/microbeads-ban-bill-uk-cosmetic-products-government-outlaws-microplastics-a7852346.html> [<https://perma.cc/SBF8-29JY>].

¹²⁴ Darryl Fears, *A Campaign to Eliminate Plastic Straws is Sucking in Thousands of Converts*, WASH. POST (June 24, 2017), https://www.washingtonpost.com/national/health-science/a-campaign-to-eliminate-plastic-straws-is-sucking-in-thousands-of-converts/2017/06/24/d53f70cc-4c5a-11e7-9669-250d0b15f83b_story.html?utm_term=.1545b56024d7 [<https://perma.cc/YZ2V-JP4B>].

¹²⁵ *Id.*

¹²⁶ *Id.*

¹²⁷ *Id.*

¹²⁸ *Id.*

Regarding the second movement, the efforts to abolish single-use plastic bags are increasing, although they are mostly still in the planning stage.¹²⁹ Numerous news and data collection groups are trying to map the attempts and advances in that sense.¹³⁰ The Kenya case is attracting a lot of attention because making, selling, or using a plastic bag is now a crime in the country, and those who disobey may face imprisonment or fines that may reach \$40,000.00.¹³¹ This law—the toughest in the world—has made headlines worldwide,¹³² but many countries already have legislation to partially or completely ban single-use plastic bags, such as France, Belgium, Denmark, Morocco, Italy, Mauritania, China, Australia, Canada, Brazil, and many others.¹³³

The plastic bag example also reinforces the importance of public awareness. Although initiatives against plastic bags have grown, and despite knowing that plastic bags are one of the biggest villains of the environment, resistance to change is still a major issue.¹³⁴ In Brazil, for instance, bans are still partial and localized because bans are decentralized

¹²⁹ See *Where Plastic Bags Are Banned Around the World?*, REUSETHISBAG (2019), <https://www.reusethisbag.com/articles/where-are-plastic-bags-banned-around-the-world/> [<https://perma.cc/TKP5-T6JC>].

¹³⁰ See *id.*

¹³¹ Katherine Houreld & John Ndiso, *Kenya imposes world's toughest law against plastic bags*, REUTERS (Aug. 28, 2017), <https://af.reuters.com/article/africaTech/idAFKCN1B80PH-OZATP> [<https://perma.cc/V3K7-PBXR>].

¹³² See *id.*; Karla Lant, *Kenya just banned plastic bags—and the fine is up to \$38,000 and jail time*, BUSINESS INSIDER (Aug. 29, 2017), <http://www.businessinsider.com/kenya-just-banned-plastic-bags-2017-8?international=true&r=US&IR=T> [<https://perma.cc/4LPB-HTTP>]; Matt Hickman, *Kenya enacts world's toughest plastic bag ban*, MNN (Aug. 30, 2017, 8:27 AM), <https://www.mnn.com/lifestyle/recycling/blogs/kenya-enacts-worlds-toughest-plastic-bag-ban> [<https://perma.cc/N3M2-XP6M>]; Lorraine Chow, *Kenya Enforces World's Toughest Law Against Plastic Bags*, ECOWATCH (Aug. 30, 2017, 9:14 AM), <https://www.ecowatch.com/kenya-plastic-bag-ban-2478631203.html> [<https://perma.cc/X9QH-MXEN>]; Kevin Lui, *Violators of Kenya's Tough New Plastic Bag Law Could Get Four Years Behind Bars*, TIME (Aug. 28, 2017), <http://time.com/4919720/kenya-plastic-bag-law-jail-fines/> [<https://perma.cc/9T3T-CYMK>]; *Produzir ou usar sacolas plásticas no Quênia poderá levar à prisão*, O GLOBO (Aug. 28, 2017), <https://oglobo.globo.com/sociedade/sustentabilidade/produzir-ou-usar-sacolas-plasticas-no-kenia-podera-levar-prisao-21755715> [<https://perma.cc/7NSN-QE8C>]; *Hasta cuatro años de cárcel por usar bolsas de plástico en Kenia*, EL PAÍS (Sept. 1, 2017), https://elpais.com/elpais/2017/08/31/album/504192893_734936.html#1504192893_734936_1504200196 [<https://perma.cc/UZ3Q-S7G5>].

¹³³ G. Cabrera, *Countries with Plastic Bag Bans*, ABC (Aug. 28, 2017), <http://www.abc.net.au/news/2017-08-28/countries-with-plastic-bag-bans/8850284> [<https://perma.cc/9PZJ-5MFC>].

¹³⁴ Paola Lima, *Sacola Plástica é uma das Maiores Vilãs do meio Ambiente*, SENADO (Apr. 19, 2016), <http://www12.senado.leg.br/noticias/materias/2016/04/19/sacola-plastica-e-uma-das-maiores-vilas-do-meio-ambiente> [<https://perma.cc/Q388-KEXT>].

and only found in particular regional areas.¹³⁵ In Brazil, cities like Belo Horizonte and Sao Paulo already have regulation against the distribution of plastic bags in supermarkets.¹³⁶ On the other hand, in the Metropolitan Area of Vitoria, the government went back on laws because people were unwilling to obey them, and in the city of Rio de Janeiro, the law is inefficient.¹³⁷ Similarly, at the national level, there are two legislative proposals, dating from 2011 and 2012, with which Congress still has to deal.¹³⁸

These examples clearly warn of the challenges related to regulatory frameworks. From passing a proposal until its enforcement, there are many influences and obstacles involved.¹³⁹ That implies that the well-known problem of efficacy in law is of great concern to solutions to the plastic pollution problem, where identifying precise influences, causes, and consequences is even more challenging.¹⁴⁰

The last “R” is recycling, meaning that “products can be reprocessed and converted into raw material to be used in another or the same product.”¹⁴¹ Recycling includes four categories: “primary (mechanical reprocessing into a product with equivalent properties), secondary (mechanical reprocessing into products requiring lower properties), tertiary (recovery of chemical constituents), and quaternary (recovery of energy).”¹⁴² This is even more complex in the case of plastics, which are mixed with other products or pigmented in a way that may interfere with the recycling process.¹⁴³

¹³⁵ Prakash Jha, *Decentralization and Federalism in Brazil*, 68 INDIAN J. OF POL. SCI. 157, 157 (2007).

¹³⁶ Lima, *supra* note 134.

¹³⁷ See *Sacolas plásticas voltam a ser distribuídas gratuitamente em supermercados de Vila Velha*, FOLHA VITORIA (July 25, 2012), <http://www.folhavitoria.com.br/politica/noticia/2012/07/sacolas-plasticas-voltam-a-ser-distribuidas-gratuitamente-em-supermercados-de-vila-velha.html> [<https://perma.cc/TE7N-PW3Z>]; Daiane Costa, *Lei contra sacolas plásticas não pega no Rio*, O GLOBO (Apr. 15, 2015), <https://oglobo.globo.com/economia/defesa-do-consumidor/lei-contra-sacolas-plasticas-nao-pega-no-rio-15876913> [<https://perma.cc/2BWX-6ZB5>].

¹³⁸ PL 1103/2011, de 14 de Abril de 2011; PL 1494/202, de 11 de Julho de 2012 (proposed statute not in force).

¹³⁹ See Anna Flavia Roches, *Brazil's Sao Paulo launches plastic bag restrictions, fines*, POLIS INSTITUTE (Apr. 9, 2015), http://polis.org.br/wp-content/uploads/Beth_plastic_news.pdf [<https://perma.cc/99V6-2RJB>] (describing how Sao Paulo's plastic bag ban took over three years to take effect due to legal and political challenges).

¹⁴⁰ *See id.*

¹⁴¹ CAMILLERI, *supra* note 111, at 177.

¹⁴² Hopewell et al., *supra* note 31, at 2118.

¹⁴³ Tom Szaky, *The Many Challenges of Plastic Recycling*, SUSTAINABLE BRANDS (2016), <https://sustainablebrands.com/read/waste-not/the-many-challenges-of-plastic-recycling> [<https://perma.cc/3NHJ-5WW5>].

All of the possibilities described above are parts of the solution, but, as is evident, they are not enough.¹⁴⁴ Innovation plays a big role in trying to keep pace with plastic pollution.¹⁴⁵

As a first example, there is scientific research to improve existing processes.¹⁴⁶ Plastic and resource consultant Nextek has come up with a new pigment to replace carbon black, since this is not identifiable by infrared sensor in sorting facilities, making it difficult to recycle.¹⁴⁷ Moreover, scientists from the University of Bath developed biodegradable cellulose microbeads that may be used to replace those made from plastic in cosmetics.¹⁴⁸

Solving packaging, and mainly water bottles, is a common concern.¹⁴⁹ We highlight in that sense innovative solutions aimed at edible packaging.¹⁵⁰ A British startup created an edible bubble that explodes in the mouth of the drinker, allowing the drinker to consume the water inside it normally.¹⁵¹ These Ooho Bubbles can keep the water inside because of a thin membrane made of natural sugar extract, and if they are not consumed within four weeks, they completely biodegrade.¹⁵² Another edible packaging solution is being developed by the biomedical engineer David Edwards.¹⁵³ The bottles would be made of biodegradable material and have a taste close to the beverage.¹⁵⁴ Similarly, Ari Jonsson, an Icelandic student, found a way to make plastic bottles from seaweed, which may also be eaten after use and, if not, the empty bottle starts to degrade.¹⁵⁵

¹⁴⁴ See CAMILLERI, *supra* note 111, at 175–76.

¹⁴⁵ See Sarah LeBrecque, *6 problematic plastic products and the companies finding solutions*, THE GUARDIAN (June 28, 2017), <https://www.theguardian.com/suez-circular-economy-zone/2017/jun/28/6-problematic-plastic-products-and-the-companies-finding-solutions> [<https://perma.cc/C4DP-JZHL>].

¹⁴⁶ *Id.*

¹⁴⁷ *Id.*

¹⁴⁸ *Id.*

¹⁴⁹ See Daiana Geremias, *Bolhas de agua Cosmetivas Podem Substituir Garrafas Plásticas*, TECMUNDO (Apr. 13, 2017), <https://www.tecmundo.com.br/curiosidade/115821-bolhas-agua-comestiveis-substituir-garrafas-plasticas.htm> [<https://perma.cc/8Z9L-C5G3>].

¹⁵⁰ See *id.* (advocating for the use of edible water packaging to replace disposable plastic water bottles).

¹⁵¹ *Id.*

¹⁵² *Id.*

¹⁵³ Renan Hamann, *No futuro voce vai beber o refrigerante e comer a garrafa*, TECMUNDO (Feb. 23, 2012), <https://www.tecmundo.com.br/ciencia/19705-no-futuro-voce-vai-beber-o-refrigerante-e-comer-a-garrafa.htm> [<https://perma.cc/F66K-HCF2>].

¹⁵⁴ *Id.*

¹⁵⁵ *Estudante usa alga para criar Garrafa de Agua Biodegradavel*, PENSAMENTO VERDE (Apr. 1, 2016), <https://www.pensamentoverde.com.br/atitude/estudante-usa-alga-para-criar-garrafa-de-agua-biodegradavel/> [<https://perma.cc/4NH5-HN6P>].

Those innovative solutions described so far focus on the *ex ante* perspective—before the plastics pollute the ocean.¹⁵⁶ Many studies also concentrate on the *ex post* perspective—recovering the plastics after they have polluted the ocean—even though we are still far from a real solution; there are possible removal processes, but their rates of success are essentially unknown.¹⁵⁷

Some studies demonstrate what may be expected.¹⁵⁸ Depending on the species of the seabird, for example, removal of plastic from stomach content can be quite rapid if exposure to plastic stops.¹⁵⁹ This is particularly important because microplastics might fragment to undetectable sizes, sink, be deposited on shorelines, or be ingested and subsequently reduced in size (e.g., due to digestive grinding) and/or transported to land or the sea floor upon egestion.¹⁶⁰ This indicates that the challenge of removing plastic from the environment is huge and diverse, but may depend on how fauna can recover from damage once exposure ceases.

Although the first news may appear optimistic, the amount of work to be done to even diagnose the extent of the problem and then deal with it is still enormous. Science is only beginning to determine its impact.

Here we describe some advances in removing plastics from the ocean.¹⁶¹ The first one is the discovery, in Japan in 2016, of a bacteria that is capable of completely decomposing PET plastic.¹⁶² Before that, the only description of a species interacting with PET was of two filamentous fungi that could grow in mineral mediums containing PET, and even the substances capable of hydrolyzing PET are very few.¹⁶³ The bacteria

¹⁵⁶ See *id.*; Geremias, *supra* note 149; Hamann, *supra* note 153.

¹⁵⁷ See Peter Sherman & Erik van Sebille, *Modeling marine surface microplastic transport to access optimal removal locations*, ENVIRON. RES. LETT. 11 (2016).

¹⁵⁸ See Jan van Franeker & Kara Lavender Law, *Seabirds, Gyres and Global Trends*, 203 ENVTL. POLLUTION 89, 91 (2013).

¹⁵⁹ *Id.*

¹⁶⁰ van Sebille et al., *supra* note 72, at 10.

¹⁶¹ We are also aware of other similar initiatives, such as the larvae that eat polyethylene, but we selected two that have been well-studied. In the case of the larvae, for example, the precise side effects and other secondary results are still unknown. *Plastic-eating caterpillars could save the planet: an escape from a shopping bag triggers an idea*, THE ECONOMIST (Apr. 29, 2017), <https://www.economist.com/news/science-and-technology/21721328-escape-shopping-bag-triggers-idea-plastic-eating-caterpillars-could?fsrc=scn/fb/te/bl/ed/moth-eatenplastic-eating-caterpillars-could-save-the-planet> [<https://perma.cc/MY87-WG32>].

¹⁶² *Cientistas descobrem bactéria capaz de desintegrar plástico de garrafa PET*, G1 (Mar. 3, 2016), <http://g1.globo.com/natureza/noticia/2016/03/cientistas-descobrem-bacteria-capaz-de-desintegrar-plastico-de-garrafa-pet.html> [<https://perma.cc/4RW7-ZU6D>].

¹⁶³ Shosuke Yoshida et al., *A bacterium that degrades and assimilates poly(ethylene terephthalate)*, 351 SCIENCE 1196, 1196 (2016).

ideonella sakaienses adheres to PET and secretes PETase, and also achieves an intermediate reaction, leading to an efficient conversion of PET into its environmentally benign monomers.¹⁶⁴ A group of scientists used an RNA sequence to identify the enzymes responsible for PET degradation.¹⁶⁵

Two other young scientists are researching a similar subject, but are instead focused on creating a genetically modified bacterium that can break down plastics eighty times faster than the current best known organism.¹⁶⁶ The chemical products of the reaction are water and CO₂, and the resulting cell bacteria may be used to feed fish.¹⁶⁷

Another approach is the one used by The Ocean Cleanup, a non-governmental organization whose plans are to clean 50% of the Great Pacific Garbage Patch (the North Pacific Gyre) in five years with the full-scale deployment of their technological systems.¹⁶⁸ Boyan Slat, founder and CEO of The Ocean Cleanup, has an idea to use the concentration of plastics due to ocean currents and apply the technology he developed.¹⁶⁹ A continuous hard-walled floating pipe made from high density polyethylene would autonomously stay in the gyre.¹⁷⁰ Real-time telemetry coupled with algorithms would allow one to monitor condition, performance and trajectory, as well as to determine optimal deployment locations.¹⁷¹

The Ocean Cleanup plans to start the Pacific clean-up by 2018 and scale up globally by 2020.¹⁷² In order to do so, the non-governmental organization is preparing the first clean-up system deployment, finalizing

¹⁶⁴ *Id.* at 1196–97.

¹⁶⁵ *Id.* At 1198.

¹⁶⁶ Knowledge@Wharton High School, *Biotech Innovation That Breaks Down Plastic and Feeds the Fish*, THE WHARTON SCHOOL (Mar. 10, 2016), <https://kwhs.wharton.upenn.edu/2016/03/biotech-innovation-that-breaks-down-plastic-and-feeds-the-fish/> [<https://perma.cc/PL45-J83Q>].

¹⁶⁷ *Id.*; *Estudantes criam bactéria que come plástico dos oceanos e o transforma em água*, INSTITUTO DE MICROBIOLOGIA PAULO DE GÓES, <http://www.microbiologia.ufrj.br/portal/index.php/pt/destaques/novidades-sobre-a-micro/443-estudantes-criam-bacteria-que-come-plastico-dos-oceanos-e-o-transforma-em-agua> [<https://perma.cc/MGB7-CU25>] (last visited Apr. 3, 2019).

¹⁶⁸ *The Largest Cleanup in History*, THE OCEAN CLEANUP, <https://www.theoceancleanup.com/> [<https://perma.cc/QM3D-JLQB>] (last visited Apr. 3, 2019).

¹⁶⁹ *Boyan Slat Bio*, BOYAN SLAT, <http://www.boyanlat.com/> [<https://perma.cc/A3M8-VYB8>] (last visited Apr. 3, 2019).

¹⁷⁰ *Technology: How it Works*, THE OCEAN CLEANUP, <https://www.theoceancleanup.com/technology/> [<https://perma.cc/QM3D-JLQB>] (last visited Apr. 3, 2019) (noting the existence of a pipe to contain waste during clean-up efforts).

¹⁷¹ *Id.*

¹⁷² *Milestones*, THE OCEAN CLEANUP, <https://www.theoceancleanup.com/milestones/> [<https://perma.cc/FXT6-6RFH>] (last visited Apr. 3, 2019).

detailed engineering, and testing system components.¹⁷³ To get to this point, the institution organized a crowdfunding project, produced the first high-resolution map of the Great Pacific Garbage Patch, tested a scale model, launched a prototype, and did an aerial expedition.¹⁷⁴

Naturally, this is not an exhaustive description of all the attempts around the world,¹⁷⁵ but it demonstrates the challenge, the innumerable possibilities, and the road ahead. Finally, we did not address to what extent it is possible to facilitate the implementation of these solutions with legal rules. That is one of the issues we wish to discuss in the last section of this Article. We now examine to what extent the plastic pollution problem has been addressed in international law.

II. INSTRUMENTS UNDER HARD LAW

In this section of the Article we will first review potential international (hard) law instruments that could have some relevance for the plastic soup problem. Of course, we will address those instruments in a problem-oriented way. This implies that we are not going to discuss every amendment or protocol which may have changed the original instrument. A list of all conventions, multilateral instruments, and amendments under the scope of the International Maritime Organization (“IMO”), as of July 10, 2017, is available on the IMO website.¹⁷⁶ That list of course contains instruments not considered in this research because they are not related to plastic pollution. Besides, the selected instruments all belong to the strict international scenario. Others—such as regional instruments—are beyond the scope of this Article.

¹⁷³ At the time this Article was finished (July 2018), The Ocean Cleanup was preparing to launch its first clean-up system for the North Pacific from California. *System 001*, THE OCEAN CLEANUP, <https://www.theoceancleanup.com/system001/> [<https://perma.cc/2BPQ-RME8>] (last visited Apr. 3, 2019).

¹⁷⁴ *Id.* (showcasing a timeline of System 001).

¹⁷⁵ There is, for example, a very new approach being conducted by another non-governmental organization. See *A smart solution to plastic pollution*, THE GREAT BUBBLE BARRIER, <https://thegreatbubblebarrier.com/en/> [<https://perma.cc/GWF5-WZVE>] (last visited Apr. 3, 2019). The Great Bubble Barrier’s focus is to prevent the plastics that end up in rivers from reaching the oceans. However, they are still at the stage of raising money to build at least a scale model for presentations. *The Bubble Barrier*, THE GREAT BUBBLE BARRIER, <https://thegreatbubblebarrier.com/en/bubble-barrier-en/> [<https://perma.cc/EVK3-J8ZQ>] (last visited Apr. 3, 2019).

¹⁷⁶ *Status of Conventions*, INT’L MARITIME ORG., <http://www.imo.org/en/About/Conventions/StatusOfConventions/Pages/Default.aspx> [<https://perma.cc/3PKL-ZXZ5>] (last visited Apr. 3, 2019).

A. *United Nations Convention on the Law of the Sea*

Adopted in 1982 in Montego Bay, the United Nations Convention on the Law of the Sea (“UNCLOS”) focuses on solving problems related to the economic exploitation of the oceans and correlated sovereignty issues.¹⁷⁷ Nevertheless, UNCLOS also adopted several approaches on preventing, reducing, and controlling pollution of the marine environment, especially from articles 192 onward.¹⁷⁸ As no reservations to its terms are allowed, all of the contracting parties have to agree with all of its clauses.¹⁷⁹

The scope of UNCLOS is primarily to regulate shipping, not to protect the environment.¹⁸⁰ Thus, even with the considered approaches concerning pollution, when it does relate to the environment, UNCLOS mostly focuses on fishing.¹⁸¹ Although UNCLOS does not literally state which are the “living resources” under its scope of protection, it is clear that an important goal of UNCLOS is to protect fisheries.¹⁸² UNCLOS is therefore primarily focused on fish stocks, not with a view on protecting the maritime environment, but rather to enable the availability of the fish resource to all those interested in exploring marine resources in the future.¹⁸³

Still, “UNCLOS provides a comprehensive legal framework for the protection and preservation of the marine environment under Part XII,”¹⁸⁴ reinforcing the first idea about the comprehensiveness of the instrument’s focus on environmental protection. This elevates the importance of UNCLOS, even concerning plastics, especially considering the definition of marine pollution—under article 1(1)(4):

[T]he introduction by man, directly or indirectly, of substances or energy into the marine environment, including

¹⁷⁷ *The United Nations Convention on the Law of the Sea (A historical perspective)*, UNITED NATIONS, http://www.un.org/Depts/los/convention_agreements/convention_historical_perspective.htm [<https://perma.cc/7X88-67ZV>] (last visited Apr. 3, 2019).

¹⁷⁸ UN Convention on the Law of the Sea, Dec. 10, 1982, 1833 U.N.T.S. 397, arts. 192–95, 204–22, 237, https://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf [<https://perma.cc/99TJ-UAFA>] (last visited Apr. 3, 2019) [hereinafter UNCLOS].

¹⁷⁹ *Id.* at art. 309.

¹⁸⁰ *See id.* at arts. 17–22, 34–44, 261.

¹⁸¹ *See id.* at arts. 116–20.

¹⁸² *See id.* at pmb., art. 21.

¹⁸³ *See id.* at arts. 116–20.

¹⁸⁴ Megan S. Wong, *The United Nations Convention on the Law of the Sea 1982*, in 5 ELGAR ENCYCLOPEDIA OF ENVTL. L. 153 (Michael Faure ed., 2017).

estuaries, which results or is likely to result in such deleterious effects as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment of quality for use of sea water and reduction of amenities.¹⁸⁵

This definition enables concerns related to the plastic pollution of the oceans to be directly placed under UNCLOS's protection. Besides, UNCLOS enhances the likelihood of success insofar as it covers six types of marine pollution: (i) from land-based sources; (ii) from seabed activities subject to national jurisdiction; (iii) from activities in the Area;¹⁸⁶ (iv) from dumping; (v) from vessels; and (vi) from or through the atmosphere.¹⁸⁷ In other words, UNCLOS has approaches that cover all sources of plastic pollution.

Moreover, article 210(4) of UNCLOS provides that "States . . . shall endeavour to establish global and regional rules, standards and recommended practices and procedures to prevent, reduce and control such pollution."¹⁸⁸ This means that UNCLOS, as a binding instrument, imposes obligations on States that are provided under other instruments, consequently enabling a reflexive binding effect to those other international and regional instruments. This provides for a major protection, not only by introducing new and more specific approaches, but also by encouraging States to also adopt such documents in order to be able to influence decisions.

UNCLOS, pursuant to article 235(1), also provides that "States are responsible for the fulfilment of their international obligations concerning the protection and preservation of the marine environment," and that "they shall be liable in accordance with international law."¹⁸⁹ Together with the establishment of the International Tribunal for the Law of the Sea ("ITLOS"), this means that UNCLOS institutes several tools for dispute settlement¹⁹⁰ and creates remedies.

In spite of not being the first international instrument governing the law of the sea and even to protect against marine pollution, UNCLOS

¹⁸⁵ UNCLOS, *supra* note 178, at art. I(4).

¹⁸⁶ According to article 1(1) of UNCLOS, "Area means the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction." *Id.* at art. I.

¹⁸⁷ Wong, *supra* note 184, at 154.

¹⁸⁸ UNCLOS, *supra* note 178, at art. 210.

¹⁸⁹ *Id.* at art. 235.

¹⁹⁰ *See, e.g., id.* at arts. 186–88.

appears first in this list because of the importance it plays in the development of the international law of the sea and several related treaties. Furthermore, it codified the basic principles, such as the protection of the marine environment, as customary international law, and contains rules of reference to “generally accepted international rules and standards” with regard to the preservation and protection of the marine environment.¹⁹¹ The 1972 London Dumping Convention, which will be discussed in the next Section, is an important example of conferring binding effects to other international instruments. Nonetheless, “under the *pacta tertiis nec nocent nec prosunt* principle . . . the Secretary General of the United Nations, in his 1995 Report on the Law of the Sea, has affirmed that the provisions of the London Convention qualify as the ‘global rules and standards’”¹⁹² mentioned in article 210(4) of UNCLOS.

The main importance of UNCLOS is that, for specific issues, it requires the relevant provisions to be read in the light of other conventions, regional treaties, and standards set by competent international organizations.¹⁹³ This means that UNCLOS itself does not provide any framework for the plastic pollution of the oceans.

There is, however, another relevant aspect to the discussion. As mentioned, UNCLOS’s main purpose is to solve sovereignty issues in seas and oceans.¹⁹⁴ Those competency aspects may influence the discussion about the plastic pollution especially from an *ex post* perspective, meaning that recovering the plastic pollution from international waters directly relates to who has the authority over it.

Thus, before being able to assess to what extent this actually covers the problem of plastic pollution, we need to identify how UNCLOS deals with the jurisdiction matter in a broader sense.

The first relevant step to take to determine sovereignty in seas and oceans is to establish the region to which we are referring. In that sense, UNCLOS establishes different zones.¹⁹⁵ The Territorial Sea extends until twelve nautical miles from the baseline.¹⁹⁶ The Contiguous

¹⁹¹ See *id.* at art. 211.

¹⁹² Gian Maria Farnelli & Attila Tanzi, *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter 1972 and 1996 Protocol*, in 5 ELGAR ENCYCLOPEDIA OF ENVTL. L. 178 (Michael Faure ed., 2017) (quoting UNCLOS, *supra* note 178, at art. 210(4)).

¹⁹³ See, e.g., UNCLOS, *supra* note 178, at arts. 207–12.

¹⁹⁴ See UNITED NATIONS, *supra* note 15.

¹⁹⁵ See UNCLOS, *supra* note 178, at arts. 3, 4, 33, 57.

¹⁹⁶ *Id.* at art 3. The baseline is defined by UNCLOS, under art. 5: “Except where otherwise provided in this Convention, the normal baseline for measuring the breadth of the

Zone may extend such control for specific purposes, but no more than twelve more nautical miles.¹⁹⁷ The Exclusive Economic Zone (“EEZ”) goes up to 200 nautical miles from the baseline.¹⁹⁸ Apart from those, UNCLOS also defines the continental shelf and the Area—respectively, the seabed under the EEZ and the High Seas—as well as the seas and the enclosed seas.¹⁹⁹ Finally, there are the High Seas, which are any international waters “that are not included in the exclusive economic zone, in the territorial sea or in the internal waters of a State, or in the archipelagic waters of an archipelagic State.”²⁰⁰

From there, UNCLOS details the competencies, jurisdictions, rights, and duties of the States in each of those parts.²⁰¹ For the purposes of this Article, it is enough to know that: (i) in the Territorial Sea, coastal States exercise control;²⁰² (ii) in the Contiguous Zone, coastal States exercise control only when necessary to the specific purpose why the Zone was established;²⁰³ (iii) in the EEZ, the rights and jurisdiction of the coastal State and the rights and freedoms of other States are governed by UNCLOS,²⁰⁴ and the coastal State only has certain rights of exploitation at the EEZ;²⁰⁵ and (iv) the High Seas are open to all States and ruled by international law.²⁰⁶

As described before, all of these zones are relevant to the plastic pollution; however, the High Seas present the highest concentrations, mainly in the gyres.²⁰⁷ Moreover, the approach to the pollution in the Territorial Sea, in the Contiguous Zone, and in the EEZ, to different

territorial sea is the low-water line along the coast as marked on large-scale charts officially recognized by the coastal State.” *Id.* at art. 5.

¹⁹⁷ *Id.* at art. 33.

¹⁹⁸ *Id.* at art. 57.

¹⁹⁹ *Id.* at arts. 1, 122.

²⁰⁰ *Id.* at art. 86.

²⁰¹ UNCLOS, *supra* note 178, at arts. 2–16, 33, 55–75, 87.

²⁰² *Id.*

²⁰³ *Id.* at art. 33.

²⁰⁴ *Id.* at arts. 55–75.

²⁰⁵ *Id.* at art. 55.

²⁰⁶ *Id.* at art. 87.

²⁰⁷ See Irene Banos Ruiz, *Sunken Oil Tanker: How to Protect the High Seas Environment?*, DEUTSCHE WELLE (Jan. 15, 2018), <https://www.dw.com/en/sunken-oil-tanker-how-to-protect-high-seas-environment/a-42150179> [<https://perma.cc/8JUG-8CTN>]; see also *Garbage Patches: How Gyres Take Our Trash Out to Sea*, NOAA, <https://oceanservice.noaa.gov/podcast/mar18/nop14-ocean-garbage-patches.html> [<https://perma.cc/6AEB-2NKA>] (last visited Apr. 3, 2019).

extents, demands much more from a national and regional approach than from an international one. This is, of course, also important and will be mentioned further in this Article, but for now we should focus on understanding how international law addresses the competencies and jurisdiction of the High Seas.

Articles 91 and 92 of UNCLOS solve this issue by requiring that a ship's nationality must be the same as the jurisdiction identified on its flag.²⁰⁸ This is not enough to solve the plastic soup problem, not only because the main concern is the land-based sources, but also because: (i) the so-called flags of convenience²⁰⁹ are a challenge to this solution; and (ii) preventing and recovering the plastic pollution will rarely happen inside a ship.

The flag of a ship serves the purpose of connecting the applicable regulation to the relationships and facts occurring on the ship when it is at sea.²¹⁰ Flags are especially important because ships travel in international waters, where it would be difficult to determine who is responsible and what rules would have to be followed.²¹¹

By 1905, as was made clear in a decision by the Permanent Court of Arbitration at The Hague, the ability of "every sovereign to decide to wh[ich ships] he will accord the rights to fly his flag and . . . to prescribe the rules governing such grant" had passed into customary international law.²¹²

However, this solution is also the cause of the above-mentioned problem of the flags of convenience. Historically, shipowners have strategically chosen to fly under other States' flags, either to avoid taxes, or to prevent difficulties during wars, among other reasons.²¹³ This behavior has relevant impacts on environmental protection, because it usually means lowering the environmental, safety, and labor standards.²¹⁴

²⁰⁸ UNCLOS, *supra* note 178, at arts. 91–92.

²⁰⁹ *Id.* at 92.

²¹⁰ ELIZABETH R. DESOMBRE, *FLAGGING STANDARDS: GLOBALIZATION AND ENVIRONMENTAL, SAFETY, AND LABOR REGULATIONS AT SEA* 69 (2006).

²¹¹ *Id.*

²¹² *Id.* (quoting *Muscat Dhows Case (Fr. v. Gr. Brit.)*, Hague Ct. Rep. 69, 72–73 (Perm. Ct. Arb. 1905)).

²¹³ *Id.* at 72.

²¹⁴ See H. Edwin Anderson III, *The Nationality of Ships and Flags of Convenience:*

B. *The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (1972 London Dumping Convention) and London Protocol (2006)*

The Convention on the Prevention of Marine Pollution by Dumping Wastes and Other Matter, also known as the 1972 London Dumping Convention (“1972 Convention”), addresses the waste issue in a general way.²¹⁵ As one of the first international instruments to protect the marine environment—having entered in force in 1975—its importance is clear.²¹⁶

Another relevant point is that the 1972 Convention explicitly prohibits the dumping of “persistent plastics and other persistent synthetic materials, for example, netting and ropes, which may float or may remain in suspension in the sea in such a manner as to interfere materially with fishing, navigation or other legitimate uses of the sea.”²¹⁷ This statement is found in article IV(1)(a) and Annex I(4).²¹⁸ However, Annex I has only been in force since 2006.²¹⁹ It was introduced by the 1996 London Convention and Protocol (“LC&P”), which only entered in force in 2006 and “was agreed to further modernize the Convention and, eventually, replace it.”²²⁰ Furthermore, article XII establishes which polluting substances States should prevent, but it does not include plastic.²²¹

Regarding consequences of non-compliance, the 1972 Convention develops procedures to assess liability and settle disputes (article X), and further recommends that parties “at their first consultative meeting consider procedures for the settlement of disputes concerning the interpretation and application of this Convention.”²²²

In order to assist national authorities, the contracting parties developed guidelines on how to regulate ocean dumps and on how to

Economics, Politics, and Alternatives, 21 TULANE MARITIME L.J. 149–50 (1996); RODNEY P. CARLISLE, SOVEREIGNTY FOR SALE: THE ORIGINS AND EVOLUTION OF THE PANAMANIAN AND LIBERIAN FLAGS OF CONVENIENCE 115 (1981); DESOMBRE, *supra* note 210, at 14.

²¹⁵ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Dec. 29, 1972, 26 U.S.T. 2403, 1046 U.N.T.S. 120, <http://www.imo.org/en/OurWork/Environment/LCLP/Documents/LC1972.pdf> [hereinafter 1972 Convention].

²¹⁶ *Id.*

²¹⁷ *Id.*

²¹⁸ *Id.*

²¹⁹ *Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter*, INT'L MARITIME ORG., <http://www.imo.org/en/OurWork/Environment/LCLP/Pages/default.aspx> [https://perma.cc/FY3G-HNUV] (last visited Apr. 3, 2019).

²²⁰ *Id.*; 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Nov. 7, 1996, 36 I.L.M. 1 (1997) [hereinafter 1996 Protocol].

²²¹ 1972 Convention, *supra* note 215, at art. XI.

²²² *Id.* at art. XI.

meet their obligations under the two instruments.²²³ Specific guidelines addressing the materials are listed in Annex I of the updated 1972 Convention.²²⁴

For a long time there were discussions regarding the application and effectiveness of the 1972 Convention, which explains in large part the many protocols and assessment procedures.²²⁵ In that sense, one of the most important tools under the 1972 Convention framework is the compliance review mechanism. Each contracting state is required “[n]o later than two years after the entry into force of [the] Protocol . . . [to] establish those procedures and mechanisms necessary to assess and promote compliance with [the] Protocol,” according to article 11(1) of the 1996 LC&P.²²⁶ In addition, the 29th Consultative Meeting, in 2007, approved the Compliance Group, which monitors obedience by member states.²²⁷

Regarding the effectiveness of the LC&P, it “mainly depends on its capacity to attract participation, in order to foster environmental awareness.”²²⁸ Because of that, one of the main downsides of the LC&P is the lack of provisions to solve technical, scientific, and mainly financial obstacles to change the behavior of sea dumping.²²⁹

All in all, the LC&P is considered in legal doctrine to be “a positive achievement in the field of protection of the marine environment.”²³⁰ However, if specifically considering the LC&P’s ability to deal with plastic pollution in the oceans, the 1972 Convention is even more limited. “It covers dumping from ships, platforms and aircraft. It does not cover emissions from land based sources nor wastes coming from exploration and operations of seabed resources, nor storage of material in a purpose other than eliminating.”²³¹ When confronted with data that shows that 80% of the plastic that ends up in the ocean comes from land-based sources,²³² the conclusion is that, even if effective, the LC&P deals with only one part of the plastic problem.

²²³ See INT’L MARITIME ORG., *supra* note 219.

²²⁴ 1972 Convention, *supra* note 215, at Annex I.

²²⁵ Gerard Peet, *London Dumping Convention: Obsolete or Effective?*, 22 MARINE POLLUTION BULLETIN 56, 56–58 (1991).

²²⁶ 1996 Protocol, *supra* note 220, at art. 11(1).

²²⁷ Farnelli & Tanzi, *supra* note 192.

²²⁸ *Id.* at 182.

²²⁹ *Id.*

²³⁰ *Id.*

²³¹ INT’L NAVIGATION ASS’N, PIANC, SUSTAINABLE MARITIME NAVIGATION 23, <http://www.imo.org/en/OurWork/Environment/LCLP/recentevents/Documents/PIANC%20report%20for%20SG37.pdf> [<https://perma.cc/T256-4KF3>] (last visited Apr. 3, 2019).

²³² SHEAVLY, *supra* note 25.

C. *International Convention for the Prevention of Pollution from Ships—Annex V*

The current form of the International Convention for the Prevention of Pollution from Ships (“MARPOL”) is a combination of the 1973 IMO Convention and the 1978 IMO Protocol.²³³ Annex V was adopted in 2011 and is the only part of the document that mentions plastics, prohibiting the discharge of all plastics into the sea, as stated in Regulation 3(2).²³⁴ The only exception to this prohibition are those listed in Regulation 7, but they are not relevant for the purposes of this analysis because they are the usual legal exceptions, such as accidents or the necessity of protecting life.²³⁵

MARPOL has particular relevance in the sense that it explicitly regulates plastic disposal in the oceans. The main problem of MARPOL’s approach is that, once again, the convention prevents pollution from ships, while 80% of the plastic pollution in the oceans comes from land-based sources.²³⁶ MARPOL shows the need for a specific convention to address specific kinds of pollution because its scope is too broad. In the case of plastic, this would probably mean returning back to the LC&P, including its limitations.²³⁷ Moreover, there are no mentions of implementation issues in MARPOL.²³⁸

One of the main limitations of MARPOL is an old problem of maritime law: the flags of convenience.²³⁹ As explained previously in this Article, this means that shipowners often choose to navigate under the

²³³ Historical Background: Int’l Convention for the Prevention of Pollution from Ships (MARPOL), IMO, [http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-\(MARPOL\).aspx](http://www.imo.org/en/About/Conventions/ListOfConventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx) [https://perma.cc/WG2L-R5KX] (last visited Apr. 3, 2019).

²³⁴ Amendments To The Annex Of The Protocol of 1978 Relating to the International Convention for the Prevention of Pollution from Ships 1973, Int’l Maritime Org. (July 15, 2011), [http://www.imo.org/en/OurWork/Environment/PollutionPrevention/Garbage/Documents/2014%20revision/RESOLUTION%20MEPC.201\(62\)%20Revised%20MARPOL%20Annex%20V.pdf](http://www.imo.org/en/OurWork/Environment/PollutionPrevention/Garbage/Documents/2014%20revision/RESOLUTION%20MEPC.201(62)%20Revised%20MARPOL%20Annex%20V.pdf) [https://perma.cc/B7J3-TGMY].

²³⁵ *Id.*

²³⁶ Peter Van den Dries, *The collection of ship’s waste in Belgian seaports*, OVAM (June 13–17, 2016), http://www.un.org/depts/los/consultative_process/ICP17_Presentations/Van_den_dries.pdf [https://perma.cc/CH4W-S8GZ].

²³⁷ INT’L NAVIGATION ASS’N, *supra* note 231, at 23.

²³⁸ *See, e.g., id.* at 31.

²³⁹ Gian Maria Farnelli, *International Convention for the Prevention of Pollution from Ships MARPOL 2012 (and Annexes I, II, III, IV, V and VI)*, in 5 ELGAR ENCYCLOPEDIA OF ENVTL L. 166–76 (Michael Faure ed., 2017).

flag that has lower regulatory standards²⁴⁰ or, in this case, is not a party to MARPOL.

Another limitation of MARPOL is the lack of economic incentives to promote innovation on the construction of ships.²⁴¹ This is mostly inapplicable to plastics because such lack of investment is relevant to leaks and accidents—typically related to pollution such as oil.²⁴² The use of grandfather clauses²⁴³ is one of several caveats²⁴⁴ of MARPOL.

Finally, the general conclusion is that MARPOL may be considered effective, due to its mandatory technical regime.²⁴⁵ On the other hand, those restraints show that there is still much to improve. Literature considers Annex I—related to oil discharge—as a large success, whilst Annexes III to VI are impaired due to their optional nature.²⁴⁶

D. *Convention on Biological Diversity and the Jakarta Mandate*

The relationship between the Convention on Biological Diversity (“CBD”) and the problem of plastic pollution in the oceans is not as direct as with the other international documents. However, the CBD plays an important role in the sense that plastics have a great impact on nature and marine life.²⁴⁷ That is also recognized by the CBD itself when noting, for instance, that “it is vital to anticipate, prevent and attack the causes of significant reduction or loss of biological diversity at source.”²⁴⁸

Hence, once more the approach to pollution is general, but, especially due to the nature and breadth of the CBD, it is possible to assume that plastic pollution is included.

The Conferences of the Parties (“COP”) of the CBD plays a major role, and the marine environment has been central since COP 2, which took place in 1995.²⁴⁹ At that time, the decisions made on this topic were

²⁴⁰ DESOMBRE, *supra* note 210, at 71–72.

²⁴¹ Farnelli, *supra* note 239, at 173.

²⁴² *Id.* at 167.

²⁴³ *Id.* at 170, 173. Grandfather clauses are rules that provide that an old rule continues to apply to some existing situations while a new rule will apply to all future cases.

²⁴⁴ *Id.* at 173.

²⁴⁵ *Id.*

²⁴⁶ *Id.*

²⁴⁷ See Farnelli, *supra* note 239, at 166 (noting the need to prevent pollution to preserve marine environment).

²⁴⁸ UN Conference on Environment and Development, Convention on Biological Diversity, U.N. Doc. UNEP/Bio.Div/N7-INC.S/4, *reprinted in* 31 I.L.M. 818, <https://www.cbd.int/doc/legal/cbd-en.pdf> [<https://perma.cc/5B3D-NK5P>].

²⁴⁹ THE CONTRACTING PARTIES TO THE NAIROBI CONVENTION, IUCN EASTERN AFRICA

collected in the Ministerial Statement and then issued as the Jakarta Mandate on Marine and Coastal Biodiversity (the “Jakarta Mandate”).²⁵⁰

The Jakarta Mandate represents “a significant step forward” because it establishes a set of clear of actions for parties to the CBD to take.²⁵¹ It also encourages major international institutions to improve their current programs and develop new ones, recognizes the need to conserve and sustainably use marine biodiversity, and initiates a process under the CBD to “address . . . the most urgent threats to marine and coastal biodiversity.”²⁵²

In 2001, a workshop to evaluate progress on CBD implementation in Eastern Africa²⁵³ concluded that more work needs to be done in all areas addressed by the CBD, even though a number of national and regional plans and strategies were already in place.²⁵⁴ It also highlighted the importance of implementation by international, non-governmental, and non-profit organizations to the development of the region.²⁵⁵

On the other hand, during COP 10, the parties to the CBD agreed that the countdown to achieve the targets planned for 2010 had failed.²⁵⁶ For this reason, contracting parties decided to establish the Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets.²⁵⁷ Naturally, they do not focus solely on the ocean and even less so on plastic pollution of the oceans.²⁵⁸ Yet, it is possible to apply the same reasoning, which can be supported by the statement in Targets 8 and 11.²⁵⁹

Target 8 proposes that “by 2020, pollution, including from excess nutrients, has been brought to levels that are not detrimental to ecosystem function and biodiversity.”²⁶⁰ Target 11 provides effective and equitable

PROGRAMME, CONSERVATION OF COASTAL AND MARINE BIODIVERSITY IN THE EASTERN AFRICA REGION: PROGRESS IN IMPLEMENTATION OF JAKARTA MANDATE 1–2 (Apr. 2001), <https://portals.iucn.org/library/sites/library/files/documents/2001-027.pdf> [<https://perma.cc/8ZP7-H926>].

²⁵⁰ *Id.* at 2.

²⁵¹ *Id.*

²⁵² *Id.*

²⁵³ *See generally id.*

²⁵⁴ *Id.* at iv.

²⁵⁵ THE CONTRACTING PARTIES TO THE NAIROBI CONVENTION, *supra* note 249, at 40–43.

²⁵⁶ Davide Marino et al., *Monitoring the Convention on Biological Diversity (CBD) framework using evaluation of effectiveness methods: the Italian case*, 55 *ECOLOGICAL INDICATORS* 172, 172–82 (2015).

²⁵⁷ *Id.*

²⁵⁸ *Id.* at 172.

²⁵⁹ Secretariat of the Convention on Biological Diversity, *Strategic Plan for Biodiversity 2011–2020 and the Aichi Targets: Living in Harmony with Nature*, UNITED NATIONS, <https://www.cbd.int/doc/strategic-plan/2011-2020/Aichi-Targets-EN.pdf> [<https://perma.cc/TPH6-QERK>] (last visited Apr. 3, 2019).

²⁶⁰ *Id.*

management to terrestrial and inland water, as well as coastal and marine areas.²⁶¹ Future data and analysis will show if the Aichi Targets had a better impact than the targets planned up to 2010.

E. Convention on the Conservation of Migratory Species of Wild Animals

As with the CBD, the Convention on the Conservation of Migratory Species of Wild Animals (the “CMS” or the “Bonn Convention”)²⁶² relates to plastic pollution of the oceans because this type of pollution may harm wild animals. More specifically in this case, as stated in the preamble of the CMS, addressing migratory species also means addressing species in international waters, when referring to recommendation 32 of the Action Plan adopted by the United Nations Conference on the Human Environment (Stockholm, 1972).²⁶³

According to the Secretariat of the Bonn Convention, “the legal instruments under CMS may range from legally binding Agreements to less formal Memoranda of Understanding and can be adapted to fit the requirements of each region.”²⁶⁴

The CMS was adopted in 1979, but the more significant advances occurred in 2014, mainly because of the influence of COP 11 on the CMS.²⁶⁵ The Conference witnessed the realignment of a series of policy directions for the CMS and the elaboration of a new Strategic Plan for Migratory Species for the years 2015–2023.²⁶⁶

In a broader sense, “the CMS regime stands out for its dynamic development since the adoption of the Bonn Convention, more than for its substantive provisions.”²⁶⁷ Among those developments, the number of parties, listed species, and subsidiary instruments is constantly increasing.²⁶⁸

²⁶¹ *Id.*

²⁶² Convention on the Conservation of Migratory Species of Wild Animals, June 23, 1979, 19 I.L.M. 15, 1651 U.N.T.S. 28,395.

²⁶³ Report of the United Nations Conference on the Human Environment, Stockholm, June 5–16, 1972, 27th Sess., U.N. Doc. A/CONF.48/14 (1972).

²⁶⁴ *Secretariat of the Convention on the Conservation of Migratory Species of Wild Animals (UNEP/CMS)*, UN BONN, <http://unbonn.org/CMS> [<http://perma.cc/CJR9-FML7>] (last visited Apr. 3, 2019).

²⁶⁵ Richard C. Caddell, *Convention on the Conservation of Migratory Species of Wild Animals (CMS)*, 25 YEARBOOK OF INT'L ENVTL. L. 269–74 (2014).

²⁶⁶ *Id.*

²⁶⁷ Melissa Lewis & Arie Trouwborst, *Bonn Convention on the Conservation of Migratory Species of Wild Animals 1979*, in 5 ELGAR ENCYCLOPEDIA OF ENVTL. L. 25–34 (Michael Faure ed., 2017).

²⁶⁸ *Id.* at 33.

Another positive aspect of the Bonn Convention implementation is the flexible approach used in its application, as with, for example, the growing relevance of the CMS regime for non-migratory species.²⁶⁹

Regarding the broader negative aspects, there are resource constraints, which frustrate the possibility of adequate implementation, especially considering the wide range of activities related to CMS.²⁷⁰ This is the main reason why the CMS is not considered to be effective.²⁷¹

Regardless the (in)effectiveness of the Bonn Convention, its impact on plastic pollution of the oceans seems irrelevant to the present analysis. There are, however, specific agreements brought under the Bonn Convention, which each focus on particular species to be protected.²⁷² Those are undoubtedly useful, but still the question arises as to the immediate influence of the Bonn Convention or its related agreements in the fight against plastic pollution of the oceans.

F. Summary

This brief overview of a few international conventions shows that there are conventions that indirectly could have some influence on plastic pollution.²⁷³ On the other hand, it equally shows that none of the conventions directly focus on the central issue of this Article: the plastic soup. MARPOL and other conventions prohibiting the discharge of plastics into the sea are undoubtedly important as they can contribute to preventing plastic disposal.²⁷⁴ Others have more of an indirect impact, such as the CMS. Those species are undoubtedly negatively affected by plastics.²⁷⁵ Yet, the Bonn Convention does not indicate specific measures on how those migratory species will be protected from the increasing amount of plastic.²⁷⁶

²⁶⁹ *Id.* at 31.

²⁷⁰ *Id.* at 33–34.

²⁷¹ *See id.*

²⁷² *See Agreements*, CMS, <http://www.cms.int/en/cms-instruments/agreements> [<http://perma.cc/DLE9-CK7U>] (last visited Apr. 3, 2019).

²⁷³ Obviously other instruments could be discussed as well, for example, the United Nations Convention on the Non-Navigational Uses of International Watercourses or the United Nations Economic Commission for Europe's Convention on the Protection and Use of Transboundary Watercourses and International Lakes. We did not discuss those instruments within the scope of this Section as they may be less directly relevant to the problem of the plastic pollution of the oceans. For further analysis see, e.g., Linda Finska & Julie Gjørtz Howden, *Troubled waters—Where is the bridge? Confronting marine plastic pollution from international watercourses*, 27 *RECIEL* 245, 247–49 (2018).

²⁷⁴ *Supra* Section I.C.

²⁷⁵ *Supra* Section II.E.

²⁷⁶ *Id.*

As a result, under the currently applicable legal framework, there are no international conventions that can directly contribute to preventing the problem of the plastic soup. This means that, in the future, it may be important to at least ask the question whether a specific convention would be appropriate to deal with the plastic soup problem. However, it is also important to address soft law instruments that could play a role in this respect.

III. INSTRUMENTS UNDER SOFT LAW

This Section of the Article will examine the plastic pollution problem from the perspective of international soft law instruments. First, however, the concept of soft law in international law merits some explanation:

International law is founded on the principle of sovereignty: every State is sovereign over its territory, and all States are coequal. Historically, international law was limited primarily to interactions between States that consented to bind themselves (and thereby limit their sovereignty) whether by treaty or recognizing a principle of customary law.²⁷⁷

More recently, “this State-centric, treaty-oriented view of international law has evolved to include a broader range of actors and types of law.”²⁷⁸ Even more important, this view has evolved to incorporate new instruments that function without the need for a binding element—soft law.²⁷⁹ The fact that the traditional law concept lacks this element greatly contributes to a split in opinions.

Some legal scholars assert that international law should be neither hard nor soft law because, they say, it is not law at all.²⁸⁰ Nonetheless, even amongst those who do not share this opinion, there is controversy, with many stating the same about the nature of soft law.²⁸¹

We, however, affiliate with the group²⁸² that considers international law—in all of its forms—as, in fact, law. Of course, as is common

²⁷⁷ Carl Brunch & John Broderick, *International Law and Processes*, in 16 ELGAR ENCYCLOPEDIA OF ENVTL. L. 35, 36 (Michael Faure ed., 2017).

²⁷⁸ *Id.*

²⁷⁹ *See id.* at 39–40.

²⁸⁰ Prosper Weil, *Towards Relative Normativity in International Law*, 77 AM. J. OF INT’L L. 413, 415 n.7 (1983).

²⁸¹ *Compare id.* with Andrew T. Guzman & Timothy L. Meyer, *International Soft Law*, 2 J. OF LEGAL ANALYSIS 171, 171–72 (2010); Linda A.J. Senden, *Soft Law and its Implications for Institutional Balance in the EC*, 1 UTRECHT L. REV. 79, 79 (2005).

²⁸² *See* Guzman & Meyer, *supra* note 281, at 171–72; Senden, *supra* note 281, at 79.

with different fields of law, international law has its own unique characteristics, but it is nonetheless law.

We will now address relevant soft law instruments in a problem-oriented manner. This implies that we are not going to discuss every provision of those instruments. Our approach is to address in a general way the discussion and implementation steps as well as the academic conclusions regarding the effectiveness of each instrument. When relevant to the focus of the plastic soup, some specific provisions will also be discussed.

The soft law instruments will be discussed in a chronological order, which will not necessarily reflect their importance.

A. *Agenda 21 and the Johannesburg Plan of Implementation*

Agenda 21, together with the Rio Declaration on Environment and Development and the Statement of Principles for the Sustainable Management of Forests, was one of the main products of the United Nations Conference on Environment and Development, also known as UNCED or Rio92.²⁸³ It delivered several development and environmental objectives²⁸⁴ that are too broad and too complex to be implemented in the short term or with simple solutions. That is why “the full implementation of Agenda 21, the Programme for Further Implementation of Agenda 21 and the Commitments to the Rio principles, were strongly reaffirmed at the World Summit on Sustainable Development (“WSSD”) held in Johannesburg”²⁸⁵ in 2002.

Agenda 21 is more focused on general statements, such as eradicating poverty and changing unsustainable patterns of production and consumption.²⁸⁶ This can be explained by the main goal of the Agenda, which is promoting change in national and local governments by encouraging action on 115 programs to facilitate the transition toward sustainable development.²⁸⁷ Still, it does not mention plastics.

²⁸³ UNITED NATIONS DEP'T OF ECON. & SOC. AFF., SUSTAINABLE DEVELOPMENT IN THE 21ST CENTURY 5, 7 (Oct. 2012), https://sustainabledevelopment.un.org/content/documents/1372Study2_final.pdf [<https://perma.cc/C6C5-HHVF>].

²⁸⁴ United Nations Conference on Environment and Development, *Agenda 21*, U.N. Doc. A/CONF. 151/26/Rev. 1 (1992) [hereinafter *Agenda 21*].

²⁸⁵ *Agenda 21*, UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS KNOWLEDGE PLATFORM, <https://sustainabledevelopment.un.org/outcomedocuments/agenda21> [<https://perma.cc/WD7U-RFPV>] (last visited Apr. 3, 2019).

²⁸⁶ *United Nations Conference on Environment & Development Rio de Janeiro, Brazil, 3 to 14 June 1992*, UNITED NATIONS SUSTAINABLE DEVELOPMENT 4 (1992), <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf> [<https://perma.cc/G2A2-U2AQ>].

²⁸⁷ DOUGLAS ROCHE, THE UNITED NATIONS IN THE 21ST CENTURY: GRAPPLING WITH THE WORLD'S MOST CHALLENGING ISSUES: MILITARISM, THE ENVIRONMENT, HUMAN RIGHTS, INEQUALITY 48 (2015).

Concrete practical changes put in place by Agenda 21 are difficult to measure, but the number of local governments participating is a safe indication of progress towards achieving the actions proposed. Already in 2002, the year of the World Summit on Sustainable Development, eighty-five countries had developed strategies for implementing Agenda 21,²⁸⁸ which is less than half of the signatory countries.

If considered as an absolute number, this may be considered an impressive number of countries introducing sustainability in their home policies, but the local outcomes—which would be the core impact intended by Agenda 21—do not give reason to celebrate. The national and regional results of Agenda 21 are mostly nonexistent or weak, according to academic literature.²⁸⁹ This happens for different reasons in different countries, so we describe some of them, even though the key element to successful implementation—at least in the European Union—seems to be related to the interest and engagement of governments and local administrations.²⁹⁰

For example, there seems to be a consensus regarding Australia's lack of progress with Agenda 21. Political and financial barriers led to lack of progress in Victorian councils,²⁹¹ where the program should be discussed and implemented. Even those scholars who consider that the Australian councils showed progress through political willingness, administrative capacity, and ability to network, say that raising awareness and involving people is one of the main difficulties; thus, Agenda 21 remains in place at an abstract level, lacking any real impacts.²⁹²

In the Brazilian context, pessimism also dominates. This is mostly because of low concern and the absence or incompleteness of government instruments to evaluate the implemented actions, but also due to the need to improve participation in the process.²⁹³

²⁸⁸ UNITED NATIONS DEP'T OF ECON. & SOC. AFF., *supra* note 283, at 7.

²⁸⁹ Methodological criticism is not being taken into account in our Article. See David Gibbs, *Book Reviews*, 24 *TRANS. INST. BR. GEO.* 243, 243 (1999) (reviewing TIM O'RIORDAN, *SUSTAINABLE DEVELOPMENT IN WESTERN EUROPE: COMING TO TERMS WITH AGENDA 21* (1997)).

²⁹⁰ See generally Isabel M. Garcia-Sanchez & Jose-Manuel Prado-Lorenzo, *Determinant Factors in the Degree of Implementation of Local Agenda 21 in the European Union*, 16 *SUSTAINABLE DEV.* 17 (2008).

²⁹¹ See David Mercer & Benjamin Jotkowitz, *Local Agenda 21 and Barriers to Sustainability at the Local Government Level in Victoria, Australia*, 31 *AUSTL. GEO.* 163, 178–79 (2000).

²⁹² See Stella Whittaker, *Are Australian councils 'Willing and Able' to Implement Local Agenda 21?*, 2 *LOC. ENV'T* 319, 319 (1997).

²⁹³ See Tadeu Fabricio Malheiros, Arlindo Phlippi Jr. & Sonia Maria Viggiani Coutinho, *Agenda 21 Nacional e Indicadores de Desenvolvimento Sustentavel: contexto brasileiro*, 17 *SAÚDE SOC. SÃO PAULO* 7, 17 (2008).

The analysis regarding China is still negative, but a little bit more positive; however, the reported environmental advances can only be partially attributed to Agenda 21 and other soft law international instruments.²⁹⁴ Among the factors that limit progress are bad planning, administrative fragmentation, failure of the private sector to get involved,²⁹⁵ bureaucratic infighting, disagreements between central and provincial governments, and corruption.²⁹⁶ Furthermore, the consensus is that the environment will still decline for a long time in the future due to China's development plan.²⁹⁷

Italy appears to be a mostly positive example, despite several challenges still to be overcome. "Effective frameworks for enhancing local sustainability policies, capacity building within local communities, and improving innovation in local government and decision-making processes" are some of the positive aspects.²⁹⁸

There are several reviews that discuss other countries. Many of them report mostly negative conclusions, as is the case of Indonesia,²⁹⁹ New Zealand,³⁰⁰ Norway,³⁰¹ Poland,³⁰² Seoul (South Korea),³⁰³ and the USA.³⁰⁴ Others report mostly positive conclusions, such as in the Czech Republic,³⁰⁵

²⁹⁴ Paul Harris & Chihiro Udagawa, *Defusing the bombshell? Agenda 21 and economic development in China*, 11 REV. OF INT'L POL'Y ECON. 618, 637 (2004).

²⁹⁵ Xiaoliu Yang & Jinwu Pang, *Implementing China's "Water Agenda 21,"* 4 FRONTIER ECOLOGY & ENV'T 362, 367 (2006).

²⁹⁶ Harris & Udagawa, *supra* note 294, at 636.

²⁹⁷ *Id.* at 362.

²⁹⁸ See Walter Sancassiani, *Local agenda 21 in Italy: an effective governance tool for facilitating local communities' participation and promoting capacity building for sustainability*, 10 LOC. ENV'T 189, 197, 200 (2005).

²⁹⁹ See Adrian Atkinson, *Surabaya, Indonesia: Local Agenda 21 in the context of radical political reform*, 5 CITY 47, 63, 64 (2001).

³⁰⁰ See Stephen Knight, *Agenda 21 in New Zealand: Not Dead, Just Resting*, 7 AUSTL. J. OF ENVTL. MGMT. 213, 214 (2000).

³⁰¹ See Carlo Aall, *Municipal Environmental Policy in Norway: From 'mainstream' policy to 'real' Agenda 21?*, 5 LOC. ENV'T 451, 458, 460–62 (2000); Carlo Aall, *The early experiences of local climate change adaptation in Norwegian compared with that of local environmental policy, Local Agenda 21 and local climate change mitigation*, 17 LOC. ENV'T 579, 589, 592–93 (2012).

³⁰² See Justyna Grochowalska, *The Implementation of Agenda 21 in Poland*, 8 EUR. ENV'T 79, 84 (1998).

³⁰³ Yearn-Hong Choi, *Local Agenda 21: Seoul Toward an Environmental City*, 3 INT'L J. URB. SCI. 109, 119 (1999).

³⁰⁴ See Jeffrey M. Berry & Kent E. Portney, *The Tea Party versus Agenda 21: local groups and sustainability policies in U.S. cities*, 26 ENVTL. POL'Y 118, 133–34 (2017).

³⁰⁵ Viktor Kveton et al., *Contribution of Local Agenda 21 to Practical Implementation of Sustainable Development: The Case of the Czech Republic*, 22 EUR. PLAN. STUD., 515–36 (2014).

Germany,³⁰⁶ Peru,³⁰⁷ and Sweden.³⁰⁸ Some—for instance, Japan³⁰⁹—report some progress but still do not conclude whether the results have been positive or negative. Finally, for countries such as Portugal³¹⁰ and the United Kingdom,³¹¹ conclusions go in two completely different directions.

Overall, what we see is that results are heterogeneous around the world and sometimes even inside one country. Moreover, the practical results are hard to measure.

Unlikely as it seems at first glance, efforts are different in distinct regions. A comparative example showed that:

[C]lose to 6,000 sustainability plans have been prepared for European communities versus about 100 for North American communities. A total of 20 Indian cities have started sustainability planning efforts. There is an extensive support network for European communities and much less

³⁰⁶ See Kristine Kern et al., *The Diffusion of Local Agenda 21 in Germany: Comparing the German Federal States*, 16 ENVTL. POL'Y 604, 620–21 (2007); Christian Beuerman & Bernhard Budrick, *The Sustainability Transition in Germany: Some Early Stage Experiences*, in SUSTAINABLE DEVELOPMENT IN WESTERN EUROPE: COMING TO TERMS WITH AGENDA 21 83, 103–04 (Tim O'Riordan & Heather Voisey eds. 1997).

³⁰⁷ See Florian Steinberg & Liliana Miranda, *Local agenda 21, capacity building and the cities of Peru*, 29 HABITAT INT'L 163, 164, 178 (2005).

³⁰⁸ For the optimistic conclusions, see Abdul Khakee, *Assessing Institutional Capital Building in a Local Agenda 21 Process in Goteborg*, 3 PLAN. THEORY & PRAC. 53, 66 (2002); Sofie Adolfsson Jörby, *Local Agenda 21 in Four Swedish Municipalities: A Tool towards Sustainability?*, 45 J. OF ENVTL. PLAN. & MGMT. 219, 240–41 (2002); Sofie Adolfsson Jörby, *Local Agenda 21 in Practice—A Swedish Example*, 8 SUSTAINABLE DEV. 201, 212 (2000). For the conclusions on possible positive outcomes, see Katarina Eckerberg & Björn Forsberg, *Implementing agenda 21 in local government: The Swedish experience*, 3 LOC. ENV'T 49, 64 (2002).

³⁰⁹ See Brendan Barrett & Mikoto Usui, *Local Agenda 21 in Japan: Transforming local environmental governance*, 7 LOC. ENV'T, 49, 64 (2002).

³¹⁰ For the optimistic conclusions, see Norma Carter, Fernando Nunes da Silva & Fernanda Magalhaes, *Local Agenda 21: Progress in Portugal*, 7 EURO. URB. REG'L STUD. 181, 184 (2000). For the pessimistic conclusions, see Teresa Fidélis & Sara Moreno Pires, *Surrender or resistance to the implementation of Local Agenda 21 in Portugal: the challenges of local governance for sustainable development*, 52 J. OF ENVTL. PLAN. & MGMT. 497, 497, 504–05, 515 (2009).

³¹¹ For the optimistic conclusions, see Paul Selman, *Local Agenda 21: Substance or Spin?*, 41 J. ENVTL. OF PLAN. & MGMT. 533, 550–52 (1998). For the pessimistic conclusions, see Alan Patterson & Kate S. Theobald, *Sustainable Development, Agenda 21 and the New Local Governance in Britain*, 29 REG'L STUD. 773, 773 (1995); Guy Jackson & Nigel Morpeth, *Local Agenda 21 and Community Participation in Tourism Policy and Planning: Future or Fallacy*, 2 CURRENT ISSUES IN TOURISM 1, 1, 31–32 (1999). For a report on some progress, see Alister Scott, *Whose Futures? A Comparative Study of Local Agenda 21 in Mid Wales*, 14 PLAN. PRAC. RES. 401, 418–19 (1999).

so in North American and Indian communities. Most sustainability/biodiversity/urban ecosystems research is ongoing in Europe and North America and there is a beginning surge of activity in India.³¹²

However, even when the efforts exist and are effective, there is virtually no direct effect on plastic pollution. Some common strategies are the development of thematic policies that articulate broad sustainable development objectives; traditional master plans based on national planning cycles; mechanisms for coordination with donors; and strategies to address international obligations to integrate environmental considerations into thematic activities.³¹³

The same conclusion derives from another success of Agenda 21: helping to “put the concept of sustainable human development at the heart of development, as opposed to more technology-oriented ‘solutions’ in the so-called ‘development decades’ of the 1960s and 1970s.”³¹⁴

Agenda 21 also had some early accomplishments through the creation of the Commission on Sustainable Development (“CSD”) and its placement in the Economic and Social Council. This affected many areas, including the issue of the oceans, as with the United Nations Open-ended Informal Consultative Process on Oceans and the Law of the Sea.³¹⁵

Consumption and production patterns, on the other hand, are consistent failures of Agenda 21. Although it focuses on advancing towards a circular economy or more sustainable production/consumption models, business as usual prevails and global commons, such as the oceans, continue to be managed unsustainably and to be degraded beyond their ability to recover.³¹⁶

In one summary of the evolution of the state of the oceans, as mentioned in the analysis contained in chapter 17 of Agenda 21, experts state that the oceans have severely declined in the twenty years that followed Rio.³¹⁷ There is a small exception regarding commitments with

³¹² Richard C. Smardon, *A comparison of Local Agenda 21 implementation in North American, European and Indian cities*, 19 MGMT. OF ENVTL. QUALITY: AN INT'L J. 118, 118 (2008).

³¹³ *Agenda 21 Implementation: Progress, Challenges, and the Role of Geographic Information*, in NATIONAL RESEARCH COUNCIL, DOWN TO EARTH: GEOGRAPHICAL INFORMATION FOR SUSTAINABLE DEVELOPMENT IN AFRICA (2002).

³¹⁴ STAKEHOLDER FORUM FOR A SUSTAINABLE FUTURE, REVIEW OF IMPLEMENTATION OF AGENDA 21 AND THE RIO PRINCIPLES 5 (Jan. 2012), https://sustainabledevelopment.un.org/content/documents/641Synthesis_report_Web.pdf [<https://perma.cc/9EGL-RNKG>].

³¹⁵ *Id.* at 5–6.

³¹⁶ *Id.* at 15–16.

³¹⁷ *Id.* at 29.

the integrated coastal zone management and regarding the EU Marine Strategy Framework Directive.³¹⁸ We also highlight the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (“GPA”) as a positive outcome of Agenda 21—as will be further explained in the following Section—since the GPA came as a response to the recommendations in Agenda 21.³¹⁹

B. Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities and Related International Instruments

The GPA is “the only global intergovernmental mechanism directly addressing the connectivity between terrestrial, freshwater, coastal and marine ecosystems.”³²⁰ Its main goal is to provide a conceptual and practical guide for national and regional authorities on how “to prevent, reduce, control and/or eliminate marine degradation from land-based activities.”³²¹ This is already a significant upside GPA from the plastic pollution perspective because 80% of plastic pollution comes from land-based sources.³²²

In addition, although the GPA generally addresses all kinds of marine degradation, it is also possible to identify specific concerns regarding plastics. Examples of this can be found in the mobile apps offered on the UNEP website,³²³ which include Marine LitterWatch,³²⁴ Planet Ocean,³²⁵ and Beat the MicroBead.³²⁶

³¹⁸ *Id.*

³¹⁹ Press Release, 110 Governments Adopt Ambitious Global Programme to Tackle Marine Degradation, U.N. Press Release HE/915 (Nov. 8, 1995), <http://www.un.org/press/en/1995/19951108.he915.html> [<https://perma.cc/BVK6-L47C>].

³²⁰ *Why does addressing land-based pollution matter?*, UNITED NATIONS ENV’T PROGRAMME, <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/why-does-addressing-land> [<https://perma.cc/3H65-G45E>] (last visited Apr. 3, 2019).

³²¹ *Id.*

³²² SHEAVLY, *supra* note 25.

³²³ *UNEP Publications*, GOOGLE PLAY, <https://play.google.com/store/apps/details?id=air.com.yudu.ReaderAIR4950255> [<https://perma.cc/C35U-VEA7>] (last visited Apr. 3, 2019).

³²⁴ *Marine Litter Watch*, EUR. ENV’T AGENCY, <https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/marine-litterwatch> [<https://perma.cc/8B8E-59R4>] (last visited Apr. 3, 2019). This mobile app was created by the European Environment Agency to target communities interested in marine litter activities. As a result, more information and data are being collected.

³²⁵ *Planet Ocean*, GOOGLE PLAY, https://play.google.com/store/apps/details?id=com.goodplanet.oceanplanet&hl=en_US [<https://perma.cc/AV2F-RHYQ>] (last visited Apr. 3, 2019). This is a mobile app with the same scope of Marine Litter Watch, but with a global focus.

³²⁶ *Beat the Microbead*, GOOGLE PLAY, <https://play.google.com/store/apps/details?id=org>

UNEP, as secretariat to the GPA, aims to facilitate implementation at the national, regional, and international levels, “as [t]he GPA Coordination Office receives its mandate every 5 years through a process known as Intergovernmental Reviews.”³²⁷ After its adoption in 1995, GPA passed through four reviews: (i) in 2001, the First Intergovernmental Review Meeting on the Implementation of the GPA (“IGR-1”), held in Montreal, Canada; (ii) in 2006, the Second Intergovernmental Review Meeting on the Implementation of the GPA (“IGR-2”), held in Beijing, China; (iii) in 2012, the Third Intergovernmental Review Meeting on the Implementation of the GPA (“IGR-3”), held in Manila, The Philippines; and (iv) in 2017, the Fourth Intergovernmental Review Meeting on the Implementation of the GPA (“IGR-4”), held in Bali, Jakarta Raya, Indonesia. Each of these Intergovernmental Reviews had their own specific objectives and outcomes.³²⁸

IGR-1 focused on reviewing the status of implementation in order to define realistic targets, activities and responsibilities, as well as devise feasible financial, institutional, and technological arrangements.³²⁹ The delegates addressed: (i) “a review of the accomplishments in GPA implementation from 1995 to 2001”; (ii) “the GPA’s Strategic Action Plan on Municipal Waste-water”; and (iii) “the 2002–2006 work programme for the GPA Coordination Office; coastal and ocean governance.”³³⁰ Finally, the “delegates adopted the Montreal Declaration on the Protection of the Marine Environment from Land-based Activities, in which they commit to improving and accelerating implementation of the GPA through actions related to mainstreaming of the GPA, oceans and coastal governance, and financing of the GPA.”³³¹

IGR-2 concentrated on: (i) “[strengthening] the implementation of the GPA at national, regional and global levels”; (ii) “[contributing] to

.plasticsoupfoundation.microbeads [https://perma.cc/5JAT-74K2] (last visited Apr. 3, 2019). This mobile app was created by the North Sea Foundation and the Plastic Soup Foundation to easily check if a product contains microbeads. *Id.*

³²⁷ *GPA—Global Programme of Action*, UN ATLAS OF THE OCEANS, <http://www.oceansatlas.org/subtopic/en/c/796/> [https://perma.cc/S84B-7XJT] (last visited Apr. 3, 2019).

³²⁸ The Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities, UNITED NATIONS ENV'T PROGRAMME, https://wedocs.unep.org/bitstream/handle/20.500.11822/11144/wbrs18_pre_%20%288%29.pdf?sequence=1&isAllowed=y [https://perma.cc/247N-FUAY] (last visited Apr. 3, 2019).

³²⁹ *First intergovernmental review meeting on the implementation of the GPA*, UNITED NATIONS ENV'T PROGRAMME, <https://www.unenvironment.org/fr/node/944> [https://perma.cc/JG3Q-HQ9G] (last visited Apr. 3, 2019).

³³⁰ *Id.*

³³¹ *Id.*

the achievement of specific targets of the Johannesburg Plan of Implementation, as they relate to the GPA, the ecosystem approach, and sanitation”; and (iii) “provid[ing] guidance on the programme of work for the United Nations Environment Programme (UNEP)/GPA Coordination Office for the period 2007–2011.”³³² The major outcomes of this effort were the review of the accomplishments from 2001 to 2006, the development of guidance for implementation from 2007 to 2011, the establishment of nineteen partnerships on mainstreaming the implementation of the GPA, and the elaboration of the Beijing Declaration on Furthering the Implementation of the GPA.³³³

The First Global Conference on Land-Ocean Connections, a gathering of scientists, experts, policy makers and NGOs, made recommendations for IGR-3.³³⁴ This third conference aimed to: (i) review the implementation of the GPA Coordination Office Work Programme 2007–2011 and define its future programme; (ii) identify, discuss and build recommendations to address emerging issues in relation to the protection of the marine environment from land-based activities; and (iii) prepare input from the Rio+20 process government participants.³³⁵ The delegates achieved all of the goals through the release of reports and/or declarations.³³⁶

At the IGR-3, sixty-five governments and the European Commission recommended the establishment of the Global Partnership on Marine Litter (“GPML”) as contained in the Manila Declaration on Furthering the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (“Manila Declaration”).³³⁷ Launched officially at Rio+20, “the GPML is a multi-stakeholder global partnership, which brings together international agencies, governments,

³³² *Second Intergovernmental Review Meeting on the Implementation of the GPA*, UNITED NATIONS ENV'T PROGRAMME, <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/governing-gpa/second> [https://perma.cc/AB4P-M5DV] (last visited Apr. 3, 2019).

³³³ *Id.*

³³⁴ *First global conference on land-ocean connections*, UNITED NATIONS ENV'T PROGRAMME, <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/governing-gpa/first-global> [https://perma.cc/ZZA9-ZSP4] (last visited Apr. 3, 2019).

³³⁵ *Third intergovernmental review meeting on the implementation of the GPA*, UNITED NATIONS ENV'T PROGRAMME, <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/governing-global-programme-0> [https://perma.cc/3WJF-9MJV] (last visited Apr. 3, 2019).

³³⁶ *Id.*

³³⁷ Manila Declaration on Furthering the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities, UNEP/GCSS.XII/INF/10 annex, Jan. 26, 2012.

NGOs, academia, the private sector, civil society and individuals under the common vision to reduce and better manage marine litter.”³³⁸ The primary focus of the GPML is implementing the Honolulu Strategy, which has three main goals to reduce the amount and the impact of: (i) land-based litter and solid waste introduced into the marine environment; (ii) sea-based sources of marine debris; and (iii) accumulated marine debris on shorelines, in benthic habitats, and pelagic waters.³³⁹

Finally, IGR-4 was held in 2017, when the following topics were discussed: (i) strategic directions for the GPA that would address the challenge of marine pollution and support commitments and actions from governments and other actors; (ii) options to develop a targeted global approach to combat marine litter; and (iii) innovative approaches to finance investments in wastewater treatment particularly in developing countries; (iv) addressing nutrient pollution by considering norms and standard setting including relevant private sector interests; (v) options for diversifying the GPA’s funding; and (vi) strengthening cooperation with the Regional Seas Programmes to curb marine pollution originating on land.³⁴⁰

In conducting a general evaluation of the GPA, it is first possible to affirm its necessity because of the amount of land-based sources of marine pollution. Bettina Meier-Wehren reminds us that even the common assumption that developed countries have cleaned up their actions after the efforts beginning in the 1970s is incorrect, as can be seen in the case of Australia.³⁴¹

Regardless of its importance, many challenges still impede the successful implementation of the GPA. Primarily, there are “the lack of interest on the side of states, the non-binding status of the GPA and lack of compliance mechanisms, as well as lack of assistance for developing countries.”³⁴² Moreover, there is no sign that these issues are improving, which leads to the risk that the GPA will fail.³⁴³

³³⁸ UNITED NATIONS ENV'T PROGRAMME, INPUTS TO THE SECRETARY-GENERAL'S REPORT ON MARINE DEBRIS, PLASTICS, AND MICROPLASTICS 3, http://www.un.org/depts/los/general_assembly/contributions_2016/UNEP_Contribution_to_ICP_on_marine_debris.pdf [<http://perma.cc/9TAT-NMER>] (last visited Apr. 3, 2019) [hereinafter INPUTS TO THE SECRETARY-GENERAL'S REPORT].

³³⁹ *Id.* at 3.

³⁴⁰ *Fourth Intergovernmental Review Meeting of the Global Programme of Action*, UNITED NATIONS ENV'T PROGRAMME, <http://cep.unep.org/fourth-intergovernmental-meeting-of-the-global-programme-of-action> [<https://perma.cc/63HW-RSAA>] (last visited Apr. 3, 2019).

³⁴¹ Bettina Meier-Wehren, *The Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities*, 17 N.Z. J. ENVTL. L. 1, 36 (2013).

³⁴² *Id.*

³⁴³ *Id.* at 40.

UNEP/GPA did, however, contain important advances, including some that are plastic-related. For example, the GPA publication *Valuing Plastics*, “noted that the overall natural capital cost of plastics use in the consumer goods sector each year is US\$75 billion—calculated as the negative financial impact of issues such as pollution of the marine environment or air pollution caused by incinerating plastics.”³⁴⁴ Also, the GPA led to Resolution 1/6: Marine plastic debris and microplastics, which was released by the United Nations Environment Assembly and requested a study about most issues related to plastic pollution.³⁴⁵ Likewise, UNEP/GPA enables the subject of plastic pollution to be discussed at high political levels, such as the G7 Summit 2015.³⁴⁶ In addition, the GPML is working on the online Marine Litter Network and on education and awareness activities, such as the Massive Open Online Course on Marine Litter.³⁴⁷

UNEP is also helping to develop regional programs, which are one of the main ways to achieve GPA’s goals. They utilize the GPA’s content, but in a more specific and contextualized manner. There are, for example, the Abidjan Convention,³⁴⁸ the Barcelona Convention,³⁴⁹ and at least thirteen others.³⁵⁰

³⁴⁴ INPUTS TO THE SECRETARY-GENERAL’S REPORT, *supra* note 338, at 3.

³⁴⁵ Resolution 1/6: Marine Plastic Debris and Microplastics, United Nations Environment Assembly (June 2014), <https://wedocs.unep.org/bitstream/handle/20.500.11822/17285/K1402364.pdf?sequence=3&isAllowed=y> [<https://perma.cc/FX5X-BSHG>].

³⁴⁶ INPUTS TO THE SECRETARY-GENERAL’S REPORT, *supra* note 338, at 1.

³⁴⁷ UNITED NATIONS ENV’T PROGRAMME, *supra* note 328, at 4–6.

³⁴⁸ *Welcome of the Abidjan Convention Secretariat*, UNITED NATIONS ENV’T PROGRAMME, <http://abidjanconvention.org/> [<https://perma.cc/XV5H-QR82>] (last visited Apr. 3, 2019). The Abidjan Convention covers a coastline of over 14,000 km, in a marine area from Mauritania to South Africa: “The Convention provides an overarching legal framework for all marine-related programmes in West, Central and Southern Africa.” *Id.*

³⁴⁹ The Barcelona Convention was adopted in 1995 to replace the Mediterranean Action Plan of 1975. It involves twenty-two parties, including countries from the European Union and from the Mediterranean area. As of 2017, it includes seven protocols to deal with specific issues such as dumping, land-based activities, hazardous waste, and many more. The Barcelona Convention, Eur. Comm’n, http://ec.europa.eu/environment/marine/international-cooperation/regional-sea-conventions/barcelona-convention/index_en.htm [<https://perma.cc/4TRE-ABC8>].

³⁵⁰ Other relevant conventions include: the Bucharest Convention; the Cartagena Convention; the Action Plan for the Protection and Development of the Marine Environment and Coastal Areas of the East Asian Region; the Nairobi Convention; the Kuwait Convention; the Action Plan for the Protection, Management and Development of the Marine and Coastal Environment of the North-West Pacific Region; the Jeddah Convention; the South Asian Seas Action Plan; the Lima Convention; the Noumea Convention; the Helsinki Convention; the Oslo Convention; and the Paris Convention. *See generally* GPA COORDINATION OFF.,

C. *FAO Code of Conduct for Responsible Fisheries*

The Food and Agriculture Organization (“FAO”) Code of Conduct for Responsible Fisheries (“the Code”) is a voluntary document created due to emerging concerns of States on how to responsibly manage fisheries in the EEZs,³⁵¹ which, according to UNCLOS, are under their management.³⁵² One of the Code’s main goals is to establish a basis for regulating fisheries in high seas; thus, it is relevant to the goals of this Article.³⁵³

Fisheries and plastic pollution of the oceans are involved in a two-way relationship: the plastic pollution affects marine life, but the fisheries are one of the sources of plastic pollution. Still, there are no specific mentions to plastic in the Code, although pollution and conservation are recurring themes.³⁵⁴

Adopted in 1995, the Code is voluntary in nature. However, certain parts are based on relevant rules of international law, including UNCLOS. Some of its provisions already have or may have a binding effect in the future by means of other obligatory legal instruments between the countries who are parties to the Code.³⁵⁵

The principles and standards brought under the Code inspired the adoption of some regional and national initiatives, such as the European Council Regulation EC 2371/2002,³⁵⁶ Canada’s Oceans Act,³⁵⁷ and the U.S. Commission on Ocean Policy.³⁵⁸ This already shows positive outcomes from the Code, although there are still only a few countries on the path to compliance.³⁵⁹

UNITED NATIONS ENV’T PROGRAMME, PARTNERS IN IMPLEMENTING THE GPA: REGIONAL SEAS (Dec. 1999).

³⁵¹ The EEZs contain approximately 90% of the world’s marine fisheries. Those and other information about the history of the construction of the Code may be found in its preface. FOOD & AGRICULTURE ORG. OF THE UNITED NATIONS, CODE OF CONDUCT FOR RESPONSIBLE FISHERIES v (1995), <http://www.fao.org/3/a-v9878e.pdf> [<https://perma.cc/DWY7-Z5HN>] [hereinafter RESPONSIBLE FISHERIES].

³⁵² UNCLOS, *supra* note 178, at art. 56.

³⁵³ RESPONSIBLE FISHERIES, *supra* note 351, at v–vi.

³⁵⁴ *See id.* at 6.

³⁵⁵ *Id.* at 1.

³⁵⁶ Council Regulation 2371/2002, 2002 O.J. (L 358) (EC).

³⁵⁷ Oceans Act, R.S.C. 1995, c. 31.

³⁵⁸ *See* U.S. COMM’N ON OCEAN POLICY, PRELIMINARY REPORT 245 (Apr. 2004), https://govinfo.library.unt.edu/oceancommission/documents/prelimreport/00_complete_prelim_report.pdf [<https://perma.cc/SP3S-N9F3>].

³⁵⁹ Marta Coll et al., *Sustainability implications of honouring the Code of Conduct for Responsible Fisheries*, 23 GLOB. ENVTL. CHANGE 157, 165–66 (2013).

A 2013 study about the effectiveness of article 7 showed the Code's potential, and concluded that there have been many positive impacts for the countries that have adopted it.³⁶⁰ After considering "the loss in production index and the related probability of sustainable fishing index, the mean trophic level of the catch, total catches, and the primary production required to sustain the catch," the study found that countries with higher levels of Code compliance experienced a decrease in the loss in production index and an increase in the sustainability of their fisheries.³⁶¹

Thus, the conclusions of the study have interesting implications for our analysis, but they cannot be directly tied to the issue of plastic pollution in the oceans. However, this same study also concluded that compliance with the Code clearly led to an improvement in exploited marine ecosystems.³⁶²

Another study, conducted in 2011, showed slightly different results, and argued that "the Code as an international policy instrument remains relevant and adaptable to the current international fisheries context, and that its guiding principles and provisions have been endorsed and adopted in almost unanimous fashion . . . and integrated into fisheries policy letters and legal frameworks" by countries in Asia, Africa, and the Caribbean.³⁶³

However, both studies agree that there are still major challenges regarding the Code's effectiveness. Recent concerns focus on a need for much more efficiency, improving elements such as combating illegal, unreported and unregulated fishing, and designing and implementing other necessary measures.³⁶⁴ The 2011 study also mentions the need for administrative inertia, the lack of political will and stamina, and short-sighted economic considerations as important causes for these concerns.³⁶⁵

D. *Sustainable Development Goals*

In the year 2000, during the UN Millennium Summit, world leaders adopted the UN Millennium Declaration, committing to a global partnership to reduce poverty via eight targets by a 2015 deadline.³⁶⁶ An independent advisory board lead a task force of "more than 250 experts from around the world, including scientists, development practitioners,

³⁶⁰ *See generally id.*

³⁶¹ *Id.* at 157.

³⁶² *Id.* at 163.

³⁶³ Gilles Hosch et al., *The 1995 FAO Code of Conduct for Responsible Fisheries: Adopting, implementing or scoring results?*, 35 MARINE POL'Y 189, 189 (2011).

³⁶⁴ *Id.* at 195.

³⁶⁵ *Id.* at 193, 195–96.

³⁶⁶ G.A. Res. 55/2, 2000 United Nations Millennium Declaration (Sept. 18, 2000).

parliamentarians, policymakers, and representatives from civil society, UN agencies, the World Bank, the IMF, and the private sector,³⁶⁷ and submitted its recommendations to the UN Secretary General.

Those eight goals are: “(i) eradicate extreme poverty and hunger; (ii) achieve universal primary education; (iii) promote gender equality and empower women; (iv) reduce child mortality; (v) improve maternal health; (vi) combat HIV/AIDS, malaria and other diseases; (vii) ensure environmental sustainability; and (viii) develop a global partnership for development.”³⁶⁸

Since the UN considered the Millennium Development Goals (“MDGs”) a success, it pushed for the adoption of the seventeen Sustainable Development Goals (“SDGs”) as part of a post-2015 agenda.³⁶⁹ The process involved in drafting the latter was very different, and included many more political actors in an intergovernmental discussion that lasted three years.³⁷⁰ This new approach mainly tried to guarantee greater involvement of member states and civil society.³⁷¹ It also explains, in large part, the larger number and elevated degree of complexity of the SDGs because consensus was necessary.

Each of the SDGs deals with specific target or targets—169 in total—and with indicators that are used to monitor and review how the goals are progressing. All goals, targets and indicators are available on the UN Sustainable Development Goals Knowledge Platform,³⁷² but because there are too many to specify here, we highlight those that have closer relationships to plastic pollution of the oceans.

Goal 6’s objective is to “[e]nsure availability and sustainable management of water and sanitation for all.”³⁷³ Although the goal relates more to drinking and inland waters, it also impacts plastics, especially regarding levels of pollution because rivers will end up in seas or oceans. In

³⁶⁷ UN MILLENNIUM PROJECT, INNOVATION: APPLYING KNOWLEDGE IN DEVELOPMENT (2005).

³⁶⁸ *Id.* at xxii–xxiii.

³⁶⁹ JEFFREY SACHS CENTER ON SUSTAINABLE DEVELOPMENT, *Sustainable Development Goals (SDGs)*, <http://jeffreysachs.center/sdg> [<https://perma.cc/WX2M-X24L>] (last visited Apr. 3, 2019).

³⁷⁰ *Id.*

³⁷¹ For a discussion about this process and about the democratic aspects involved, see Luísa Cortat Simonetti Goncalves, *Um Passo Na Direção do Uso de Ferramentas Democráticas no Âmbito Internacional: a experiência dos diálogos pelo desenvolvimento sustentável na Rio+20*, in DIREITOS FUNDAMENTAIS E DEMOCRACIA 141 (1st ed.) (CONPED/UFF Org., 2012).

³⁷² *Sustainable Development Goals*, UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS KNOWLEDGE PLATFORM, <https://sustainabledevelopment.un.org/?menu=1300> [<https://perma.cc/7QWX-NV8Z>] (last visited Apr. 3, 2019).

³⁷³ *Sustainable Development Goal 6*, UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS KNOWLEDGE PLATFORM, <https://sustainabledevelopment.un.org/sdg6> [<https://perma.cc/9JAU-TXUZ>] (last visited Apr. 3, 2019).

that sense, target 6.3 is of particular importance: “improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally.”³⁷⁴

Goal 12 addresses another aspect of the problem, with a focus on “ensur[ing] sustainable consumption and production patterns.”³⁷⁵ This SDG shows a clearer and closer relationship with plastic pollution of the oceans, mainly through targets 12.5, 12.6, and 12.8.³⁷⁶

Target 12.5 aims to reduce substantially, by 2030, “waste generation through prevention, reduction, recycling and reuse,” which will be monitored by measuring the national recycling rate in tons of material recycled—indicator 12.5.1.³⁷⁷ It naturally does not specify plastics in particular because it has to be broader in order to achieve its main goal, but plastics are obviously included in the efforts.

This can also be seen in target 12.6, which hopes to “[e]ncourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle,” and counts the number of companies publishing sustainability reports as an indicator (12.6.1) of progress.³⁷⁸ The main problem here seems to be overestimating the power of reporting. First, although publishing these reports has the upside of forcing companies to think about sustainability and the need to have something to report, it does not necessarily mean that the companies will adopt more sustainable practices. This suggests a second point: that, many times, these reports mention broad projects that reflect more intentions than actions.

Target 12.8, in turn, tries to ensure that by 2030 “people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.”³⁷⁹ This is a very important consideration when it comes to facing the problem of the plastic pollution of the oceans, as discussed previously in this Article. Indicator 12.8.1 tries to cover everything that should be included in information access and public awareness, by measuring to what extent: “(i) global citizenship education and (ii) education for sustainable development (including climate

³⁷⁴ *Id.*

³⁷⁵ *Sustainable Development Goal 12*, UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS KNOWLEDGE PLATFORM, <https://sustainabledevelopment.un.org/sdg12> [<https://perma.cc/QUD6-FU7X>] (last visited Apr. 3, 2019).

³⁷⁶ *Id.*

³⁷⁷ *Id.*

³⁷⁸ *Id.*

³⁷⁹ *Id.*

change education) are mainstreamed in (a) national education policies; (b) curricula; (c) teacher education; and (d) student assessment.”³⁸⁰

Finally, there is goal 14: “conserve and sustainably use the oceans, seas and marine resources for sustainable development.”³⁸¹ Thus, it is possible to assert that this entire goal is related to plastic pollution of the oceans, but some targets and indicators seem to be more on point, which explains why they will be discussed in greater depth below.

Target 14.1 addresses the important aspects of land-based sources and marine debris by aiming to “prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution” by 2025.³⁸² The centrality of land-based sources to plastic pollution of the oceans is already something notable in itself, as we have discussed throughout this Article.

Indicator 14.1.1 then specifically accounts for plastic by establishing an index of coastal eutrophication and floating plastic debris density as a way to measure progress.³⁸³ Of course, a big part of the problem—in particular microplastics and plastics in the seabeds—is left out, but this indicator visibly acknowledges the importance of addressing plastics to the conservation and sustainable use of the oceans, seas, and marine resources.

Target 14.A shows the need for further studies and research and, consequently, more accurate data and information regarding plastics, even if it does not mention plastics explicitly. Some of the tactics to improve ocean health include “increas[ing] scientific knowledge, develop[ing] research capacity and transfer[ring] marine technology.”³⁸⁴ Indicator 14.A.1 provides that monitoring should consider the “[p]roportion of total research budget allocated to research in the field of marine technology.”³⁸⁵

Target 14.C addresses the main discussion of this Article by trying to stimulate compliance with the international instruments related to the protection of the oceans. The target aims to “[e]nhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as

³⁸⁰ *Id.*

³⁸¹ *Sustainable Development Goal 14*, UNITED NATIONS SUSTAINABLE DEVELOPMENT GOALS KNOWLEDGE PLATFORM, <https://sustainabledevelopment.un.org/sdg14> [<https://perma.cc/U43Z-T5RZ>] (last visited Apr. 3, 2019) [hereinafter *Sustainable Development Goal 14*].

³⁸² *Id.*

³⁸³ *Id.*

³⁸⁴ *Id.*

³⁸⁵ *Id.*

recalled in paragraph 158 of *The Future We Want*.³⁸⁶ And the indicator (14.C.1) of the progress towards that is the “number of countries making progress in ratifying, accepting and implementing through legal, policy and institutional frameworks, ocean-related instruments that implement international law, as reflected in [UNCLOS], for the conservation and sustainable use of the oceans and their resources.”³⁸⁷ This represents a significant advance in the effectiveness of international instruments, even considering that there are no fixed ways to measure implementation.

Specifically, regarding goal 14, there has been an interesting outcome in the UN itself. A meeting held in New York in June of 2017 involving heads of States, civil society and stakeholders resulted in a document entitled *Our ocean, our future: call for action*.³⁸⁸ It explicitly mentions plastics as an urgent issue to be addressed and refers to plastics and microplastics, as well as to the need to reduce their use.³⁸⁹

With less than four years having passed between when the SDGs were adopted and the completion of this Article, it is not yet possible to determine the effectiveness of the SDGs. However, the results from the MDGs show what may be expected. At the same time, the challenges and difficulties experienced with the MDGs were addressed in the SDGs through elaboration and avoiding repetition, which leads to some optimism.

For that reason, we return to the UN assumption that the MDGs were a success by looking into the conclusions contained in *The Millennium Development Goals Report 2015*.³⁹⁰ In this report, success is measured by numbers stated for each of the eight goals,³⁹¹ which show “profound achievements.”³⁹² As an example, we mention some of the outcomes of goal 7 (“ensure environmental sustainability”):

- 1.9 billion people have gained access to piped drinking water—from 2.3 billion in 1990 to 4.2 billion in 2015³⁹³

³⁸⁶ *Id.*

³⁸⁷ *Sustainable Development Goal 14*, *supra* note 381.

³⁸⁸ G.A. Res. 71/312 (July 6, 2017).

³⁸⁹ *Id.* at 1.

³⁹⁰ UNITED NATIONS, *THE MILLENNIUM DEVELOPMENT GOALS REPORT 2015* (2015), [http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20\(July%2015\).pdf](http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%2015).pdf) [<https://perma.cc/UKW9-URFG>] (last visited Apr. 3, 2019) [hereinafter MDGs REPORT].

³⁹¹ *Id.* at 4–7.

³⁹² *Id.* at 4.

³⁹³ *Id.* at 7. This shows how there are different ways to analyze the same data. For instance, being that the total population increased by around 2.1 billion between these years, there

- Since 1990, 98% of ozone-depleting substances have been eliminated³⁹⁴
- One hundred forty-seven countries have met the drinking water target, ninety-five countries have met the sanitation target and seventy-seven countries have achieved both goals³⁹⁵
- Worldwide, 2.1 billion people now have improved access to sanitation³⁹⁶
- The percentage of the urban population in developing regions residing in slums fell from approximately 39.4% in 2000 to 29.7% in 2014.³⁹⁷

However, the same report stresses that “[d]espite many successes, the poorer and most vulnerable people are being left behind.”³⁹⁸ The report also highlights the importance of “sustainable data for sustainable development,”³⁹⁹ with the following observations:

- “What gets measured gets done”
- “Real data improvement occurs when demand and policy support meet”
- “Despite improvement, critical data for development policymaking are still lacking”
- “Only by counting the uncounted can we reach the unreached”
- “Real-time data is needed to deliver better decisions faster”
- “Geospatial data can support monitoring in many aspects of development, from health care to natural resource management”

was no real growth in access. *See Population, total*, WORLD BANK, <https://data.worldbank.org/indicator/SP.POP.TOTL> [<https://perma.cc/ZX8Z-XMPW>] (last visited Apr. 3, 2019). In fact, it is possible to argue that there was a decrease in access.

³⁹⁴ MDGs REPORT, *supra* note 390, at 7.

³⁹⁵ *Id.*

³⁹⁶ *Id.* However, applying the same reasoning that was applied to the numbers on drinking water, it is also possible to argue that this actually represents the continuance of a population growth trend, instead of an improvement. WORLD BANK, *supra* note 393.

³⁹⁷ MDGs REPORT, *supra* note 390, at 7.

³⁹⁸ *Id.* at 8.

³⁹⁹ *Id.* at 10.

- “Strengthening statistical capacity is the foundation for monitoring progress of the new development agenda”
- “New technology is changing the way data are collected and disseminated”
- “Global standards and an integrated statistics system are key elements for effective monitoring”
- “Promoting open, easily accessible data and data literacy is key for effective use of data for development decision-making”
- “Together we can measure what we treasure”⁴⁰⁰

More than that, there are doubts about the supposedly good results. For example, regarding the first so-called success we have highlighted—about improved access to piped drinking water—there are different ways to analyze the same data. The increase in the world population during the same years mentioned in the report was approximately 2.1 billion people.⁴⁰¹ If we recall that the increased access to piped drinking water applies to 1.9 billion people, we may argue that there was no real growth in access to drinking water, and it is even possible to argue that there was a decrease relative to the total population growth rate.

Nonetheless, “while not entirely satisfactory they nevertheless reflect that a certain progress was made towards realization of the goals and targets which were to be fulfilled by 2015.”⁴⁰²

The conclusions—even, and maybe especially, the negative ones—suggest areas for improvement as part of a post-2015 agenda. In any case, these conclusions seem to have been taken into consideration in the SDGs, mainly in the elaboration process and in the types of indicators chosen. Finally, regarding the plastic pollution of the oceans, we have shown that the SDGs came as an improvement, with provisions closely related to the problem. In other words, there is room for cautious optimism regarding the SDGs.

E. Summary

This brief overview of a few international soft law instruments shows that on the one hand there are documents that indirectly could

⁴⁰⁰ *Id.* at 10–13.

⁴⁰¹ WORLD BANK, *supra* note 393.

⁴⁰² Zofia Wysockińska, *Millennium Development Goals/UN And Sustainable Development Goals/UN As Instruments for Realising Sustainable Development Concept In The Global Economy*, 20 COMP. ECON. RES. 101, 103 (2017).

have some influence on plastic pollution. On the other hand, it shows that none of the instruments directly focuses on the central issue of this Article: the plastic soup. In general, these instruments are broader and, therefore, more challenging to measure than hard law, as we saw with the heterogeneous outcomes and controversial academic analysis. However, all of them show signs of progress, especially related to raising awareness and incentivizing regional and local initiatives. Therefore, soft law has shown, in general, more positive results than hard law. Yet, under the currently applicable legal framework, there are no international soft law instruments that can directly contribute to solving the problem of the plastic soup. This means that, in the future, it may be important at least to ask the question as to whether a specific soft law would be appropriate to deal with the plastic soup problem, mainly as an important step to encourage a change in international behavior. Finally, it is essential to keep in mind that the fight against the plastic soup is constantly evolving. The fact that within the framework of the Basel Convention, there have been talks recently to expand its scope to include specific types of plastics that contribute to the plastic soup is a sign of the interest in solving the plastic soup problem.⁴⁰³ At this stage it is still too early to judge the importance of that step, but it does show that at the international level there is an increasing awareness of the importance of this topic.

IV. INTERNATIONAL INSTRUMENTS AND THE PLASTIC SOUP

The descriptions and discussions about the international instruments lead to the conclusion that, in general, the problem of plastic pollution of the oceans is not addressed directly by any of those instruments. This is an aspect of major concern mainly for two reasons: the plastic soup is already considered by some as the largest environmental harm caused by mankind,⁴⁰⁴ and because it affects international waters, it is essentially an international law problem.

Of course, there are a few broader instruments that prohibit waste discharge, which naturally includes plastic. There is, however, a consensus in the literature regarding the lack of effectiveness of most of those instruments. The analysis of Agenda 21 reinforces such perspective by

⁴⁰³ Laura Green, *Global Marine Plastic Waste and the Newly Recommended Amendment to the Basel Convention: a Bandage or a Bandaid?*, BLOG OF THE EUR. J. INT'L L. (Sept. 12, 2018), <https://www.ejiltalk.org/global-marine-plastic-waste-and-the-newly-recommended-amendment-to-the-basel-convention-a-bandage-or-a-bandaid/> [https://perma.cc/9ZYE-JRMR].

⁴⁰⁴ Laura Parker, *We made plastic. We depend on it. Now we're drowning in it.*, NATIONAL GEOGRAPHIC (June 2018), <https://www.nationalgeographic.com/magazine/2018/06/plastic-planet-waste-pollution-trash-crisis/> [https://perma.cc/7MAZ-U8NW].

highlighting the failure of the international community regarding the plastic soup and the oceans more broadly, demonstrating that “[i]n the 20 years since Rio, the state of world’s oceans and coastal areas has continued to decline.”⁴⁰⁵

However, as mentioned before, the international instruments and their complexity have several positive as well as several negative aspects. On the upside, we could identify, for example, that: UNCLOS covers six types of sources of marine pollution;⁴⁰⁶ the London Protocol of 2006 explicitly prohibits the dumping of plastics into the oceans;⁴⁰⁷ Agenda 21 helped to bring sustainable human development closer to the heart of development;⁴⁰⁸ the GPA is achieving many intergovernmental advances regarding land-based activities;⁴⁰⁹ the FAO Code, when implemented, induces good national results;⁴¹⁰ and the SDGs are expected to attain many successes.

In order to do a more specific analysis of the effectiveness of the international instruments discussed and, mainly, to address the next steps, we discuss the issue from two perspectives. The first regards the *ex ante* perspective, the focus on the emission of plastics into the ocean, which obviously should be avoided. It concerns broader issues like the production and consumption of plastics, but mostly the disposal of plastics which ultimately makes them end up in the ocean. The second aspect addresses the issue more from an *ex post* perspective, and therefore looks at recovery. The *ex post* perspective refers to the problem of plastics already present in the ocean. Such an analysis is made by evaluating possible solutions and discussing lessons learned.

A. Ex Ante Perspective

From the previous two sections it appears that the main problems with the current international instruments (both hard law and soft law) are that none of them explicitly deal with preventing the discharge of plastic into the ocean. Likewise, the lack of effectiveness of most of the instruments is also a problem.

Table 1 summarizes the ways in which the nine instruments (plus the London Protocol) discussed in the previous two sections deal with the

⁴⁰⁵ STAKEHOLDER FORUM FOR A SUSTAINABLE FUTURE, *supra* note 314, at 29.

⁴⁰⁶ UNCLOS, *supra* note 178, at arts. 207–12.

⁴⁰⁷ Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, Aug. 30, 1975, 26 U.S.T. 2403, 1046 U.N.T.S. 120.

⁴⁰⁸ *Agenda 21*, *supra* note 284, at Chapter 2.

⁴⁰⁹ UNITED NATIONS ENV'T PROGRAMME, *supra* note 328.

⁴¹⁰ SHEAVLY, *supra* note 25.

issue of plastic. When a particular instrument mentions the word plastic, it is put in the “yes” column in the following Table 1.

TABLE 1: SUMMARY OF MENTIONS TO PLASTICS IN THE INTERNATIONAL INSTRUMENTS

	Mention of plastics?	
	YES	NO
Hard Law	London Protocol (2006) ⁴¹¹ MARPOL (Annex V)	UNCLOS London Convention CBD CMS
Soft Law	GPA ⁴¹² SDGs	Agenda 21 FAO Code

A feature to note is the fact that the only two hard law documents that mention plastic do not prevent dumping from land-based activity, which represents—as mentioned before—80% of the plastic that ends up in the oceans.⁴¹³ Secondly, one of the two soft law instruments that mention plastics—the SDGs—only have to be reached by 2030, so the SDGs could have only just started to produce effects. That makes it more difficult to evaluate practical outcomes.

This should be read together with the broader approach of each document and with their general effectiveness. Table 2 summarizes elements of the international instruments, and while it does not capture the full complexity of the instruments, it is helpful for visualizing all of the elements and how they relate to the instruments’ efficacy. Thus, it is important to keep in mind that: (i) all instruments have several positive and negative aspects, but the table only displays them if related to possible outcomes facing the plastic pollution of the oceans; (ii) it leaves out whether the instruments reference plastic because that is already accounted for in Table 1; and (iii) general effectiveness is assessed in a binary “yes” or “no” response, based on the literature review offered before, and not only regarding the plastic pollution of the oceans. None of those constraints influence the conclusions that will be derived from the descriptions.

⁴¹¹ Considered separately from the London Convention because parties may choose to sign only one or both.

⁴¹² This supposes that some of the programs adopted under the GPA refer to plastics.

⁴¹³ SHEAVLY, *supra* note 25.

TABLE 2: SUMMARY OF PLASTIC-RELATED ASPECTS AND EFFICACY OF THE INTERNATIONAL INSTRUMENTS⁴¹⁴

	Strengths	Weaknesses	Effectiveness
UNCLOS	Addresses 6 sources of marine pollution	No explicit mention of plastics	Yes
London Convention and London Protocol (2006)	Offers guidelines to assist national authorities Counts with review mechanisms	Plastic is not listed as pollution to be prevented by States Lack of provisions to solve technical, scientific and financial obstacles to change the behavior of sea dumping Only covers dumping from ships, platforms and aircrafts	Yes
MARPOL	Prohibits the discharge of all plastics into the sea	Only mention to plastic is in an annex Only prevents pollution from ships Flags of convenience	Yes
CBD	Jakarta mandate brings a checklist of concrete measures Strategic plan Aichi targets	2010 goals failed	No
CMS	Strategic plan	Resources constraints	Yes

⁴¹⁴ This table does not include SDGs, whose outcomes can only be measured after 2030, or, for partial remarks, after a few more years of implementation.

	Strengths	Weaknesses	Effectiveness
Agenda 21	Helped to bring sustainable human development closer to the heart of development CSD	Failure towards sustainable consumption and production patterns (business as usual prevailed) State of oceans severely declined in the 20 years after	Yes
GPA	Addresses the connection between terrestrial, freshwater, coastal and marine ecosystems Focus on land-based activities GPLM <i>Valuing plastics</i> report Access to high political levels Online marine litter network Activities to raise awareness Help to develop regional programmes	Non-binding Thus, lack of compliance mechanisms	Yes
FAO Code	Influence in regional and national initiatives Good results in countries that adopted	Administrative inertia Lack of political will Short-sighted economic considerations	Yes

The overview provided in the table implies that, in a broader perspective, international law is making progress in those areas. However, if we compare the information displayed in both tables, the results related to plastic pollution of the oceans are much worse. The two hard law

instruments that refer to plastics, London Protocol 2006 and MARPOL, do not cover land-based activities, and they face enforcement difficulties. The one with the best opportunities, the GPA, is soft law and as such faces problems like states' willingness and a lack of compliance mechanisms, even though there are some good results.

Therefore, the central matter seems to be the necessity of addressing land-based sources of plastic pollution. In this respect, regional, national, and local actions gain prominence.

After the analysis made so far, we can conclude that international instruments implemented through or with the help of regional actions are the ones showing the best results.⁴¹⁵ We take, for example, the literature referring to Agenda 21. Also, the GPA regional and local programs, although they are still under analysis and it is hard to make conclusions about practical results, appear to have made progress much faster than global programs. SDGs provide an additional example of some possible progress at this level. Finally, “[o]ne alternative [to either a top-down or bottom-up approach] could be a development strategy building on horizontal collaboration between actors and organizations. Collaboration can take place in the form of networks, innovation systems, partnerships, clusters or Triple Helix, where the aim is to achieve something that participants cannot do individually.”⁴¹⁶ Such an alternative is more likely to be achieved at regional and local levels, where the transaction costs for the parties involved are significantly lower, never excluding, of course, the possibility of an international framework.

The need to approach the land-based sources, combined with the potential success of regional programs, points toward the need for a differentiated approach to address the *ex ante* part of plastic pollution of the oceans. We therefore come to balanced conclusions with respect to the effectiveness of the current international legal instruments as well as the need to employ other instruments. The current hard law instruments, so we concluded, are hardly effective and most of them do not explicitly address the prevention of plastic pollution. Some soft law instruments do, and especially when they act through regional initiatives

⁴¹⁵ Obviously there are regional actions, for example at the EU level, to prevent emission of wastes into the waters. See, e.g., Thomas J. De Römph & Geert Van Calster, *REACH in a Circular Economy: The Obstacles for Plastics Recyclers and Regulators*, 27 *RECIEL* 267, 267 (2018). However, given our focus on international law instruments, EU law is beyond the reach of our Article.

⁴¹⁶ GRAN BRULIN & LENNART SVENSSON, *MANAGING SUSTAINABLE DEVELOPMENT PROGRAMMES: A LEARNING APPROACH TO CHANGE* 59 (2011).

seem to have been most effective. However, although the plastic pollution is by nature undoubtedly a transboundary problem, which would necessitate a remedy via international law, we do not necessarily plead in favor of yet another international law instrument aiming at the prevention of plastic pollution. The feasibility of such a new instrument coming into being is relatively small, and, moreover, most actions to prevent the plastic soup have to be taken at the domestic level as we indicated that 80% of the pollution of the oceans is land-based.⁴¹⁷ The current international legal framework should therefore be considered in combination with solutions at the domestic level (for example aiming at the reduction of plastic, discussed above in Section II.D).⁴¹⁸ In addition, solutions based on corporate social responsibility of the plastic producers could also stimulate the reduction and recycling of plastic and, therefore, prevent plastics from ending up in the ocean. Discussing those solutions based on domestic law or corporate social responsibility is, however, beyond the scope of this Article.

Besides, looking back and trying to understand the lessons learned that may help solve plastic pollution of the oceans, the paths to be chosen, either globalized or localized, would have to consider the importance of some of the aspects indicated in Table 2 above. We summarize those lessons in six suggestions, that show the goals of an international regulatory framework to address the plastic soup:

1. Addressing all sources of plastic pollution and the connection between terrestrial, freshwater, coastal, and marine ecosystems;
2. Establishing guidelines, targets and indicators, helping the goals to become more concrete and more easily evaluated;
3. Foreseeing the possibility of reviewing and of compliance mechanisms;
4. Strengthening technical, scientific and financial resources;
5. Clarifying economic impacts—and mainly gains—of the changes involved in adopting the instrument;
6. Gathering and interpreting data and information.

⁴¹⁷ SHEAVLY, *supra* note 25.

⁴¹⁸ For an example discussed previously concerning the aim of reducing plastic, see *supra* Section II.D.

B. Ex Post Perspective: Perceptions and Lessons Learned

As we indicated in the introduction and when discussing the technical aspects of the plastic soup in Part I, most of the solutions that can currently be found in both international hard and soft law instruments focus on preventing plastics from ending up in the ocean. That obviously is important, given the old saying that “prevention is better than cure.” However, we equally indicated that those solutions are far from perfect and plastic pollution of the oceans continues to increase.⁴¹⁹ Moreover, even if (hypothetically) the emission of plastics into the ocean were to stop, there would still be an enormous plastic soup that is currently polluting the ocean. This question of how, from an *ex post* perspective, the current pollution could be cured is not addressed in either the legal or policy instruments we have discussed so far. The question arises: to what extent is a legal solution necessary or indicated to facilitate technical solutions? In order to contribute to that debate, we will first review the possible technical solutions to the plastic soup, building upon the overview provided in Section I.D. We will then establish that there are specific impediments that may restrict the implementation of those technical solutions. The question of whether legal instruments are needed to stimulate the implementation of those technical solutions will be analyzed using a law and economics approach. The final subsection summarizes the findings with respect to the question whether a legal solution is needed to implement the technical solutions.

1. Technical Solutions

We will first review the status of implementation of the technical solutions that were discussed in Section I.D. To the extent that those technical solutions have not been implemented yet, the question arises as to what the causes are of that specific failure.

Going back to the proposed technical solutions, regarding the *ex post* perspective, the existing solutions include the two bacteria capable of decomposing PET, one discovered in nature and the other genetically modified to do so, and the initiative from The Ocean Cleanup. As mentioned in the overview of the plastic pollution problem,⁴²⁰ we cannot describe every single initiative around the world, but the ones selected represent the different available formats. In other words, leaving aside

⁴¹⁹ Parker, *supra* note 404.

⁴²⁰ See *supra* Section I.D.

some initiatives that have the same nature and, thus, face the same challenges, does not influence the results discussed here.

First, we analyze the possibility of using the two bacteria that eat plastics. The use of these bacteria is, however, very recent. Their presentation to the academic world only happened at the end of 2017, which makes it very complex to assess the status of implementation.⁴²¹ It is too soon to affirm if these bacteria are not being used because they will be in a near future or because there is no prospect of doing so. From this, we can only estimate what challenges could arise. One challenge is that obviously an innovation would need the protection from intellectual property rights. Assuming that a patent can be granted to the inventor, that should, in light of the economics of patents, provide sufficient incentives to invest in research and development. Marketing the patent provides a monopoly right which would allow the inventor to recover the initial costs of research and development. That is the well-known law and economics theory of patents. The question is not so much whether the patent protection can adequately protect inventors against potential free-riding and thus generate sufficient incentives for innovation. A more important question is probably whether the invention could be marketed in such a way that sufficient funds could be generated to recover the initial costs.

Another solution discussed in Section I.D was provided by The Ocean Cleanup, an NGO which would, to put it shortly, clean up the ocean on a voluntary basis. This solution also has particular challenges. According to the information on the organization's website, everything is progressing as planned.⁴²² Not only is funding not a concern, but they also claim they would be, alone, able to implement the system on a global scale—meaning the five gyres—by 2020, and reduce plastics in the oceans to close to zero by 2050.⁴²³ This is almost too good to be true. Recall that the data we mentioned in the introduction show a minimum of eight million tons of plastic entering the ocean each year.⁴²⁴ The question therefore arises whether expecting The Ocean Cleanup to be able to remove all plastics by 2050 is overly optimistic. The website does not make precisely clear how this amazing result would be achieved; there is some reason to believe that this positive presentation may also be an attempt to acquire sponsoring for the initiative.

⁴²¹ Deborah Netburn, *Newly discovered bacteria can eat plastic bottles*, PHYS (Mar. 11, 2016), <https://phys.org/news/2016-03-newly-bacteria-plastic-bottles.html> [<https://perma.cc/8QP8-JVAG>].

⁴²² THE OCEAN CLEANUP, *supra* note 168.

⁴²³ *Id.*

⁴²⁴ See ELLEN MACARTHUR FOUNDATION, *supra* note 6.

The way the initiative is presented, it seems that voluntary clean-up could provide this solution. The organization does not mention specific obstacles. That does not mean, however, that there are no lessons related to difficulties that may be faced by non-profit organizations engaging in cleaning the oceans. The NGO has been supported in different ways by the Dutch government on different occasions.⁴²⁵ The government *inter alia* supported the foundation in obtaining the research permits necessary to conduct studies on the seas and beaches under the sovereignty of foreign countries. The government also supported the NGO by providing the Dutch “flag” for the cleaning system, thus equating it to a Dutch seagoing vessel.⁴²⁶ Still, the major challenge faced by the NGO would be a financial one. This can be derived from the milestones described by The Ocean Cleanup,⁴²⁷ and also from the situation with other organizations, such as The Great Bubble Barrier.⁴²⁸

For The Ocean Cleanup, a great part of the funding came from very successful crowdfunding, which collected \$2.2 million.⁴²⁹ Now, the organization has several partners such as Akzo Nobel, Deloitte, and the government of the Netherlands, among others.⁴³⁰ To the Great Bubble Barrier, funding remains the main challenge. As of July 11, 2018, its crowdfunding campaign raised 53,753 Euros, while they needed 25,000 Euros to build a scale model for demonstrations, 50,000 Euros to build a bubble barrier without a catchment system, and 100,000 Euros to build a fully functioning bubble barrier.⁴³¹

⁴²⁵ Interview with Arnoud Passenier, civil servant for the *Ministerie van Infrastructuur en Waterstaat*, in The Hague, The Netherlands (June 25, 2018).

⁴²⁶ Ellen Hoogland, *The Dutch State to Support The Ocean Cleanup's High Seas Activities*, THE OCEAN CLEANUP (June 8, 2018), <https://www.theoceancleanup.com/updates/the-dutch-state-to-support-the-ocean-cleanups-high-seas-activities/> [<https://perma.cc/NYF3-FPAX>] (last visited Apr. 3, 2019). The full text of the agreement is available in Dutch. See Covenant tussen de Minister van Infrastructuur en Waterstaat en The Ocean Cleanup betreffende de inzet van systemen bedoeld om plastic op volle zee, dat drijft in de bovenste waterlagen, op te ruimen (Covenant between the Minister of Infrastructure and Water Management and The Ocean Cleanup concerning the use of systems intended to clean up plastic on the high seas floating in the upper water layers) 6 Juli, Stcrt. 2018, 1, 8, <https://zoek.officielebekendmakingen.nl/stcrt-2018-31907.html#d17e790> [<https://perma.cc/6LQC-Z3W3>].

⁴²⁷ See THE OCEAN CLEANUP, *supra* note 168 (explaining how crowdfunding is an important source of financing).

⁴²⁸ Although it is not an innovation to clean the oceans, whereas preventing plastics in inner waters from entering the oceans is, this illustrates the initial difficulty non-profit organizations face when raising money for new ideas or initiatives.

⁴²⁹ THE OCEAN CLEANUP, *supra* note 168.

⁴³⁰ *Id.*

⁴³¹ *Milestones and Goals*, THE GREAT BUBBLE BARRIER, <https://thegreatbubblebarrier.com/en/timeline-en/> [<https://perma.cc/47B4-MUPU>] (last visited Apr. 3, 2019).

A striking feature is that so far only non-profit organizations are active in the *ex post* clean-up of the oceans. Corporations at best match the activities of NGOs. This raises the interesting question of why corporations have not yet engaged more actively in the clean-up of plastic pollution.⁴³² The most logical answer is that there is no profitable market, especially because companies claim that recovery is still too costly.⁴³³ But there may be other impediments as well. These findings, therefore, call for an economic approach to the plastic soup problem, examining whether it would be possible to create sufficient financial incentives to clean up plastic pollution from the ocean.

2. A Law and Economics Approach

The starting point for analyzing the plastic soup from an economic perspective should be that plastic pollution in the oceans is not just a

⁴³² There are only a few incipient activities. For example, Adidas, in partnership with Parley, is producing and selling shoes made from recovered plastics. Adam Wentworth, *Adidas has sold one million shoes made from recycled ocean plastic*, CLIMATE ACTION (Mar. 15, 2018), <http://www.climateaction.org/news/adidas-has-sold-one-million-shoes-made-from-recycled-ocean-plastic> [https://perma.cc/G2UE-6X6Q]. From November 15, 2016, to March 15, 2018, they sold one million pairs, while their financial performance is continuously increasing. *Id.* The same partnership is producing jerseys made from recovered plastics, which are already being used by Real Madrid and Bayern Munchen. Charlotte Dreizen, *Where and how ocean plastic is being used as feedstock*, GREENBLUE, <https://greenblue.org/where-and-how-ocean-plastic-is-being-used-as-feedstock/> [https://perma.cc/ZL6U-EPL8] (last visited Apr. 3, 2019); Renato Cunha, *A decisão da Adidas de utilizar somente poliéster reciclado poderia influenciar toda indústria da moda?*, STYLO URBANO (Aug. 17, 2018), <http://www.stylourbano.com.br/a-decisao-da-adidas-de-utilizar-somente-poliester-reciclado-poderia-influenciar-toda-industria-da-moda/> [https://perma.cc/DP08-HY9R]. Procter & Gamble, after initiatives focusing on recycling plastics, released in April 2018 a limited edition of Head and Shoulders bottles produced from recovered plastics. Dreizen, *supra*. Technical aspects pose a future environmental concern, however, because the color of the new plastics adds black pigments, making the recycling of those bottles virtually impossible. Colm Gorey, *Recycled black plastic could be hiding a serious health hazard*, SILICON REPUBLIC (May 31, 2018), <https://www.siliconrepublic.com/innovation/black-plastic-health-hazard> [https://perma.cc/42EJ-WVXN]. Combining their solution with the new pigment mentioned in Section I.D. could provide an alternative, in our opinion. Procter & Gamble also launched in October 2017 a 100% recycled bottle, 10% of which comprises plastics recovered from oceans, and 90% comprises post-consumer recycled plastics. *See* Dreizen, *supra*. “Dell, which is using 25% ocean plastic in its 100% post-consumer recycled content laptop trays, stress that this is a deliberate aspect to their sustainability initiatives.” *Id.* Those initiatives, however, use plastics from bottles recovered from beaches, not the high seas, which shows they are actually not yet dealing with the core problem addressed by this Article.

⁴³³ *But see* Maala, *Virginie Helias, Vice President for Global Sustainability, P&G, Maala Conference, 2017*, YOUTUBE (Dec. 25, 2017) at 2:25–3:09, <https://www.youtube.com/watch?v=hDhGO5Y45lw> [https://perma.cc/C3GP-6EFB] (Procter & Gamble explaining how it uses sustainability as a marketing strategy based on its recent consumer feedback surveys).

huge environmental and social problem, but that it also constitutes economic waste. First, from a social perspective, “[t]he economic costs of marine litter are often borne by those affected rather than those responsible for the problem.”⁴³⁴ In that sense, millions of dollars are lost in fishing and tourism revenue, and the cleaning costs are shifted to governments and communities, which in the United States alone, for example, are estimated to equal \$10.8 billion per year—and that’s only for coastal areas because the plastic soup is not being addressed yet.⁴³⁵

Therefore, recovery represents a negative externality that, as a market failure, not only needs to be corrected but is economically interesting to be corrected. A UNEP report from 2014 estimates a total natural capital cost of \$110 billion per year in services and products, and that does not even include microplastics or impacts by plastic-in-supply-chain, because of a lack of information.⁴³⁶ This same report also highlights that, in the long term, companies that spontaneously take those costs into account are more efficient and have higher values in the market.⁴³⁷ Besides, there is also the loss of a potential feedstock and, consequently, loss of a potential new market, which could be a source of more profits for companies.

Nevertheless, the activity is not yet being conducted. The profitability of an economic activity usually provides enough incentives to create a new market, unless there are barriers to market entry or market failures. “In general, such barriers can arise from two sources: first, from statutory and other legal restrictions on entry; and second, from technological conditions of production known as *economies of scale*.”⁴³⁸

Regarding the first barrier, the question arises whether the lack of regulation of the plastic soup in high seas would constitute a barrier to undertake action. The answer to that question is not so clear. One could argue that the waste that has been disposed of is a so-called *res nullius*, to which no one claims any particular property rights, the result of which is that no one could object if someone were to take the initiative

⁴³⁴ SURFRIDER FOUND. & UCLA’S FRANK G. WELLS ENVTL. L. CLINIC, FEDERAL ACTIONS TO ADDRESS PLASTIC MARINE POLLUTION: PREVENTING MARINE PLASTIC POLLUTION THROUGH UPSTREAM CONTROLS AND LIFE-CYCLE MANAGEMENT 4 (2013), https://law.ucla.edu/~media/Files/UCLA/Law/Pages/Publications/CEN_EMM_PUB%20Surfrider%20UCLA%20-%20Plastics%20Solutions.ashx [<https://perma.cc/G554-KUK9>].

⁴³⁵ *Id.*

⁴³⁶ United Nations Env’t Programme, *Valuing Plastics: The Business Case for Measuring, Managing and Disclosing Plastic Use in the Consumer Goods Industry* 28–29 (2014), <https://wedocs.unep.org/rest/bitstreams/16290/retrieve> [<https://perma.cc/X79K-EX4C>].

⁴³⁷ *Id.* at 19.

⁴³⁸ ROBERT COOTER & THOMAS ULEN, *LAW & ECONOMICS* 29 (6th ed. 2016), <http://scholarship.law.berkeley.edu/books/2> [<https://perma.cc/CVY9-AVD9>] (emphasis in original).

to clean up the waste. Yet, it may be that the uncertainty concerning the legal status could also be a barrier to take action. Whether that is actually the case is simply not known.

Regarding the second barrier, economies of scale refers to “a condition of production in which the greater the level of output, the lower the average cost of production.”⁴³⁹ However, there is no data available to support the conclusion that this is the case with the recovery of plastic from the oceans. It is, of course, a possibility, but that will have to be left to future research.

There are several ways in which the plastic soup problem could be approached from an economic perspective. The first possible approach would be to consider the plastic an asset with a positive economic value. From an economic perspective, the plastic could then be considered a non-excludable and non-rivalrous good. The costs of excluding the use of non-paying consumers would be too high and at the same time consumption by one may exclude the consumption by others.

a. Creating Property Rights?

This is a framework economically defined as the *tragedy of the commons*.⁴⁴⁰ The tragedy of the commons basically emerges from the

⁴³⁹ *Id.*

⁴⁴⁰ Garrett Harden explains the tragedy of the commons as follows:

The tragedy of the commons develops in this way. Picture a pasture open to all. It is to be expected that each herdsman will try to keep as many cattle as possible on the commons. Such an arrangement may work reasonably satisfactorily for centuries because tribal wars, poaching, and disease keep the numbers of both man and beast well below the carrying capacity of the land. Finally, however, comes the day of reckoning, that is, the day when the long-desired goal of social stability becomes a reality. At this point, the inherent logic of the commons remorselessly generates tragedy. As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously, he asks, “What is the utility to me of adding one more animal to my herd?” This utility has one negative and one positive component. 1) The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1. 2) The negative component is a function of the additional overgrazing created by one more animal. Since, however, the effects of overgrazing are shared by all the herdsmen, the negative utility for any particular decisionmaking herdsman is only a fraction of -1. Adding together the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add

absence of property rights and open access to a resource.⁴⁴¹ The problem with an open-access resource is that everyone could, in theory, take resources from the ocean without restriction or limits. To the extent that those assets are valuable, an open-access resource will easily become subject to overharvesting. Pure open access could, therefore, lead to a depletion of species or other valuable resources.⁴⁴² Under the open-access regime, private ownership is simply established by the person who takes first access.⁴⁴³ The first mover advantage will in practice lead to a race whereby all try to harvest as much as possible, and as quickly as possible, from the resource in order to prevent others from getting there first. Empirical evidence showed that this has for example led to overexploitation of surf clams: in order to increase the catch, clammers invested too much in equipment in order to be able to harvest clams rapidly.⁴⁴⁴ Also, in oil extraction, there has been a tendency to overcapitalize in order to pump faster because ownership rights are only attached upon extraction, not upon discovery.⁴⁴⁵ These examples (and of course overfishing could easily be added) show that, without rules regulating the use of those common resources (like forests or the oceans), extinction may be the result. Hence, this underscores the importance to society of developing mechanisms that allow an exclusive control of such a resource, i.e., vesting property rights.

The question arises to what extent this scenario is applicable to the plastic soup. If plastic has an economic value, one could suppose that the first movers in this open-access regime would have indeed come in to recover the plastic. However, such overharvesting has not been observed. But the problem with ocean plastic recovery may be related to the lack of property regime assigned to the plastic. The problem may be that the

another animal to his herd. And another; and another . . . But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit—in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all.

Garrett Hardin, *The Tragedy of the Commons*, 162 *SCIENCE* 1244–48 (1968).

⁴⁴¹ *Id.*

⁴⁴² See MICHAEL FAURE & GORAN SKOGH, *THE ECONOMIC ANALYSIS OF ENVIRONMENTAL POLICY AND LAW: AN INTRODUCTION* 42 (2003).

⁴⁴³ See *id.* at 41–42.

⁴⁴⁴ Franz T. Litz, *Harnessing Market Forces in Natural Resources Management: Lessons from the Surf Clam Fishery*, 21 *B.C. ENVTL. AFF. L. REV.* 335, 345–56 (1994).

⁴⁴⁵ Gary D. Libecap & Steven N. Wiggins, *Contractual Responses to the Common Pool: Prorating of Crude Oil Production*, 74 *AM. ECON. REV.* 87, 88 (1984).

absence of clarity with respect to the legal status of the plastic would inhibit private actors from engaging in this new market.⁴⁴⁶ A first conclusion is therefore that, to the extent that a market solution to remove the plastic in the ocean has not yet emerged because of legal uncertainty, regulation may be necessary to clarify the legal status of the plastic in order to create opportunities for the market to emerge. Yet, this suggestion is formulated with some caution as it is not known whether legal uncertainty in fact inhibits commercial parties from removing the plastic.

b. Application of the Coase Theorem?

To the extent that a positive economic value of the plastic cannot be established, plastic pollution of the oceans remains a negative externality. The traditional starting point to analyze negative externalities provided in law and economics is the application of the so-called Coase Theorem.⁴⁴⁷

Coase Theorem says that “[i]t is always possible to modify by transactions on the market the initial legal delimitation of rights. And, of course, if such market transactions are costless, such a rearrangement of rights will always take place if it would lead to an increase in the value of production.”⁴⁴⁸ More commonly, we would say that if the transaction costs are zero or sufficiently low, negotiation will lead to an efficient allocation of resources, irrespective of the initial distribution of property rights.

However, we have discussed that, in the case of the plastic soup not only is the externality problem not being solved, but it is also increasing. This indicates that the transaction costs are apparently not low enough to allow bargaining. This is natural in an international scenario, with so many countries, organizations, and other actors, which may inhibit efficient bargaining.

The major problem inhibiting efficient bargaining could be related to the fact that the stakeholders involved are not clearly identified. As long as property rights over the plastic are not clear, even if, for example, one company would like to take the plastic, it is not clear at all with whom

⁴⁴⁶ Financial aspects could also be an explanation, but we already addressed this issue. See *supra* note 429 and accompanying text. Furthermore, specifically regarding corporations, investments usually are enhanced when there is legal certainty. See *generally Rule of Law and Development*, UN & THE RULE OF LAW, <https://www.un.org/ruleoflaw/rule-of-law-and-development/> [<https://perma.cc/G6FW-MS66>] (last visited Apr. 3, 2019).

⁴⁴⁷ See *generally* Ronald H. Coase, *The Problem of Social Cost*, 3 J. OF L. & ECON. 1 (1960).

⁴⁴⁸ *Id.* at 15.

it would have to bargain to obtain the plastic. More likely we are again in the hypothetical where there is an absence of property rights and hence open access as discussed in the previous subsection. The plastic soup is also not a classic Coasean bargaining situation as there are no clearly identifiable victims who could negotiate with either the polluters (who would in most cases not be identifiable) or with the corporation who might offer a solution.

c. Taxation?

If transaction costs to bargaining remain prohibitive, the classic response to externalities is the Pigouvian tax. Originally discussed by Pigou, the goal of such taxation is precisely to correct a negative externality by charging it to the causer—in this case, the polluter.⁴⁴⁹

Before applying the idea to the specific situation of plastic pollution of the oceans, let us clarify why the main criticism to taxation would not apply in this case. Such criticism comes from Carlton and Loury's conclusion that, in the long run, a Pigouvian Tax "will not in general lead to an efficient allocation of resources."⁴⁵⁰ We can even leave aside their suggestions and the discussions with Kohn because, at this moment, the concern with the plastic pollution of the oceans is to raise money to start the cleaning.⁴⁵¹ Thus, the discussion of the long term is, of course, important, but does not apply at the present moment. Moreover, the discussion on the efficiency of the Pigouvian Tax is more related to the impacts it may or may not cause from the *ex ante* perspective. Indeed, taxation has two functions: one is revenue generating, and the other is that it incentivizes preventing pollution.⁴⁵² Both effects would be needed in the case of the plastic soup, making taxation potentially an ideal solution. In addition, such a solution would be consistent with the polluter-pays principle, as provided by Principle 16 of the Rio Declaration.⁴⁵³

⁴⁴⁹ See generally ARTHUR C. PIGOU, *THE ECONOMICS OF WELFARE* (4th ed. 1932).

⁴⁵⁰ Dennis W. Carlton & Glenn C. Loury, *The Limitations of Pigouvian Taxes as a Long-Run Remedy for Externalities*, 95 Q.J. OF ECON. 559, 559 (1980).

⁴⁵¹ Cf. *id.*; Dennis W. Carlton & Glenn C. Loury, *The Limitation of Pigouvian Taxes as a Long-Run Remedy for Externalities: An Extension of Results*, 101 THE Q. J. OF ECON. 631, 631–34 (1986); Robert E. Kohn, *The Limitations of Pigouvian Taxes as a Long-Run Remedy for Externalities: Comment*, 101 THE Q. J. OF ECON. 625, 625–30 (1986).

⁴⁵² ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, *ENVIRONMENTAL TAXATION: A GUIDE FOR POLICY MAKERS 1* (2011), <https://www.oecd.org/env/tools-evaluation/48164926.pdf> [<https://perma.cc/RT8W-UX63>].

⁴⁵³ UN Conference on Env't and Dev., *Rio Declaration on Environment and Development*, U.N. Doc. A/Conf. 151/26 (1992), principle 16 [hereinafter *Rio Declaration*] ("National authorities should endeavour to promote the internalization of environmental costs and

Moving then to the application of this kind of taxation to our problem, we need to assess if it is possible to identify the polluters that would be responsible for paying, and if there is a regulation format that could enable the creation of the tax. From our discussion about the sources of plastic pollution and of companies' roles in the process—presented in the overview about the plastic soup—one could assume that corporations would be a natural first choice to bear the tax burden. However, corporations are not universally recognized as subjects of international law.⁴⁵⁴ There is also no international authority with competence to establish a tax. Therefore, taxation would have to be imposed by nation states. Theoretically, an international instrument could be created that leads states to create the tax nationally and pass along the revenues to an international organization responsible for spending it for the recovery of plastic from the oceans. This or other similar initiatives would, however, face many challenges: discussing and approving an international instrument; determining the organization that would be responsible; and selecting the initiatives or institutions that would receive the investments among other challenges. Recall that the largest part of the plastic soup is situated on the high seas, and the discussion on UNCLOS taught that it is only flag states that have jurisdiction on the high seas.⁴⁵⁵ The major problem, therefore, is that taxation *ex post* (i.e., recovering the plastic already in the ocean) will not be feasible for the simple reason that there may not be any authority with jurisdiction to impose and collect the tax. Taxation could be used to address the *ex ante* prevention, but in that case, at the national or regional level.

d. Liability Rules?

Another well-known instrument to address negative externalities is the use of liability rules.⁴⁵⁶ However, in an international scenario, it

the use of economic instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest and without distorting international trade and investment.”).

⁴⁵⁴ There is an ongoing discussion in the literature regarding this status. However, because there is still no consensus, it would prevent a solution in the form of an international binding document from directly imposing obligations on corporations. See Jose Alvarez, *Are Corporations “Subjects” of International Law?*, 9 SANTA CLARA J. INT'L L. 1 (2011); Douglas Cassel & Anita Ramasastry, *White Paper: Options for a Treaty on Business and Human Rights*, 6 NOTRE DAME J. OF INT'L AND COMP. L. 1 (2016); Jonathan I. Charney, *Transnational Corporations and Developing Public International Law*, 1983 DUKE L.J., 748 (1983); Emeka Duruigbo, *Corporate Accountability and Liability for International Human Rights Abuses: Recent Changes and Recurring Challenges*, 6 N.W.J. INT'L HUM. RTS. 222 (2008).

⁴⁵⁵ See *supra* Section II.A.

⁴⁵⁶ Or responsibility, if the distinction proposed by Kearney were adopted: “[T]he term

does not seem to be the most effective or even efficient solution, as “[t]he law of international responsibility and liability for environmental harm is a complicated mix of customary law, sparse precedents from arbitral or judicial panels, liability provisions in international agreements, and domestic law.”⁴⁵⁷ Furthermore, liability regarding international environmental damage is a field that still needs development,⁴⁵⁸ which means that solutions through this path demand time that the environment does not have.

It would also not be clear how a liability regime could be implemented at the international level. Within the international legal framework, this would imply a liability or responsibility of states for violating primary international law obligations.⁴⁵⁹ To the extent it was already possible to attribute the existing plastic soup problem to the acts of one particular state (which will in most cases be practically impossible) a finding of such liability would not necessarily result in a clean-up of the already existing plastic soup. The polluter state will not necessarily have jurisdiction over the territory where the plastic soup is located and may therefore not be in a position to engage in clean-up. Liability could at best be considered a classic private law remedy under domestic law. Liability could only lead to incentives for prevention and compensation if the plastic soup pollution could be attributed to particular sources, which may often be impossible.

Liability rules are, therefore, not a likely solution.

e. Funding?

An alternative, which is to some extent related to the taxation solution, is the creation of an international compensation fund. A compensation fund could potentially solve the financial aspect by raising revenues for cleaning up the plastic soup. Depending upon who finances the fund, it could equally contribute to prevention. To the extent that the states finance the fund, it could be created through international law. Since contributions by the states to the fund could be differentiated by,

‘responsibility’ should be used only in connection with internationally wrongful acts and that, with reference to the possible injurious consequences arising out of the performance of certain lawful activities, the more suitable term ‘liability’ should be used.” Summary Record of the 1243 meeting, [1973] 1 Y.B. Int’l L. Comm’n 211, U.N. Doc. A/CN.4/1973.

⁴⁵⁷ Robert V. Percival, *International responsibility and liability for environmental harm*, in ROUTLEDGE HANDBOOK OF INTERNATIONAL ENVIRONMENTAL LAW Ch. 38 (S. Alam et al. eds., 2015).

⁴⁵⁸ PHILIPPE SANDS & JACQUELINE PEEL, *PRINCIPLES OF INTERNATIONAL ENVIRONMENTAL LAW* 869 (3rd ed. 2012).

⁴⁵⁹ See *supra* Parts II and III for examples.

for example, taking into account GDP, the creation of a fund could equally align with the principle of common and differentiated possibilities as it is included in Principle 7 of the Rio Declaration.⁴⁶⁰

In that sense, some experiences may enlighten the vicissitudes of such a solution. Examples are the Multilateral Fund for the Implementation of the Montreal Protocol,⁴⁶¹ the Green Climate Fund,⁴⁶² the Climate Investment Funds,⁴⁶³ and the Global Environmental Facility.⁴⁶⁴

Regarding the Multilateral Fund, many analyses are cautiously optimistic,⁴⁶⁵ but some distinguish other types of global environmental

⁴⁶⁰ Principle 7 states:

States shall co-operate in a spirit of global partnership to conserve, protect and restore the health and integrity of the Earth's ecosystem. In view of the different contributions to global environmental degradation, States have common but differentiated responsibilities. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.

Rio Declaration, *supra* note 453, at principle 7.

⁴⁶¹ Established in 1991 after a decision of the Second Meeting of the Parties to the Montreal Protocol. Its goal is to undo damage done to the Earth's ozone layer. *See* MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL, <http://www.multilateralfund.org/default.aspx> [<https://perma.cc/S8RC-Q7CB>] (last visited Apr. 3, 2019).

⁴⁶² Established in 2010 by the 194 parties to the United Nations Framework Convention on Climate Change (UNFCCC) as a financial resource to aid developing countries in limiting carbon emissions. *See Who We Are*, GREEN CLIMATE FUND, <https://www.greenclimate.fund/who-we-are/about-the-fund> [<https://perma.cc/AW8D-JDHN>] (last visited Apr. 3, 2019).

⁴⁶³ Composed of four programs, the fund was established in 2008 and focuses on efforts to empower transformations in the energy, climate resilience, transport and forestry sectors. Only fourteen countries are listed as donors. *See Donors & MDBS*, CLIMATE INVESTMENT FUND, <https://www.climateinvestmentfunds.org/finances> [<https://perma.cc/LR98-YJKX>] (last visited Apr. 3, 2019).

⁴⁶⁴ Established in 1992, at the juncture of the Rio Earth Summit. The fund has thirty-nine donors. The funds are disbursed to government agencies, civil society organizations, private sector companies, research institutions, and a large array of potential partners, to implement projects and programs in developing countries. *See Funding*, GLOBAL ENVIRONMENTAL FACILITY, <https://www.thegef.org/about/funding> [<https://perma.cc/8XPS-F4GE>] (last visited Apr. 3, 2019).

⁴⁶⁵ *See, e.g.*, Andrew Jordan & Tim O'Riordan, *The Multilateral Ozone Fund of the Montreal Protocol*, 8 GLOB. ENVTL. CHANGE 171, 171 (1998); Karen Raubenheimer & Alistair McIlgorm, *Is the Montreal Protocol a model that can help solve the global marine plastic debris problem?*, 81 MARINE POL'Y 322 (2017); Frank Biermann & Udo E. Simonis, *The Multilateral Ozone Fund: A case study on institutional learning*, 26 INT'L J. OF SOC. ECON. 239 (1999); Ralph Luken & Tamas Grof, *The Montreal Protocol's multilateral fund and sustainable development*, 56 ECOLOGICAL ECON. 241 (2006); CLIMATE AND ENVIRONMENTAL PROTECTION: INTERNATIONAL FUNDING (Jackson M. Garcia ed., 2014).

frameworks; for example, Jordan and O’Riordan point out that “[t]he stock of ozone-depleting chemicals was technically discoverable and calculable, and substitutes were for the most part already present or on offer,”⁴⁶⁶ which is clearly not the case with plastic pollution.⁴⁶⁷

3. Implementation

Plastic pollution of the oceans is a huge problem, both in quantity and in quality. There may be some solutions to remove the plastic. However, notwithstanding some optimistic voices from NGOs who engage in voluntary clean-up, it is unlikely that, without financing, the existing plastic pollution will be removed.⁴⁶⁸ We indicated, using a law and economics approach, that a variety of different legal and policy instruments could be employed to arrange this clean-up. The solutions may depend on whether the plastic could be reused (and would have an economic value) or whether the plastic would only be considered to have a negative value and would thus be a negative externality. However, no matter which of these options apply, we made clear that one important impediment to solving the current plastic soup is the absence of any legal regulation. In economic terms, the high seas, but also plastic pollution on the high seas, are open-access resources. The absence of legal rules specifying the rights to that plastic may inhibit the emergence of a market solution. To the extent that legal uncertainty inhibits this market solution, a legal clarification would thus be needed. This could be provided by either allocating property rights or via regulation. The regulation would ideally both aim at the prevention of plastics further ending up in the ocean and focus on *ex post* removal of plastic currently in the oceans.

The most suitable instrument to guarantee plastic clean-up, assuming that the plastic has a negative value, would be taxation. Taxation could potentially provide incentives and could generate the funds necessary to organize the clean-up. Even if one could not imagine a classic Pigouvian tax on polluters (who could probably not be identified), a similar result (of financing the clean-up) could be solved through the creation

⁴⁶⁶ Jordan & O’Riordan, *supra* note 465.

⁴⁶⁷ Raubenheimer & McIlgorn, *supra* note 465 (suggesting a model based on the Montreal Protocol to address the marine plastic debris problem. However, the conditions that explain the success of the Montreal Protocol (that technical solutions were available as well as substitutes for the ozone depleting substances) unfortunately do not apply to the problem of the plastic soup).

⁴⁶⁸ See THE OCEAN CLEANUP, *supra* note 168 (illustrating that large scale pollution clean-up efforts in the ocean require much funding).

of a fund. However, some regulation is also necessary in that case to make clear what the specific status is of the plastic soup and of the cleaning structures on the high seas. This indicates that the search for a solution to the clean-up of the plastic soup not only constitutes a search for an optimal mix of instruments but also that determining at which level governance solutions would have to be implemented is equally important.

No matter which type of solution is preferred (creation of property rights, creation of a fund financed by industry or by states) some rules would have to be put in place to organize a clean-up. As this clean-up would have to take place in the high seas it is obvious that this solution cannot come from domestic law, but must rely on an international approach. One way of solving this dilemma is to look for options within existing treaties. A first possibility would be to address the options provided through an amendment to UNCLOS. UNCLOS is a fruitful instrument because its goal is to set the grounds for jurisdiction in international waters, focusing on solving problems related to sovereignty and jurisdiction in international waters. Furthermore, as seen, it already has provisions related to pollution of the oceans.⁴⁶⁹ That is why the first possibility is to use UNCLOS's text and/or tools to start the framework for plastic recovery from the oceans.

We do not ignore, however, the problems that approach would imply. The main problem would be that UNCLOS is already so accepted in the international community, to the point of being considered customary law, that making alterations in the text would be virtually impossible.⁴⁷⁰ Moreover, according to UNCLOS article 313(2), if any State party objects to the amendment, it is considered rejected, increasing the challenge.⁴⁷¹

From there derives the second problem: even if the amendment passes, it would only bind the States who are parties to the convention, but not necessarily the others—for example, the United States—because it would not have the status of customary law that most UNCLOS provisions have. “It is not the written text which contributes towards the customary law, but the instances whereby States apply these rules in a concrete case, or refer to them, or vote upon them, which do so.”⁴⁷² Besides, “State practice,

⁴⁶⁹ See UNCLOS, *supra* note 178, at arts. 207–12.

⁴⁷⁰ See Raul Pedrozo, *Is It Time for the United States to Join the Law of the Sea Convention?*, 41 J. MAR. L. & COM., 151, 164 (2010) (explaining the difficulties of amending UNCLOS).

⁴⁷¹ UNCLOS, *supra* note 178, at art. 313(2).

⁴⁷² MARK E. VILLIGER, CUSTOMARY INTERNATIONAL LAW AND TREATIES: A STUDY OF THEIR INTERACTIONS AND INTERRELATIONS WITH SPECIAL CONSIDERATION OF THE 1969 VIENNA CONVENTION ON THE LAW OF TREATIES 10 (1985).

in order to give rise to customary law, must be accompanied by *opinio juris*, i.e., by a belief (or rather a statement) by States that certain conduct is required or permitted by customary law.”⁴⁷³

Another possibility related to existing instruments is to use the experience of soft law instruments such as the GPA. The GPA so far seems to show positive results and also provides promising options through the so-called IGRs.⁴⁷⁴ Once again, using this experience could mean using the Programme itself or starting a new one, based on its text and/or tools, focused solely on plastics. Actually, being optimistic, the GPA is already going in this direction, as we may conclude from the progression of the themes and outcomes of the IGRs.

An alternative is obviously to start all over again and to create a new convention just to solve the plastic soup. However, this is, in our opinion, not feasible. It is simply not very likely that there would be sufficient support among countries to create such a new binding international instrument. It may also take many years before such an instrument could come into existence.

However, as we also indicated, as far as the *ex ante* prevention is concerned, solutions cannot only come from the international level, but equally require implementation in domestic law. For example, the imposition of a tax to stimulate reducing plastic or recycling or extended producer responsibility imposed upon the producers of plastic, would have to be implemented at the domestic (or regional) level. Although those instruments primarily aim at prevention (reducing emission of plastics into the ocean), they could potentially also generate financing for cleaning up the current plastic soup problem.

CONCLUSION

It is surprising that our Article is, as far as we could acknowledge, the first legal⁴⁷⁵ one to address comprehensively an environmental problem

⁴⁷³ Michael Akehurst, *Custom as a Source of International Law*, 47 BRIT. YEARBOOK OF INT'L L. 1, 43 (1976).

⁴⁷⁴ UNITED NATIONS ENV'T PROGRAMME, *supra* note 328.

⁴⁷⁵ There are many papers about plastic pollution in other fields, especially chemistry. See Anthony L. Andradry, *The plastic in microplastics: a review*, 119 MARINE POLLUTION BULL. 12 (2017); Austin K. Baldwin, Steven R. Corsi & Sherri A. Mason, *Plastic Debris in 29 Great Lakes Tributaries: Relations to Watershed Attributes and Hydrology*, 50 ENV'T. SCI. TECH. 10377 (2016); HOLLMAN ET AL., *supra* note 34; Hopewell et al., *supra* note 31; Jenna R. Jambeck et al., *Plastic waste inputs from land into the ocean*, 347 SCI. MAG. 768 (2015); Laurent C.M. Lebreton et al., *River plastic emissions to the world's oceans*, 8 NAT. COMM. 15611 (2017); Schmidt et al., *supra* note 48; VALAVANIDIS & VLACHOGIANNI, *supra* note 5.

that according to some is considered one of the largest ecological problems of this century.⁴⁷⁶ The reason why there is so little literature addressing the problem of the plastic soup is probably that it is also very difficult to grasp, especially in legal terms. Not only should a distinction be made between incentives to be provided for a further reduction of emissions of plastic into the oceans, but at the same time solutions need to be developed to remove the plastic which already is in the oceans. The latter is an especially difficult issue, as most of the plastic is located in legal no-man's-land, being the high seas on which, according to UNCLOS, only flag states have jurisdiction.⁴⁷⁷ These flag states obviously wish to exercise their jurisdiction on ships and not on the pollution of the oceans where their ships sail.

In this Article, we started by sketching the nature of the plastic soup problem, describing the fact that more than 80% of the plastic pollution of the ocean comes from land-based sources, but also indicating that the magnitude of the pollution problem is today already beyond imagination, with at least 8 million tons of plastics still leaking into the ocean each year.⁴⁷⁸ That shows that this problem cannot be ignored by environmental law. Because the problem mostly occurs in international waters, our primary approach was to analyze to what extent the problem is addressed in current international law instruments. The results in that respect were simply disappointing. Many international conventions (hard law instruments) do not mention plastics at all; there are only two (the London Protocol 2006 and MARPOL Annex V)⁴⁷⁹ that refer to plastics. Plastics receive more attention in some soft law instruments, such as the GPA⁴⁸⁰ and the SDGs.⁴⁸¹ Still, the major problem with all of the instruments we reviewed is that they contain (sometimes explicitly and precisely, but mostly very generally and vaguely), prohibitions on emitting plastic into

⁴⁷⁶ Amcham Brasil, *Plástico é o maior desafio ambiental do século XXI, segundo ONU Meio Ambiente*, ESTADÃO, <https://economia.estadao.com.br/blogs/ecoando/plastico-e-o-maiorde-safio-ambiental-do-seculo-xxi-segundo-onu-meio-ambiente/> [<https://perma.cc/9CFS-GHCK>] (last visited Apr. 3, 2019); Laura Parker, *Plástico—Nós o criamos. Dependemos dele. Mas ele nos ameaça*, NATIONAL GEOGRAPHIC, <https://www.nationalgeographicbrasil.com/2018/05/lixo-plasticoplaneta-poluicao-lixao-consumo> [<https://perma.cc/3GHB-SVXC>] (last visited Apr. 3, 2019); Pam Wright & Bob Henson, *Earth Day 2018: The 10 Most Pressing Environmental Concerns Facing Our Planet—And Rays of Hope for Each*, THE WEATHER CHANNEL (Apr. 20, 2018), <https://weather.com/science/environment/news/2018-04-18-earth-day-2018-10-concerning-things-future-of-planet/> [<https://perma.cc/X6TE-BD44>].

⁴⁷⁷ UNCLOS, *supra* note 178, at arts. 216–17.

⁴⁷⁸ SHEAVLY, *supra* note 25.

⁴⁷⁹ 1972 Convention, *supra* note 215; Farnelli, *supra* note 239, at 172.

⁴⁸⁰ See UNITED NATIONS ENV'T PROGRAMME, *supra* note 328.

⁴⁸¹ See JEFFREY SACHS CENTER ON SUSTAINABLE DEVELOPMENT, *supra* note 369.

the ocean. To be effective, those instruments of course would need to be transposed and implemented at the domestic level, and domestic legislation implementing those conventions needs to be enforced as well. One problem is that most of the conventions that mention plastic focus on emissions from ships, but the most important source (land-based emissions) was not featured in most of the international instruments that we reviewed. Moreover, the fact that there is no effective enforcement follows from the continuing emissions of plastic into the ocean.

None of the international law instruments we reviewed address the crucial question how the current plastic soup can be eliminated. We reviewed a variety of instruments that could theoretically be implemented to achieve that goal. Classic instruments, such as the creation of property rights, taxation and compensation funds could serve the goals of financing the clean-up and preventing further pollution. Moreover, in some cases the plastic may have an economic value, meaning market solutions to stimulate clean-up could be implemented. However, a major problem implementing those solutions is that most of the plastic is situated on the high seas. We therefore argue that if any solution is to be put in place, a legal framework would have to be implemented to create at least a clear background with respect to the status of the plastic waste. In the absence of such a clear legal status, incentives to stimulate clean-up (whether via a convention or through the creation of property rights) might fail. We suggest that such a legal framework could be created perhaps via UNCLOS (if a hard law solution is preferred) or through the GPA. However, we realize and discuss many impediments in the creation of such an international tool, even if it were merely based on an amendment to an existing instrument.

To some extent we are therefore confronted with a paradox: As the plastic is located in international waters, the solution should by definition be international. But, its location in international waters is precisely what causes international solutions to be very difficult to implement. It is for that reason that one may have to consider the limits of solving the plastic soup problem (especially the clean-up) via international law instruments. The current approach of voluntary solutions could be further stimulated especially if companies would, based on their corporate social responsibility, join those voluntary initiatives toward clean-up. Domestic law also remains crucial, not only to implement, for example, *ex ante* regulation aiming at the reduction and recycling of plastics. Domestic law could (for example via a taxation system) also generate finances to clean up the current plastic soup problem. However, even if the plastic soup could effectively be cleaned up, it still needs an international legal

framework to be able to proceed to such a clean-up. That, once more, shows that the problem of the plastic soup central to this Article is very complex. It undoubtedly necessitates a mix of domestic law, a new international legal instrument (or amendment), and voluntary private initiatives. In this Article we presented the actions needed in the international law context and demonstrate that such a smart mix of different instruments needs to be implemented. Only then can the plastic soup problem indeed be solved by 2050.