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Strategic approaches to assess marine litter stakeholders in Ireland

This research was funded by the Irish Research Council, under the Marie Skłodowska-Curie Actions COFUND Collaborative Research Fellowships for a Responsive and Innovative Europe (CAROLINE) Fellowship Programme (Ref. CLNE/2018/524)

Project Acronym and Name	IMP.act – Managing for Microplastics: A baseline to inform policy stakeholders	
Grant Reference	CNLE/2018/524	
Document type	Report	
Document version and WP Number	V 1.3	WP1
Document title	Strategic approaches to assess marine litter stakeholders in Ireland	
Authors	João Frias, Róisín Nash	
Contact	joao.frias@gmit.ie / roisin.nash@gmit.ie	
Release date	March 2020	

For bibliographic purposes this document should be cited as:

Frias, J. and Nash. R., (2020). DPSIR model and Stakeholder analysis.

Contents

1. Executive Summary

Managing for Microplastics: A Baseline to Inform Policy Stakeholders (IMP.act) is a research project focused on assessing a baseline for microplastic pollution in Galway Bay and its environs. This project aims to contribute to existent or future local short-, medium- and long-term management plans of this study area and is divided into 5 work packages (WP), each focused on a different aspect of the identification and characterisation of inputs, hotspots of accumulation and distribution patterns of microplastics in Galway Bay.

Work package 1 (WP1) is dedicated to the background characterisation through a comprehensive analysis of the main drivers, pressures, state, impacts and responses (DPSIR), stakeholders, and perceptions about marine litter and microplastic pollution.

Although this project follows a local approach to data collection, the results from this project can potentially be used in strategic and targeted measures to minimise the impacts on marine litter and microplastic pollution in a wider context. Therefore, this document provides an overview of the main stakeholders and their perceptions about the marine litter and microplastic pollution issue, as well as DPSIR analysis within the Irish context.

Recommendations in this report will be in context of the local and national environmental commitments with the European Commission, namely the Marine Strategy Framework Directive (MSFD) and the 2030 Agenda for Sustainable Development, particularly through the Sustainable Development Goals.

2. Aims and goals

The overall goal of the IMP.act project is to provide baseline data about inputs, sources, sinks and distribution of microplastics in Galway Bay and its environs. The baseline data, which focuses on three environmental matrices: a) water surface; b) sediment and c) biota, will contribute to estimate accumulation trends within the bay. Data collected could potentially contribute to the development of a long-term management framework targeted at monitoring, assessing, mitigating and reducing microplastic pollution in this geographical area.

Although the project is focused on a local scale, the scope and goals go beyond the projects' case study area.

The overall aims of the IMP.act project are:

1. Identify the mains sources, inputs, hotspots of accumulation and distribution patterns of microplastics (MPs) in Galway bay and its environs;
2. Assess quantitative and qualitative analysis of MPs retrieved from environmental samples;
3. Assess MP ingestion in characteristic marine species in this geographic area;
4. Provide a spatial-temporal basis for statistical and distribution models;
5. Create educational outreach and awareness materials,
6. Develop a management tool to inform policy makers.

3. Introduction

3.1 Background

Among the extensive anthropogenic pressures that affect aquatic ecosystems worldwide, plastic marine litter pose a significant threat with socio-economic and environmental risks, as it direct and indirect impacts wildlife, ecosystems and local economies (UNEP, 2009; GEF, 2012; Jang et. al, 2014). Although marine litter has been reported in the environment since the 1970's, international awareness on this topic only started after the turn of the century, particularly influenced by the research efforts of Cap. Charles Moore, Prof. Richard Thompson, Dr. François Galgani and Prof. Peter Ryan (GEF, 2012).

Estimates suggest that approximately 80% of marine litter derives from land-based sources, particularly from urban centres and industries along coastal areas, while the remaining 20% result from maritime- and marine-based human activities; with plastic litter being the main contributor (EUNOMIA, 2016). Regarding distribution in the environment, recent estimates suggest that marine litter is found in beaches and coastal areas (~5%), floating in the ocean surface or at the water column (~1%) and deposited in the ocean floor (~94%), with approximately 12.2 million tonnes of plastic per annum entering the marine environment (EUNOMIA, 2016).

Marine litter and microplastic pollution are ubiquitous pollution issues which have been widely investigated in the last decades, in order to reduce knowledge gaps on:

(1) Definition of microplastics (Frias and Nash, 2019; Hartmann *et al.,* 2019; Rochman *et al.,* 2019)
(2) Production, use and fate of plastic materials (Jambeck *et al.,* 2015; Geyer *et al.,* 2017; Brooks *et al.,* 2018)
(3) Distribution and accumulation in coastal areas and in the ocean (Eriksen et al., 2014; van Sebille *et al.,* 2015, Lebreton et al., 2018);
(4) Entanglement on abandoned, lost or discarded fishing gear (FAO, 2016);
(5) Ingestion of microplastics (microbeads, fragments and fibres) by marine species (Setälä et al, 2014; Ivar do Sul and Costa, 2015, Kühn *et al.,* 2015; Neves *et al.,* 2015; Rochman *et al.,* 2015, Watts *et al.,* 2015; Hara *et al.,* 2019);
(6) Characterisation of persistent organic pollutants and trace metals adsorbed to plastics (Mizukawa *et al.,* 2013; Rochman *et al.,* 2014; Brennecke *et al.,* 2016);
(7) Identification of common polymer types (Vianello *et al.,* 2013; Frias *et al.,* 2014 and 2016);
(8) Potential distribution of invasive species attached to plastics (Barnes and Milner, 2005) and
(9) Direct socio-economic impacts (Luís and Spinola, 2010; Jang *et al.,* 2014).

Although the data gathered so far contributes to a better understanding of the global problem, there is still a long way towards solutions and mitigation strategies that effectively reduce the sources and amounts of waste produced globally. The Marine Strategy Framework Directive (MSFD) and the Sustainable Development Goals (SDGs) highly contribute to assess indicators that can be used to measure effectiveness of environmental policies, particularly after the publication of the European Strategy for Plastics in a Circular Economy (EC, 2018). More recently, the United Nations has proclaimed a Decade of Ocean Science for Sustainable Development

(2021-2030) to "support efforts to reverse the cycle of decline in ocean health and gather ocean stakeholders worldwide behind a common framework that will ensure ocean science can fully support countries in creating improved conditions for sustainable development of the Ocean" (UNESCO, 2020).

With aims to contribute to the policy and frameworks mentioned, this report focusses on two different assessment approaches that identify key aspects related to plastic marine litter and microplastic pollution (DPSIR model) and key social partners and stakeholders in Ireland (stakeholder analysis model).

3.2 DPSIR framework

Despite the several approaches used to both develop and structure environmental indicators, one of the most common tools used is the drivers-pressure-state-impact-response (DPSIR) model. This framework developed by the European Environmental Agency (EEA) describes relations and causal interactions between society and the environment. This framework is based on the P-S-R (pressure-state-response) framework model proposed by the Organisation for Economic Co-Operation and Development (OECD, 1993). The DPSIR framework (Figure 1) is widely used as a policy tool that compiles different socio-economic and environmental indicators as part of a chain of casual links or flows, starting from the 'drivers' or driving forces through 'pressures' to 'state' and 'impact' that will lead to policy 'responses'.

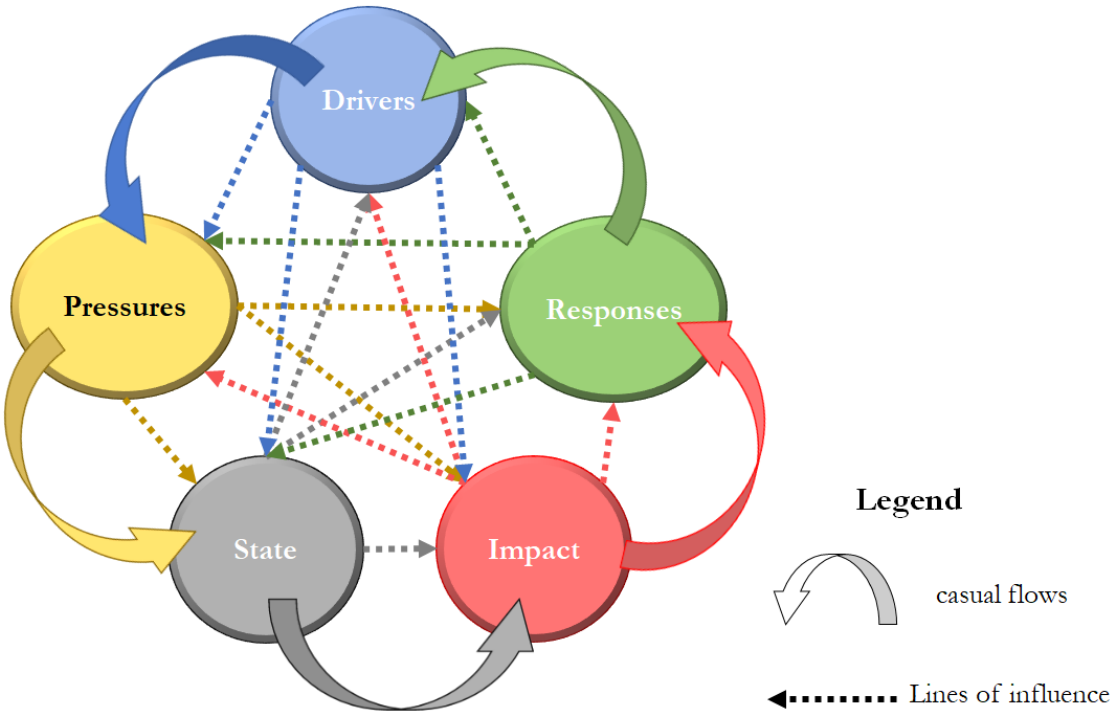

Figure 1- DPSIR framework for reporting on environmental issues (adapted from EEA, 1999)

The framework model is composed of five elements or category indicators: 1) Drivers, 2) Pressures, 3) State, 4) Impact and 5) Responses (Figure 1), and the definitions of each can be found in Table 1.

Table 1- DPSIR framework elements and definitions (adapted from EEA, 2007 and Maxim et al., 2009)

Elements	Definitions
1) Drivers or driving forces	
	are the changes in the socio-economic and institutional systems that have direct or indirect influence in the environmental state. The EEA's definition is 'the social, demographic and economic developments in societies and the corresponding changes in lifestyles, overall levels of consumption and production patterns (EEA, 2007)'. Drivers create Pressures
2) Pressures	
	are the anthropogenic factors that induce environmental changes (Impacts). Pressures correspond to the release and emission of substances, physical and biological agents and the use of land or resources by anthropogenic activities. The pressures exerted by society are transported into the environment and transformed by a variety of natural processes, which manifest themselves in changes in environmental conditions. Pressures influence the State
3) State	
	is by definition 'the abiotic condition of soil, air and water, as well as the biotic condition (biodiversity) at ecosystem/habitat, species/community and genetic level' (EEA, 2007). State corresponds to the natural or socio-economic system and it refers to a wide range of features, from the qualitative and the quantitative characteristics of the ecosystem and the quantity and quality of resources to even larger socio-economic issues. Indicators of state depend of the focus of the problem addressed. The combination of current State and the existing Pressures explain Impacts
4) Impact	
	are changes in environmental functions that affect the social, economic and environmental dimensions. They are caused by changes in the State of the system and can include changes in environmental functions such as air, water and soil quality, human and ecosystem health, social cohesion, access to resources and resource availability. Impacts generate Responses
5) Responses	
	are the measures taken to address drivers, pressures, state or impact. They are policy actions which are directly or indirectly created by the perception of Impacts. Responses attempt to mitigate, compensate, reduce, eliminate or prevent consequences and can come from different levels of society (individuals, governments, industry, non-governmental organisations, etc). Responses can influence trends in Drivers, Pressures, State and Impact.

According to Kristensen, 2004, each of the components of the DPSIR framework can be further explained as:

1) Drivers are basic needs which can either be primary (access to shelter, water, food) or secondary (mobility, entertainment, culture) and are variable for different social actors (e.g.

the needs for the industrial sector or for a nation are very different than individual needs). Drivers are dependent on population (number, age, gender, education and political stability); energy production and use; land use and agriculture; waste production, collection, processing and disposal; non-industrial sectors; transport, industry, mining and refineries.

2) Pressures are caused by human activities such as transportation, food or energy production which meet the needs. All production activities cause pressures on the environment either by a) excessive use of environmental resources, b) changes in land use or c) point and diffuse emission of chemicals, waste, radiation and noise to air, water and soil. Pressures are dependent on the use of resources, direct and indirect emissions to air, water and soil, production of waste, noise, radiation and vibration.
3) State is directly and indirectly affected as a consequence of the pressures exerted into the environment. State often refers to the quality of environmental compartments and the ecosystem health in relation to the ecosystem functions they fulfil. State indicators are water, soil and water quality; and ecosystem and human health.
4) Impacts represent the physical, chemical and biological state changes of the environment and determine how the quality of ecosystems affect the socio-economic welfare of human beings.
5) Responses by policy makers or relevant stakeholders are a result of undesired impacts that affect any part of the chain between drivers and impacts.

Taking into consideration all the different components and aspects mentioned, two DPSIR analyses were conducted focusing on plastic and microplastic pollution at a global scale (figure 2) and at the local scale of Galway Bay and its environs (figure 3).

Despite some similarities between the two models, figure 2 focuses on the wider supply chain and casual relations between the different components of the DPSIR model, including some scenarios that might not be relevant at the local scale. For instance, using the example of clogging of the drainage systems has different impacts whether it is at a residential areas, as general population might not be aware of personal care products having microplastics as ingredients and clogging for example their showers; or at a municipal area, where urban littering might contribute to the clogging of the rainfall drainage systems potentially causing urban sewage issues during storm-like events.

Both DPSIR models have specific drivers, pressures and impacts, which in some cases might be similar. Nonetheless, these environmental indicators are important to monitor policy responses and understand how policies might change or evolve based on the environmental indicators (EEA,1999).

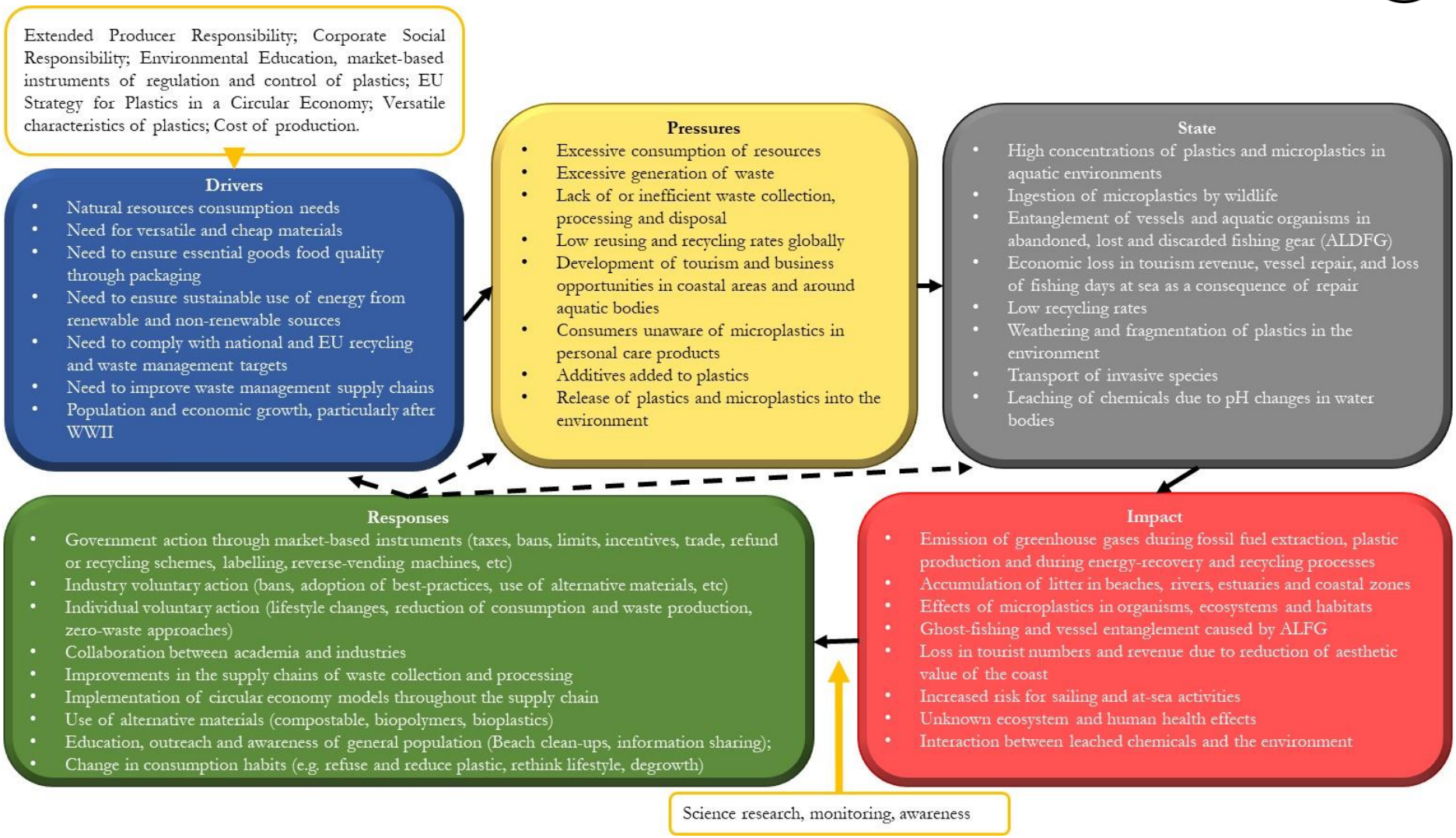

Figure 2 – General DPSIR model for plastic and microplastics

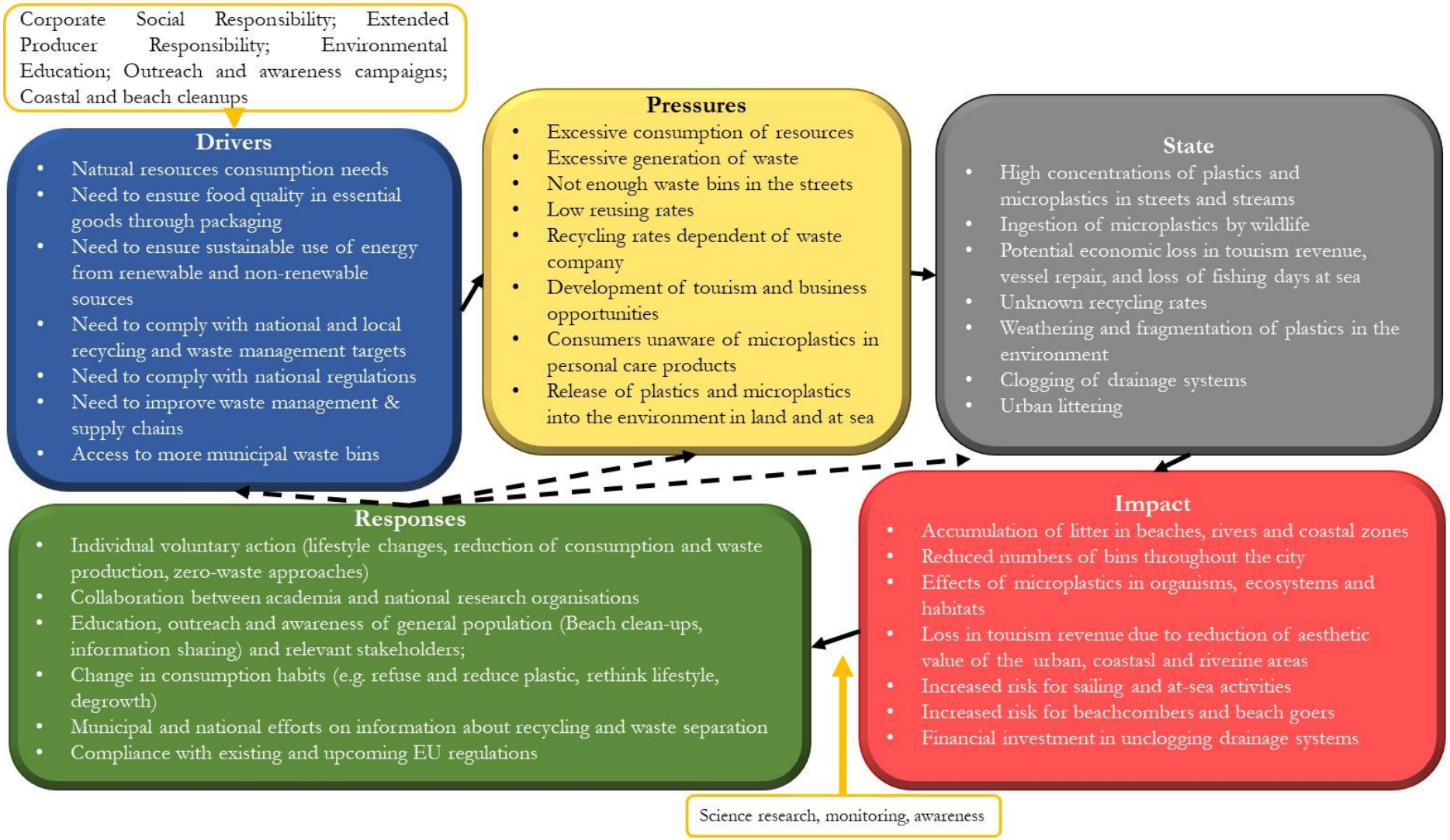

Figure 3 - DPSIR model for plastics in microplastics focused on Galway Bay and its environs

3.3 Stakeholder analysis

Another useful framework used for policy and information management of processes and projects is the stakeholder analysis. This analysis is a process dedicated to understanding whose interests need to be considered while developing or implementing a policy or small, medium or large-scale program (Schmeer, 2009). It requires a systematic gathering of qualitative information that is regularly analysed to assess the interests or stakes of each of the social partners or interested parties.

The stakeholders are social actors that have diverse vested interests in the policy or program being promoted, and are analysed on their knowledge, interest, position for or against, ability to potentially create alliances and ability to affect the process (through power and/or leadership) (Schmeer, 2009). In a stakeholder analysis there are different types of stakeholders depending on how they might be affected by positive or negative actions of a project, program or process actions.

The most affected are primary stakeholders, the intermediates are secondary and the least impacted are tertiary stakeholders. Key stakeholders are a different set within this classification and are those that have significant influence upon or importance within the program or policy at stake (Schmeer, 2009). This last group are extremely important to the success of the analysis. Stakeholder can also be internal (part of the project or process) or external (partners what benefit or that will be affected by the decisions).

In order to identify key stakeholders, Mendelow, 1981, created a prioritisation grid based on the different motivations and levels of interest that stakeholders might have (Figure 4).

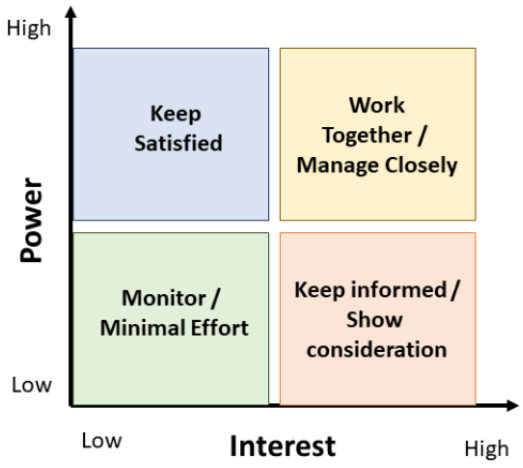

Figure 4 – Power/Interest grid for stakeholder prioritization. Adapted from Mendelow (1981)

The grid is a visual way to understand which stakeholders are important to (1) keep satisfied, (2) work together / manage closely, (3) monitor / minimal effort and (4) keep informed / show consideration. What sets the quadrants apart is the communication and engagement strategy with each. Some stakeholders will be solely informed (3-monitor), other will be informed and consulted throughout the process (1 – keep satisfied and 4 – keep informed). The key stakeholders are part of the 2 – work together / manage closely and these are the

stakeholders which is important to keep informed, consult and collaborate with. Table 2 shows a general list of stakeholders and their motivations and Table 3 shows the main stakeholders in the IMP.act project.

Table 2 – General list of stakeholders

Stakeholders	Motivations
Policy Stakeholders	
Policy markers – national level	Policy makers at national and local levels are responsible for complying with European, national and local regulations, making them an extremely important stakeholders in research projects. Their motivation is how the research project respond or contribute to policy frameworks, such as the Marine Strategy Framework Directive or the European Strategy for Plastics in a Circular Economy.
Policy makers – local level	
Academia Stakeholders	
Universities and Research Centres	Academic stakeholders have the know-how, knowledge, expertise and research experience to test different hypothesis to verify whether what is being perceived as a stressor is in fact causing environmental impact. Their motivation is on how to become more efficient in providing accurate results while contributing to understand the effects and impacts of emerging contaminants in the environment.
Higher education students	
Research-driven institutions, networks and hubs	
Other relevant research projects	
Private Sector Stakeholders	
Public business supporting agencies	The private sector has know-how, knowledge, expertise and experience in providing high quality goods and services that meet the demand and needs of companies and citizens. They are very important stakeholders in a policy process as they sector highly contributes to the Gross Domestic Product (GDP). Their motivations are in line with high performance associated with Quality Assurance and Quality Control (QA/QC).
SMEs	
Trade Associations	
Plastic industries	
Waste managers	
Other local business	
Outreach Stakeholders	
Grassroots movements	Outreach stakeholders have a wide range of technical know-how as well as education and communication expertise. Their motivation depends on their individual mission for example one or a combination of education, outreach and awareness and sustainable development. They are important stakeholders as they can bring the community opinions to the project debate processes.
Environmental charities	
National Parks	
Non-governmental organisations	
Citizen-driven innovation labs	
Community groups	

Table 3 - Stakeholder mapping for IMP.act project. Adapted from from Mendelow (1981)

Power / Influence		Impact: low	Impact: high
	high	Agriculture and Food Development Authority Clare County Council Galway City County Council Marine Institute Environmental Protection Agency Ireland's Seafood Development Agency Department of Agriculture, Food and the Marine Department of Housing, Planning and Local Government Department of Communications, Climate Action and Environment Food and Safety Authority of Ireland Irish Research Council Enterprise Ireland Science Foundation Ireland Galway County Council	Marine and Freshwater Research Centre Galway-Mayo Institute of Technology Irish Whale and Dolphin Group
	low	RREUSE ITSligo Fab Lab Limerick NUIG/GMIT Subaqua Club FAB Foundation Ireland WeCreate Workshop Galway Sea Scouts Galway Tourism Sligo Sport and Recreation Partnership Waterford Harbour Sailing Club Galway Subaqua Club Northern Ireland Environmental Link Irish Underwater Council Birdwatch Ireland Aloha Surfschool	National Parks and Wildlife Service Polymer Technology Ireland Barna Recycling AquaTT Community Reuse Network Ireland Galway Environmental Network CuanBeo CleanCoasts Coastwatch Europe Inshore Fisheries Forum Irish Farming Association Irish Sailing National University Ireland Galway University College Dublin University College Cork ITSligo Inshore Fisheries Forum Irish Fish Producers Organisation

The stakeholder mapping is an important exercise to regularly conduct in every project, as it is a dynamic and evolving assessment tool among all stakeholders, a table 3 shows the initial stakeholder assessment for the IMP.act project, which is likely to evolve over time. As data is gathered and converted into knowledge, the position of the low power and low interest and low power and high interest social partners might change. As such it is of the utmost importance to keep every partner engaged.

4. Strategies to engage stakeholders

In order to manage and liaise with diverse stakeholders who might have opposing interests requires specific and tailored engagement strategies. Engagement strategies can be done on one-on-one, small groups or large audiences, and is now more amenable than ever due to the wide range of traditional and digital technologies and resources available. Traditional approaches include training sessions for small groups, dissemination forums, concept workshops, guided museum tours, educational fieldtrips, among others. These approaches often use leaflets, posters, banners, textbooks, reports or any other supporting materials to be shared among the different social partners. In these events, stakeholders must work together, often having to seek mutual grounds in order to complete the tasks proposed by facilitators. Digital approaches include videoconferences, use of mobile apps for data collection, online document sharing and editing, infographics and fully interactive websites. Engagement strategies will often be a combination of several media including radio and television broadcasts, advertisement in newspapers and online, live performance events such flash mobs, interviews in talk-shows, outreach and awareness campaigns in schools and with general public, etc.

There are several steps involved in conducting an efficient and effective stakeholder engagement process including 1) planning the engagement strategy, 2) mapping stakeholders, 3) encouraging engagement, 4) getting feedback and assessment, 5) devising an action plan and follow up monitoring (Leal Filho *et al.,* 2016; Raposo *et al.,* 2018).

The engagement strategy sets the vision and level of ambition for the engagement event(s). It also identifies the target audience(s) and the most suitable activities to engage them and the subsequent best method to disseminate the relevant messages and outcomes of the event. Stakeholder mapping defines the criteria to identify and prioritize stakeholders, focusing on short-, medium- and long-term goals to drive the approach. Engagement activities are aimed at inclusivity to ensure equitable contributions from stakeholders and to mitigate any potential tensions at the beginning, while allowing the stakeholders to remain focused and achieve the workshop goals and priorities. Feedback is extremely important and is usually the first type of assessment from an engagement activity. This reflective exercise can identify knowledge gaps and propose unforeseen positive and negative aspects of the engagement activity allowing future engagement to be more successful. Feedback is also important to collect quantitative and qualitative data that can be used in analytical assessments in order to identify relevant Specific, Measurable, Attainable, Realistic and Time-bound (SMART) indicators. Once this feedback process is concluded, an action plan where opportunities are identified and the project goals are revisited can serve as the first steps for follow-up, monitoring and for either future engagement or evaluations reports.

Stakeholder engagement action plans are more effective if they include different approaches, media, tools and infographics that can serve as a reminder for individuals and allows them to change behaviours in the long-term.

5. References

1. Barnes D.K.A. and Milner P. (2005). Drifting plastic and its consequences for sessile organism dispersal in the Atlantic Ocean. Marine Biology 146: 815-825. https://doi.org/10.1007/s00227-004-1474-8
2. Brennecke, D., Duarte, B., Paiva, F., Caçador, I., Canning-Clode, J., (2016). Microplastics as vectors for heavy metal contamination from the marine environment. Estuarine, Coastal and Shelf Science, 178, pp. 189-195. https://doi.org/10.1016/j.ecss.2015.12.003
3. Brooks, A., Wang, S., Jambeck, J. R., (2018). The Chinese import ban and its impact on global plastic waste trade. Science Advances, 4 (6) https://doi.org/10.1126/sciadv.aat0131
4. EC, 2018. European Strategy for Plastics in a Circular Economy. COM/2018/028. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1516265440535&uri=COM:2018:28:FIN
5. EEA, 1999. Environmental indicators: typology and overview. Technical report No. 25. Smeets, E., Weterings, R.. European Environment Agency, Copenhagen, 19 pages. https://www.eea.europa.eu/publications/TEC25
6. EEA, 2007. Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe. Technical Report No. 11. European Environment Agency, Copenhagen, 186 pages, ISSN 1725–2237. https://www.eea.europa.eu/publications/technical_report_2007_11
7. EUNOMIA, 2016. Plastics in the Marine Environment. https://www.eunomia.co.uk/reports-tools/plastics-in-the-marine-environment/
8. Eriksen M., Lebreton L.C.M., Carson H.S., Thiel M., Moore C.J., Borerro J.C., Galgani F., Ryan P.G., Reisser J., (2014). Plastic Pollution in the World's Oceans: More than 5 Trillion Plastic Pieces Weighing over 250,000 Tons Afloat at Sea, PLoS One 9(12). https://doi.org/10.1371/journal.pone.0111913
9. FAO, (2016). Abandoned, lost and discarded gillnets and trammel nets: methods to estimate ghost fishing mortality, and the status of regional monitoring and management, by Eric Gilman, Francis Chopin, Petri Suuronen and Blaise Kuemlangan. FAO Fisheries and Aquaculture Technical Paper No. 600. Rome. Italy. http://www.fao.org/3/a-i5051e.pdf
10. Frias, J. P. G. L., Otero, V., & Sobral, P. (2014). Evidence of microplastics in samples of zooplankton from Portuguese coastal waters. Marine Environmental Research. 95: 89–95. https://doi.org/10.1016/j.marenvres.2014.01.001
11. Frias, J. P. G. L., Gago, J., Otero, V., & Sobral, P., (2016). Microplastics in coastal sediments from Southern Portuguese shelf waters. Marine Environmental Research, 114: 24-30. https://doi.org/10.1016/j.marenvres.2015.12.006
12. Hara, J., Frias, J., Nash, R., (2020), Quantification of microplastic ingestion by the decapod crustacean Nephrops norvegicus from Irish waters. Marine Pollution Bulletin, 152, 110905. https://doi.org/10.1016/j.marpolbul.2020.110905
13. Hartmann, N., Hüffer, T., Thompson, R.C., et al., (2019) . Are We Speaking the Same Language? Recommendations for a Definition and Categorization Framework for Plastic Debris. Environ. Sci. Technol. 2019, 53, 3, 1039-1047. https://doi.org/10.1021/acs.est.8b05297
14. Ivar do Sul J.A., Costa M.F. (2014) The present and future of microplastics pollution in the marine environment. Environmental Pollution 185, 352-364. https://doi.org/10.1016/j.envpol.2013.10.036
15. Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., et al. 2015. Plastic waste inputs from land into the ocean. Science, 347, 768–771. https://doi.org/10.1126/science.1260352
16. Jang, Y.C., Hong, S., Lee, J., Lee, M.J., Shim, W. J., (2014). Estimation of lost tourism revenue in Geoje Island from the 2011 marine debris pollution event in South Korea. Marine Pollution Bulletin, 81 (1), 49-54. https://doi.org/10.1016/j.marpolbul.2014.02.021
17. Lebreton, L., Slat, B., Ferrari, F., Sainte-Rose, B., Marthouse, R., Hajbane, S., Cunsolo, S., Schwarz et al. (2018). Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. Scientific Reports 8., Article 4666 (2018). https://doi.org/10.1038/s41598-018-22939-w
18. Leal Filho W., Brandli L. (2016) Engaging Stakeholders for Sustainable Development. In: Leal Filho W., Brandli L. (eds) Engaging Stakeholders in Education for Sustainable Development at University Level. World Sustainability Series. Springer, Cham. https://doi.org/10.1007/978-3-319-26734-0_21

19. Luís, I., P., Spínola, H. (2010). The influence of a voluntary fee in the consumption of plastic bags on supermarkets from Madeira Island (Portugal). Journal of Environmental Planning and Management, 53(7) 883-889. https://doi.org/10.1080/09640568.2010.490054
20. Maxim, L., Spangenberg, J. H., O'Connor, M. (2009). An analysis of risks for biodiversity under the DPSIR framework. Ecological Economics, 69 (1), pp. 12-23. https://doi.org/10.1016/j.ecolecon.2009.03.017
21. Mendelow, A. L., (1981). Environmental Scanning – the impact of Stakeholder concept. ICIS Proceedings Paper. Association for Information Systems, Paper 20. https://aisel.aisnet.org/icis1981/20
22. Mizukawa, K., Takada, H., Ito, M., Geok., Y.B., Hosoda, J., Yamashita, R., Saha, M., Suzuki, S., Miguez, C., Frias, J., Antunes, J. C., Sobral, P., Santos, I., Micaelo, C., Ferreira, A. M., (2013). Monitoring of a wide range of organic micropollutants on the Portuguese coast using plastic resin pellets. Marine Pollution Bulletin, 70 (1-2), pp. 296-302. https://doi.org/10.1016/j.marpolbul.2013.02.008
23. Raposo A., Durão A., Morais M.M., Vasconcelos L. (2018) Public Participation: A Tool for Water Conservation and Environmental Management. In: Mortal A. et al. (eds) INCREaSE. INCREaSE 2017. Springer, Cham. https://doi.org/10.1007/978-3-319-70272-8_47
24. Rochman C.M., Kross S.M., Armstrong J.B., Bogan M.T., Darling E.S., Green S.J., Smyth A.R., Veríssimo D., (2015) Scientific Evidence Supports a Ban on Microbeads. Environmental Science and Technology 46, 10759-10761. https://doi.org/10.1021/acs.est.5b03909
25. Rochman, C. M., Hentschel, B. T., Teh, S. J. Long-term sorption of metals is similar among plastic types: implications for plastic debris in aquatic environments. PLOS ONE 9(1), e85433 (2014) https://doi.org/10.1371/journal.pone.0085433
26. Rochman, C., Brookson, C., Bikker, J., Djuric, N., et al., (2019). Rethinking Microplastics as a diverse Contamination Suite. Environmental Toxicology and Chemistry—Volume 38, Number 4—pp. 703–711, 2019 https://doi.org/10.1002/etc.4371
27. Setälä O., Fleming-Lehtinen V., Lehtiniemi M., (2014) Ingestion and transfer of microplastics in the planktonic food web. Environmental Pollution 185, 77-83. https://doi.org/10.1016/j.envpol.2013.10.013
28. Schmeer, K., (2009). Stakeholder Analysis Guidelines. https://www.who.int/workforcealliance/knowledge/toolkit/33.pdf
29. UNEP, (2009). Marine Litter: A Global Challenge. Nairobi: United Nations Environment Programme (UNEP). 232 pp. ISBN 978-92-807-3029-6. https://www.unenvironment.org/resources/report/marine-litter-global-challenge-0
30. UNESCO, 2020. United Nations Decade of Ocean Science for Sustainable Development (2021-2030. https://en.unesco.org/ocean-decade
31. Vianello, A., Boldrin, A., Guerriero, P., Moschino, V., Rella, R., Sturaro, A., Da Ros, L., (2013). Microplastic particles in sediments of Lagoon of Venice, Italy: first observations on occurrence, spatial patterns and identification, Estuarine, Coastal and Shelf Science, https://doi.org/10.1016/j.ecss.2013.03.022
32. van Sebille, E., Wilcox, C., Lebreton, L., Maximenko, N., Hardesty, B. D., van Franeker, J. A., ... Law, K. L. (2015). A global inventory of small floating plastic debris. *Environmental Research Letters*, *10*(12), [124006]. https://doi.org/10.1088/1748-9326/10/12/124006
33. Watts, A., J. R., Urbina, M., A., Corr, S., Lewis, C., Galloway, T. S., (2015) Ingestion of Plastic Microfibers by the Crab Carcinus maenas and Its Effect on Food Consumption and Energy Balance. Environ. Sci. Technol., 49 (24), pp 14597–14604. https://doi.org/10.1021/acs.est.5b04026

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2020