Title: Microplastics in our ocean as a transdisciplinary challenge: Lessons from a co-learning workshop

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Abstract

This conference report summarizes the current challenges of researching microplastics pollution in the ocean as debated by international experts and stakeholders at a workshop held in San Sebastián, Spain, 1 – 2 October 2019. The transdisciplinary, co-learning approach of this report stressed the need to incorporate multiple perspective in solving the problem of microplastics and resulted in three proposed actions: (i) filtering microplastics from waste waters; (ii) mandatory ecolabels on plastic products packages; and (iii) circular economy of packaging plastics.

1. Introduction: Plastics in our ocean: a micro or macro challenge

Plastics are increasingly used worldwide, with global productions exceeding 350 million tonnes in 2018, with about 62 million tonnes produced in Europe (Jambeck et al., 2015; Plastics Europe, 2019). It was estimated that in 2010 about 5 to 13 million tonnes of these produced plastics entered the ocean and this number will only be increasing as it was estimated that about 12,000 Mt of plastic waste might end up in the natural environment by 2050 (Geyer et al., 2017; Jambeck et al., 2015). Plastic waste is hence an urgent sustainability problem for which transformative solutions are needed.

Plastics are generally divided into macroplastics and the smaller microplastics (plastic particles below 5 mm in diameter (Kershaw, 2015)). Contamination of the ocean caused by plastics is aggravated owing to the following reasons: (i) plastics persist for long periods of time in the ocean, (ii) some plastics contain hazardous chemicals which are released progressively into the ocean contaminating it further, (iii) plastic items with densities above that of the ocean water sink into the ocean and cannot be recovered, (iv) most plastics degrade into small pieces with time, i.e. microplastics. Microplastics are created through the fragmentation of macro, or mesoplastics, produced to simplify transport (UNEP, 2006) or added to products such as personal care and cosmetic products (Napper et al., 2015). Nowadays, even in remote regions (Lavers and Bond, 2017), such the arctic ocean (Bergmann et al., 2017; Peeken et al., 2018), or the deep sea (Peng et al., 2018; Woodall et al., 2014) microplastics are present. This raises significant concern, as microplastics, including nanoplastics (particles with <100 nm in diameter, da Costa et al., 2016), may have adverse effects on the health of marine life (Cole et al., 2011; Wright et al., 2013), as well as on human health (Carbery et al., 2018; Thompson et al., 2009) and well-being (Williams et al., 2016) and great economic costs (European Commission, 2018).

In 2019 the European Parliament has approved a law to ban single-use plastics by 2021 in the European Union (EU, 2019). This is one step towards reaching the Sustainable Development Goals regarding responsible consumption and production (SDG 12) and for the life below water (SDG 14) (UN, 2015), as much of this single-use plastic contributes to the plastic pollution of our oceans (UNEP, 2006). However,

this focus on single-use plastics might not be sufficient and further steps to decrease (micro)plastic pollution in general are urgently needed.

One way of achieving positive changes promoting and sustaining regulations in regard to the problem of plastics is by harnessing the collective intelligence, wisdom and workforce of a wide range of stakeholders. By aiming to understand the problem comprehensively and to create plausible solutions in an encompassing way and within the science-policy-society interface. One of such actions could be a participatory event gathering of a heterogeneous group of people face-to-face. During such an event and by means of a structured methodology, people can work and learn together, listen to each other and co-create. This type of events has been practiced by the authors of this article for the European context, highlighting the real impact such transdisciplinary co-learning events can have for the whole territory.

2. Lessons from a transdisciplinary, co-learning workshop

Transdisciplinary events and conferences are increasing, even in large scale events (e.g. Leventon et al., 2019). Transdisciplinarity is a form of research that addresses "the knowledge demands for societal problem solving regarding complex societal concerns" (Hirsch Hadorn et al., 2006 :p122). Since the problem of plastic waste permeates the science-policy-society interface, solutions require equally comprehensive actions. An example of such type of actions was the capacity-building workshop "Plastics in our ocean: a micro or macro challenge?" (1 – 2 October 2019, San Sebastián, Spain) at the premises of nanoGUNE. The event was organised in collaboration with ZUBIGUNE and financed by the European Commission through the 2nd Capacity Building call made by the European Project EKLIPSE of Horizon 2020 research and innovation programme. The event focused on understanding the societal challenge of reducing and preventing the presence of plastics and microplastics in our ocean. The goal was the co-learning about the current situation and negative effects of different forms of plastics in the ocean, assess the utility of plastics in our daily life and revise current practices of consumption, use and management of these materials in Europe at a societal scale. Participants were selected after a broad call, seeking for a group below 20 units and a balanced representation of: European Country, professional profile and different Institution. The selection returned a heterogeneous group of 17 participants (6 males/11 females) from Portugal, Spain, France, Italy, Slovenia, Latvia, Germany and Greece, with different professional profiles (Education, Policy, Industry, Research), expertise ("Education and/or marine ecosystems", "Water treatment", "Life cycle/value chain of plastics", "Policy and related") and sectors (public, private and non-profit sectors) (see Figure 1).

In occasion of the workshop both participants and hosts entered unfamiliar grounds of knowledge co-creation, facing the complexity of the issue on purposive, normative and pragmatic level of societal problem solving (Hirsch Hadorn et al., 2006). While doing so, the event delved into the question which role of

science, technology, industry, policy and society could play to accomplish the challenge of reducing plastics pollution.

The participatory process started with the formulation of two discussion-generating questions: “What are the actions needed to reduce and prevent the presence of plastics and microplastics in our ocean?” and “What are the policy sub-challenges related to the event challenge which need to be addressed?”. These two questions were aimed to structure discussion, create dialogue and guide the participants through the 2 days. The participant from DG MARE of the European Commission presented the normative framework and the prospective directions of the Commission on the topic. Thereafter, the co-learning, co-creation of knowledge was ensured through alternated sessions of workshops (Figure 1): Structured Democratic Dialogue Process (Christakis and Bausch, 2006; Flanagan and Christakis, 2010), world café and panel discussion. Participants were arranged in four expert groups based on their expertise (as above): Education and Marine Ecosystems, Water treatment, Life cycle/value chain of plastic, Policy and related. Each group elaborated on the first triggering question during an initial session by applying Structured Democratic Dialogue Process. Only one outcome had to be produced by each group (aim for day 1, see Figure 1) and brought to the next stage, i.e. its discussion following the second triggering question (aim for day 2, see Figure 1).

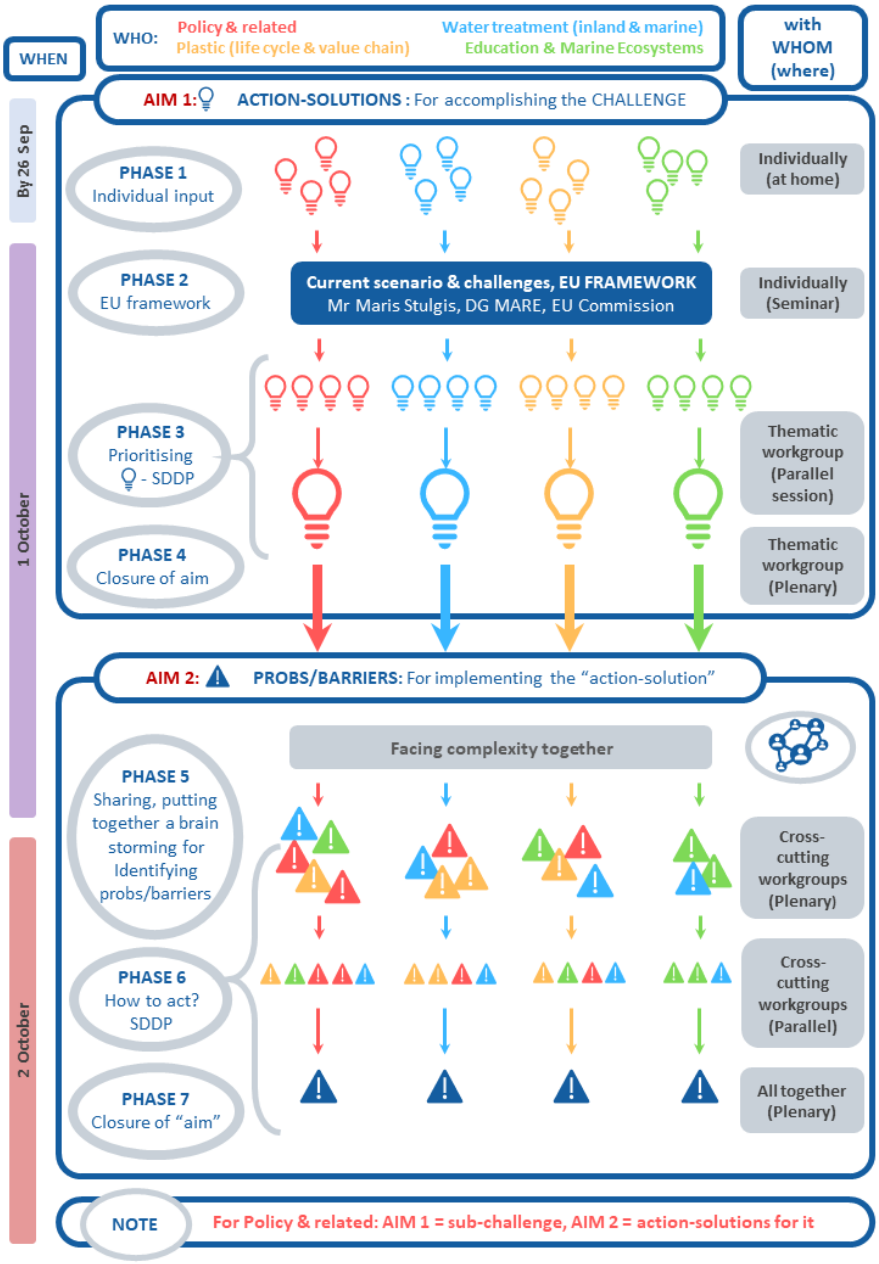

Figure 1 The participatory co-learning process of the 2-day workshop, including the individual input in preparation for this event. "Aim" relates to the specific workshop setting and the objectives to be reached for the day.

3. Response to triggering questions: Proposed actions

This activity generated three independent outcomes, each coming for the four expert groups:

(i) filtering microplastics from waste waters

(ii) mandatory ecolabels on plastic products packages

(iii) circular economy of packaging plastics

Firstly, participants discussed about the problems and constraints associated to the use of filtering to capture microplastics from water. Filtering in waste water treatment plants has been said to be only partly effective in removing microplastics from entering the oceans (Carr et al., 2016; Talvitie et al., 2015). However, technical improvements such as filtering at source (i.e. a filter for washing machines (McIlwraith et al., 2019)) or from sediments (Coppock et al., 2017) could be used additionally. Questions arose regarding the feasibility of global and widespread appropriate filtering techniques because of the involved costs and uncertain fate of the sludge retained by filters. Further, filtering will only reduce microplastics inputs from wastewater, not from fragmentation in the ocean.

Secondly, participants identified problems and barriers associated to the creation of a mandatory eco-label (ec.europa.eu/environment/ecolabel/) on plastic package products. The idea was to sustain environmental awareness and informed consumer behaviour (Rashid, 2009) when buying, which ultimately can create incentives for companies (Iraldo and Barberio, 2017) to reduce plastic packaging with less plastic. The eco-label was suggested to be consumer friendly, hence clear and transparent to quickly understand and inform about the global impact of the package. It remained uncertain how much of this process would have to be directed by regulations vs. market dynamics.

Thirdly, participants listed and analysed barriers for the establishment of a circular economy for packaging plastics (Huysman et al., 2017) with the final goal of using sustainable, biodegradable, recyclable and recycled materials in the production line. The EU Waste Framework Directive (Directive 2008/98/EC) already has the target to achieve a recycling rate of 50 % for certain materials by our current year of writing, 2020 (see also (EU, 2019)). There are, however, continued pitfalls. Biodegradability is difficult to achieve and fosters a continued use of plastic, instead of an actual consumption decrease (Haider et al., 2019), while a toxic-free production is paramount for a sustainable recycling of plastic (Leslie et al., 2016). Even highly industrialized EU Member States face difficulty in the operationalization of a circular economy for plastic waste (Van Eygen et al., 2018), posing the question on how applicable this goal is at global level. Further, special attention has to be given to environmental justice issues, such as legal and illegal waste trade (Brooks et al., 2018; Qu et al., 2019).

4. Conclusion

Microplastics waste is a global problem which permeates the science-policy-society interface. Solutions to this problem, hence, should be equally comprehensive and encompassing. Transdisciplinary approaches can be one way, to address the challenges of microplastics waste. The complexity of challenges related to the topic was reflected in the complexities of proposed action to generate sustainable outcomes, which the Structured Democratic Dialogue channelled into main points. The co-learning approach across perspectives

and solutions proved to be demanding yet feasible. The proposed actions are starting points for future discussion and show the need to include technical advancements, with social-ecological system thinking and environmental justice. This event contributed to dissemination of the practice of Responsible Research and Innovation across Europe (European Commission, 2020) and the promotion of the blue growth (European Commission, 2017) strategy of the European Commission. This event also contributed to strengthen democracy in Europe through the practice of a transparent and collective exercise towards solving our own complex societal problems. We firmly believe that such transdisciplinary workshops should become a mainstay in scientific endeavours when dealing with complex social ecological problems – this is especially true for conferences or larger workshops in which these types of exercises could be included based on existing research on transdisciplinary co-learning exercises in sustainability science (e.g. Lang et al., 2012).

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