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Solid and plastic waste from land to oceans – Challenges, opportunities and need for innovation in remedial and preventive measures

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Marine plastic pollution has become a major concern that is not limited to coastal areas but which has spread offshore forming trash gyres in the oceans. Drifting plastics have adverse effects on ecosystems and marine species with harmful effects including entanglement, ingestion, and suffocation. Floating plastics are vehicles to toxic pollutants and non-indigenous marine species that threaten biodiversity and affect human health. Micropastics (particles < 5 mm) are found in table salt - among other foods - and have therefore breached our diet.

About eight million metric tons of plastics are estimated to travel yearly into oceans. Predictive models that use data on solid waste generated per capita, estimate plastics moving from land to ocean through rivers. Watercourses running through densely populated areas generate mismanaged plastic waste, with about 88% conveyed through the top-ten ranked rivers. On a smaller scale, we developed a predictive model for rivers in Lebanon and concluded that such models require time series parameters related to river seasonality, climate change, hydrologic factors, and human activity near river beds.

Innovative techniques are recommended to reduce plastics at the source rather than react through remedial actions. Innovation should target bio-based manufacturing as well as biodegradable final products. Plastic-to-energy is part of remediation as proven by pyrolysis plants in the United States and Japan, in addition to promising technologies that aim at turning plastics into fuels. Recycling is another component of remedial actions, but recycled plastics lose their physical properties and become non-recyclable. If no disruptive innovation occurs to displace traditional plastics at the source, their production worldwide is expected to grow by about 4% yearly in the next ten years. Therefore, it is recommended to develop and commercialize process and product innovation as part of a preventive rather than remedial strategy.

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