

# Think Global, Act Local: Local Knowledge Is Critical to Inform Positive Change When It Comes to Microplastics

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Microplastic contamination in the marine environment is a global issue. Across the world, policies at the national and international level are needed to facilitate the scale of change needed to tackle this significant problem. However, sources and patterns of plastic contamination vary around the world, and the most pressing actions differ from one location to another. Therefore, local policies are a critical part of the solution; recognizing local sources will enable mitigations with measurable impacts. Here, we highlight how investigating the contamination comprehensively in one location can inform relevant mitigation strategies that can be transferred globally. We examine the San Francisco Bay in California, USA—the largest estuary on the West Coast of the Americas, and home to over 7 million people. The local contamination of microplastics in surface water, sediments, and fish from this urban bay is reportedly higher than many places studied to date.<sup>1</sup> This example demonstrates the value of local monitoring in identifying sources, informing local mitigation strategies and developing an array of solutions to stem the multifaceted tide of plastic pollution entering our global oceans.

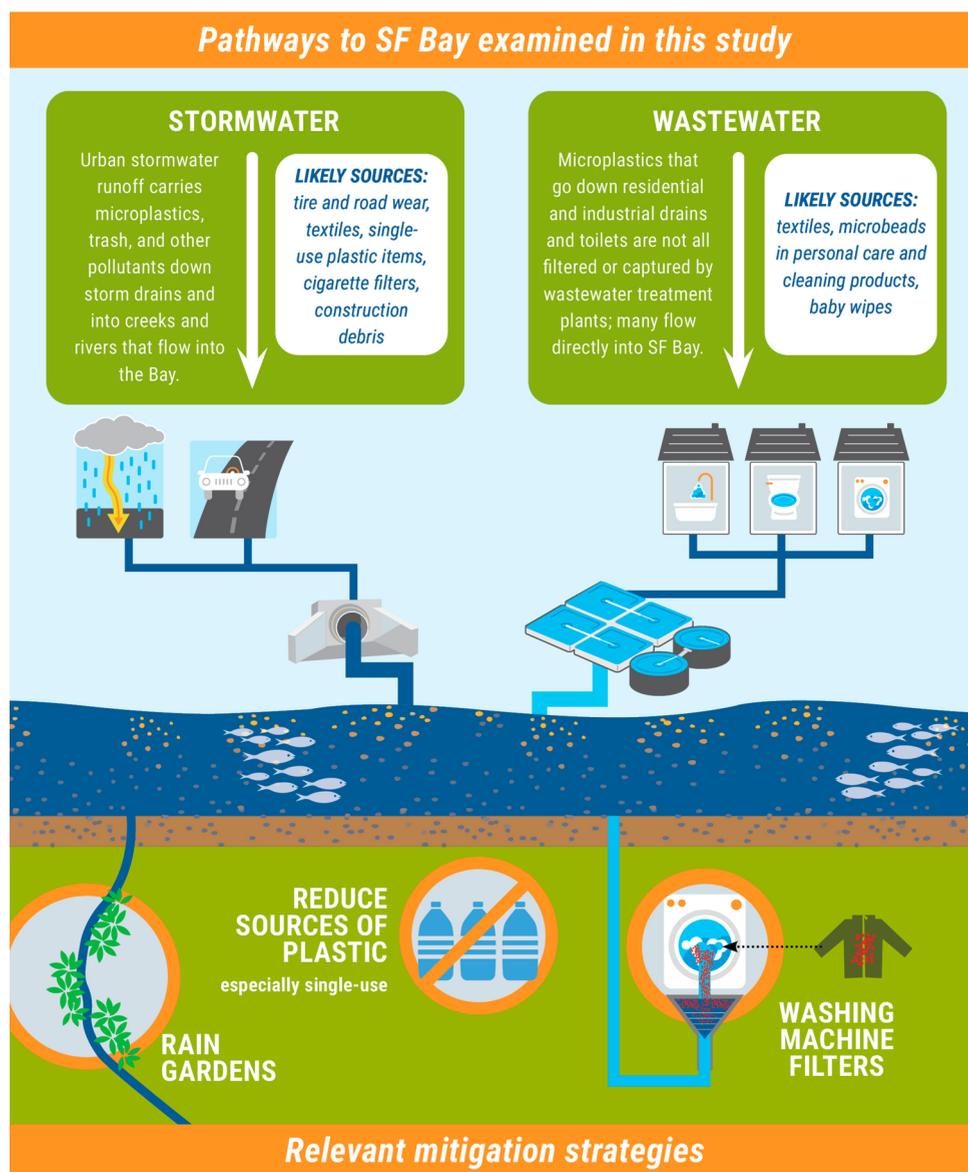
In the recent study of plastics in the San Francisco Bay area by Zhu et al.,<sup>1</sup> a sampling campaign of more than 400 samples found that urban wastewater effluent and stormwater runoff

were important pathways for microplastics to reach the urban bay. Combined, they release an estimated annual loading of seven trillion microplastics.<sup>2</sup> In wastewater samples, fibers were the most frequently identified morphology, followed by fragments. This is consistent with studies documenting the discharge of fibers shed from textiles during washing.<sup>3</sup> However, urban stormwater runoff was a significantly greater pathway of microplastics than wastewater.<sup>1</sup> Fragments were the most frequently identified morphology in stormwater, followed by fibers. Nearly half of the fragments were black fragments with a distinctive rubbery texture. Analysis of several of these fragments by pyrolysis–gas chromatography–mass spectrometry demonstrated tire wear as a source.

Overall, the local results from this case study inform mitigation options specific to the region (Figure 1). For wastewater, mitigation strategies can be aimed at reducing fibers, perhaps through the use of filters on washing machines to keep fibers from entering wastewater,<sup>3</sup> promotion of different washing practices, development of standardized methods to measure fiber shedding, and the creation of textiles with lower shed rates. For urban runoff, technologies to capture plastic trash and microplastics in storm drains or tributaries before they reach the Bay would be effective solutions. This may include green stormwater infrastructure, such as bioretention cells or raingardens on storm drains,<sup>4</sup> and trash trapping technology, such as Seabins or a Trash Wheel in tributaries. In addition to mitigation strategies to trap particles in stormwater and wastewater, actions can be implemented to prevent contamination further upstream. This may include reducing plastic use, particularly the low-value single-use items that are commonly littered and observed on coastlines around the world. Local and statewide policies that reduce single-use plastics were identified as effective legislative actions that communities can take to address plastic pollution.<sup>5</sup>

The San Francisco Bay study also highlighted the need for further study to fully identify and evaluate other potential microplastic sources and transport pathways, for example from

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**Figure 1.** We examined stormwater runoff and treated wastewater effluent as two potential pathways for microplastics to reach San Francisco Bay. The types of microplastics we found in these two sample types, in addition to fish, water and sediments within the bay, informed relevant mitigations strategies to reduce microplastic emissions to this important marine ecosystem.

industrial effluents, agricultural runoff, and atmospheric deposition. Long-term monitoring programs are also required to measure the effectiveness of adopted mitigation strategies over time and may also result in an improved understanding of the contaminant burden, inform additional local approaches, and confirm resources are being directed efficiently.

In different economies around the world, where plastic consumption and waste management vary, local monitoring is also needed to inform best practices. In some places, effective mitigation strategies may be the adoption of new solid waste management strategies, changes in the import/export of waste, taxes or bans on different plastic products, or a formal cleanup strategy. For example, locations with preproduction pellet contamination may focus on zero pellet loss from industry. In locations that support multiple active commercial fisheries and where fishing debris is commonly observed, policies relevant to incentivizing the return of fishing gear may be most relevant. Thus, local knowledge and long-term monitoring strategies are

critical to inform effective local solutions. In addition, although the sources and mitigations described in the San Francisco Bay example above may be most relevant to this region of the USA, they may also bear some relevance to other urban locations. Effective global communications of monitoring results and mitigation strategies is also a key part of accelerating the implementation of solutions and behavior change globally.

In summary, international agreements and national action plans should provide the foundational support for local investigations that lead to implementation of science-informed actions relevant in each geography. Here, our comprehensive investigation of the San Francisco Bay demonstrates the importance of local sampling campaigns to inform solutions on the ground and feed into global databases to better understand the issue on a larger scale. For plastic pollution, we need to think globally, collaborate globally, regionally, and nationally, and act locally.

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### Notes

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