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An imperative to focus the plastic pollution problem on place-based solutions

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There is an increased focus on plastic pollution and the resultant harms in our oceans and on our shores at local, regional, and global scales. New technologies are being developed and trialed, multilateral agreements are coming into play, and the role of a circular economy is increasingly touted as the key to help solve the plastic pollution crisis. Simultaneously, we are witnessing the disruption of global supply chains from the COVID-19 pandemic, increased fuel prices and increased scope and scale of natural disasters. Individual countries are setting national targets and are developing national plans of action to combat plastic pollution. In this paper, we focus on Australia's National Plastics Plan as a case study of a national approach to addressing this transboundary issue. We discuss the Plan in relation to supply chains, the role of standards and best practices, and principles for a successful circular plastic economy. We explicitly consider the role of reverse logistics and regional approaches that could be developed and implemented within island nations. Overall, we argue for culturally appropriate, economically and environmentally place-based solutions as a necessary approach to help reduce plastic losses to the environment, acknowledging that plastics leakage to the environment is a social equity issue.

KEYWORDS

Australia, circular economy, place-based solutions, plastic, plastic supply chain, reverse logistics

Introduction

Plastic production is increasing globally at unprecedented rates. Accordingly, plastic pollution is now described as a crisis and a wicked problem (Landon-Lane, 2018; Vince and Stoett, 2018; Stoll et al., 2020), which transcends geopolitical borders and affects individuals and countries preferentially based upon wealth. Further confounding the management of wicked problems is the notion that “decisions are not allowed to be wrong” (Rittel and Webber, 1973; Landon-Lane, 2018). This 21st-century tragedy of the commons (Vince and Hardesty, 2018) affects the most remote marine environments, with plastics that weigh thousands of kilograms (e.g., derelict fishing gear; see Richardson et al., 2019) to those small enough to pass through tissues and cell boundaries (Järvenpää et al., 2022). Plastics of all sizes have been discovered in the most remote marine

environments from the arctic to the Antarctic (Kelly et al., 2020; Collard et al., 2021), including the deepest depths of the ocean in the Mariana Trench (Chiba et al., 2018). It is estimated that globally, around nearly 80% of all plastics ever produced has accumulated in landfills or the natural environment, while only 9% of all plastics have been recycled and 12% has been incinerated (Geyer et al., 2017). Plastic is estimated have a social and environmental cost of US \$2.2 trillion each year (Forrest et al., 2019). An estimated 19 to 23 million metric tons of plastic waste has entered aquatic and marine ecosystems on a global scale, and this is predicted to reach up to 53 million metric tons annually by 2030 if current trends continue (Borrelle et al., 2020).

While plastic has only been in production for around 60 years, its ubiquity in society—and in the environment—is notorious. Up to 80% of the plastic found in the coastal and marine environment is sourced from the land, and we require socially, culturally appropriate, place-based solutions to prevent manufactured plastics reaching the global ocean. The plastic problem is so widespread across the world's terrestrial and marine environments that microplastics have been found in the snow on the Swiss Alps (Bergmann et al., 2019) and on the Antarctic continent (Zhang et al., 2020), as well as in the deepest depths of the ocean (Barrett et al., 2020). The impact of plastics on human health as a result of its presence in the environment is still relatively unknown, however, some evidence suggests that the leaching of endocrine disrupters from plastic can be linked to numerous human health issues (Flaws et al., 2020). The global COVID-19 pandemic has further complicated the problem resulting in an increase of single-use plastic and personal protective equipment use and waste in the environment (Prata et al., 2020; Silva et al., 2020; Schofield et al., 2021). This transboundary problem has grown exponentially. To address this, policy making needs to be responsive to maximise effectiveness.

There are a number of international measures, including treaties and soft law/governance attempts to support and encourage international collaboration to reduce plastic losses to the environment. The Honolulu Strategy is a global framework document which meant to guide countries toward reducing plastic inputs to the marine environment (UNEP, 2011). Following this, we have seen the Manila Declaration on Furthering the Implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (2012), the G7 Action Plan to Combat Marine Litter (2015), and more recently, the Basel Convention. To date, the Basel Convention is the sole global instrument that addresses plastic waste in a legally binding framework, however, compliance is difficult to enforce (Raubenheimer and McIlgorm, 2018). In March 2022 UNEP passed a Resolution “To end Plastic Pollution”

which will begin the negotiations toward a legally binding agreement by 2024. In the meanwhile, nation states such as Australia will need to manage their plastic use through national approaches.

Australia's National Plastic Plan

Historically, waste management has happened at state and local levels. However, in 2021 the federal government announced a National Plastics Plan (DAWE, 2021), which followed the first National Plastics Summit in early 2020.

This Plan outlines that the Australian government will address plastic pollution by

“working with industry to fast-track the phase-out of particularly problematic plastic materials; stopping the export of unprocessed plastic waste and promoting product stewardship through the Recycling and Waste Reduction Act 2020; unprecedented investments to turbo-charge Australia's plastic recycling capacity; research to make Australia a global leader in plastic recycling and reprocessing; community education to help consumers make informed decisions and recycle correctly” (DAWE, 2021).

The aims of the Plastics Plan include, *inter alia*, to phase out non-compostable plastic packaging, consumer education, actions to reduce plastics leaking into the marine environment and an emphasis on research. This Plan has a number of targets for the immediate future including phasing out expanded polystyrene in consumer packaging by 2022 and having 100% reusable, recyclable or compostable packaging by 2025. The *Recycling and Waste Reduction Act* (2020) provides a national framework to manage waste and recycling across Australia including waste exports (DAWE, 2021). These regulations and plans provide a national framework; however, it is the state and local governments that are responsible for waste management and recycling efforts. While the responsibility falls on local governments in national and state plans, support and resources by upper levels of government will deliver a nationally coordinated approach and ensure effective implementation. For example, in multilevel political systems, such as Australia, local governments are responsible for waste management. With increased pressure to grow recycling capabilities, more resources will be required. Additionally, successful implementation of the Plan will require developing resilient supply-chains that overcome system shocks such as oil prices affecting recycling sector economics, disruptions in global supply chains from waste bans and COVID-19, and the increasing influence of politics on the plastics sector (Ebner and Iacovidou, 2021).

The effect of COVID-19 on plastic pollution and supply chains

In December 2019, the SARS-CoV-2 virus began to spread around the world, the first pandemic of such severity in centuries. Given the severity of the respiratory syndrome that results from the novel coronavirus and its highly contagious nature, what began as a health crisis has quickly become an economic, social, political and environmental threat (Silva et al., 2020). Initially, the world experienced a global shutdown in international and domestic travel. Consequent to people becoming less mobile were decreased carbon emissions, increased sightings of wildlife in urban areas, and potentially decreased amounts of several types of plastic waste lost to the environment. However, this decrease was counteracted by the tremendous growth in single-use plastic personal protective equipment (PPE) and other medical waste associated with the pandemic (Ammendolia et al., 2021; Schofield et al., 2021). Additionally, there was a proliferation of single-use plastic bags, cups and take away containers associated with the food industry (Parashar and Hait, 2021). This demand on plastics for packaging, medical use and other applications is expected to grow (Prata et al., 2020). We have also seen plastic industry lobbyists utilize the hygiene and cleanliness concerns of customers to pressure jurisdictions to reverse or delay policies to ban or reduce single-use plastics (Prata et al., 2020; Silva et al., 2020; Da Costa, 2021).

Increasing disruptions to supply chains around the world began in early 2020 when the World Health Organization declared COVID-19 a global health emergency (Hedwall, 2020; Magableh, 2021). Supply chain disruptions have occurred for a range of products such as medicines and medical equipment including PPE, fuel, electricity, food, toilet paper and other household goods. Examples of supply chain disruptions have included demand drop (e.g., airline travel), demand surge (e.g., toilet paper, online shopping), reduction in productivity (e.g., retail or restaurant jobs), storage/access restrictions (e.g., storage warehouses, meat production and storage facilities, etc.), a shortage of raw materials (e.g., electronics parts such as memory chips, building materials) (Pujawan and Bah, 2022). These supply chain disruptions are unevenly distributed among countries, industries and communities and highlight the instability within global markets (Bassett et al., 2021; Castañeda-Navarrete et al., 2021). Countries are seeking to reduce their reliability on global markets by building and strengthening resilient regional and domestic markets. One approach that is seeing an increased focus is the shift to an increasingly circular plastics economy. This focus is heightened by the desire to buffer supply chains from system shocks (such as having resulted from the current COVID-19 pandemic, political instability, and other emergent or urgent crises (Vince and Hardesty, in press).

The potential for a plastics circular economy

The magnification of single-use plastic consumption, insufficient disposal and management during the pandemic highlighted the urgent need to close the plastic loop. Recently, there has been a shift in perspective, as countries begin to acknowledge the value of plastic and a circular plastic economy (Yuan et al., 2021). If we treat plastic as a commodity, rather than as waste, we will increase the market for material recovery. A voluntary contribution from industry has been proposed as one approach to support the elimination of plastic pollution and help drive a circular plastic economy (Forrest et al., 2019). Embedding a whole of life cycle approach that includes plastics manufacturers and multinational corporations will undoubtedly assist in changing the dial on the global community's relationship with plastic. Current circular economy solutions can often be derived from experiences and management of waste in OECD (Organization for Economic Co-operation and Development) countries and may lack applicability to low-income nations or communities (Mihai et al., 2022). This only emphasizes the need for circular economy solutions to be place-based, tailored to a region, so that they adequately address necessary social and ethical dimensions (Murray et al., 2017). For example, some argue that plastic waste in developing countries could be solved by locally managed decentralized circular economy models (Browning et al., 2021). Circular approaches need to consider context, socioeconomics and transport as well as culture, social and economic context. Approaches suitable in higher OECD countries may not be appropriate in small island developing states, for example, where land and resources are much more limited.

Australia has established an Australian Circular Economy Hub and Marketplace to support the transition for Australian companies, communities and individuals to a circular system. In Australia, the adoption of circular economy principles could abate approximately 165 million tons of carbon pollution each year (Thorpe and Carmody, 2021) and establishing a plastics circular economy has been valued at \$2 trillion. Lengthening and diversifying supply-chains within a circular system will buffer supply-chains from system shocks such as disruptions caused by catastrophic weather events or pandemics. At present, recirculating many plastic polymers back into the economy are constrained by material quality, product design and current sorting, handling and processing practices (Hahladakis and Iacovidou, 2018). Advancements in reprocessing and sorting technology alongside the redesigning of plastic products will progress the quality standard improvements required to increase secondary material recovery and recycling and enable a circular model transition to succeed (Hahladakis and Iacovidou, 2018). Circular plastics solutions that are adapted to the

small island context where landfill space is scarce, and waste infrastructure is often lacking are more likely to succeed. Taking a regional approach may yield more positive, collaborative outcomes, whereby materials recovery is more likely to prosper, and circular businesses can develop that are place-based, socially and culturally appropriate, whilst keeping financial benefits local.

Harnessing innovations and technology opportunities

It seems that nearly on a daily basis, we learn of novel approaches to addressing the plastic waste issue. These include everything from social enterprises such as recovering things and turning them into artwork or toys (<https://oceansonline.com/>) to chemical recycling (Thiounn and Smith, 2020), alternative packaging materials such as seaweed (Teixeira-Costa and Andrade, 2022), refillable container systems, and the proliferation of “degradable/biodegradable” plastic bags, food containers, and other food associated items (Evans et al., 2020). Product design and recycling systems (including the collection, sorting and reprocessing of materials) is a crucial point where government and industry can work hand-in-hand to provide products to consumers that make recycling easier and advance plastic pollution reductions. Success will require collaboration across the whole lifecycle of plastic packaging production, and to date, the pace to achieving a sustainable circular plastics economy has been slow (Gerassimidou et al., 2022). Advances in plastic-alternative materials will facilitate the phase-out of problematic and hard to recycle single-use plastics, such as expanded polystyrene used for packaging fill and consumer food and beverage containers; and microbeads used in cosmetic, cleaning, and personal care products. Advances in software programs will facilitate more recycling, such as the Recycle Mate or CurbCycle App to aid consumer decision-making regarding the recyclability of a product; or AI-enabled autonomous sorting systems in material recovery facilities. Australia is funding projects advancing their technology capacity to recycling plastics and integrating plastic waste into other materials. For example, recently projects funded by the Cooperative Research Center span chemical recycling of plastics, integrating plastic waste as a concrete or asphalt aggregate, and smart/AI technologies to improve recycling facility efficiency and material quality (CRC-P, 2022).

Advances in technology to capture and clean litter trap devices on urban drainage networks will improve the capture of plastics before they reach the ocean. Advancements in product labeling and polymer composite standards will additionally facilitate increases in recycling rates. For example, simplifying the complexity of current polymers and polymer composites could improve their recirculation into new

products (Kummerer et al., 2020). Make international accepted definitions for biodegradable, degradable, oxo-degradable plastic standards to improve trust and transparency in domestic and international supply-chains. Improve product labeling to provide information that makes it easier for consumers to dispose of the item correctly (Burrows et al., 2022). For example, Australia aims to have 80% of supermarket products to display the Australasian Recycling Label, a world-leading label system (United Nations Environment Programme Consumers International, 2020) which provides information on how each component of the product should be disposed (Figure 1). Furthermore, consideration of the important role logistics can play in moving material between locations is critical to reduce carbon costs, increase benefits where they are needed and advance opportunities for increased circularity.

Australia as a regional leader

A fundamental springboard that launched plastic pollution into the forefront of the minds of decision-makers was a 2015 paper which included a list of the top 20 countries that are losing mismanaged plastic waste to the ocean (see Jambeck et al., 2015). At least half of these countries are within the Asia-Pacific region. Australia, also an island nation within the region, has a unique opportunity to provide guidance and support to neighboring countries.

Australia can become a leader in reducing plastic waste domestically and in the Asia-Pacific region. One major step Australia has taken toward reducing its waste burden on other countries is banning the export of unsorted mixed plastics and unprocessed single polymer or resin plastics. Australia has a larger technological and financial capacity compared to many of its neighbors, putting Australia in a position to develop and trial different management solutions and support neighboring nations to do the same. The country has prioritized supporting community-led projects that address local environmental priorities (i.e., place-based solutions) through the Plan and has funded over 1,330 community-led projects in 2019–20 to the value of \$18 AUS million.

A target of Australia's National Plastics Plan is to phase-out problematic and unnecessary single-use plastics such as expanded polystyrene packaging fill and consumer food and beverage containers. With clear targets, the country is looking at domestic business opportunities and being a regional leader. For example, the country has successfully supported industry to voluntary phase-out plastic microbeads from 99.3% of cosmetic, cleaning and personal care products sold in Australia.

Furthermore, Commonwealth procurement rules and sustainable procurement guidelines have been updated to



ensure recycled materials are purchased. Consumers can feel confident that the plastic they place in their recycling bin is recycled and placed back on the shelf as a new product for them to purchase.

The mismatch between political cycles and policy implementation—Agenda setting

A risk to any policy, particularly those that arise from surges in public interest, is its discontinued or delayed implementation due to changes in elected governments, political agenda, and public attention (Bailey, 2022). Amid the disruptions of the COVID-19 pandemic, Australia moved forward with policy actions that target reducing plastic waste. With plastic pollution identified as an important global issue, increased focus from government and industry to tackle the problem will be key. Governments often take low-risk approaches, typical of wicked problems, to deal with creeping crises such as plastic pollution (McConnell, 2018; Mæland and Staupé-Delgado, 2020). The “crisis overreaction” to COVID-19 was used as a political tool by many nations, such as the US, Australia and Canada to win national elections in 2020 and 2021 (Maor, 2020). The COVID-19 focus overshadowed the plastic issue. The outcome of the most recent Federal election in Australia held in May resulted in a change of government. While plastics were not a major focus of the campaign, environmental issues and climate change were key topics. The Australia National

Plastics Plan does provide long-term guidance for actions that extend beyond a single political cycle, and the change of government will determine how the Plan will continue to be utilized. The Plan’s success will require collaboration between and within those implementing the Plan and its end users. Long-term political will could buffer the Plan’s momentum against declining interest which often occurs during change of ministers or government (especially if the political party that forms government changes) (Hudson et al., 2019). Currently, few countries have the mechanisms need to support more robust policies (Gold 2014). Australia’s commitment to UNEA and the upcoming Plastics Treaty may be the catalyst to keep plastics on the agenda.

A call to action

A fundamental shift in society’s relationship with plastics can include a multitude of approaches. By treating plastic as a commodity rather than as waste and with economic incentives, materials recovery will be improved, which in turn can drive new business opportunities. There is also a substantial role for best practice guidelines and standards, whether for food safe packaging, for targets such as those set by the National Plastics Plan of Australia, or by industry, local or state governments, or from grass roots campaigns (Willis et al., 2022). Taking a regional approach to materials recovery will likely also yield benefits, particularly if reverse logistics are included in products through supply chains. It is an exciting time with the recent

binding UNEA 5.2 resolution passed earlier in 2022. There is an increased will and focus on plastics from local to global scales. In this decade of the Ocean, there are multiple opportunities to shift the dial on plastics, from inception, to manufacture, through use and materials recovery. Focusing on place-based, equitable solutions will result in improved outcomes locally, regionally, and globally.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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