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Planet versus plastic: The case of plastic pollution through the lens of philately

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Perspective

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Abstract

Plastic pollution is recognised as one of this century's most significant environmental challenges and has the characteristics of a super wicked problem. Though researchers and governments around the globe are coming up with promising technological interventions, awareness among citizens and stringent policies are the need of the hour to tackle this issue. A few countries have issued postage stamps and postal materials showcasing the various dimensions of plastic pollution. Historically, stamps depicted every progress, problem and various milestones of humanity spanning multiple fields. We contend that the plastic pollution problems and impact should be depicted through postage stamps from all countries. Through this feat, the message of the need for sustainable usage of plastics for the common good of all species can be spread by showcasing various dimensions of the sustainability of plastic usage in postage materials. This article discusses the rise of plastic pollution, its emerging impacts, and contemporary issues and mitigation strategies through postage stamps and materials. Philately can be a medium for providing environmental awareness, considering the case of plastic pollution. It can be a strong driver to promote consciousness regarding various environmental problems among students undergoing multiple levels of education and the general public.

Impact statement

This article provides an overview of plastic pollution as depicted through postage stamps of different countries. Though electronic media is widespread in this era, postage stamps and postal materials showcase a nation's stand on various contemporary issues. We have collated up-to-date details of postal materials issued on the plastic pollution theme. Each section of the manuscript discusses different aspects of plastic pollution with relevant postage materials. This article is one of the first to depict the case of plastic pollution philately.

Introduction

Plastic pollution has evolved as a global environmental problem in recent years, partly due to advanced detection techniques and dedicated research programmes by national-international agencies and scientific institutions. Plastic pollutants are now ubiquitous in the atmosphere, hydrosphere, biosphere and lithosphere. Annually, 19–23 million tonnes of plastic debris seep into aquatic environments, contaminating rivers, lakes and oceans (UNEP, 2023), where the pathways are often from land-based sources and poor management strategies. For example, during the COVID-19 pandemic, the global waste management systems collapsed (Luhar et al., 2022), resulting in ~1.6 million tonnes of plastic waste per day worldwide in 2021 (Ekanayake et al., 2023). This led to pandemic-induced plastic pollutants being reported widely in freshwater and marine ecosystems (Jarabe et al., 2023; Vince, 2023; VishnuRadhan et al., 2022; Wang et al., 2023). The 2024 Earth Day theme "Planet vs. Plastics," highlights the necessity of preserving natural resources and the environment, as well as the significance of moving away from the reliance on plastic sources such as fossil fuels and toward sustainable and renewable energy sources.

The impacts of plastic pollutants on the earth's system are far-reaching, posing various human and ecosystem health impacts. The plastic litter and associated debris entangle, kill and injure hundreds of marine species yearly (Ozturk and Altinok, 2020). The impact is equally profound in terrestrial ecosystems when animals ingest plastic waste and suffer intestinal blockages or fatal damages in many instances (Lai, 2022). When exposed to environmental conditions such as sunlight, salt water and microorganisms, the macroplastics manifest into smaller counterparts, termed micro and nanoplastics (VishnuRadhan et al., 2019). These smaller plastic particles are very potent and are known to induce human health impacts (VishnuRadhan et al., 2021; Khan and Jia, 2023). Plastic particles have recently been detected in human blood (Leslie et al., 2022),

lung (Jenner et al., 2022), semen (Montano et al., 2023), breast milk (Ragusa et al., 2022) and placenta (Ragusa et al., 2021).

All this evidence points to the fact that plastic pollution is evolving into a super wicked environmental problem. Wicked problems are intricate, multifaceted and interconnected social and environmental challenges confronting society. These issues are marked by inherent disconnections and conflicts among stakeholder groups, which often intensify the complexity and push solutions further out of reach (de Salas et al., 2022). Super wicked problems are a group of even more complex challenges having further exacerbating features (Lazarus, 2008). It primarily has four features: (1) when the deadline for figuring out the solution is quite close, (2) there is not a single organisation in charge of solving problems, (3) people trying to fix the issue are also contributing to it, and (4) some policies unreasonably obstruct progress in the future (Levin et al., 2012; Auld et al., 2021). Plastic pollution issues have all the above characteristics, and there is an immediate responsibility with the producers for well-designed, non-damaging plastic products, as consumers often have no choice but to buy single-use plastic items. This can also help sensitise citizens and aid in changing consumer behaviour, such as opting out of single-use plastic products. In this article, we showcase philately, the collection and study of postage stamps, to disseminate the pressing issues of plastic pollutants to the broader public. The first postage stamp, "the Penny Black" was issued in the United Kingdom on May 1, 1840, but its usage became valid starting from May 6, 1840. Since the issue of the first postage stamp, postage stamps have depict national and international accomplishments and cultural heritage, commemorating institutions and personalities of national and international importance, environmental awareness, biodiversity and are used to announce both national and international events. Stamps are eventually used as a medium by authorities to disseminate messages and information (Hirwade and Nawlakhe, 2012).

There are promising attempts to draw the attention of the general public towards various environmental themes through philately, such as climate change (Toth and Hillger, 2013), droughts (WMO, 2015), global environmental challenges (Brunn 2017), the state of the planet's well-being (Brunn 2018), ecological education (Cioruța and Pop, 2020), and wildlife conservation and habitat protection (Cohen and Altman, 2021). We hope our article will add to the growing body of literature that strives to impart awareness of pressing environmental issues through philately.

The rise of plastic pollutants

Chewing gum and shellac are natural materials that were first used to create plastics because they naturally possessed plastic qualities. The next stage in creating plastics was the chemical alteration of raw materials, including rubber, nitrocellulose, collagen and galalite. The development of entirely synthetic materials started over a century ago (Plastics Europe, 2021). The metallurgist Alexander Parkes invented Parkesine in 1855, which we now call celluloid. A significant breakthrough was in 1907, with the creation of Bakelite by Leo Baekeland (Figure 1a). Bakelite, a thermosetting phenol formaldehyde resin, was the first synthetic, mass-produced plastic used in multiple products, from electrical switches to telephones. Figure 1b shows a Bakelite stamp box used in the early 1960s from the Smithsonian's National Postal Museum collection. Since the Bakelite era, various types of plastics and their widespread usage have exploded. Currently, most modern plastics are derived from fossil fuels because plastic raw materials are a cheap byproduct of the fossil fuel industry. Thus, plastic products have an immense climate signature since fossil fuels are known as a primary contributor to global warming (Figure 2) (Masson-Delmotte et al., 2021).

In 1950, plastic production was ~2 tonnes, which surged with increased population and wide applications, fuelled by technological advancements, and thus started the era of plastic waste. Most of the plastic waste (~80%) originates from terrestrial sources, and less than 10% of the 7 billion tonnes of plastic waste produced worldwide to date has been recycled (EU, 2023). As per the United Nations Environment Programme (UNEP), the amount of plastic waste produced increased in the early 2000s, more in a single decade than in the preceding 40 years. Currently, an estimated 400 million tonnes of plastic waste are produced each year, and over the next several decades, this amount is anticipated to rise significantly (Lampitt et al., 2023). Recycling has been largely ineffective in offsetting the impact of rising global plastic production due to low global recycling rates, although reuse and/or reprocessing has

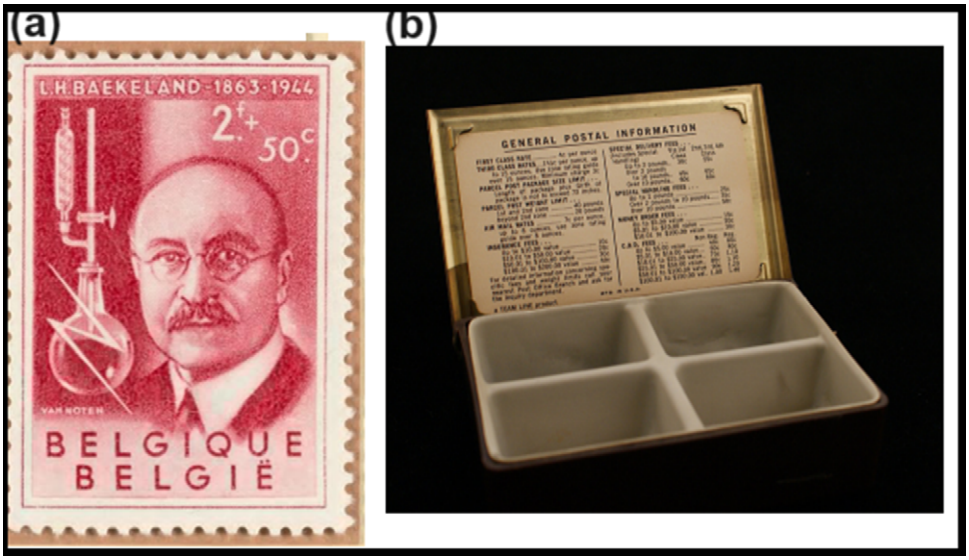

Figure 1. a) Belgian semi-postal stamp commemorating Leo H. Baekeland issued in 1955, b) Bakelite stamp box (National Postal Museum Collection, Record id: npm_2012.2007.19).

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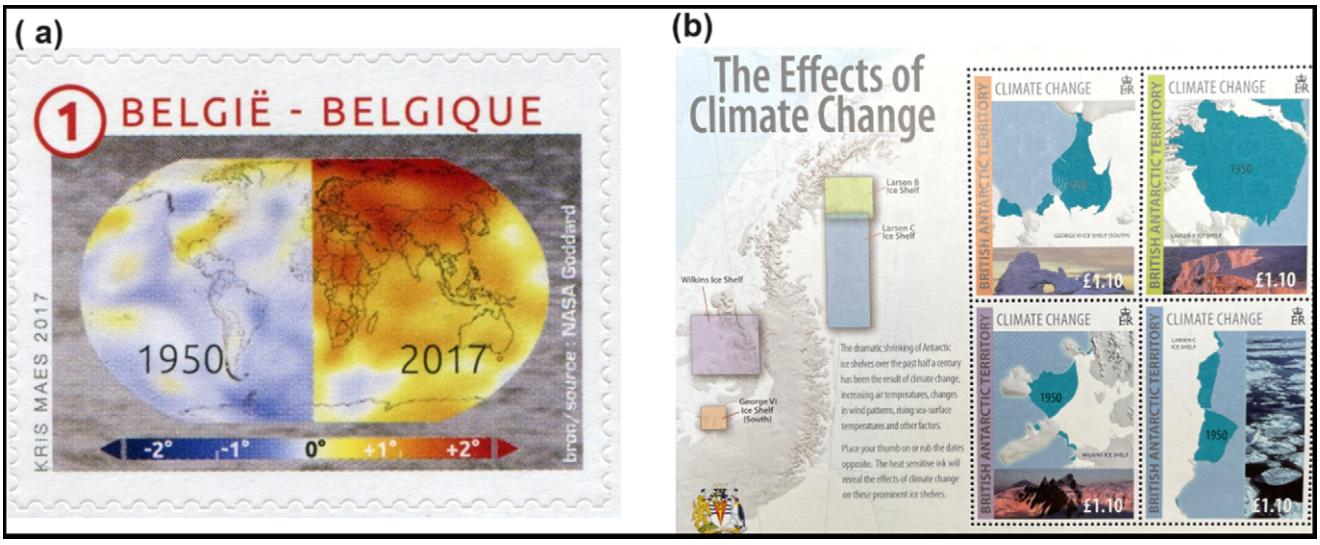

Figure 2. a) Development of global warming (1950–2017) issued by Bpost (Belgium) in 2017, b) Stamp about climate change by the British Antarctic Territory in 2009.

been widely advertised as one solution to counter plastic waste (Singh and Walker, 2024). Globally, the accumulation of mismanaged plastic waste is a growing concern, and it is projected to be 155–265 Mt. y^{-1} by 2060 from 60 to 99 Mt. in 2015 in a business-as-usual scenario (Lebreton and Andrady, 2019).

The emergency of the plastic pollution situation: An India post case

Plastic pollution is a global environmental problem that needs immediate attention from various stakeholders, including governments, international agencies, private players and the general public. Here, we show the case of two philately items issued by India Post in 1997 and 2018. The first one is a first-day cover issued in 1997 (Figure 3) to commemorate the PLASTINDIA Exhibition 1997 held in New Delhi. The tagline was "Use Plastics Save Tree." The PLASTINDIA Exhibition and Conference is held every 3 years, started in 1990 by the PLASTINDIA Foundation, an apex body founded by major associations, organisations and institutions related to the plastics industry of India.

On World Environment Day in 2018, the India Post came up with a miniature sheet with four stamps (Figure 4) and a tagline, "Beat Plastic Pollution." India was the global host of World Environment Day on June 5, 2018, with "Beat Plastic Pollution" as the theme. In just a span of 20 years, the wonder material plastic has turned into an environmental problem. This shows the fast-evolving nature of plastic pollution problems and their environmental impacts. Since then, the government of India has started various programmes that commit to eliminating single-use plastic product pollution, including banning single-use plastic products with low utility and high littering potential (MEA, 2023). A legislative foundation for efficient plastic waste management in the nation was established by the Plastic Waste Management Rules of 2016 and subsequent amendments. The Plastic Waste Management Amendment Rules 2021, which banned 19 categories of single-use plastics, were enacted in 2022. The import, production, sale, stocking and use of identified single-use plastic items like earbuds with plastic sticks, plastic flags, plates, cups, cutlery and other similar disposable plastic products have been banned from July 01, 2022. Several steps have been taken nationwide to guarantee the successful

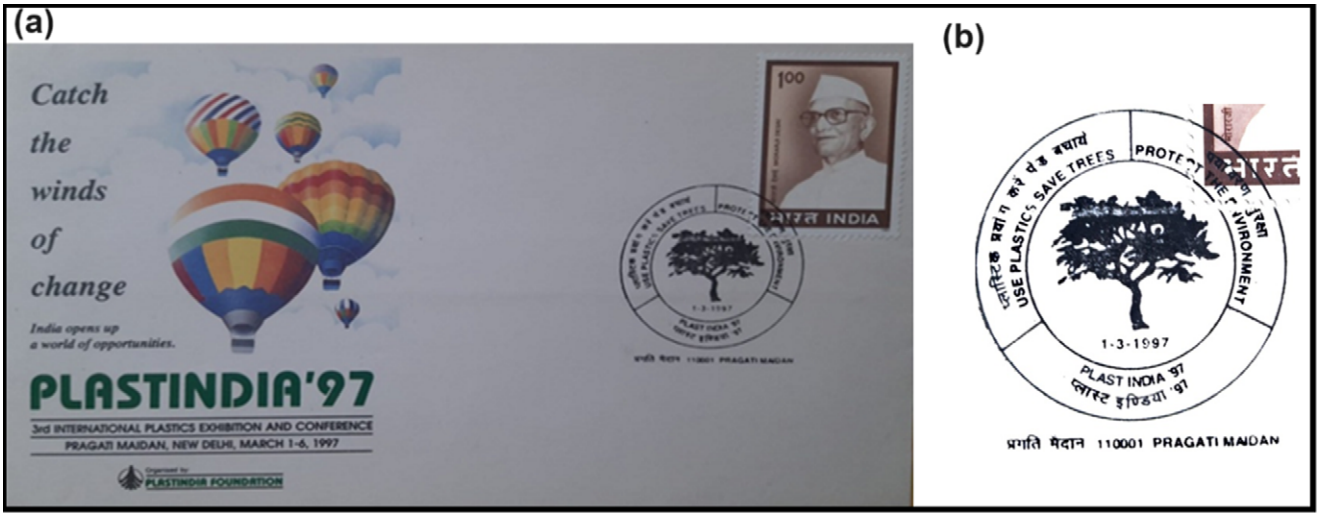

Figure 3. a) 1997 – PLASTINDIA 97 First Day Cover, b) Magnified view of the seal showing "Use Plastics Save Trees."

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Figure 4. 2018 World Environment Day Miniature Stamp MNH by India Post.

implementation of the aforementioned revisions, including the notification of the Extended Producer Responsibility Guidelines with an emphasis on processing waste from plastic packaging through the Plastic Waste Management Amendment Rules, 2022 (CPCB, 2024). Though there are demographic challenges and challenges due to the relevance of plastic in many sustainable development goals (SDGs; de Sousa, 2021), India has initiated and implemented various policy frameworks and national programmes for managing plastic pollution. The latest advancement in this direction is the initiative to formulate a framework for the National Marine Litter Policy (Sambandam et al., 2024).

The depth of the plastic pollution: Contemporary issues

One of the major environmental problems is the leakage of plastic pollutants to water bodies and, ultimately, the oceans. Estimates show that 1.15–2.41 million tonnes of plastic waste from rivers enter the ocean annually (Lebreton et al., 2017; Pattiaratchi et al., 2022). More than 1,000 rivers contribute to the riverine emission of plastic (~ 0.8–2.7 million metric tonnes) into the ocean, which is a whopping 80% of global riverine plastic emissions into the ocean (Meijer et al., 2021).

Recent studies show that the degradation of macro to microplastics in the marine ecosystem can transfer from one trophic level to another, ultimately reaching the apex predators from the base of the food chain (Nelms et al., 2018; Sarker et al., 2022; Zheng et al., 2022). The impacts of plastic pollutants on the marine ecosystem have caught the attention of postal departments of some countries much before the recent surge in plastic pollution-related research. In 2012, Régie Nationale des Postes of Burundi issued a miniature sheet (Figure 5) themed "Mer de Plastique du Pacifique Nord" or Sea of Plastic, North Pacific, and another miniature sheet highlighting the Great Pacific garbage patch (Figure 6). This move is very encouraging, as this is one of the first stamps depicting the perils of plastic pollution. There is substantial information in the French form of the text. The translation of the text (Figure 5) is as follows: "Environmental researchers believe that 90% of garbage in ocean dumps is plastic, which is not biodegradable. The water absorbs the chemical products contained in the petroleum-based plastic materials; most of these products are persistent organic pollutants that will never disappear. Plastic debris is responsible for the death of 1 million marine birds per year. Also, 100,000 marine mammals and turtles, mostly killed by the entanglement of synthetic fishing lines and nets." The translation of text in the second sheet (Figure 6) is as follows: "Oceanic fauna is duped while accumulating the floating particles of floating plastic assuming that they are consuming zooplanktons. While this process, they absorb the chemicals present in the plastic particles. Larger fishes then consume this fauna, along with small fishes. The harmful chemicals

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Figure 5. Burundi 2011 MNH MS, "Mer de Plastique du Pacifique Nord" or Sea of Plastic.

from plastic will also be biomagnified in larger fishes, which will finally reach human populations. The oceanographic research vessel Kaisei is working on the great Pacific garbage. The kaisei project is a scientific and commercial mission that aims to study and clean the great Pacific garbage. The Great Pacific Garbage is one subtropical gyre zone of the north of Pacific, showing one of the five vortex oceanic currents of the world. Floating garbage constitutes 90% of plastic in the world oceans. Regarding statistics, there will be in each square km of ocean around 50,000 particles of floating plastic debris."

Approximately 80–90% of plastic waste in Africa is mismanaged and inadequately disposed of, polluting the oceans and rivers within and around the continent, which is further projected to increase by 2025 (Okeke et al., 2022), but countries like Rwanda are an exception in the region due to their sustainable plastic waste management strategies. According to a recent report (EA, 2024), 60% of the world's mismanaged plastic waste comes from 12 countries (China, India, Russia, Brazil, Mexico, Vietnam, Iran, Indonesia, Egypt, Pakistan, the United States and Turkey). These mismanaged plastics form an essential component of oceanic garbage patches. The central North Pacific Ocean contains a garbage patch, or gyre of marine debris, known variously as the Great Pacific Garbage Patch, the Pacific Trash Vortex and the North Pacific Garbage Patch. This garbage patch is linked to the subtropical gyre system. There are five major gyres: the North and South Pacific Subtropical Gyres, the North and South Atlantic Subtropical Gyres and the Indian Ocean Subtropical Gyre. All these gyre systems harbour garbage patches (Eriksen et al., 2016), and plastic trash is a major component (Stubbins et al., 2021). As a result, a thriving ecosystem of species that exclusively depends on garbage patches is ever-expanding (Haram et al., 2023). This makes the ocean clean-up initiatives of scooping up the floating plastics controversial (Bergmann et al., 2023) and futile until plastic production and consumption are reduced (Kersley, 2024).

The floating and submerged plastics also harm large marine organisms through ingestion and entanglement. This leads to a significant issue faced by marine ecosystems, which is called ghost fishing by ghost gear. The term "ghost gear" refers to the loose, lost

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Figure 6. Burundi 2012 MNH MS, Dangers of plastic waste in the Northern Pacific.

and abandoned fishing gear that makes up 10% of the plastic debris in the world's oceans. Additionally, it is the deadliest type of marine plastic because abandoned hooks, nets and trawlers entangle and kill marine life. Ghost fishing is a form of unreported food waste and ecological harm (Scott, 2023). The abandoned, lost or otherwise discarded fishing gear (ALDFG) impacts biodiversity, affecting marine and freshwater species and contributing to the extinction risks of wildlife (Gunasekaran et al., 2024). The ghost fishing impacts are often a function of time, ranging from days to years (Lively and Good, 2019). There are initiatives to counter ghost fishing impacts, such as the "ghost diving" mission and the Global Ghost Gear Initiative (GGGI), the world's largest cross-sectoral alliance committed to driving solutions to the problem of ALDFG. The Poste Maroc of Morocco issued a set of 4 stamps (Figure 7) in 2020 with the theme "Campaign Against Plastic Pollution," highlighting plastic's impact on marine life. In 2021, the CTT Correios de Portugal of Portugal issued two stamps (Figure 8) on the theme "United Nations Decade of Ocean Sciences for Sustainable Development" where the perils of ghost fishing are depicted. Similarly, the Cook Islands issued a set of four stamps (Figure 9) on the Campaign against Plastic Pollution in Oceans in 2023. The issue highlighted the impacts of plastics on whales, dolphins, crustaceans and turtles.

The Tusass (Greenland) issued two stamps (Figure 10) as a part of the 2019 "The Greenland Environment series" showing the harmful impacts of plastic on fish and shorebirds that ingest floating plastic. A recent global assessment of marine plastic exposure risk for 7,137 oceanic birds found high exposure risk areas in the

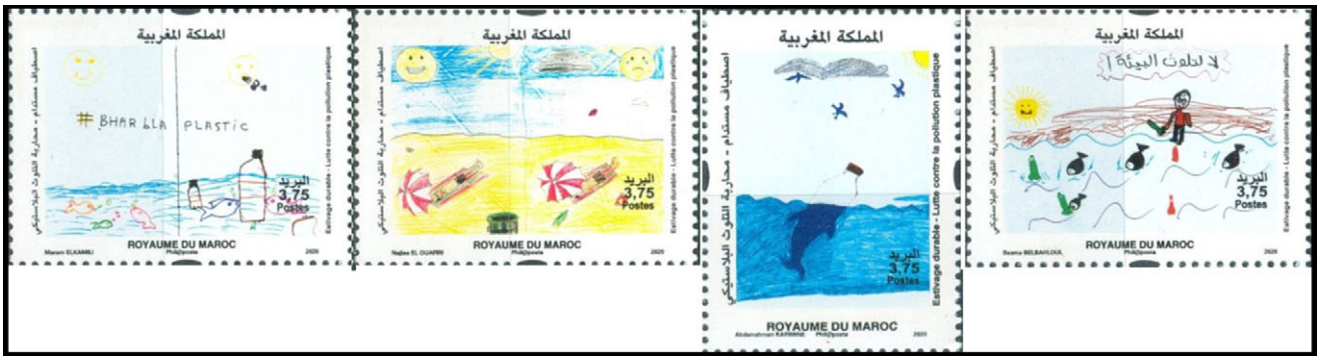

Figure 7. Se-tenant "Campaign Against Plastic Pollution" stamp set issued by the Poste Maroc (Morocco).

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Figure 8. "United Nations Decade of Ocean Sciences for Sustainable Development" stamps issued by the CTT Correios de Portugal.

Mediterranean and Black Seas, the northeast Pacific, northwest Pacific, South Atlantic and southwest Indian oceans, along with an indication of the exposure risk being disproportionately high for threatened species (Clark et al., 2023). Macroplastics can induce damage directly at the exposure site, while microplastics can be mobilised throughout the bodies of seabirds, causing widespread pathological issues (Rivers-Auty et al., 2023).

Microplastics can serve as vehicles for the potential colonisation of pathogens, absorb persistent organic pollutants and are carriers of antibiotic-resistance genes, ultimately posing a threat to marine ecosystems (Chen et al., 2023). Microplastics are also observed widely in various seafood items. The seafood safety studies that are currently available are not conclusive, and there is evidence that orally administered microplastics at high levels for an extended time may pose a risk to consumers (Gündogdu et al., 2023). The Pošta Slovenije of Slovenia issued a definitive stamp on the theme "Microplastics in the Sea" in 2018, which is an acknowledgement to the growing issues posed by microplastics. The atmosphere plays a vital role in microplastic transport, facilitating continuous exchanges with land and ocean (Fu et al., 2023). However, a recent study showed the oceanic emission of microplastics into the atmosphere by bubble bursting (Shaw et al., 2023). Once the plastic particles leave the ocean's surface, the surface winds can transport them into the atmosphere and subsequently carry them across long distances. This is highly relevant, as atmospheric plastics have a definite climate signature (VishnuRadhan et al., 2021) besides the fact that the source materials of most of the plastics are fossil fuel-based raw materials. Plastic pollutants also emit greenhouse gases such as methane and ethylene when undergoing degradation (Royer et al., 2018). The different variants of plastic pollutants are colossal storehouses of carbon, and thus are an unexplored branch of the global carbon cycle (Zhu, 2021). Microplastics are also known to be a major threat to ocean carbon sequestration (Sharma et al., 2023). The Hrvatska pošta of Croatia recently issued a stamp (Figure 11) on the theme "Climate Action, Plastic in the Sea 2023." The changing global climate and increasing plastic pollution will have compounding effects on various earth system processes in the future. There are calls to view plastic pollutants as having their own environmental or biogeochemical cycle to derive sustainable solutions to this global problem in the Anthropocene (Bank and Hansson, 2019; Brahney et al., 2021).

The mitigation strategies: Recent scenarios

Plastic is an anthropogenic innovation that has made a broad spectrum of positive impacts on various scientific, technological,

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Figure 9. Cook Islands – 2023 – stop plastic ocean pollution – set of 4.

Figure 10. The Greenland Environment: Plastic Pollution (2019).

Figure 11. Croatia 2023, themed "Climate Action – Plastic Waste in the Sea."

social and economic fields. The unsustainable production, use and mishandling of plastics have led to an increase in plastic pollution worldwide, which has resulted in the degradation of plastics into micro (nano) plastics that threaten sustainability (Walker and Fequet, 2023). Phasing out plastics is a near-impossible feat and can affect human progress. There are various reasons for plastic waste pile-up, from socio-economic dynamics to technological issues, such as lack of expertise in handling hazardous waste. Other reasons include inadequate infrastructure development for recycling and recovery and, most importantly, a lack of knowledge of the laws and regulations (Kibria et al., 2023). Even though businesses, consumers, policymakers and scientists have begun to address the plastic issue, their efforts are frequently driven by behavioural costs. Behavioural costs are obstacles that require the expenditure of resources such as money, time, effort, distance and availability to be overcome the obstacles. Environmental attitudes and behavioural costs act as mutually compensatory factors of environmental protection (Kaiser et al., 2021). A person weighs the behavioural costs and advantages of values in consumption activities when making a demand choice. Raising behavioural costs, like taxes and prohibitions, can encourage people to take mitigation measures (Simone, 1957; Steg et al., 2014). Increasing behavioural benefits and lowering the behavioural costs of reducing plastic pollution for decision-makers offer a more promising pathway to large-scale societal mitigation actions (Jia et al., 2019).

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Using the current technologies in material sciences to develop alternate materials with lower environmental signatures is a promising approach. Finding locally sourced, biodegradable materials is appealing because it presents a chance to implement a circular economy strategy for packaging and other plastic applications. Additionally, it might increase employment and local economic activity (Hira et al., 2022). The linear economy of plastics leads to excessive carbon dioxide emissions and leakage into the environment, and it requires a reform to a greener circular model (Sheldon and Norton, 2020). The circular plastic economy is gaining momentum due to numerous challenges prompted by the linear economy of plastic, where the goal is to reduce, reuse and recycle all plastic. The transition to the circular economy should be made across the entire plastics value chain, which can ensure circular design, production, use and waste management (Johansen et al., 2022; EMF, 2023). In plastic management, the idea of a closed-loop recycling chain is thought to be the best way to create a sustainable circular economy. Thermochemical technology, which converts plastic wastes into renewable resources, is the essential technical link in the plastic recycling chain (Kwon et al., 2023). The Liechtensteinische Post (The Principality of Liechtenstein) introduced a stamp in 2020 (Figure 12a) made of recycled polyethylene terephthalate (PET) thread through embroidery. Liechtenstein is encouraging the recovery of recyclable materials from waste by issuing a globe-shaped stamp. The polyester yarn thread used for the stamp issues is obtained from 3,100 recycled PET bottles with a volume of 600 ml. The Vatican also issued an embroidery stamp made from recycled plastic bottles in 2022 (Figure 12b). Around 45,000 stamps were produced using 3.9 million meters of polyester yarn obtained through the recycling of 4,000 plastic bottles having 600 ml. This equals 75 m of yarn per stamp and eight stamps produced from each bottle. Recycling plastic waste into usable products is one way to mitigate growing plastic pollutants in the environmental compartments. Recycling plastic waste is a prerequisite to creating a circular economy and devising circular solutions to plastic pollution. Understanding the effects of recycling on the environment and selecting the best recycling options for particular plastic polymers is essential to ensuring a circular economy for plastics (Schwarz et al., 2021). Pos Malaysia issued a postage stamp in 2022 (Figure 13) with the theme of recycling for a circular economy. The miniature sheet included pictures of waste recycling and grading, marine turtles and SDGs. Plastic recycling is a complex process that varies based on the type of plastic involved. Different polymers require distinct recycling methods. This complexity increases the costs associated with plastic waste management, posing significant challenges for underdeveloped and developing countries that often lack the necessary funding and infrastructure to support comprehensive recycling systems. Among some of the largest contributors to plastic pollution, these regions face hurdles such as limited financial resources, inadequate waste collection systems, insufficient policy enforcement and lack of public awareness. Many developing nations rely on informal waste management sectors, leading to inefficiencies and health risks for workers. In addition, a lack of market demand for recycled plastic further discourages investment in sustainable recycling initiatives. Many consumer plastic products contain multi-layered or mixed materials that are difficult to separate and recycle, increasing the complexity. Some solutions and mitigation measures for addressing recycling issues are infrastructure development tailored to the geographical need, regulatory instruments, awareness campaigns, Extended Producer Responsibility (EPR), and international support.

Addressing plastic pollution will enhance humanity's progress towards SDGs. At least 12 United Nations SDGs are directly or indirectly impacted by (micro)plastic pollution (Walker, 2021). Plastic is an essential component for the interventions related to various SDGs. Plastic is paramount in modern society, sustainable development and the success of the 2030 Agenda (de Sousa, 2021). The catch is to find a sustainable balance between plastic usage and waste generation. Many targets of various SDGs directly or indirectly address plastic pollution and its impacts. Though none of the 17 goals are specific to plastic pollution, seven are directly linked (PSF, 2021). These are SDGs 3 (good health and well-being), 6 (clean water and sanitation for all), 11 (sustainable cities and communities), 12 (responsible consumption and production), 13 (climate action), 14 (life below water), and 15 (life on land). In 2016, the United Nations Postal Administration highlighted the 17 SDGs on stamps issued on October 24 (Figure 14) on United Nations Day. The issue showcased the themes of all the SDGs.

Eliminating the accumulated plastic waste in various environmental compartments should be regarded as significant and urgent as reducing the generation of new plastic waste (Li et al., 2021). Mitigation strategies should combine scientific, technological, social and psychological factors. The future of plastic pollutants can be doomed by channelling the accumulated waste towards resource recovery and preventing plastic waste's leakage into various environmental compartments. Moreover, phasing out the plastic polymer types posing the most significant environmental hazards and replacing those with eco-friendly alternatives can ensure the positive culmination of various societal, environmental and economic factors. This can help in reducing the impacts of

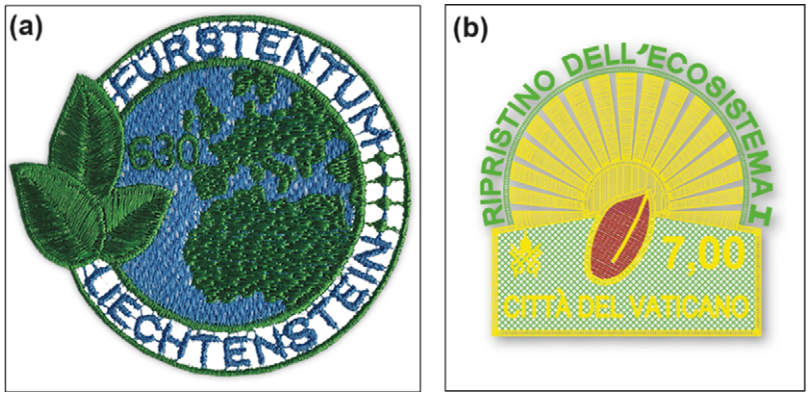

Figure 12. a) 2020 Liechtensteinische Post (The Principality of Liechtenstein) PET recycling stamp, b) 2022 "PET-RECYCLING – embroidery stamp mint, Vatican."

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Figure 13. Malaysia 2022 – recycling circular economy.

Figure 14. The 2016 United Nations Postal Administration (UNPA) stamps on sustainable development goals (SDGs).

plastic pollution on various environmental compartments. In addition to this, cities which are the cradle of plastic pollution issues can be protected in a sustainable way. The United States Post issued 4 stamps (Figure 15) as early as 1970 with these messages in their anti-pollution-themed issue. Protection of the environment can preserve the integrity of earth system boundaries and ensure a sustainable future for all species.

There is an emerging urgency for accelerating research, innovations and actionable solutions for devising mitigation strategies. A significant portion of scientific research on plastic pollution remains

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Figure 15. The 1970 United States anti-pollution set of 4 stamps.

focused on identifying pollutants and their presence across oceans, soil, or the atmosphere. While such identification is essential to understanding the scale and distribution of plastic pollution, there is an equally pressing need to advance research beyond identification. More efforts should be directed towards developing innovative solutions for pollution mitigation, plastic degradation and sustainable alternatives. An essential aspect of the mitigation strategy that requires greater emphasis is the simultaneous and accelerated development of effective recycling systems and plastic replacement alternatives. Tackling plastic pollution effectively demands a parallel, hand-in-hand approach that enhances recycling infrastructure while investing in research and deploying viable alternatives to conventional plastics. Forward-looking approaches that balance identification, recycling improvements and sustainable alternatives can fast-track mitigation strategies, including innovations in biodegradable material development, circular economy models and advanced recycling techniques.

The philately of plastic pollution: What's next?

The Universal Postal Union (UPU) now has 192 member countries, and ~ 10 countries have issued stamps on aspects directly related to plastic pollution. Many economically developed nations did not issue stamps or postal materials on plastic pollution. Larger, more powerful countries may prioritize environmental awareness campaigns along with energy security, economic stability, or national defence. Plastic pollution, along with other significant goals, can be seen as an immediate priority. Many developed countries have ties to fossil fuel and plastic industries, and acknowledging plastic pollution through stamps can be seen as a conflict to those industries. In addition, there can be an assumption that existing waste management and recycling systems are sufficient in developed countries, and the general public may not be aware of the plastic waste export. For example, the top 10 countries exporting plastic waste are high-income, developed nations, seven of which are in Europe, and large exporters such as the USA and Japan (Jackman, 2024; WEF, 2023). Depicting plastic pollution issues through stamps can be a symbolic action that can eventually lead to substantive actions such as corporate responsibility measures, legislative initiatives and technological advancements. The lack of symbolic action by major developed nations can be seen as a missed opportunity to set an example and inspire global efforts toward sustainability. The limited number of countries issuing stamps related to plastic pollution reflects a broader challenge in achieving global consensus in the fight against plastic pollution. This showcases the need for enhanced international cooperation and public engagement in tackling plastic pollution issues.

Philately, as a medium to spread environmental messages, primarily attracts a niche audience and specialists. However, stamps have a unique potential to communicate powerful messages and inspire action on pressing global issues, such as plastic pollution, as stamp subjects are often seen as policy and action support by the respective governments. Comprehensive strategies are required to engage a broader audience and create meaningful awareness through stamps to maximise the impact and outreach of using stamps to sensitise citizens regarding pressing environmental problems. These include educational outreach and curriculum Integration, community engagement and public events, leveraging digital and social media platforms, philately competitions and cross-disciplinary collaboration. Educational institutions should be motivated to incorporate stamp-based storytelling into environmental studies curriculums and use stamps as a visual tool. Organising philatelic exhibitions in collaboration with philatelic societies can foster curiosity and engagement among students and educators. In addition, developing educational kits that integrate stamps with lesson plans can make learning emerging about environmental issues such as plastic pollution more informative and enjoyable. Social media platforms play a major role in disseminating information to a wider public. These platforms can be used to share engaging content about stamps, including their historical context, design process and the message they convey about plastic pollution and other contemporary environmental issues. Formulating interactive digital campaigns

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such as interactive quizzes, virtual philatelic exhibitions and extended reality (XR) experiences can help captivate the attention of younger audiences and non-traditional philatelists. Involving environmental activists and digital content creators can enhance the reach and acceptability of the campaigns. Environmental organisations, local governments and community groups can collaborate to host workshops, exhibitions and awareness drives that showcase how stamps can narrate the story of environmental issues and inspire change. Organising public events and Do it yourself (DIY) workshops such as "write a letter," "post a letter" and "design your stamp" on the plastic pollution topic, conducting thematic collection displays on various facets of environmental pollution, and tagging these events with beach clean-ups and community recycling programmes will give a new dimension to philately-assisted awareness. Transdisciplinary collaborations between writers, artists, philatelists, environmentalists and sustainability researchers can aid in creating multidisciplinary projects that blend philately with literature, visual art, and environmental advocacy, thereby reaching a wider and diverse audience. Developing stamp-themed merchandise, calendars and educational materials can reiterate the messages of sustainable practices and the perils of environmental plastic pollution. Collaborations with postal services to release commemorative stamps and postal cancellations alongside sustainability campaigns can further promote the cause. Local, regional and national competitions to create stamp designs and narratives related to plastic pollution can foster a sense of involvement and creative expression among citizens. In addition, philatelists and environmentalists should work together to develop and contribute to online archives exclusively for emerging environmental themes in philately. Through these multi-faceted strategies, we can extend the reach of the philatelic theme discussed in this paper beyond traditional collectors and transform it into an engaging, educational and action-driven platform for raising awareness and driving efforts toward plastic pollution mitigation. By implementing these multi-faceted strategies, we can extend the reach of the philatelic initiatives beyond traditional collectors and transform it into an engaging, educational and action-driven platform for raising awareness and driving efforts toward plastic pollution mitigation.

Conclusion

Plastic pollution is a global environmental threat, and researchers and policymakers have been racing against time to find mitigation strategies and pragmatic solutions in recent years. Creating awareness is a primary step towards reducing plastic pollution and ensuring sustainable consumption. As most consumer plastic types are accumulating in the environment, phasing out single-use plastics and creating a circular plastic economy can help the case of mitigation and long-term sustainability. This article is structured into an analytical piece on how plastic pollution is depicted on stamps, and this can help disseminate the perils of plastic pollution among non-specialists, for example, students, school teachers, business owners and the general public. Though we have covered all the stamps explicitly addressing plastic pollution to date, the number of countries issued on this theme is minimal. We expect more countries to initiate thematic issues related to environmental and ecosystem problems created by plastic pollutants. This will help spread the message of judicious and sustainable usage of plastic products in the coming years.

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