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Barriers to successful implementation of plastics management policies in Africa: A case study of South Africa's plastic pollution management challenges

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Data availability

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Conflict of interest

The authors declare no conflict of interest

Abstract

Plastic pollution is a critical environmental threat with far-reaching impacts on ecosystems, biodiversity, and human health, and has recently been recognized as part of the broader planetary crisis. While global efforts have advanced policies addressing plastics across their lifecycle, South Africa has made notable progress in domestic policy development, particularly through its ratification of international conventions targeting marine and transboundary plastic pollution. Despite this progress, significant challenges persist in translating policy into action. Domestically, although regulatory mechanisms exist—including those targeting single-use plastics and extended producer responsibility (EPR) schemes—implementation gaps remain. A key barrier is the lack of widespread environmental education and public awareness campaigns, which limits citizen engagement and behavioural change. Additionally, fragmented municipal waste systems and the exclusion of informal waste pickers from formal waste governance structures further exacerbate the issue. These systemic challenges result in persistent plastic accumulation in natural environments and the continued degradation of vulnerable ecosystems. The current paper recommends that any policy enforcement or green initiative be supported by coordinated national environmental awareness campaigns. Furthermore, informal waste pickers—who contribute significantly to plastic recovery—must be formally integrated into EPR schemes, as outlined in existing regulatory provisions. While policies targeting plastic bags are in place, enforcement is limited, and single-use plastics continue to pose significant challenges. To strengthen plastic waste governance, South Africa should consider a phased ban on problematic single-use plastics, coupled with the promotion of affordable, sustainable alternatives. Compared to other developing countries, South Africa has made commendable policy advances; however, a greater investment in citizen-focused implementation strategies is required. Without such action, well-crafted policies risk remaining ineffectual and failing to produce meaningful environmental outcomes.

Keywords: Plastic pollution in Africa, South African National Environmental Management Waste Act, Plastic Bags Levy, South African Environmental Conservation Act, Extended Producer Responsibility.

Introduction

The current load of plastics and their impact on the integrity of different water resources is at the attention of the global community. By estimate, about 4 – 4.75 million tons of plastics are being produced annually, culminating in over 9 billion tons of plastics produced since the 1950s (Chen et al., 2021; Matthews et al., 2021). While the plastic production has increased significantly, especially the single-use

plastics (SUPs), appropriate management of the plastic waste has not grown in parallel. Only 9 – 11% of plastics are currently being recycled; mainly due to the high cost of recycling when compared to the primary production, and the difficulty of recycling certain plastic types (Suzuki et al., 2024). The rest of the plastics that are not being recycled, or at least incinerated, have found their way into the environment, with the aquatic environment bearing the biggest load; at least five trillion plastic pieces are floating in global waters (Eriksen et al., 2014). The plastics in the environment tend to break down over time and release particulate (microplastics, nanoplastics) and dissolved (plastic chemicals) pollutants (Adeniran et al., 2022; Aguirre-Martínez et al., 2023). In the last 20 years, microplastics research has moved from merely understanding their environmental exposure to measuring their uptake in different organisms, including human beings, and their effects. Much of this research has shown that plastics not only compromise the integrity of the environment, but human health is also at risk (Nguyen et al., 2023). Accordingly, management practices of plastics production and plastic waste treatment have to be strengthened to ensure the steady reduction of the current load of plastics (and plastics pollutants) in the environment.

South Africa is one of the top three contributors to plastic pollution in the African environment, together with Nigeria and Egypt (Sadan & de Kock, 2021). The 2010 classification of mismanaged waste also put South Africa in the top 20 (No. 11) countries with the highest proportion of mismanaged waste (Jambeck et al., 2015). Unsurprisingly, a later study focused on the plastic marine inputs found South Africa's impact to be significant. The study investigated the total plastic waste marine input from Tanzania, Kenya, Mozambique, and South Africa (Pucino et al., 2020). Of the 162,000 tonnes of plastics leaked into the marine environment, 79,000 tonnes were from South Africa, with Kenya, Tanzania, and Mozambique accounting for 37,000, 29 000, and 17,000 tonnes, respectively (Pucino et al., 2020). This is evidence of the mismanaged plastic waste in South Africa; the proportion of mismanaged waste, as estimated in 2015, was at 56% (Jambeck et al., 2015). In recent years, these numbers have not changed much. South Africa currently generates 2,389 tonnes of plastic waste; 2,371 of this is generated domestically, while 18 tonnes are from imports (IUCN-EA-QUANTIS, 2021). Of all generated plastic waste, 70% is collected; of this 14% is recycled, 28% is disposed of in sanitary landfills or incineration facilities, and 28% disposed of in unsanitary landfills or dumpsites (IUCN-EA-QUANTIS, 2021). However, by estimation, at least 58% of all of this plastic waste is mismanaged (IUCN-EA-QUANTIS, 2021). This means at least 1672 tonnes of generated plastic waste end up in the environment and leak into the (mainly) aquatic ecosystems. In managing this waste, South Africa mainly uses landfilling, a prevalent practice especially in townships. For context, townships in South Africa are underdeveloped metropolitan areas that were often constructed on the

outsskirts of towns and cities by the apartheid spatial planning system (Adeniran & Shakantu, 2022). To date, these areas remain underdeveloped and waste collection is non-existent or intermittent, despite being home to a large population of South African citizens. Due to the lack of waste collection in these areas, it can be assumed that the waste quantities generated fall outside of the official waste quantification as discussed above. Consequently, most of South Africa's environment is loaded with plastic waste. By estimate, it is at least 90% of the solid waste, including plastics, that is landfilled (Adeniran & Shakantu, 2022; Rasmeni & Madyira, 2019). The major challenge currently is the growth of the townships, lack of service delivery in these areas, and subsequent shortage of sites for formal landfill sites (Rasmeni & Madyira, 2019). This has resulted in the crisis of plastic waste being disposed of in the open environment. While this plastic pollution crisis quantification is still sparse, at least 46 studies reporting microplastics in the marine and freshwater environment in South Africa were completed by 2023 (Dahms & Greenfield, 2024). A majority of these studies, despite methodological challenges as highlighted by Dahms & Greenfield (2024), reported secondary microplastics, indicating the significant contribution of plastic waste to the contamination of the aquatic environment. Strengthening of the inclusive plastics management strategies is thus required to avert the current crisis and preserve environmental integrity.

One of the globally proposed strategies to mitigate the risks of plastics to the environment and human health is the regulation of the plastics production, usage, and waste. The gradual implementation of policies at specific and/or different stages of the plastics value chain has the potential to curb the current load of plastic pollutants in the environment. Although the general plastics waste regulations date as far back as 1993 with the introduction of a plastics tax in Denmark (Abate & Elofsson, 2024), it was not until 2015 that the Microbeads-free Waters Act (USA) was introduced to target microbeads in cosmetic products specifically (Alam & Rahman, 2025). This act influenced and informed similar acts later introduced in Canada (Microbeads in Toiletries Regulations, 2017) (Akhbarizadeh et al., 2024), the United Kingdom (The Environmental Protection (Microbeads) Regulations 2017) (Atem et al., 2024), and Ireland (Microbeads (Prohibition) Act 2019) (Watkins et al., 2019). These regulations moved from just targeting the production and sale of microbead-containing cosmetic products to include interstate sale and imports of such products. Additionally, other products, such as cleaning products, have also been targeted, as in the case of New Zealand (Waste Minimisation (Microbeads) Regulations 2017) (Watkins et al., 2019). The 2023 policy by the European Commission (EU 2023/2055 Restriction of microplastics intentionally added to products), through ECHA, is the most comprehensive policy yet, targeting the elimination of the use across the commercial market (European Union, 2023). Beyond just microbeads, policies need to address the challenge of plastic pollutants across the value chain, from production to waste. Australia's National

Plastics Plan (2021) is the most comprehensive strategy yet, focusing on eliminating plastic waste and microplastics throughout the plastics life cycle. These policies and other relevant policies are summarized in Xanthos & Walker (2017).

The African plastic pollutants research, like in many other developing countries, is still in its infancy. The major shift in the policy space, however, came in 2001 with the introduction of a plastic bag ban in Bangladesh (Nadiruzzaman et al., 2022), introduction of plastic bags levies in South Africa (2004) (Dikgang et al., 2012a), and the total ban of plastic bags in Rwanda (2008) (Behuria, 2021). At present, at least 35 African countries have laws controlling the consumption and production of plastic bags (Deme et al., 2022; Nyathi & Togo, 2020). However, environmental research on the continent, specifically around the environmental and health risks emanating from poor plastic waste management practices, is lagging behind (Akindele & Alimba, 2021). Infrastructure investment is also required to foster collaboration and plastic pollution research and development (Nel et al., 2021). Notwithstanding, there has been a steady increase in the plastics research, especially to quantify the environmental exposure and health risks of plastics pollutants (Nel et al., 2021; Oceng et al., 2023). In South Africa, where most of the data on micro-/plastics exposure in the continent is concentrated (Akindele & Alimba, 2021), there has been an increase in studies aimed at quantifying plastic pollutants in the aquatic environment and their potential risks to the environment and to human health.

While the research on plastic pollution and its environmental impact is gaining momentum in South Africa, the policy development lags behind quite significantly. Owing to the challenges with data availability, lack of infrastructure investment, lack of capacity in plastics research, and lack of coordinated development effort to prioritize plastic pollution as part of the national agenda, the policies have since experienced stagnancy (Khangale et al., 2020; Oelofse et al., 2024; Van Rensburg et al., 2020). Herein, the progress in policy development to deal with plastics, from production to waste, is reviewed. The review presents the progress of the i) National plastics levy regulations (2003), ii) National Environmental Management: Waste Act (2008), iii) Plastics Pact South Africa, v) the adoption of the international conventions on plastics, vi) Informal sector integration, and vii) Status of plastic waste recycling.

Approach

The current paper focuses on the management of plastics and plastic waste in South Africa. To achieve a comprehensive understanding of the measures put in place by South Africa to avert the environmental risks of plastic pollution, specific regulatory frameworks are reviewed herein, with their

progress assessed. The South African participation in international agreements and/or initiatives related to plastics pollution reduction is detailed. These include the Basel Convention, London Protocol, MARPOL Convention, Nairobi Convention, Abidjan Convention, UNCLOS, UN Watercourses Convention, and the Stockholm Convention. Although the Plastics Pact is a voluntary multi-stakeholder initiative, it is relevant to the achievement of the objectives of the London Protocol, specifically in the reduction of plastic volumes that enter the environment (source reduction). As such, the Plastics Pact South Africa's impact is evaluated herein. For the purpose of this review, the specific domestic regulations reviewed are limited to 1. Plastics bag levy (Environmental Conservation Act, 2003 Amendment), 2. National Environmental Management: Waste Act 2008. Additionally, For scientific literature, Google Scholar, Web of Science, and ScienceDirect were employed with search terms such as "Plastics load in the environment", "Plastic pollution in Africa", "Microplastics pollution data", "Plastics management policies", "Microplastics policies", "Microplastics in cosmetics regulations", "Microplastics research Africa", "Plastics pollution South Africa", "Plastic bags levy South Africa", "NEMA South Africa", "Basel Convention South Africa", and "Consumer education plastics management". For grey literature, South African government websites, through Google search, were used to source different reports, regulations, and standards. The Plastics Pact, Plastics Pact SA, Basel Convention, and United Nations reports and documents were sourced directly from official websites. Any other grey literature was sourced using Google search, from confirmed and official websites. All documents reviewed herein were reported in English.

Study limitations

This study uses only the official documents from the South African government, peer-reviewed literature, confirmed text for the international conventions, and the Plastics Pact. Outside of these sources, no other sources were explored, particularly grey literature especially where the source could not be confirmed. Furthermore, standards and/policy documents that could not be accessed were excluded. This may leave out the other details/perceptions relevant to understanding the impact of the reviewed regulations and their impact. The UNEA INC-5 text draft was deliberately excluded from this paper because, despite the text representing the possibility of a binding international instrument, the negotiations were ongoing at the time of writing this paper, and thus the subject of the available Chair's Text was not final.

International initiatives

International conventions and agreements

South Africa, as an emerging economy, plays a major role in the international arena. In 1994, South Africa became a party to the Basel Convention, which regulates the transboundary movement of hazardous waste (The Basel Convention, 1989). The full ratification of the Ban Amendment to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes was signed in 2016 (United Nations, 2016). Among other waste, the convention regulates the transboundary movement of plastic waste; focusing on plastic in its entirety, or specific components of plastics, such as plastic chemicals, or other associated harmful substances (Gailhofer, 2023). The recent report from the Basel Convention forum on plastic chemicals, held in Chile, indicates that plastics contain thousands of chemicals that pose a significant threat to the environment (Correa, 2024). Accordingly, there is an urgent need to develop an internationally binding agreement to regulate plastics throughout their entire lifecycle to protect the environment and human health (Correa, 2024). Meanwhile, South African waste exports seem to be mainly in the areas of metals and e-waste; the data show South Africa is the biggest hub for hazardous waste imports in Africa, with at least 31 658 tons imported and 29 883 tons of hazardous materials exported to South Korea, Japan, France, and Belgium in 2017 (Yang, 2020). About 50% of the imported materials were for disposal while the exports were mainly metallic waste for recovery (Yang, 2020). The hazardous waste and its classification are defined under the South African National Standards (SANS) for identification and classification of dangerous good for transport (SANS 10228: 2010) housed by the South African Bureau of Standards (SABS) (SABS, 2010). These are regulated under the NEM: WA, and the transboundary trade is facilitated under the Basel Convention (DEA, 2011). Accordingly, the hazardous waste is disposed of using landfilling; there are currently three high to extreme risk landfill sites in South Africa, i.e., Holfontein in Springs, Vissershok in Cape Town, and Aloes in Port Elizabeth, and at least 28 permitted low to moderate risk landfill sites for all hazardous waste (Brice et al., 2006). Other hazardous waste is incinerated under strict regulations (Brice et al., 2006). Other waste imports are mainly metal-containing e-waste that is used to feed the manufacturing sector (Yang, 2020). The imports of plastic waste have so far not been reported in literature, thus the progress of the convention in regulating plastic waste trade cannot be assessed.

In addition to the Basel Convention, South Africa is party to the London Protocol, MARPOL, Nairobi Convention, Abidjan Convention, UNCLOS, UN Watercourses Convention, and the Stockholm Convention. The London Convention (Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter) was promulgated in 1972 to prohibit the deliberate disposal of waste and other matter in the marine environment, and to promote the effective control of all sources of pollution of the marine environment (International Atomic Energy Agency, 1974). The Convention was amended in 1996 to the

London Protocol, coming into effect in 2006, to make provisions for carbon dioxide (CO₂) removal sourcing, storage, and transport (Carbon Gap, 2025). Specifically, the Protocol sought to provide “...*the international legal basis for sub-seabed geological storage of CO₂ and for transboundary CO₂ transport in international marine environments*” (Carbon Gap, 2025). The Protocol does not specifically refer to plastics or plastic waste. However, it targets all sources of marine pollution, particularly solid waste, which includes plastic waste. Closely related to the Protocol is the MARPOL (International Convention for the Prevention of Pollution from Ships, 1973/78), introduced in 1973 (MARPOL, 1973). The MARPOL convention regulates marine pollution from ships through different regulations addressing different substances that may leak from ships, from hazardous substances to waste. Initially, the convention targeted garbage in totality (Annex V, MARPOL 1973) (MARPOL, 1973). However, the latest amendment to Annex V of the convention explicitly prohibits the discharge of plastics, plastic materials, and plastic packaging (International Maritime Organization, 2017). In 1982, the Law of the Sea was promulgated; the United Nations Convention on the Law of the Sea (UNCLOS) establishes a legal framework for ocean governance, covering boundaries, navigation, resources, research, environmental protection, and dispute resolution (United Nations, 1982). The UNCLOS also addresses marine protection through specific provisions, i.e. protection and preservation of the marine environment (Article 192), prevention, reduction, and control of pollution of the marine environment (Article 194), and prohibition of pollution from land-based sources, seabed activities, anthropogenic activities in coastal areas, dumping, vessels, and atmospheric sources (Articles 207 – 212) (United Nations, 1982). Although these regulations do not mention plastics specifically, plastics are covered under the general provisions due to their ubiquitous nature. Regionally, the Abidjan (The Convention for Cooperation in the Protection, Management and Development of the Marine and Coastal Environment of the Atlantic Coast of the West and Central Africa Region) and Nairobi (Nairobi Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Western Indian Ocean Region) Conventions provide the legal framework for the protection of the Atlantic and West Indian Oceans, respectively (Nairobi Convention, 1985; UNEP, 2017). These conventions were specifically set in place to protect the marine environment, and thus signed into by the coastal countries. Both conventions only imply plastics in their text through the prohibition of dumping, seabed activities, atmospheric, and land-based sources of pollution (Nairobi Convention, 1985; UNEP, 2017). However, the current (2025 – 2028) workplan of the Nairobi Convention focuses heavily on plastics and microplastics (Objective 42 (e)) (UNEP, 2024), albeit plastics are still not being included in the main text. Beyond the marine environment, The UN Watercourses Convention (1997) regulates the equitable and sustainable use and protection of international and shared freshwater

watercourses (Rieu-Clarke et al., 2012). Although plastic is not mentioned explicitly, the provision to tackle plastic pollution in transboundary states is made through a broad provision on pollution prevention, water resources prevention, and sustainable development (Rieu-Clarke et al., 2012). This convention is further enhanced by the Protocol on Shared Watercourses in the Southern African Development Community of 2000, wherein South Africa is a signatory. Although this protocol does not refer to plastics specifically, it requires member states of the transboundary freshwater systems to protect the aquatic ecosystems and prevent pollution (SADC, 2000). Specifically, Article 4 (Section 2, a and b) requires the transboundary member states to protect and preserve the shared water courses, and prevent, reduce, and control pollution and environmental degradation that may cause significant harm to the environment and human health (SADC, 2000).

The Stockholm Convention on persistent organic pollutants (POPS) (adopted 22 May 2001) deviates from the conventions discussed above by focusing on the persistent organic pollutants rather than general waste. The Stockholm Convention seeks to protect the environment and human health against the harmful effects of POPs (Idowu et al., 2013). While the Stockholm Convention may not target plastics directly, it makes provisions for the control of plastics-related chemicals, including POPs. These include decabromodiphenyl ether (DBE) used as a plastic additive and PFOA-related compounds such as fluoroelastomers used in plastic accessories for car interiors (Annex A, Part 1) (Idowu et al., 2013). The target on plastic chemicals is relevant due to the increasing evidence of their persistence and risks. South Africa is a party to all the conventions listed above, with the majority in effect.

Other international, non-binding initiatives

South Africa, through the private sector network, participates in the global movement convened by the MacArthur Foundation focused on the implementation of circular economy solutions for plastics (Ellen MacArthur Foundation, 2021). Among others, the objectives of the plastics pact are to reduce the use of SUPs, eliminate unnecessary and problematic plastic packaging, and increase the recycled content in plastic packaging (Ellen MacArthur Foundation, 2021). The plastics pact South Africa has specifically set three targets, taking action against unnecessary and problematic plastic packaging, ensuring that 100% of plastic packaging is reusable, recyclable, or compostable, ensuring that a minimum of 70% of plastic packaging are recycled, and achieving a minimum of 30% recycled content across all plastic packaging (The SA Plastics Pact, 2025). According to their latest annual report, the Plastic Pact SA has made progress in achieving some of its targets. These include a 91% reduction of plastic straw use, 78% reduction in the use of plastic cutlery, 81% recyclability of all plastics used, and 18% recycled materials against the target

of 30% for all plastics packaging (SA Plastics Pact, 2024). In general, the plastics pact initiative is progressive in encouraging and supporting local businesses to transition to the circular economy of plastics, thereby reducing their environmental impact. However, it should be noted that the plastics pact only represents a selected group of businesses and institutions. This initiative focuses on private sector institutions to achieve their targets and does not represent the government or the government's policy efforts. Furthermore, the plastics pact focuses on the mid to downstream part of the plastics life cycle, leaving major gaps in plastics management efforts. While their progress since establishment in 2020 is commendable, the majority of the challenges still require policy and regulatory intervention for inclusive progress.

Legally binding regulations

Plastic bags levy

South Africa's plastic taxes and levy was introduced in 2003, Section 24 (d) of the Environmental Conservation Act (Act No. 73 of 1989), with the environmental levy introduced as part of the Customs and Excise Act of 1964 (Revenue Laws Amendment Act 45 of 2003). These legislations were put in place to reduce the consumption and subsequent waste generation from the use of plastic bags. In summary, the regulations placed levies on plastic bags to discourage excessive use, and encouraged the introduction of thicker (30 – 80 μm) reusable plastic bags to replace the thinner (17 μm) single-use bags (Dikgang et al., 2012a). The regulation provided a latitude for the reduction of 6 μm , which reduced the minimum gauge to 24 μm over five years (Dikgang et al., 2012a). Additionally, a levy of ZAR 0.46 was placed on each plastic bag; the price was subsequently reduced to ZAR 0.32, with the retailers paying ZAR 0.15 and charging the consumers ZAR 0.17 for plastic bags (O'Brien & Thondhlana, 2019). As per the regulation, part of the levy was to be dedicated to environmental initiatives (O'Brien & Thondhlana, 2019). By 2009, data showed that only 13% of the levy had actually reached such initiatives (Dikgang et al., 2012a). These regulations were updated in 2021, specifically to introduce annual increases on the plastics bag levy to ZAR 0.25 per bag, and for all carrier and flat bags to contain at least 50% recycled content by the beginning of 2023, 75% recycled material by 1 January 2025, with 100% targeted by 01 January 2027 (DFFE, 2021). The regulations further prohibited the production, sale, and importation of plastic carrier and flat bags that do not comply with the National Regulator for Compulsory Specifications Act (Act 5 of 2008) (DFFE, 2021). Section 13 (1) (a) of the National Regulator for Compulsory Specifications Act (Act 5 of 2008), amended in 2013, specifies the materials, film thickness, bag strength, production testing, and labelling ("NRCS Approval XXXXX") (DTI, 2013). The levy was increased further, by ZAR 0.28 to the current price of ZAR 0.32

in April 2024 (Subban et al., 2024). Currently, all of the collected levies are not ring-fenced for any specific programs and thus go into the general fiscus (South African Government, 2017).

The move from free plastic bags to paying for plastic bags was well-intentioned to alleviate the challenge of improperly managed waste, and it worked, albeit for a little while. The target of the regulations was a 50% reduction in waste generation and plastic bag use by 2012 (Dikgang et al., 2012a). According to reports, the consumption reduction reached 76 – 80% for the first three months, but rose to 30% - 80% of the initial production capacity after the price per bag was lowered, and continued to rise ever since (Dikgang et al., 2012b; Muposhi et al., 2021; O'Brien & Thondhlana, 2019). Additionally, the regulations governing the thickness of plastic bags did not have an impact on consumption and demand (Adeyanju et al., 2021). Thus, plastic bags still form a major part of the mismanaged waste burdening the environment; to date, the plastic bag waste is highly visible due to unchecked littering and non-recycling (O'Brien & Thondhlana, 2019). Experts argue several reasons why the taxing/levying of plastic bags did not work as well as in other countries where this was implemented. One of the major reasons is the top-down approach, which ignores the pre-emptive advocacy campaigns to raise consumer awareness (Dikgang et al., 2012b). The second challenge was that the regulations did not provide for or discuss any alternatives to plastic bags (Adeyanju et al., 2021). Therefore, as the consumers got used to paying for the bags, it did not make a difference in their overall budget. That is, the low price of plastic bags increased the consumption because consumers became accustomed to paying, consequently absorbing the charge, which is significantly lower than their grocery budget into their grocery budget (Dikgang et al., 2012a).

Although no data exist on the actual impact of the plastic bag levy and its effects on the littering challenge (Dikgang et al., 2012a), it can be assumed that this initiative has not been able to address the issues of plastic pollution in the environment. The 2021 amendment to fast-track the recycling of plastics does not seem to have had a measurable impact yet. Hence, major retailers have taken the initiative to promote the less use of plastic bags and green environmental initiatives. Retailers like Pick n Pay, Woolworths Holdings Limited, and Shoprite Holdings Limited have generally been proactive in this regard; however, the recent study by Muposhi & Shamhuyenzva (2021) shows that such initiatives are perceived negatively by consumers. According to this study, 90% of the respondents view such initiatives as a form of “green capitalism” (tendency by corporations of seeking to maximize profits using environmental sustainability propositions) (Muposhi & Shamhuyenzva, 2021).

A rather concerted effort is thus necessary, which is centered around consumer education and public awareness initiatives. In fact, a consumer-based study at the retailer level showed that there is a

general lack of understanding of the problem of plastics pollution in South Africa, hence the ineffectiveness of monetary interventions as an environmental protection measure (Abiola et al., 2023); thus, rigorous behavioral interventions are recommended (Abiola et al., 2023). Furthermore, there is a need for the introduction of alternatives to plastic bags, which should be as affordable as plastic bags, and can be reused several times to offset the environmental impact (O'Brien & Thondhlana, 2019).

The introduction of the outright banning of plastic bags in South Africa might be the actual solution to dealing with the current challenge of plastic bag pollution. However, this might not be as straightforward for South Africa as the previous regulations seem to have failed. At the center of these failures, however, is the lack of consideration of consumer education and environmental awareness campaigns. Without these, even the ban might fail. In fact, the life cycle assessment conducted in 2009 shows that the resistance to the outright ban of plastic bags may grow which makes the decisions on plastic bags 'politically correct' but irrational (O'Brien & Thondhlana, 2019); this means that the taxation of the plastic bags supports revenue generation for the government but does nothing to address the environmental pollution challenges (Desalegn & Tangl, 2022). To ensure the successful implementation of the current policies and the consideration of the outright ban of plastic bags, consumer education and environmental awareness initiatives are mandatory. The inaction is not an option as South Africa continues to have one of the most polluted environments; in 2015, South Africa was ranked 11th out of 20 countries with the highest input of plastic waste into the ocean (Jambeck et al., 2015). Given the current deteriorating infrastructure and poor service delivery, with 34.1% of the population not receiving any waste collection services (Mazhandu et al., 2021a), the situation might be worse. While the government is promoting recycling as the best practice to deal with current environmental challenges, data shows that only 10 – 16% of plastic waste is being recycled, with an estimated 84 – 90% being landfilled (Hector & Lambrechts, 2024; Mazhandu et al., 2021a). This thus requires the revision of the plastic bag and other environmental management policies to adopt a citizen-centered approach, with consumer education prioritized. This can be achieved through the use of media for maximum reach and the development of environmental education in community-based programmes through civil society.

National Environmental Management Act (NEMA)

The NEMA (Act 107 of 1998) was amended in 2008 with the introduction of the NEM: Waste Act (NEM: WA) (Act 59 of 2008) to reform waste management, promote sustainable waste practices, and protect human health and the environment in South Africa (DFFE, 2009). Specifically, for plastic waste, the regulations extend the producer responsibility (extended producer responsibility – EPR) to the entire

lifecycle of their products, while also encouraging the implementation of waste management plans to improve plastic recycling and reduce plastic pollution. Furthermore, the act sets targets for plastic packaging recycling and material recovery (Godfrey & Oelofse, 2017). Most importantly, these regulations introduce a framework for a possible ban on single-use plastics (DFFE, 2009). In 2021, the EPR regulations were introduced to further elucidate the producers' responsibility in managing plastic across their value chain. In line with the NEM: Waste Act, these regulations sought to mandate all producers (manufacturers, importers, brand owners, and retailers of regulated products) to join producer responsibility organizations (PRO) or to implement an EPR scheme to manage waste collection, recycling, and disposal (DEFF, 2021). Furthermore, these regulations provided a framework for the RRR strategy to reduce the plastic waste discharge into the environment (DEFF, 2021); these tools would thus assist in alleviating the current pollution burden. To further reduce plastic waste discharge, the South African National Standards (SANS) 695 (Compulsory Specification for Plastic Carrier Bags to improve recyclability of plastic bags) was enacted in 2013. In line with the NEM: Waste Act, these regulations require producers to incorporate at least 40 – 50% of recycled materials in all new plastics (Laws Africa, 2013). This is intended to ensure that all plastic waste is brought back into circulation, thus reducing the uncontrolled plastic waste release. All these tools are contributing to the National Waste Management Strategy, enacted in 2020, which sought to provide policy and regulatory interventions for the waste sector. The objectives of this strategy are to promote the circular economy by diverting 40% of the waste from landfill within five years (from 2020), 55% and 70% within 10 and 15 years, respectively (Olatayo et al., 2024). This would lead to the achievement of zero waste going to landfill by 2035. The list of regulations, as set out by the South African government over the years, is summarized in Table S1. The historical implementation of these and other regulations is summarized in Godfrey & Oelofse (2017).

South Africa seemingly has a comprehensive list of regulations to manage plastics, from production to waste. The total coverage of the entire plastics value chain assists in ensuring that all stakeholders play a role in ensuring zero pollution in the environment, thus safeguarding the health of the environment and the people. However, several challenges persist in the successful implementation of these regulations. Among the identified challenges, issues such as inconsistencies in the implementation of policies, systemic corruption, political interference, which often leads to futility and stagnancy of passed laws, poor environmental values and education, and generally poor waste management at the hands of municipalities stand out (Iroegbu et al., 2020). Central to these challenges is the use of landfilling for waste management. South Africa depends heavily on landfilling as the major waste management strategy; as soon as consumer products such as plastic bags, electronics, and textiles reach their end of

life, they are discarded in landfills (Adeniran et al., 2022; Godfrey & Oelofse, 2017). In 2017, about 90% of the estimated 55 million tons of generated waste was landfilled (Olatayo et al., 2024). The major challenge with landfills, currently, is that there is not enough space to continue the practice indefinitely. Hence, the National Waste Management Strategy, which gives the responsibility for managing the landfills to local municipalities per the Municipal Systems Act (Act 32 of 2000), specifically targets the implementation of the RRR as an integrated management solution (C. J. Schenck et al., 2019). Unfortunately, recycling of plastic, as with the rest of the world, has not been as successful; only 10 – 16% of the waste in South Africa has been successfully diverted from landfills to recycling so far (Godfrey & Oelofse, 2017; Hector & Lambrechts, 2024).

Challenges and loopholes in current management policies and practices

Despite the comprehensive regulations discussed above, South Africa fails dismally in the implementation phase and in meeting the set targets. Plastic pollution remains one of the biggest challenges, now threatening water security, human health, and biodiversity. Plastic pollutants such as microplastics are increasingly being found in wastewater and drinking water (Iroegbu et al., 2020), a major concern for the health of the ecosystems and the citizens. The global north seems to be progressing in setting the pace for the regulation of microplastics; microplastics use in cosmetics has been a cause for concern in the last decade. As such, several countries have enacted several policy instruments to this effect, as highlighted earlier. However, South Africa is trailing behind on this end. No regulations have been proposed so far to address microplastics pollution, at any stage of the MPs lifecycle. Although South Africa does not have a specific policy, it has set a target for MPs under the Abidjan Convention. In the *Ad Hoc* Open-ended Expert Group meeting report from 2018 in Nairobi, South Africa promised to strengthen the target on the elimination of MPs in cosmetics by phasing out MPs from cosmetic products (IISD Reporting Services, 2018). This would be achieved through industry engagement and the strengthening of public awareness to this effect (IISD Reporting Services, 2018). Despite this declaration, however, not much information is available on the actual progress of the phasing out of microbeads from cosmetic products in South Africa, nor are the awareness campaigns really noticeable in the media (as declared in the noted meeting) or elsewhere. However, this declaration shows that South Africa is aware of the scourge of MPs and potential sources that need to be addressed.

Although there is a lack of regulation instruments for MPs specifically, South Africa is not short of regulations required to deal with plastic pollution in the environment. However, plastic pollution challenges persist, and plastic waste is currently one of the biggest contributors to environmental

degradation. These challenges are a result of various barriers to successful implementation that seemingly evade the very comprehensive legal frameworks. One of these challenges is the implementation of the EPR schemes for inclusive development and successful circular economy initiatives.

The 2021 Extended Producer Responsibility (EPR) regulations under the National Environmental Management: Waste Act (2008) are a significant regulatory step, but challenges remain in enforcement, oversight, and equitable inclusion of informal recyclers. While EPR regulations place the onus on producers to manage plastic waste, the implementation landscape reveals that there is limited enforcement and compliance auditing, fragmented and underregulated Producer Responsibility Organisations (PROs), and the exclusion of informal waste pickers from legal, financial, and logistical frameworks. The EPR regulations mandate that producers are financially and operationally responsible for the end-of-life management of their products. However, weak regulatory oversight and the absence of a robust enforcement mechanism have limited the effectiveness of this policy instrument. There is currently no national database of obligated producers, and compliance audits are inconsistently performed due to limited institutional capacity. On the other hand, PROs operate independently and often with limited transparency (Gupt & Sahay, 2015). Their activities, including how funds are allocated, which partners are contracted, and how performance is measured, are not uniformly reported. This lack of central oversight and standardisation results in inefficiencies and reduces the accountability of the system (Gupt & Sahay, 2015).

Informal waste pickers, estimated at 60,000 to 215,000 across South Africa (Mazhandu et al., 2021b), recover substantial quantities of recyclable plastic. The 2021 EPR regulations, as part of the NEM: WA (2008) amendment, make a provision for the waste pickers to be integrated into the EPR regulatory framework. Specifically, the regulations require that these schemes “*integrate informal waste collectors, reclaimers and pickers into the post-consumer collection value chain*” (Section 5A (m)), and “*compensate waste collectors, reclaimers or pickers, who register with the National Registration Database, for collection services and environmental benefits, through the collection service fee by November 2022*” (Section 5A (p)). However, waste pickers still lack legal recognition and are not explicitly included in EPR regulatory frameworks. This structural exclusion is a critical legislative gap, as informal recyclers are not entitled to any of the EPR-generated financial or infrastructural support (R. Schenck & Blaauw, 2011). Without a formal role, waste pickers operate in precarious conditions, without social protections, occupational health standards, or municipal service contracts (Makhubele et al., 2019; Yu et al., 2020). Although some municipalities have initiated pilot programmes or cooperatives to engage informal waste pickers, these

efforts remain fragmented and under-resourced. Consequently, even though EPR fees collected from producers are predominantly used to support formal recycling infrastructure and downstream value chains, there is limited to no channeling of these funds towards the support and empowerment of informal waste collectors who operate at the initial point of collection (R. Schenck & Blaauw, 2011). This inequitable allocation further marginalises the informal sector and undermines the principles of just transition and inclusive circular economy development.

Other general challenges include the low recycling rate in South Africa, which is so far unsustainable due to lack of infrastructure development in the sector. This leads to low plastic recycling rates (Goga et al., 2022). However, the informal waste collectors, despite the challenges highlighted above, are responsible for 80 – 90% of the post-consumer plastic feed into this sector (Mazhandu et al., 2021b). Without the formalization of the waste pickers sector and formalised compensatory frameworks, it is unclear if more sustainability in this sector will be achieved in the long term. Recycling is further hampered by the weak enforcement of waste separation at source. Formal waste collection also presents a greater challenge in the control of plastic pollution and waste management. As highlighted earlier, due to the township expansion and intermittent municipal services in these areas, alternative waste disposal methods are always sought, with dumping always being the easiest. Where collection does happen, landfilling is still a preferred waste management strategy (C. J. Schenck et al., 2019). Unfortunately, most of the landfills are reaching capacity and/or are poorly managed, which exacerbates the problem. Lastly, there is limited monitoring of plastic pollution in the country, with significantly limited plastic flows, types, leakage pathways, and pollution hotspots (Goga et al., 2022).

These legislative gaps and challenges, coupled with the challenges specific to regulations discussed herein, create barriers to the prevention of pollution, and sustainable development that South Africa has potential to achieve. Now, more than ever, the reinforcement of current regulations is a dire need to ensure protection of the environment and human health. Moreover, the overall contribution to circular economy depends on the successful implementation of the said regulations.

Conclusions and recommendations

The South African government is not lacking in the text required to regulate the plastic consumption and waste management for the safety of the environment and the people. Learning from developed countries, the plastics bag tax introduction in 2003 was important to reduce unmanaged plastic littering in the environment. The NEM: Waste Act lays a blueprint in proper waste management, with the

EPR regulations being critical to ensuring that producers play a critical role in management of both consumption and waste management. However, it seems none of the regulations have been successfully enforced, hence the current plastic waste load in the environment which threatens the environment and human health. As earlier noted, the failure of these regulations is associated with several factors that not only fall within the control of the regulations, but include producers, and consumers. Evidently, the challenge of plastics pollution requires a multi-stakeholder approach.

It is worth appreciating the work done by the SA Plastics Pact in collaboration with the different government parastatals, institutions, and private entities in promoting waste reduction and circular economy. Additionally, the green initiatives from the major retailers are critical to ensuring that change is implemented at citizens levels. However, this is still only solving a fraction of the challenge since these initiatives target a selected few. For comprehensive policy enforcement and subsequent solutions to the plastic pollution in South Africa, the following measures are recommended;

- A comprehensive nationwide consumer education campaign on plastic pollution and its impact on the environment and human health. This can be achieved through integration into education programs, media, and different scientific forums. The successful implementation at the policy level depends on informed citizens and decision-makers. This has so far been shown to be effective in support of policy interventions in some countries. For instance, in Canada, consumer education significantly influenced the support of the plastic ban, especially among young people (De Sousa, 2023). Similarly, the success of the plastic bags levy regulations in Ireland could mainly be attributed to access to and accurate information to raise awareness about the environment (Pape et al., 2011). As reported by Deme et al. (2022), the success of policies related to consumers requires their involvement and consultation so as to invoke the individual's sense of responsibility.
- The implementation of incentivized green initiatives for plastics management systems for local municipalities. The Municipal Systems Act (Act 32 of 2000) puts the responsibility on municipalities. According to this act, the municipalities must develop integrated waste management strategies and are thus responsible for general waste management and environmental protection in areas they oversee (Kubanza & Simatele, 2020). This strategy has so far led to complete environmental degradation due to municipalities' challenges such as corruption, political interference, budget constraints, poor infrastructure maintenance, inadequate community education, and lack of skilled personnel (Mukwevho et al., 2024). To

reverse the situation, municipalities can be incentivized for green initiatives where citizens play a role. This measure would require an investment in recycling initiatives/industries which would have the secondary benefit of job creation and local economic development.

- The environmental regulations in South Africa are sufficient to ensure that the current environmental degradation from plastic waste can be reversed. However, the implementation of these regulations has failed or is failing. The review of the implementation strategies is thus recommended.
- The plastics bag tax has failed at its objective, over 20 years since its implementation. While the ban of plastic bags is risky due to the lack of development of plastic alternatives in the last two decades, it is worth considering as an alternative. However, this should be done systematically in collaboration with producers to ensure a smooth transition to the alternatives. South Africa also boasts research capacity for the development of alternatives that can support the private sector. Worth noting, the ban on plastic bags should be done gradually, with consumer awareness campaigns at the center to ensure successful implementation.
- Despite the regulatory provisions of the National Environmental Management: Waste Act (NEM: WA) of 2008, informal waste pickers continue to operate on the margins of the formal waste management system. This group plays a vital role in waste recovery and serves to mitigate the shortcomings of formal municipal waste services. It is therefore recommended that the integration and formalization of informal waste pickers be prioritized, alongside the strengthened regulation of plastic recyclers. Such integration should occur at the municipal level, in accordance with the Municipal Systems Act, which mandates local government responsibility for waste management. Formalizing this workforce would address critical gaps in waste governance, particularly in rapidly expanding township areas where unmanaged waste is increasingly prevalent.

Despite the challenges related to the economy, South Africa possesses the roadmap to lay the foundation for successful plastics management. These policies comprehensively seek to manage plastic consumption and manage plastic waste throughout the plastic products' lifecycle. This roadmap, however, requires a review and an overhaul of the implementation strategy to ensure that all stakeholders play their role in ensuring successful implementation. Unfortunately, the barriers to successful implementation, as highlighted specifically for South Africa, are also relevant for other African countries where plastics pollution is a challenge. While at least 35 countries have introduced plastic bags

policies, as discussed earlier, only eight countries have recycling mandates (Deme et al., 2022). South Africa on the other hand has sufficient policies to cover the entire lifecycle of the plastics, less microplastics, but the implementation stages have failed and suffocating the environment as a result. The recommendations above will hopefully contextualize the necessary next step to save the environment.

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