



## PLASTIC WASTE RECYCLING IN NAMIBIA AND ITS ASSOCIATED BENEFITS

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**ABSTRACT:** *Internationally, several types of research have been conducted on plastic waste: forms, sources, composition, possible effects of inappropriate handling and international best practices of recycling. One issue that is still to be made clear and known is how much and how plastic is recycled in Namibia in order to reduce or eliminate the problem of “plastic landscape”. Therefore, the objective of this paper is to examine plastic recycling in Namibia with a view to providing answers to policymakers, planners, academics and investors on how plastic can be managed. The paper employed an exploratory qualitative approach to provide answers to the research objectives. The research used face to face semi-structured interviews, document search (articles, journals, environmental organizations reports) and site visits. It was found that the spectrum of plastics (polymers) recycled in the country fell into two main categories; soft and hard which were sourced from different points of generation such as households, commercial businesses, industries and others. Plastic is the most widely used recyclable material. It is freely available in shops, but the most challenging material affecting urban environments where large volumes of plastic were generated. It was further found that total recycling of plastic was done according to the recycling symbol complete loop of recycling: collection, processing, manufacturing and subsequent re-sale of produced goods. The study recommends control of the availability of plastic through charges at the point of sale as well as having a buyback centre for recycling if the problem of the plastic landscape” is to be addressed.*

**KEYWORDS:** Biodiversity, Extended Producer Responsibility, Pollution, Polymer, Plastic Waste, Recycling, Sustainable Development.



## INTRODUCTION

Plastics are polymer-based materials that are used in many different packaged products, including water bottles, food, apparel, electrical goods, and building supplies. Due in part to technical advancements, the world's production of plastics has expanded over the past several decades (Adeniran & Shakantu 2022) leading to an insurmountable quantity of waste. Studies have shown that poor waste management generally causes health and environmental problems, with plastic waste being one of the main contributing factors (Boyu Jiang Jiming Yu & Yihang Liu 2020; Chen et.al 2021; Hoornweg & Bhada-Tata, 2015; Nathanson, 2015), such as ingestion by aquatic and terrestrial life and urban landscape pollution. According to Hopewell (2009), this trend has led to a desire for more environmentally friendly approaches to the management of plastic waste and associated problems. Recycling plastics is currently thought to be a viable, sustainable way to lessen the impacts caused by pollution from plastic waste. According to Nakatani (2014), recycling is a multifaceted system that serves the dual purposes of managing waste and producing secondary materials. The benefits of this have been recorded in numerous studies carried out worldwide.

From a historical perspective, it is important to take stock of how we got here. After the 1992 Rio de Janeiro World Conference on Environment and Sustainable Development, which was noted for paying attention to the environmental movements' critique of the disposal-based waste management approach in the 1960s and 1970s, the growth of the recycling economy was strongly encouraged. Studies conducted prior to this Summit indicate that waste was either burnt, buried, or thrown away because it was thought to be a useless mass of material. However, environmental movements held the opinion that solid waste was made up of many different materials that needed to be treated differently, such as recycled, composted, or reused rather than being thrown away (Schall, 1992 as cited in Gertsakis & Lewis, 2003). In order to save the environment, the Rio Earth Summit in 1992 promoted a resource-efficient 21st-century green economy in addition to sustainable solid waste management practices. According to Phillips and Pittman (2009), environmental challenges like resource depletion, pollution, climate change, and biodiversity loss have made it imperative to promote sustainable practices, including recycling, globally.

According to Hickman et al. (2009), recycling is the process of converting waste into other useable materials and consists of three main steps collecting and processing, manufacturing, and buying recycled goods. In addition, Schultz et al. (1995 as referenced in Omran, 2008), define recycling as a series of activities that involve used materials that would otherwise be thrown away as waste in order to transform them into new raw materials and products. This article looks at Namibia's plastic recycling programme and its advantages in the context of recycling as defined by the two authors. Situated in the south western region of Africa, Namibia is home to more than 2.6 million people and encompasses an area of 824,292 square kilometres.



## LITERATURE REVIEW

Many nations throughout the world are currently dealing with plastic waste, Szeberényi et al. (2023) state that there is currently a consensus that "limiting plastic" has gained international acceptance and that several countries have begun to impose plastic limits. On the other hand a lot of studies have been carried out highlighting various issues regarding plastic waste recycling in support of this. This literature review will highlight some of the issues covered in these studies.

The value of plastic is undisputable and is one of the most widely utilised materials in the world according to Adeniran & Winston Shakantu (2022). Plastic is used worldwide in a variety of settings, including homes, businesses and agricultural practices. In order to deal with the increased amount of plastics compelled by human behaviour through various activities of survival, Adeniran & Winston Shakantu (2022) further argue that environmentally friendly solutions, such as waste recycling and handling are required in the twenty-first century to address the challenges of plastic.

The amount of plastic waste generation is increasing the world over. Sadan & De Kock 2021 report that if "business as usual" continues, plastic use and manufacturing will increase in the coming decades in both Africa and the rest of the world. Coupled with this, countries worldwide are grappling with the increasing impacts of plastic pollution which is impacting both the environment and human health through contamination of open water sources, clogging drains, killing marine life like fish and terrestrial herbivores and unsightly scenic views of nature. The 2012 Convention on Biological Diversity in Montreal determined that marine species, such as sea turtles, were affected by ingesting or being entangled in plastic. Plastic is a non-biodegradable substance that can take up to a thousand years to degrade, which exacerbates the situation (Szeberényi et al., 2023). According to Chen et al. (2021) & Szeberényi et al. (2023), the rising production of single-use and throw-away plastics is the cause of the growing worry over plastic pollution. Given this, integrating recycling for sustainability and encouraging behavioural changes are among the 21st century's top goals as mentioned earlier on.

One other issue is to do with plastics which are very difficult to recycle. Plastic recycling is the process of recovering discarded plastics and repurposing them into useful products that are either completely distinct from or similar to their initial form. Plastics can be divided into two main groups, hard plastics, like LDPE, and soft plastics, like PET according to Szeberényi et al. (2023). Depending on their nature, these polymers can be recycled mechanically or chemically, but certain plastic varieties exhibit challenging reprocessing due to their chemical composition, resulting in a higher percentage of them being disposed of in landfills. One such example is category Code 7 which includes a wide variety of plastics including nylon and polycarbonate, as identified by Brulliard et al. (2012). Thus not all plastic is recyclable.

In general, recycling rates vary across the globe whereby more recycling is practised in developed economies than in developing economies. According to Woldemartd' Ambrières (2019), recycling rates are higher in developed economies with supportive legislation. In contrast, recycling rates are very low in developing countries with a limited industrial base. A study by Jiang et al. (2020) titled *The Environmental Impact of Plastic Garbage in Malaysia and Southeast Asia* shows that a larger portion of plastic waste generated is not recycled and



instead ends up in landfills. Thus high rates of recycling lowers negative environmental impact at the same time generating significant socioeconomic benefits, making this the target of many developing nations recycling plastic waste.

Several authors have researched the benefits of solid waste recycling in general. In the book *Plastic Recycling & Waste Management*, Szeberényi et al. (2023) discuss the advantages of recycling plastic as a way to address current waste and as a part of zero-waste and circular economy systems, which seek to decrease waste output and promote sustainability. By reducing the quantity of plastic that ends up in rivers and the ocean, recycling plastic helps to preserve natural resources and ecosystems. In certain regions of the world, plastic recycling provides a means of income for a living. For example, Ukoje (2012) and Njoroge et al. (2013) report that waste pickers in Zaria, Nigeria, and Nakuru Municipality, Kenya, respectively, were able to support themselves by gathering and selling recyclables. Fahmi & Sutton, 2010; and Memphite, 2009, who emphasised that the majority of the poor are active in solid waste recycling despite the terrible working circumstances in order to survive, also support this viewpoint. According to Fahmi & Sutton (2010), the greater part of the industry in Egypt is dominated by the long-standing informal sector. Shanker et al. (2021) in a different study, noted that household waste collectors and itinerant waste buyers (IWBs) in India gather between 6.5 and 8.5 tonnes of plastic waste every day. Despite the benefits, recycling plastics has some disadvantages as well. For instance, research indicates that as plastics break down, pollutants are created, recycling is not cost-effective, there is no guarantee that the items will be of a high calibre and recycled goods are constantly devalued and disliked.

In Namibia, plastic waste is also a cause of concern and opportunity. According to Margareth-Rose Kangootui — May 10, 2022, under the heading *Assessment of household plastic waste handling in the city*, the University of Namibia (UNAM) and the University of Natural Resources and Life Sciences Vienna (BOKU) have launched a project to address plastic waste management problems. This study will look at household waste management in order to lay the groundwork for further research on plastic waste management.

## **PROBLEM STATEMENT**

Since plastics are polymers- which are non-biodegradable by nature, they take long periods of time to decay. According to a 2020 Jiang et al. research published in the *Journal of Environmental & Earth Sciences* titled *The Environmental Impact of Plastic Waste*, "white pollution" has gotten worse because of the harsh environment, even if plastic products are convenient in people's lives. With improper handling, plastic poses both environmental and human health challenges. There have been efforts to restrict or outlaw the use of plastic due to the environmental problems that plastic has caused worldwide. The problem of plastic pollution is a global challenge, especially in regions where resources are limited to deal with the waste. Most emerging economies are faced with this challenge. Namibia like other developing countries has witnessed over the years an increase in solid waste generation particularly plastic waste mainly in urban environments. The increase in plastic waste pollution was attributed to a number of factors.

After independence, there was an increased rural-to-urban migration. With more people residing in towns and cities, demand for goods and services increased. To meet the increased demand for goods, more had to be produced and supplied. Most of the goods were/are



packaged in plastic material. Due to plastic being freely available in retail outlets, this made it easy for most people to have easy access to them. In addition, most of the plastics were not properly handled after use resulting in littering. Open dumpsites were also blamed for the pollution as waste was left vulnerable to weather elements, especially wind hence flexible plastics were immediately blown away perching in trees and subsequently landing on the ground in drains, roads and open spaces. Another revelation was that plastics especially carrier bags were used as sanitary containers, especially at night, in areas where sanitation facilities were/are limited in informal settlements (*fly-by-night*) as they were called only to end up scattered all over and perched in thorny bushes. Consequently, plastic pollution began to be an issue of concern resulting in proposals for recycling as a way of managing the problem. The main problem the nation is dealing with is that plastic waste has littered the environments of most urban areas, particularly the smaller ones where disposal is by open dumping and not landfilling, endangering both terrestrial and aquatic life (Mutede, 2019, Namibian Chamber of Environment Poster, 2017).

## OBJECTIVES

The main objective of the study was to establish how plastic recycling can reduce plastic waste going into the environment by considering the associated benefits

Therefore, the specific objectives of the study were:

1. To establish the background of plastic recycling at the industry level
2. To identify the spectrum of recyclable plastic materials
3. To examine the processes involved in recycling in the country
4. To highlight the main products manufactured
5. To establish the benefits of recycling plastics

## RESEARCH METHODOLOGY

The paper employed an exploratory qualitative approach to provide to address the research objectives. The study was conducted among formal solid waste recycling companies in the whole of Namibia and intended to establish plastic recycling activities and their benefits. There were 45 companies found, and all of them were to be interviewed. Nevertheless, a few of the businesses had ceased operations, and others declined to take part in the research. Because of this, accidental sampling a process that involves selecting study participants who are willing to participate was employed (Hoyle et al., 2002). Fifteen (15) companies were eventually interviewed. Semi-structured interviews, field observations, the internet, and easily accessible hard-copy sources like books and company brochures were all used to gather data.

Key personnel, such as directors, managers, and supervisors, were interviewed in person. These interviews were conducted in order to ascertain the workings and advantages of the plastic recycling industry. Interviews were followed by observations of some of the real activities involved such as recovery, processing and manufacturing of new products as was





reported. The purpose of the document search was to gain an understanding of how plastic recycling was done elsewhere. Content analysis was employed to examine the provided data and obtain an additional understanding of how businesses operate with regard to recycling plastic.

The section on findings gives more detail about some of the data collected from the companies regarding plastic recycling activities and processes.

## RESULTS

According to one of the company directors, Namibia began to witness a proliferation of plastic waste in urban areas. To quote his words, *The Plastic Landscape* "as it became known was so disturbing that we realized something had to be done. As industrialists, recycling was the way to go, taking a leaf from developed countries and the call for sustainability in development. This marked the beginning of serious efforts to recycle plastic waste formally, in the mid-1990s. Around 2000, some private companies gave a boost to the industry growth by starting the idea of drop-off centres at major shopping malls in Windhoek the Capital City of Namibia whereby waste generators would drop any recyclables ranging from plastic, paper and glass bottles.

A variety of plastic waste materials, shown in Table 1, were handled. The plastics were divided into soft and hard. A total of eight (8) companies were directly involved in different capacities out of the 15 that participated in the study. Soft plastics were mainly carrier bags, sheeting, wrapping and packaging, whilst hard plastics were wheelie bins, bleach and detergents containers, juice and water bottles, crate boxes, HDP, PVC, UPVC pipes, broken tables and broken chairs as given in table1.








**Table 1: Spectrum of Plastic recyclables materials**

Material	Category	Types
Plastic	Soft	Carrier bags, sheeting, wrapping packaging
	Hard	Wheelie bins, refuse bags, juice and water bottles, storage containers, HDPE, LDPE, PVC (vinyl), UPVC pipes, chairs, tables, cutlery, crate boxes, detergents containers, plastic tables and broken chairs

**Source:** Mutede (2019)

In terms of composition, these plastics were classified into seven different categories as shown in Table 2.

**Table 2: Plastic Codes, common usage and recyclability**

Resin (Recycling Code)	Common Usage	Recyclability
 <p>Code 1: Polyethylene Terephthalate(<b>PE</b> <b>TE</b>)</p>	water bottles, cooking oil containers, soft drink bottles, mouthwash bottles; peanut butter containers; salad dressing containers	High
 <p>Code 2: High-density polyethylene plastics(<b>HDPE</b>)</p>	juice bottles, shopping bags yogurt tubs, bleach, detergent and household cleaner bottles, shampoo bottles, milk jugs, butter tubs and motor oil bottles	High
 <p>Code 3 polyvinylchlorid e (<b>PVC</b> or <b>V</b> <b>plastics</b>)</p>	Plastics like window cleaner and detergent bottles, shampoo bottles, clear food packaging, cooking oil bottles, piping and fruit trays	Medium
 <p>Code 4 Low-density Polyethylene (<b>LDPE</b> plastics)</p>	Plastic shopping bags, plastic bags for bread and frozen food, and dry cleaning plastic covers.	Low
 <p>Code 5 polypropylene (<b>PP</b> (plastics)</p>	sauce bottles, bottle lids, yogurt containers, syrup bottles,	Medium
 <p>Code6 PS Polystyrene Plastics</p>	Food takeaway containers, plastic cutlery, egg tray	Low
 <p>Code7 Miscellaneous plastic (Other plastics)</p>		Typically not recycled

Source: Mutede (2019)

What follows are processes of recycling that the research established. Three major processes were identified, that is recovering, processing and manufacturing as shown in table 3 (RECYCLING LOOP)

**Table 3: Plastic Recycling Processes**

Recovery	Processing	Manufacturing
<ul style="list-style-type: none"> <li>● Collection</li> <li>● Sorting of comingled plastics according to type, texture and colour at landfill sites and Material Recovery Facilities</li> </ul>	<ul style="list-style-type: none"> <li>● Cleaning/washing and drying</li> <li>● Crushing/pressing</li> <li>● cutting/ shredding</li> <li>● heating and melting</li> <li>● Palletisation</li> <li>● packaging</li> </ul>	<ul style="list-style-type: none"> <li>● Melting,</li> <li>● Moulding or Extrusion of plastic products.</li> <li>● Packaging</li> </ul>

**Source:** *Mutede (2019)*

The study findings also revealed different products that were produced through plastic recycling. These products are not meant to package food items unless the recycled materials are from off-cuts or rejects from normal plastic manufacturing. Some of these products included confectionery packaging plastics, carrier and shopping bags, fruit and vegetable packaging, disposable cutlery, wrapping bags, refuse bags, bin liners, shrink film, cups, dishes, chairs and disposable personal protection equipment such as aprons, PVC pipes for a variety of uses such as irrigation, construction and industrial uses and bedding products such as pillows, duvets and throw over blankets.

Some benefits of plastic recycling were established during the study and Table 4 highlights some of them.

**Table 4: Benefits of Plastic Recycling**

Environmental	Economic	Social
<ul style="list-style-type: none"> <li>● Waste reduction strategy at disposal sites</li> <li>● Reduced pollution</li> <li>● Safe environment for both humans and animals</li> <li>● Clean environment</li> </ul>	<ul style="list-style-type: none"> <li>● Employment creation</li> <li>● Creation and promotion of new businesses</li> <li>● Production of cheap raw materials and goods</li> <li>● Potential source of revenue</li> </ul>	<ul style="list-style-type: none"> <li>● Source of livelihood for some people in society particularly the poor</li> <li>● Boost informal food vendors' businesses</li> </ul>

**Source:** *Mutede (2019)*

Although numbers of employed people was not considered huge, it was a welcome development as a source of employment. For example one of the companies had 400 workers employed.





## FINDINGS AND DISCUSSION

The main objective of the study was to establish plastic recycling processes in the country and associated benefits, among other things like history and products. During the study, it was observed that plastic was the only discarded waste material that completed the recycling loop of recycling within the borders of Namibia. Different types of plastics were recycled which were classified into two categories, soft and hard as highlighted in table 1. Literature highlights this as well plastics can be divided into two main groups. This classification is in line with those highlighted in a book entitled *Plastic Recycling & Waste Management* by Szeberényi et al. (2023) where plastics are also divided into the two main categories. Thus, Namibia produces these two plastic waste streams from its diverse sources such as households, industries and commercial activities. This discussion will highlight the recycling processes and its benefits.

Recovering and collection, processing and manufacturing were the three major processes of plastic recycling. Recovering and collecting plastic recyclables marked the first step in pre-processing following discard, in line with Szeberényi et al. (2023). Plastics for recycling came from two main sources: post-consumer and post-manufacturing (rejects, damaged batches, off-cuts, and packaging material). The post-consumer plastics were sourced from different sources such as households, businesses, institutions, industries and mines. Both formal and informal sectors were involved in recovery and collection activities also as reported in studies conducted in India, South Africa, Kenya and Nigeria (Szeberényi et al., 2023; Nallathambi et al. 2018; Chandak, 2012; Courtois, 2012; Velis et al., 2012; Gunsilius, Chaturvedi and Scheinberg, 2011; Gutberlet, 2010). Material Recovery Facilities (MRF) in Windhoek and Swakopmund received most of the material before pre-processing it by sorting it into Polyethylene Terephthalate (PET), High-density Polyethylene (HDPE), Vinyl Plastics (PVC or V). Materials were further sorted according to texture and colour followed by chipping/shredding, baling and transportation of some of the semi-processed materials to local markets or South Africa for further processing. Some plastics obtained from fishing companies were said to be odorous and unclean. The same was alleged of plastic from mines, which were occasionally claimed to be highly contaminated with caustic substances. Thus upon receipt, these plastics underwent thorough cleaning to remove contaminants (labels, glue residue and other mixed materials). Thus a lot of effort was needed to clean such plastics. Employees of the company, for example, required appropriate protective attire.

A sizable volume of about 60% was processed locally by one company. The sorted plastic received was processed further by washing, shredding, chipping, melting and moulding which eventually produced pellets in a process known as melt-extrusion. Extruded molten plastic dropped in cold water for cooling. After the cooling process, solidified plastic strips were cut into smaller pieces of pellets and packaged according to composition (*PETE*, *HDPE*, *LDPE*). At the time of the study, these recycled pellets were considerably cheaper compared to virgin pellets. These pellets were sold to three plastic manufacturing companies around the country for the production of a variety of products in accordance with Kutz (2011) who also asserted that pellets are important in the manufacturing of plastics. Companies involved in plastic manufacturing reported that this was quite important as recycling reduced their costs of raw materials significantly.



One company based in Windhoek was involved in the manufacturing and distribution of soft plastic packaging products such as carrier bags. The products span a wide range of the Namibian market as well as regional markets like Botswana, Angola and South Africa. Another company also specialised in the production of plastic packaging as well as tableware items such as dishware, tables and chairs for both the local and international market. The last company was in the business of manufacturing PVC and HDPE pipes which were used in agriculture, construction and manufacturing industries. These recycled products were cheaper compared to others which were available in retail outlets a development which was reported welcomed by some local irrigation farmers. The company products were for both the Namibian and regional markets. Other products like pillows, duvets and throw over blankets were produced from chipped soft clear plastic. These products were observed to pile up due to the lack of a regular market.

Research has indicated that ineffective waste management generally results in health and environmental issues, with plastic waste being one of the primary contributing factors (ingestion by aquatic and terrestrial life; pollution of urban landscapes) according to Boyu Jiang Jiming Yu & Yihang Liu 2020; Chen et al 2021; Hoornweg & Bhada-Tata, 2015 and Nathanson, 2015. Therefore, plastic recycling is a welcome development in the country. Three main benefits were highlighted; environmental, economic and social.

Direct environmental benefits were waste reduction, reduced pollution and a safe environment. In support of this finding, Szeberényi et al. (2023) note that recycling plastic reduces the amount of plastic that ends up in water bodies, protecting ecosystems and natural resources. With some reservations, waste reduction at authorised disposal sites was emphasised. More work still needed to be done since a lot of recyclable plastic was still entering the dumpsites as well as present in open spaces thus posing danger to both humans and animals. Participants were however hopeful for change in future if the charging of carrier bags could be effected and Extended Producer Responsibility (EPR) policy adopted. This is not peculiar to Namibia alone. In most developing countries, plastic waste is a huge challenge as resources and technical capacity for handling it are limited as well. In Southeast Asia, Malaysia, Jiang et al. (2020) study entitled *The Environmental Impact of Plastic Waste* reveals that a greater percentage of plastic waste generated is not recycled but only disposed of in landfills.

Recycling was also associated with economic benefits such as employment creation and promotion of new businesses, production of cheap raw materials and goods, and potential sources of revenue. The major benefit of the recycling economy identified was employment creation both directly and indirectly. Majority of workers in plastic recycling were women. The employment finding corroborates findings from other studies. Jacobsen et al. 2014; Manhart 2011; Memphita 2011 and Westphalia & Pfeiffer 2013 research findings showed that the industry employs both semi-skilled and skilled workers. As a result, there are arguments in favour of assisting the sector because of its advantages.

The demand for raw materials has increased throughout the world over time. Research indicates that the rivalry for the few accessible resources has resulted in shortages and high costs as a result of the growing demand for raw materials (Hilpert & Milder, European Technology Platform on Sustainable Mineral Resources, ETP SMR, 2013). This advancement has helped recycling become more widely recognised as a sensible strategy for advancing sustainability in the twenty-first century. Accordingly, manufacturers in the plastic



recycling industry in the country expressed hope that recycling was a positive development because it allowed them to replace expensive virgin materials with secondary less expensive raw materials that they could obtain locally. Studies conducted elsewhere have also brought attention to these advantages of recycling plastic and solid waste in general. According to studies conducted by Mosia, in 2014; Muzenda, in 2013; Tischler, in 2013; Nahman, in 2009; and Hickman *et al.* 2009, recycling has positive effects on the economy, the environment, and society in the future.

## CONCLUSION AND RECOMMENDATION

Results revealed that during the mid-1990s, industrialists began noticing the proliferation of plastic waste more than other waste streams such as paper, metals or glass, especially in urban areas. These were found anywhere in places such as open spaces, drainage and roads, even in trees which made the landscape unsightly. The most recyclable material in Namibia is plastic and, it is the substance that presents the most environmental problems in the country. Recycling of plastic involves recovery and collection, processing, manufacturing and selling of manufactured goods. However, not all plastic waste was fully recycled in the country as some was transported to South Africa for further processing. Even though the industry is still in its infancy (Mutede, 2019), the industry is a welcome development, particularly in terms of reduction of litter, employment creation and alternative means of cheaper raw material. The industry is hopeful that recycling plus other measures will save the environment and increase the availability of raw materials. Thus from these findings, Namibia is recommended to focus on having policy and legislation on recycling, to promote sustainable recycling in the country. It is also recommended to control the availability of plastic by charging it at the point of sale and to establish Buy-Back Centres for all waste if the problem of the ‘plastic landscape’ is to be eliminated.

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