



IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY



**VOLUME : Vol. ISSUE : 02 Print / Issue Publication Date: 09-Sep-2024
9, Issue 02**



ISSN : 2455-2143



DOI : 10.33564/IJEAST.2024.v09i02.001

Indexed In



WWW.IJEAST.COM

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CAUGHT IN THE PLASTIC TRAP: UNDERSTANDING THE OBSTACLES TO COMBATING PLASTIC POLLUTION IN UGANDA. A REVIEW

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Abstract: Plastic waste presents a global challenge in both urban and rural areas, overwhelming authorities and communities alike with high volumes of generated plastic waste and its associated technical and financial limitations in collection, recycling and disposal. While plastic usage offers numerous societal benefits, increased plastic pollution endangers human health, the environment, and Uganda's blue economy, affecting agricultural and aquatic activities like fishing.

As the prevalence of single-use plastics and unsustainable packaging continues to escalate, coupled with a lack of accountability throughout the plastic product lifecycle, the issue of plastic pollution has become increasingly challenging. From the dependency on fossil fuels to produce virgin plastics to the absence of incentives for upstream innovation and the, insufficient waste management infrastructure in urban and rural areas, low public awareness and high cost of sustainable alternatives to plastics, the challenges of plastic pollution control are diverse and interconnected.

In this context, a holistic understanding of the challenges surrounding plastic pollution control along the plastic life

cycle is essential for devising effective strategies aimed at mitigating its detrimental impacts on the environment and human health.

Keywords - Plastics, Plastic Waste, Pollution, Waste Management, Waste Recycling.

I. INTRODUCTION

The term "plastic" refers to any substance that comprises of polymers, which are simply big hydrocarbon molecules that are made up of the same subunits aligned in a repetitive pattern. (Subhashish, et al., 2023). Plastic pollution refers to the accumulation of plastic fragments in the environment, to levels which can harm humans, wildlife, and ecosystems (Obebe et al., 2020). Due to their light weight, durability and low cost, plastics have become almost an irreplaceable material (Verma, et al., 2016), and can be utilized in various types and forms, allowing them to be widely used in manufacturing a variety of products, including pipes, packaging materials, footwear, fabrics, public health equipment and furniture. More than a third of the world plastics consumption is of plastic bags (Andrady et al., 2009).

Globally, 8.3 billion tons of plastic have been produced to date, generating 6.3 billion tons of plastic waste with only 9% of this plastic waste being recycled, 12% incinerated and 79% in landfills yet with the current plastic production trends, it is estimated that over 12 billion tons of plastic waste will be in the environment or landfills by 2050 (Geyer, et al., 2017). In 2015 alone, Africa generated a total of 19 million tons of plastic waste, of which 17 million tons were mismanaged and locally, Uganda faces its own challenges, generating around 600 metric tons of plastic waste daily (Mutonyi, et al., 2022). Kampala city produces approximately 180 tons of plastic waste daily (Niyomukiza, et al., 2021), yet the Kampala Capital City Authority estimates its capacity to collect only 30 percent of this waste and despite a previous ban on single-use plastics in Uganda, effective enforcement measures have not been implemented. (Mutonyi, et al., 2022). Plastic pollution is rapidly increasing due to widespread use of single-use-plastics and poor waste management. Urgent action is needed to prevent severe consequences for ecosystems and human health. Implementing strict regulations, adopting sustainable alternatives, and improving recycling are crucial steps to address this crisis. This review Article evaluates the scale, nature and dangers of plastic waste, identifies obstacles to combating plastic pollution while highlighting possible recommendations to address the challenge of plastic pollution.

1. Methodology

An intensive search of academic databases including Google Scholar was conducted using keywords such as “plastics”,

“pollution”, “waste recycling”, “plastic waste”, and “waste management”. Articles published in English from 1997 to 2024 were included, especially those addressing obstacles to combating plastic pollution. Data extraction involved thematic synthesis to identify common patterns, recurring themes, and divergent viewpoints. Quality assessment criteria considered credibility, methodology robustness, and coherence of arguments, acknowledging potential biases and limitations inherent in the selected literature and methodologies. A few resourceful non academic reports were also considered.

2. Types of plastics

Plastics have achieved remarkable success as a material due to their versatility, being used in various types and forms such as natural polymers, modified natural polymers, thermosetting plastics, thermoplastics, and more recently, biodegradable plastics. (Anthony et al., 2009)

Globally, thermoplastics, which are the most commonly used plastics, exist in various forms and their respective consumptions are as follows; polystyrene (PS) 6%, polyurethane(PU) 6%, polyethylene terephthalate (PET) 7%, polypropylene (PP) 19%, and polyvinyl chloride (PVC) 13%, which collectively represent approximately 90% of all plastics. Polyethylene (PE) which includes low-density polyethylene (LDPE) plus linear low-density polyethylene (LLDPE) 17%, and high density polyethylene (HDPE) 12%, is the most popular thermoplastic (Anthony, et al., 2009) as shown in Figure 1

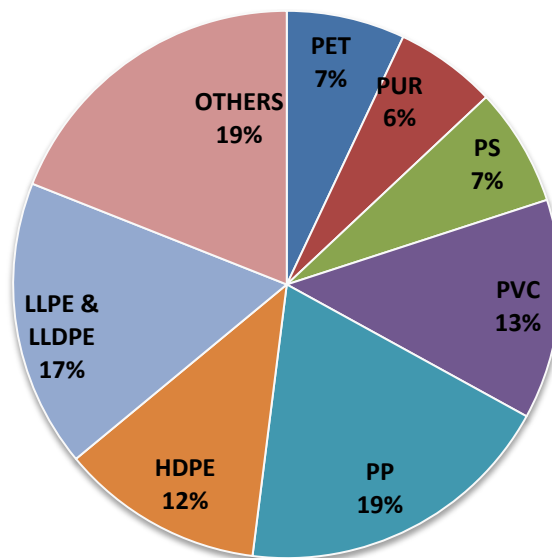


Figure 1: Global consumption of the different forms of plastics.

3. Common plastic disposal methods in Uganda

A study by Balcom et al., (2022) identified several plastic disposal mechanisms in Uganda and these included open burning, dumping in landfill, burying, recycling, pyrolysis and incineration, Indiscriminate dumping long the road sides and drainage channels is also common in urban centers (Green watch 2023) as shown in Figure 2. Whereas open burning is the most commonly used disposal method for plastics, it is globally not recommended as it is a serious cause of air pollution which is accounts for over 1.2 million deaths in Africa annually. (Mebratu D, et al., 2022)



Figure 2: Plastic bags disposed into a drainage channel along Gaddafi road, Kampala.

4. Dangers of plastics

The manufacture of plastics in factories leads to emission significant amounts of harmful gases, such as carbon monoxide and hydrogen cyanide, into the atmosphere. These emissions heavily contaminate the air, posing serious health risks to both humans and animals. (Proshad, et al, 2018). The presence of plastic fragments in water bodies, poses a significant concern to aquatic animals like fish due to the potential for entanglement, which can be fatal. (Kumar B., et al., 2020).

Despite limited knowledge of plastic ingestion on human health, the harmful health effects of many additives used in plastic production are well documented. Additives like bisphenol A (BPA), phthalates, and plastic flame retardants contain substances that, with sufficient exposure, can cause birth defects and development disorders (WWF, 2019). Several reports also indicate that animals have died from feeding on plastic waste due to littering of animal pasture with plastic (green watch 2023) as shown in figure 3



Figure 3: Animal grazing pasture littered with plastic (Green watch 2023)

Plastics also contain polymers and additives such as stabilizers, plasticizers, colorants, flame retardants among others that define the material's characteristics. (UNEP 2021). The additives make the product toxic to the environment and life, (Green watch, 2023) whereas the polymers make them non-biodegradable, staying in the soil for a long time, resulting in soil degradation, a big challenge for the agricultural sector (Global Initiative For Reconciliation, 2021). Additionally, plastic degradation releases methane, a potent greenhouse gas, exacerbating the greenhouse effect (Reddy, et al., 2014).

5. Obstacles to combating plastic pollution

There are significant obstacles to combating plastic pollution making it hard to transition from a linear to a circular plastics production model. These obstacles vary from policy framework gaps, financial, to behavioral patterns of communities among others.

Low production cost of plastics:

The cost of raw materials i.e. petroleum used for making conventional plastics, as compared to that of alternative materials, has declined over the last years (WWF 2019). This has made the production of virgin plastics cheaper and more profitable (Sadan, et al 2021), leading to their widespread use as compared to alternative biodegradable packaging materials like biodegradable plastic, paper and aluminum which are often more expensive than conventional plastic (Joint Initiative Sustainable Humanitarian Assistance Packaging Waste Management 2023). This wide spread use of conventional plastics has led to high levels of plastic waste production by humans, (Obebe et al., 2020) and this has consequently led to increased plastic pollution.



Lack of stringent laws on plastic importation:

The increase in plastic imports combined with the ever growing in-country production of plastic packaging material adds more pressure to an already struggling waste management system. Between 1994 and 2017, Uganda imported a total of 1.9 million tons of plastic in both raw and finished form (Mutonyi et al., 2022). There is therefore need for concerted efforts to regulate plastic importation. In addition to plastic importation, Plastic waste may be moved around countries via trans-boundary waterways like lakes and rivers (Sadan et al., 2021). This further makes the problem of plastic pollution uncontrollable.

Lack of extended producer responsibility:

Extended producer responsibility holds producers accountable for the environmental consequences of their products across the entire product lifecycle, from product design to the post-consumer stage hence promoting better product design and recycling (OECD 2016). The linear plastics production infrastructure that does not promote recycling poses significant challenges in attaining a circular production model that encourages zero waste (Barra, et al., 2018). A good example of extended producer responsibility is the deposit return scheme which works by placing a monetary value on waste. Consumers of goods packed in plastic bottles are charged an extra fee at purchase and upon returning the empty plastic bottle to any distributor, the fee is returned to the consumer. Therefore, instead of disposing the plastic bottle in the environment after use, the user is encouraged to return the plastic bottles, thereby doing away with plastic waste (Green watch 2023). Poor plastic waste management and absence of extended producer responsibility further exacerbate the problem. (Mwanza, et al., 2017).

Low customer awareness about alternative products:

Most members of the public are unaware of the variety of alternative biodegradable plastics on the market, and may have a lack of knowledge on material markings hence are often confused regarding sorting of waste and cannot make proper choices regarding use and disposal of plastics. This subsequently leads to improper waste disposal. Raising awareness among customers of bio-based and biodegradable plastics will certainly have a positive impact on bio-plastic market. (Stasiskiene et al., 2022)

Most plastic products cannot be recycled:

Plastic products often have a complex blend of additives such as stabilizers, plasticizers and colorants that alter the chemical and physical properties of plastics. These additives reduce the recycling potential of plastic products by introducing impurities and increasing the sorting and cleaning costs. As a result, more than 40% of plastic waste collected for recycling cannot be profitably recycled (WWF 2019). This makes plastic waste management a challenge for most countries, Uganda inclusive.

Insufficient financial and technological support:

There is a challenge of limited financial and technological support towards key players in plastic waste management (Oates, et al, 2019). Reduced funding has resulted in a decrease in the recruitment of technical staff and solid waste workers, increasing the challenges associated with solid waste collection and disposal in Kampala city (Mugweri, et al., 2019). Kampala Capital City Authority admits it struggles to manage the large amount of solid waste produced daily, plastic inclusive. Only 40% of the 1,200–1,500 tons of solid waste generated is collected, leaving the rest improperly disposed of by the public. (Water Aid 2011). The high upfront investment costs in recycling plants and associated risks hinder the adoption of circular practices (Sadan, et al, 2021). By 2022, only 9% of the total plastic ever produced worldwide had been recycled, primarily due to the intricate nature of plastic recycling, which presents an economic challenge. (Green watch, 2023).

Limited market for recycled plastic:

Recycled plastic materials are of low quality than virgin plastic, and therefore trade for a lower price. Due to its lower quality, recycled plastic has more limited reuse applications, reducing its demand, and price, as well as the profitability of recycling companies. (WWF 2019). The fact that recycled plastic is not profitable and not easily marketable makes investment in plastic recycling not an attractive venture. This in turn results in low plastic recycling rates and subsequently increases the rate of plastic pollution.

Lack of waste separation practices and infrastructure:

The lack of waste segregation containers and infrastructure poses a challenge proper to waste management. Effective reuse and recycling of waste materials necessitates proper waste segregation at the point of origin. This process entails separating various waste streams to minimize contamination of recyclable materials and decrease the amount of waste destined for landfill disposal (Mugambe, et al., 2022). The absence of waste separation, with waste generators failing to distinguish between plastic and biodegradable waste, poses a significant challenge for entities like the city and municipal councils plus other relevant authorities to effectively manage plastic waste. When plastic waste is indiscriminately mixed with biodegradable waste and deposited in landfills (figure 4), it yields detrimental consequences for the environment, human health, and animal well-being. (Green watch, 2023).



Figure 4: Unsorted plastic and biodegradable waste dumped by the roadside in Kyebando, Kampala.

Figure 5 below presents a summary of the obstacles to combating plastic pollution in Uganda, highlighted in this review paper.



Figure 5: Summary of the obstacles to combating plastic pollution in Uganda.

6. Possible solutions to plastic pollution in Uganda

Investing in Environmentally friendly packaging materials.

Decreasing dependence on plastic products and investing in alternatives is crucial for achieving a plastic-free Environment. Government of Uganda and businesses should promote and encourage consumers to shift towards alternative

materials like paper, cardboard boxes, wood, steel, and cloth for packaging, which are more environmentally friendly (Greenwatch 2023).

Waste segregation

Popularizing door-to-door garbage collection is crucial as it simplifies waste separation at the source before disposal. (Nyakaana, 1997). Provision of waste and recycling bins encourages individuals to segregate and recycle waste. (Mugambe, et al., 2022). Waste segregation is crucial in establishing an environment conducive to fostering behavioral change and promoting sustainability. Various labeled bins are thought to serve as reminders for community members to segregate waste properly when disposing of it.

Sensitization of the public about proper waste disposal:

There is a pressing necessity to sensitizing the public about the importance of responsibly disposing of solid waste and other types of waste (Nyakaana et al., 1997). These sensitization programs should highlight the importance of proper solid waste disposal as a fundamental aspect of effective environmental management. Emphasizing the importance of environmental conservation is crucial, as it is essential for ensuring a sustainable Environment.

Investing in plastic recycling infrastructure:

Investments particularly in mechanical recycling methods, offers the most promising avenue for reducing the mishandling of plastic waste. Recycling serves not only as a means to manage plastic waste but also as an efficient way to reduce the demand for virgin plastics, thereby contributing to mitigating global warming (Damayanti et al, 2022). Recycling entails shredding, washing, melting, and reforming plastic waste into new products, presenting an effective strategy for tackling plastic waste. There is a serious need for plastic recycling plants in Africa, Uganda inclusive. There is also need to provide sufficient subsidies and support to manufacturers to produce alternatives to plastic bags (Behuria, 2019). Additionally, government ought to support municipal councils, Agencies as well as private sector players to adopt a more strategic approach to proper waste management (Oates , et al, 2019). This will help manufacturers to adapt to more environmentally friendly plastics as well as enable municipal councils deal with the overwhelming quantities of discarded plastics.

Emphasizing extended producer responsibility:

Extended Producer Responsibility (EPR) ensures that producers of all materials with pollution potential are responsible for managing their products throughout the entire lifecycle, including minimizing waste generated from the production process (Green watch, 2023). There is need for Government to hold accountable all potential plastic polluters that deliberately fail to take action in addressing the drivers that perpetuate the plastic crisis. (WWF 2019).



Need for a multisectoral approach:

The complexity of the plastic pollution challenge calls for multi-stakeholder interventions and coordinated action to address challenges across the full plastics life cycle (Sadan et al., 2021). All stakeholders in plastic production and usage must be focused to a common objective of ending plastic pollution ensuring a circular plastic value chain. To achieve this goal, critical action from a wide range of stakeholders is needed to implement strategic interventions (WWF 2019).

7. Relevant Legal frameworks in Uganda

Uganda has come up with a number of legislation aimed at safeguarding and conserving the environment, serving as the foundation for policies regulating the manufacture, use, management, and disposal of plastic waste. In addition, Uganda is a signatory to international conventions such as the Basel and Bamako Conventions. These conventions focus on regulating the trans-boundary movement of waste, plastic waste inclusive. The Basel Convention was established under the United Nations while the Bamako Convention was established under the jurisdiction of the African Union. Other National Laws and Policies such as the 1995 Constitution of the Republic of Uganda, National Environment Act No.5 of 2019, Uganda National Bureau of Standards Act Chapter 327 (2013 amendment), The Public Health Act Chapter 281, National Climate Change Act, 2021, Kampala Capital City Authority Act, 2010 (2019 amendment), The Petroleum (Exploration, Development and Production) Act, 2013, National Environment (Waste Management) Regulations, 2020, The Finance (Permitted Plastic Bags and Other Plastics for Exceptional Use) Regulations, 2010, Guidelines for the Management of Landfills in Uganda, 2020 and the UNBS Standard 773 (Plastic carrier bags and flat bags specifications, 2007) among others are pivotal in addressing the challenges of plastic pollution and further solidify government's commitment to ensuring a sustainable and productive environment. (Green watch, 2023)

II. CONCLUSION

Although the Government of Uganda through its agencies such as National Environment Authority and Ministry of Water and Environment among others has undertaken a number of measures and strategies to address plastic pollution, the adverse effects of plastics are unmistakable, manifesting in the obstruction of waterways and sewers, the degradation of soil vital for agricultural productivity, and contributing to climate change through the release of greenhouse gas emissions during production and disposal. Plastics pose a significant health hazard to humans, animals, and plants alike. Despite Uganda's comparatively lower plastic consumption rates compared to developed nations; it is imperative to address the escalating demand for plastics. Their persistent presence in the environment, coupled with inadequate waste

management practices in the country, serves as major drivers of plastic pollution and necessitates urgent action.

Declaration of competing interest

The authors declare that they have no conflicting financial interests or personal relationships that could potentially influence the findings presented in this paper.

Acknowledgment

This work was supported by the National Environment Management Authority (NEMA), a government agency responsible for coordinating, monitoring, regulating and supervising environmental management in Uganda.

Authors' Contributions

E. Baluku is the author of the review, D. Twinomujuni, A. Tumwebaze, and F. S. Ogwal edited the work while R. Komakech is the corresponding author.

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