



A Review on Plastic Waste Management of Single-use Plastic & Their Impact on the Environment

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Abstract-- Single-use plastic products have become ubiquitous in modern society, leading to a global crisis of plastic pollution and its detrimental impact on the environment. This review synthesizes current literature to provide a comprehensive analysis of the management strategies for single-use plastic waste and their consequences on the environment. The review explores the ecological consequences of single-use plastic pollution across terrestrial and aquatic ecosystems, highlighting its adverse effects on wildlife, marine organisms, and ecosystem functioning. This review underscores the urgent need for holistic approaches to single-use plastic waste management that prioritize waste reduction, sustainable consumption, and circular economy principles. It calls for concerted efforts from policymakers, industry stakeholders, and the public to mitigate the environmental impact of single-use plastics and transition towards a more sustainable future.

Keywords-- *Single-use plastic, plastic waste management, ecosystems, global crisis, environment.*

I. INTRODUCTION

Plastic is omnipresent, it's inarguably the backbone of globalisation. Due to fabrication of aspired shape and specification suited for potential customers, there is a growing demand in packaging, agriculture, automobiles and biomedical. They are essential to the modern age due to growth in information technology and smart packaging system. Rapid population growth, urbanization, combined with industrial growth has together led to critical waste management issues around the world. More often than once, concurrent development in economic prosperity and industrialization conflict with environmental concerns.

The management of waste is also an important area that has drawn the attention of researchers in the recent past. If it isn't addressed properly, this can pose a serious threat to mankind. It might not only cause environmental imbalance but may also cause humans to heal that problem as well. Solid waste is a mixture of many components with different physical and chemical characteristics. All of these factors have individual effects as well as a combined impact on the environment, making it an issue that needs to be addressed immediately.

It is believed that reusing waste materials, such as plastic, paper, and metal, can lead to an increase in GDP and reduce greenhouse gas emissions. Plastics are among the most essential and indispensable materials on our planet. Plastics are significantly growing in production due to their versatility.

Plastic waste has significant environmental impacts across various ecosystems, from land to oceans. India has a population of more than 1.4 billion and generates 26,000 tonnes of plastic waste – every day. This is the equivalent of approximately 26,000 small cars!

Currently, a large fraction of plastic waste in India goes to landfill or leaks into the environment.

II. LITERATURE REVIEW

Hossain et al. (2024) presented the existing and emerging technological options suitable for recycling post-consumer flexible plastic packaging waste in India. It also discusses the status of multi-material packaging waste, and the advancement being made for its recycling. The paper also explores India's increased momentum in the use of innovative recycling techniques, such as distributed recycling and manufacturing techniques and plastic waste in steel manufacturing.

Singh et al. (2024) presented the current trash situation in India along with its problems, new initiatives, and in-progress sustainable solutions. Existing difficulties include extensive littering, informal garbage pickers, and insufficient waste collection and segregation infrastructure. The present state of waste management in India is examined in this article, with a particular focus on several categories of garbage, such as plastic waste, municipal solid waste (MSW), construction and demolition (C&D) waste, electronic debris (e-waste), etc. Including the most recent data information and studying various waste sources and management solutions, this article provides a comprehensive overview, for researchers, policymakers, and practitioners interested in India's shifting waste management landscape, of India's attempts in the twenty-first century to address the complicated problem of waste management.

Kannankai et al. (2024) presented an online survey among Keralites to understand their behaviors, opinions, and knowledge regarding plastic waste and its management. Further, the influence of sociodemographic attributes in shaping individual characteristics was also investigated. The Plastic Waste Literacy Rate (PWLR) of the state was 62%, with women and older people being increasingly pro-environmental in managing plastic waste. However, despite this positive trend, a majority of women still resort to improper methods for disposing of sanitary pads. Illicit dumping of plastic waste was more prevalent in urban areas compared to rural ones. Even though the plastic waste collection service provided by Haritha Karma Sena (HKS) received positive feedback, most of the public (40.7%) opined against levying user fees for the



same. In essence, the present work offers insights to enhance the efficiency of the existing waste management program, which will ultimately broaden the scope of adoption of the model by other regions in the developing world.

Rani et al. (2024) presented provides a comprehensive overview of the global plastic waste disposal landscape, examining it through regional perspectives, various management technologies (dumping or landfilling, incineration, and reuse and recycling), and across different sectors including agriculture and food, textile, tourism, and healthcare. Notably, this study compiles the findings on life-cycle carbon footprints associated with various plastic waste management practices as documented in the literature. Employing the bio-circular-green economy model, we advocate for the adoption of streamlined and sustainable approaches to plastic management. Unique management measures are also discussed including the utilization of bioplastics combined with smart and efficient collection processes that facilitate recycling, industrial composting, or anaerobic digestion.

Pilapitiya et al. (2024) presented summarized up-to-date research on plastic and its waste pollution. Plastic has a domain throughout human life with its versatile properties such as lightweight, high durability, flexibility, and low production cost. This article describes the applications, benefits, production, consumption, and classifications of plastics. Plastic commercialization began with the Second World War and grew all over the world within less than a century. The global annual production of plastic is more than 359 million tons. Despite all the benefits, plastics cause severe environmental and public health issues. Accordingly, this study addresses the major issues of plastic waste on the environment and human health. Plastics can degrade into micro to nano sizes, and those fine particles are more spreadable in air, water, and soil. Therefore, both terrestrial and aquatic animals go through various negative impacts such as ingestion, entangling, ulcers, low reproduction, and oxidative stress. Microplastics also degrade human health due to cardiovascular diseases, chronic kidney disease, birth defects, cancer, etc.

Ali et al. (2024) investigated the key factors aiding the growth of the e-commerce sector, the packaging plastic problems amplified by the e-commerce sector, the legislative backdrop, and a case study on how various e-commerce platforms have adapted to the changing policy landscapes. A multi-faceted solution integrating optimisations at the pre-shipping, post-shipping and legislative framework levels is proposed. The recommendation from this study can trigger a transformative change in reducing the packaging plastic waste generation and creating a sustainable e-commerce industry in the country.

Nain et al. (2024) explored the possible uses of polymers to facilitate the more efficient recycling of plastic waste. Recycling plastics has been singled out as one way to mitigate the damaging effects of plastic trash on the

environment. However, traditional recycling methods can only go so far, therefore innovative approaches are needed. This research investigates how a variety of polymers may be able to improve recycling operations. The study simulates the recycling procedure and employs experimental analysis to compare the performance of various polymers. Results show that by selecting the right polymers, recycling plastic trash can be made much more efficient, cutting down on both waste and energy consumption. The results have important ramifications for the plastic waste recycling sector and point the way towards fruitful future study in this area.

Li, Wai Chin et al. (2024) presented that Over 800 species and 87,000 individuals including seabirds, seals, whales, sea turtles, invertebrates, and fishes suffer from plastic ingestion. Large plastics such as discarded fishing materials, packing materials and ropes and net cause plastic entanglement to marine vertebrate species. The potential harmful effects to humans include generating reactive oxygen species in human liver cells adversely affecting epithelial cell function and physiological processes. The COVID-19 pandemic rapidly increases the single-use plastic products, especially in Asian countries, which worsens the problem of plastic pollution. In response to these emergent problems, mitigation measures, including the use of different recycling methods, such as thermal, chemical, and biological recycling are recommended to address plastic pollution issues.

Abbasi et al. (2024) presented complete assessment that gives a synopsis of COVID-19's impacts and difficulties on waste management. This study reviews the COVID-19 pandemic's effects and challenges on worldwide waste management for sustainable development to fill this gap. This analysis refers to the quantitative research method used to analyze bibliographic content. It provides a general overview of a research topic that may be further broken down into publications, authors, and journals

Rafey et al. (2023) analysed the plastic waste management rules, legislations, policies and practices in India during the period 1992–2020. The worldwide trend of bioplastic projects is reflected in studies in India, indicating a changed perception of bioplastics as an alternative source to conventional plastics. However, facilitating the implementation of conventional waste plastic processing plant and production of bioplastics in India involves challenges in terms of technology, developing a standardised framework and financial incentives.

Bansal et al. (2023) presented a state-of-the-art review of types of plastic and its use in concrete in varying proportions. The review reflects that the reuse of plastic waste is very less as compared to generation of plastic waste. While every industry is trying to minimize the use of plastic, some industries have come forward to research more into waste plastic use in their products for sustainable development. Using plastic to build roads is one potential solution that has gained traction in recent



years. In addition to increasing environmental sustainability, highways made of plastic are shown to be more reliable and economical. Because both plastic and bitumen are made of petroleum, they adhere to one another well. The combination lengthens the road's lifespan and increases its capacity to support weight.

Shanker et al. (2023) presented recycling technological options in India and illustrates plastic recycling clusters and reprocessing infrastructure for plastic waste (PW) recycling in India. The study shows that a majority of states in India are engaged in recycling, road construction, and co-processing in cement kilns while reprocessing capabilities among the reprocessors are highest for polypropylene (PP) and polyethylene (PE) polymer materials. This review suggests that there are key opportunities for mechanical recycling, chemical recycling, waste-to-energy approaches, and bio-based polymers as an alternative to deliver impact to India's PW problem. On the other hand, overall, polyurethane, nylon, and polyethylene terephthalate appear most competitive for chemical recycling. Compared to conventional fossil fuel energy sources, polyethylene (PE), polypropylene (PP), and polystyrene are the three main polymers with higher calorific values suitable for energy production

Bassey et al. (2023) presented the changes in the rules and regulations in India related to plastic waste management and its effects on various sectors of business. There are various plastic waste management laws and programmes that have a cascading effect on almost every sector of business. In 2016, two years after the new union government took power in New Delhi, The Ministry of Environment, Forest and Climate Change (MoEFCC) has made some improvements in rules for the collection, segregation, processing, treatment and disposal of the waste. In the pandemic era, effective plastic waste management became more important than ever.

Goh et al. (2023) presented plastic waste generation to eventual disposal. The environmental impact avoided from not producing raw materials due to plastic diverted from various EOL fates are also considered. Eleven environmental impacts were considered, including global warming potential (GWP100) and carcinogenic human toxicity (HTPc). India had the lowest net impact for nine of the categories. Open burning was identified as a hotspot for HTPc. Future scenario analyses showed that increasing mechanical plastic waste recycling can reduce the GWP100 of plastic waste EOL. Policymakers and investors can use these results to focus their efforts on waste management methods which reduce the impact of plastic waste on the environment and human health.

Singh et al. (2023) presented the processes used to make bricks from plastic waste materials, the possibility of contamination from the waste materials utilized, the lack of pertinent standards, and the public adoption of waste materials-based bricks. Furthermore, it focused on research and development required for the widespread production and use of bricks made from waste materials, not only in terms of technical, economic, and

environmental considerations but also in terms of standardization, governmental policy, and public awareness of waste recycling and sustainable development. It has been observed from the study that PET has mostly recycled plastic with greater efficiency compared to other plastics. However, worldwide global production is followed by PE, PVC, and PP. PET has only 5% contribution to the global recycling of plastics.

Yadav et al. (2023) presented review all the types of thermoplastic waste management options, evaluating various environmental parameters through life cycle assessment and list the limitations and gaps of conducted research on the same.

Idrees et al. (2023) focused on utilizing waste plastic dust in fired clay bricks and investigating its effect on their physical and mechanical properties, such as compressive strength, water absorption, and density conforming to ASTM C67. The brick specimens were prepared for this purpose with varying percentages of plastic dust (0%, 2.5%, 5%, 7.5%, 10%, 12.5%, and 15%) by mass. By increasing the plastic dust percentage, the compressive strength was reduced, and water absorption increased. However, both remained within an acceptable range and passed the criteria of most building standards.

Conlon et al. (2023) presented about zero waste businesses and consultants and makers of plastic alternatives in India to understand their experiences with plastic reduction strategies. The key stakeholder interviews reveal key insights for moving forward with plastic reduction initiatives, including challenges faced at government, business, and social levels; considerations regarding plastic waste generation; motivations for starting zero waste businesses and organizations; how it will be possible to operationalize plastic bans in India; appropriate actions for plastic waste reduction; elements that would help India shift into a more circular, regenerative economy; and locally appropriate alternatives to plastics. The discussion further delves into caveats with various alternatives to plastic materials, economic considerations, and characteristics of the zero waste network, and provides next steps for action at the government, business, and civil levels for reducing plastic waste generation in India and minimizing plastic pollution.

Hossain et al. (2022) presented on current plastic production, consumption, and waste generation in India. This review article mainly analyzes data and information regarding Indian PW management and highlights some critical issues such as reverse supply chain, effective PW management, source-specific recovery, and PW rules in India. Comprehensively, this review will help to identify implementable strategies for policymakers and research opportunities for future researchers in holistic PW management and recycling in India, focusing on the circular economy and sustainable development goals.



Kataki et al. (2022) presented reviews of the Indian plastic industry with primary focus on the evolving technologies for plastic waste valorization encompassing their level of utilization, technology readiness, and progress achieved at R&D level. The study attempts to recognize different issues related to technology, recycling, policy, research, regulation that should be given attention to formulate an improved plastic waste management strategy in the region.

Nagarajan et al. (2022) presented about identifying the global framework of waste minimisation and the lacunae in its implementation in the case of plastic waste in India. This will be based on analysis of national level regulations on plastic waste, court cases in the High Courts of India, and results of a primary field survey of unorganised sector plastic recycling units in Mumbai. By doing so, this paper seeks to explain the importance of recycling as a productive activity, and the need to incorporate concerns of workers and small-scale enterprise owners from the unorganised sector, in order to achieve a just transition to sustainable plastic waste management.

Nomani et al. (2022) presented the plastic laws and performance in the context of EPR in Pune city of India. It suggests viable recommendations and strategies from a multi-stakeholder perspective as India has experienced tremendous production, use, and discarding of plastic waste. The municipal and solid wastes proliferation of municipal waste, especially plastic waste, paved the way for the regulatory framework to implement the plastic ban in 18 states and Union Territories of India. In contrast, they have implemented a partial ban on plastic bags respectively. It addressed the phasing out of multi-layered plastics (MLP) and incorporated Extended Producer Responsibility (EPR) within the circular economy of plastic waste generation and recycling. It is generally believed that the plastic ban in India has feeble administrative support and effective implementation.

Srinivasan et al. (2022) presented the public policy on plastic carrier bags in different locations of India. It provides a comprehensive account detailing the ban details and its marketing impact as Plastic production emits large amount of harmful pollutants which pollutes our soil, air and water. Plastic carrier bags have undergone many initiatives to limit their usage. This study examines the public policies and marketing scenario on plastic bag ban and its implementation in India.

Chakraborty et al. (2022) presented an overview of the main interlinkages between persistent organic pollutants (POPs) and plastic in the waste management system of India. Both plastics and POPs share certain common traits such as persistence, resistance to biological degradation, and the ability to get transported over long distances. Throughout the processes of production, consumption, and disposal, plastics interact with and accumulate POPs through several mechanisms and end up co-existing in the

environment. Plastic waste can undergo long-range transport through rivers and the oceans, break down into microplastics and get transported through the air, or remain locked in waste dump yards and landfills.

Choudhary et al. (2022) presented the influence of institutional pressures, resource availability, personal norms, and eco-innovation behaviour on SMEs' behavioural intention towards the reduction of single-use plastics. Data collected from 305 SMEs have been analyzed to draw inferences pertinent to making SMEs CE compliant. This study presents preliminary insights and understanding of the complex problem of reducing the usage of single use plastics from an integrated theoretical perspective, which will help policy makers in India and other emerging nations to take an informed view while formulating policies for SMEs in their respective countries.

Embrandiri et al. (2022) presented about managing single use plastic wastes in combination with other municipal and medical wastes. As many countries in Africa have put into law some legislation on the use of single use plastics, the level of enforcement and implementation is questionable provided that no tangible measures have been put in practice. This is evidenced by the ever-present single use plastics strewn around. Although infrastructural and skill-related challenges are pertinent to the management of single use plastics across the continent, single use plastic waste reduction, community-based indigenous model practices which are cost effective should be encouraged. This waste reduction and recycling practice in the long run make a positive impact on people's lives by achieving sustainable development goals.

SINGH et al. (2022) presented about nursing professionals across all seniority and from various specialty departments. Overall, 550 nursing professionals were included in the study. A pretested questionnaire, comprising 16 questions, was used as a study tool. Chi-square test was applied for studying the significant association among different variables. Results: The response rate was 91% i.e., out of total 550 nursing professionals 498 participated in the study. It was observed that 37.4% of participants were in the 31-40 years age group, 95% were females, 90.6% were married and 90.4% were from the urban area. It was found that the mean knowledge score of three knowledge questions (mean=1.120, SE=0.032, SD=0.715, 95% CI=1.057-1.183) was higher among females, unmarried staff and respondents with a rural background.

in Nepal. This study was conducted among 569 Nepalese youths of age between 18-40 years. A closed ended self-administered questionnaire was distributed among the respondents and responses were collected for three weeks. The questionnaire was prepared using google form and distributed via Facebook. A snowball method was used where the respondents were asked to share the questionnaire in their network. It was found that majority of Nepalese youths have been practicing the source



segregation at their houses. The use of single use plastic is very common in Nepal with an individual using at least 208 plastic bags in a year.

III. SUMMARY

Plastic pollution, particularly from single-use plastics, has emerged as a critical environmental challenge globally. This review aims to provide a comprehensive analysis of the management strategies employed for single-use plastic waste and their consequential impacts on the environment. The review begins by elucidating the widespread proliferation of single-use plastics across various industries and their staggering contribution to global plastic waste. Subsequently, it delves into the existing waste management approaches, encompassing recycling, incineration, landfill disposal, and emerging technologies such as biodegradable alternatives and waste-to-energy conversion.

Furthermore, the environmental ramifications of single-use plastic waste are meticulously examined, spanning terrestrial, aquatic, and atmospheric ecosystems. Studies documenting the adverse effects on wildlife, marine biodiversity, human health, and climate change are synthesized to underscore the urgency of mitigative actions. Moreover, the review evaluates the efficacy and limitations of current policy interventions and regulatory frameworks aimed at curbing single-use plastic consumption and promoting sustainable waste management practices. The role of corporate responsibility, consumer behavior, and technological innovation in fostering a circular economy for plastics is also discussed.

CONCLUSION

This review underscores the imperative for multifaceted strategies integrating policy, technological innovation, public awareness, and stakeholder collaboration to address the multifaceted challenge of single-use plastic waste management and mitigate its deleterious impacts on the environment. The review of plastic waste management and its impact on the environment highlights the urgent need to address the growing crisis of single-use plastics. Single-use plastics, including bags, bottles, and packaging, pose significant environmental challenges due to their persistence in ecosystems and their harmful effects on wildlife, habitats, and human health.

Key findings underscore the detrimental environmental impact of single-use plastics, including pollution of oceans, rivers, and landscapes, contribution to climate change through carbon emissions during production and disposal, depletion of non-renewable resources, and the proliferation of microplastics in the food chain.

To mitigate these impacts, various strategies are proposed, including reduction, reuse, recycling, recovery, and policy measures such as bans and extended producer responsibility. However, challenges such as inadequate waste management infrastructure, technological

limitations in recycling, and complex global trade in plastic waste hinder effective solutions. In summary, the review underscores the pressing need for concerted action to curb the environmental impacts of single-use plastics through innovative solutions, policy interventions, and collective efforts towards a more sustainable future.

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