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Sustainable Plastic Waste Collection and Distribution Strategies in Operations Management

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Abstract. The global plastic waste crisis necessitates effective collection and distribution strategies aligned with principles of Operations Management and Sustainability. This study investigates efficient methods for managing plastic waste, focusing on mechanisms such as buy-back facilities, door-to-door collection systems, and reverse vending machines (RVMs). Among the various types of plastics, only PET, HDPE, PP, and LDPE are widely recyclable, with PET being the most preferred due to its high recyclability and potential for reuse in manufacturing. A mixed-methods approach was adopted, combining both qualitative and quantitative data collection techniques. The study involved a comparative analysis of different plastic collection strategies across various countries and regions, including deployments of RVMs in the UK, Sweden, Australia, Canada, the USA, and selected Indian cities such as Mumbai, Delhi, and Chennai. Findings reveal that RVMs offer a superior method for plastic collection due to their integrated sorting capabilities and user-friendly design. The global proliferation of over 100,000 RVM units illustrates their scalability and acceptance. Furthermore, the study highlights the environmental and economic benefits of optimized plastic waste collection, including natural resource conservation, energy savings, job creation, and reduced ecological impact. The integration of sustainable collection strategies, particularly through the deployment of RVMs, holds significant promise for enhancing waste management systems. The study emphasizes the importance of selecting appropriate technologies and infrastructures to support a circular economy. These insights contribute to operational improvements in waste logistics and support long-term sustainability goals.

Keywords: Plastic Waste Management; Reverse Vending Machines; Sustainable Operations; Recycling Strategies; Mixed-Method Approach

1. Introduction

Plastics have become one of the most transformative materials in modern history, widely used due to their versatility, durability, and cost-effectiveness. Originally developed in the late 19th century as a substitute for scarce natural resources like ivory and tortoiseshell (Amato, 2013), plastics were once hailed as a miracle material. John Wesley Hyatt's (2021) celluloid and Leo Baekeland's (2022) invention of Bakelite in 1907

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marked significant milestones in the rise of synthetic polymers, freeing manufacturing from the limitations of natural raw materials (Wagner, 2011). Over time, plastics rapidly replaced traditional materials in packaging, automotive, electronics, textiles, and even furniture, offering a low-cost, mass-producible solution to the demands of industrial and consumer economies (Rhees & Meikle, 1998).

However, the early optimism surrounding plastics has given way to growing concern over their environmental consequences. Since the 1960s, scientific and public awareness of plastic pollution has escalated. Marine plastic debris, persistent microplastics, and leaching chemical additives such as bisphenol A (BPA) and phthalates have been shown to threaten ecological systems and human health (Talsness et al., 2009; Thompson et al., 2004). Today, over 400 million tonnes of plastic waste are generated annually, yet less than 10% is recycled effectively (Singh & Walker, 2024). Plastics such as PET, HDPE, PP, and LDPE are technically recyclable, but actual recycling rates are limited by inefficient collection systems, contamination, and public disengagement (Hopewell et al., 2009).

The effectiveness of recycling is strongly dependent on the efficiency of plastic waste collection. Without proper collection, the circular economy model fails to function. According to Dodbiba and Fujita (2004), waste segregation at the point of collection significantly improves downstream processing, reduces contamination, and increases both the quantity and quality of recyclable materials. Yet, in many urban contexts, plastic waste management is hampered by fragmented systems, poor public awareness, and inadequate incentives for participation (Shen & Worrell, 2024). While some efforts like curbside pickup and drop-off points have seen moderate success, newer approaches like Reverse Vending Machines (RVMs) offer an automated, user-incentivized, and contamination-reducing model that warrants further exploration (Athukorala et al., 2021; Zia et al., 2022).

Despite the growing use of RVMs in countries like Germany, Sweden, Australia, and parts of India, academic research evaluating their comparative effectiveness remains limited. Most studies have focused on environmental outcomes or behavioral aspects of recycling, without addressing the operational management challenges and scalability of such systems. Moreover, there is insufficient comparative analysis between traditional collection methods and RVM-based systems within an operations management framework.

This study seeks to address this gap by evaluating sustainable plastic waste collection and distribution strategies through the lens of operations management. By adopting a mixed-methods approach, the research compares curbside collection, drop-off centers, buy-back systems, and RVMs in terms of efficiency, feasibility, and sustainability. It aims to determine which model offers the best operational and environmental outcomes, especially in the context of increasing global plastic consumption. The findings intend to guide policymakers, urban planners, and waste management stakeholders in designing collection systems that not only maximize recycling rates but also reduce costs, promote public participation, and support broader sustainability goals.

2. Methods

This study employed a mixed-method approach to examine and compare the effectiveness of manual plastic recyclers and Reverse Vending Machines (RVMs) in the collection and distribution of plastic waste (Gasde et al., 2021; Schyns & Shaver, 2021). The choice of this methodological design was driven by the research objective to evaluate sustainability, operational efficiency, and user engagement across different plastic collection strategies. Given the nature of the topic, which involves both numerical data and contextual understanding, integrating quantitative and qualitative methods was considered the most appropriate strategy.

The research process began with the formulation of a study plan aligned with the operational and environmental goals of the investigation. Quantitative data were collected using structured questionnaires disseminated through Google Forms. The target population included a diverse sample of 120 individuals from Hyderabad and Secunderabad, India, encompassing students, housewives, private-sector employees, and other community members with varying levels of engagement in waste management practices.

To assess differences in awareness, usage patterns, and perceptions of both manual recycling methods and RVMs, a Chi-square test was applied. This statistical tool helps to determine whether there is a significant relationship between observed outcomes and expected values across categorical variables. It was particularly useful in analyzing whether preferences for collection strategies varied significantly across different demographic segments.

A total of 160 to 177 valid responses were recorded, with minor variation due to the addition of an extra question mid-survey. Despite the slight inconsistency, the dataset remained robust for comparative analysis.

Table 1 Sampling Details

Component	Description
Sampling Size	120 respondents
Sampling Units	Individuals from various backgrounds (students, housewives, employees, etc.)
Sampling Method	Structured questionnaire (Google Forms)
Sampling Area	Hyderabad and Secunderabad, India

Table 1 outlines the key components of the sampling strategy used in this study. A total of 120 respondents were selected as the sample size, drawn from a diverse pool of individuals including students, housewives, employees, and other community members. This variety was intended to capture a broad spectrum of perspectives on plastic waste collection practices. The data were collected using a structured questionnaire distributed via Google Forms, ensuring accessibility and ease of participation. The geographical focus of the study was limited to the twin cities of Hyderabad and Secunderabad in India, providing a localized context for analyzing the effectiveness of manual collection systems and Reverse Vending Machines (RVMs) within an urban setting. This sampling approach helped generate reliable and contextually rich data for the research. This methodology facilitated a grounded, data-driven comparison of plastic collection strategies, offering insights into public attitudes, logistical efficiency, and the sustainability potential of different models.

$$\chi^2 = \sum\backslash frac\{(O_i - E_i)^2\}\{E_i\}$$

Table 2 Observed Values [O] of Ideal Methods for Collection and Sorting

	RVM	Others	Total

Ideal Method for Collection	55	45	100
Ideal Method for Sorting	80	20	100
Total	135	65	200

Table 2 presents the observed frequencies gathered from the respondents regarding their preferences for plastic waste collection and sorting methods. A total of 100 people responded to each category. Among them, 55 respondents considered Reverse Vending Machines (RVMs) ideal for collection, while 80 considered RVMs ideal for sorting. In contrast, 45 and 20 respondents preferred other methods for collection and sorting respectively. This provides a total of 200 data points, evenly distributed across the two criteria.

Table 3 Expected Values [E] for Ideal Collection and Sorting Methods

	RVM	**Others**
Ideal Method for Collection	67.5	32.5
Ideal Method for Sorting	67.5	32.5

Table 3 shows the expected frequencies for each category, assuming that there is no preference bias between RVMs and other methods. These expected values are calculated based on the proportion of totals from Table 2. Since the total number of RVM-related responses is 135 and others is 65, the expected value for each method is evenly split: 67.5 for RVM and 32.5 for others in both the collection and sorting categories. These serve as a benchmark for measuring the deviation of observed values in the chi-square test.

Table 4 Chi-Square Components: $(\text{Observed} - \text{Expected})^2$ / Expected

	RVM	**Others**
Ideal Method for Collection	2.314815	4.807692
Ideal Method for Sorting	2.314815	4.807692
Total	4.589371	9.615384

Table 4 details the individual components of the chi-square formula (O−E)2/E(O - E)^2 / E, which calculates the statistical difference between observed and expected frequencies. Each cell quantifies the extent of discrepancy. For example, the difference in responses for the collection method using RVMs contributes 2.31 to the total chi-square value, and so on. The final values for each column (RVM and Others) are summed to determine the overall chi-square statistic used in the hypothesis test.

Table 5 Final Chi-Square Analysis

Description	**Value**
Value of Chi-Square	14.142742
Degree of Freedom	1
P-Value	0.0001694

Table 5 summarizes the results of the chi-square statistical test. The computed chi-square value is 14.14 with one degree of freedom, resulting in a p-value of 0.0001694. Since the p-value is less than the standard threshold of 0.05, the null hypothesis is rejected. This confirms a statistically significant relationship between the type of collection/sorting method and user preference. Therefore, we conclude that Reverse Vending Machines (RVMs) have a statistically significant and positive impact on improving the efficiency and appeal of plastic waste collection and sorting. This finding is supported by both the chi-square analysis and the survey data collected.

3. Results and Discussion

3.1. System Performance Benchmark (Narrative Explanation)

This study focused on evaluating two key performance benchmarks: identifying the most effective method for plastic waste collection and determining the most feasible approach for plastic sorting and recycling. Both determinants are critical for designing sustainable waste management strategies within the scope of operations management. The performance of these systems was assessed based on user feedback, statistical analysis, and comparative observations between manual methods and the use of Reverse Vending Machines (RVMs).

The data analysis reveals significant insights into public perception and practical feasibility regarding plastic collection and sorting methods. As illustrated in Figure 1, a majority of respondents indicated that Reverse Vending Machines (RVMs) are the preferred and more effective method for plastic collection. This preference stems from RVMs' ability to automatically accept, identify, and store plastic waste with minimal human effort and high sorting accuracy.

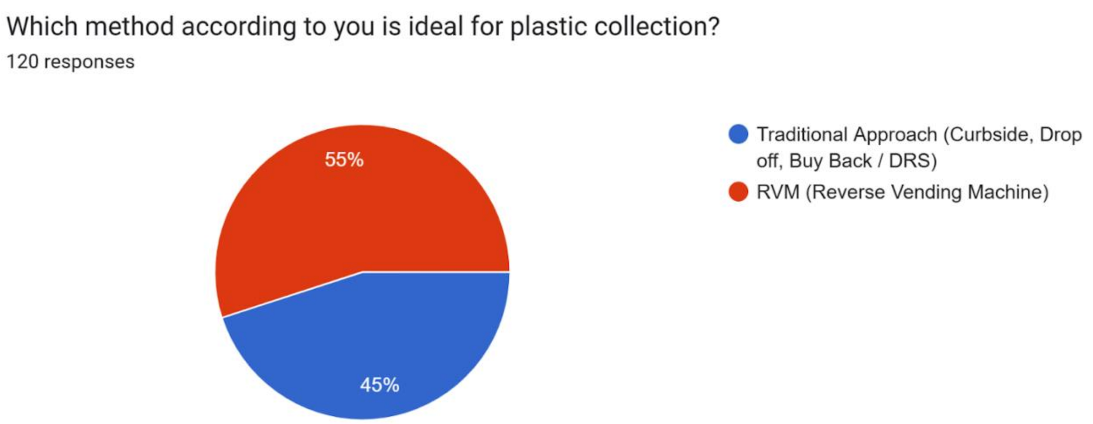

Figure 1 Methods of plastic collection.

Figure 1 illustrates respondents' preferences regarding various plastic collection methods. The data clearly shows that a majority favored Reverse Vending Machines (RVMs) over traditional approaches such as curbside collection, drop-off centers, or buy-back schemes. RVMs stood out as the most ideal method due to their simplicity, integration of technology, and ability to offer incentives in the form of cash or coupons something other collection systems typically lack.

One of the major advantages of RVMs, as highlighted by respondents, is the ease of use and cleanliness. Unlike manual collection systems that involve direct handling of waste, RVMs reduce human contact and offer a more hygienic and efficient experience.

Furthermore, the presence of financial or material incentives greatly motivates individuals to participate, creating a behavioral shift toward more active recycling practices.

Other methods, such as drop-off or buy-back centers, showed significantly lower preference due to several limitations. Drop-off systems often require people to travel longer distances, while buy-back centers operate within limited hours and infrastructure. These constraints reduce public participation. In contrast, RVMs can be installed in high-traffic areas, making them more accessible and effective. Figure 1, therefore, underscores the rising public trust in tech-driven recycling solutions like RVMs.

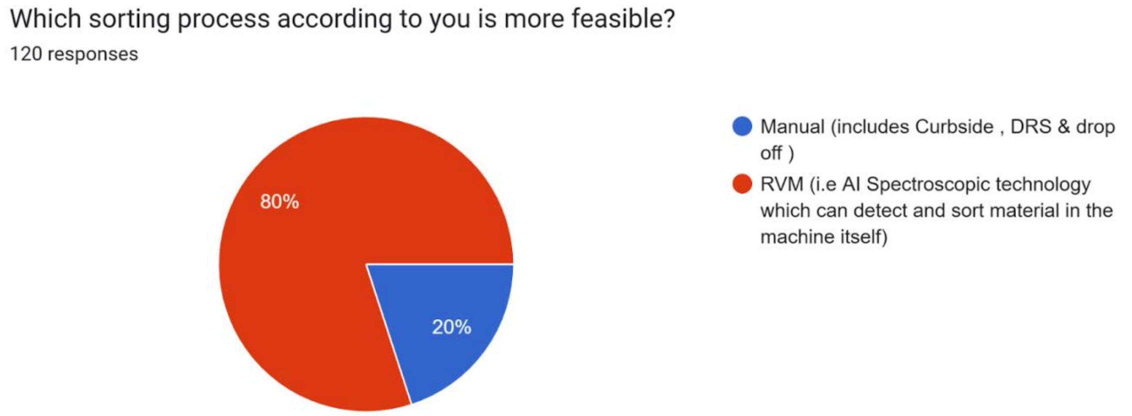

Figure 2 Sorting Process is more feasible

In Figure 2, the results further reinforce the advantage of RVMs by showing that they are also perceived as the more feasible solution for sorting plastic materials. Participants acknowledged that manual sorting methods are often labor-intensive, error-prone, and time-consuming, whereas RVMs offer integrated sorting mechanisms that improve efficiency and reduce contamination. These findings collectively suggest that the integration of RVM technology not only enhances the logistical performance of plastic waste handling but also aligns better with sustainability goals by reducing labor dependency, operational costs, and environmental risks.

Moving on to Figure 2, the study examines how feasible different sorting processes are perceived to be. Once again, RVMs were viewed as the most feasible solution. They do not merely collect waste, they also sort it automatically, identifying materials using embedded AI systems. This reduces the need for manual labor and increases the accuracy of sorting, which is a crucial step in producing high-quality recycled materials.

Manual sorting, on the other hand, poses significant challenges. It is labor-intensive, time-consuming, and exposes workers to health risks. Respondents agreed that manual methods often lead to contamination between different types of plastic. RVMs solve this problem by sorting the plastic at the point of entry, based on codes and material type, making the overall system more technically reliable and operationally efficient.

Accurate sorting plays a pivotal role in ensuring the quality and usability of recycled materials. Reverse Vending Machines (RVMs) contribute significantly to this by automatically identifying and separating plastic waste at the point of collection. Unlike manual systems, which are often prone to human error and contamination, RVMs are designed to reject non-recyclable or soiled items. As a result, the collected waste stream is already clean, well-sorted, and ready for recycling, which is a crucial step in maintaining the integrity of the materials throughout the recycling chain.

This level of precision brings several advantages. For recycling facilities, receiving pre-sorted and uncontaminated plastic means they can bypass complex sorting stages, reducing operational time and costs. It also minimizes the health and safety risks associated with manual handling of mixed waste. More importantly, it leads to higher-quality end products and a lower environmental footprint, as fewer resources are wasted in reprocessing or correcting sorting mistakes. In short, accurate sorting via RVMs strengthens the entire recycling ecosystem from collection to product remanufacturing making sustainability efforts more practical and effective.

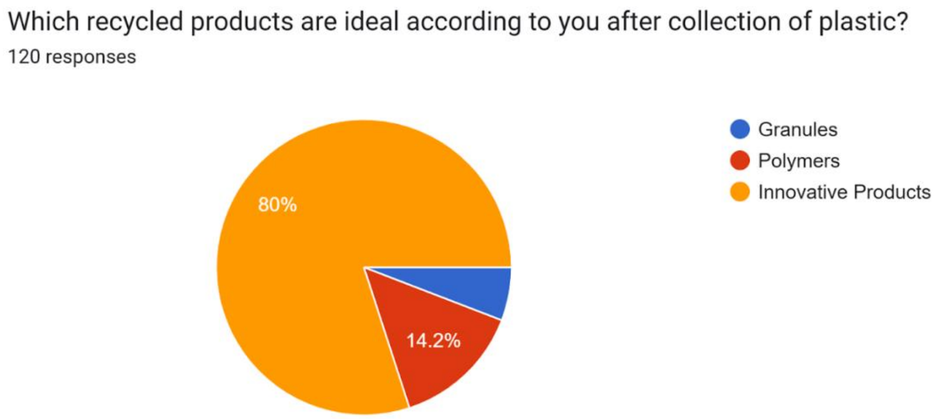

Figure 3 Recycled products are ideal after collection of plastic

Figure 3 then turns to public perception of products made from recycled plastics, especially those collected through structured systems like RVMs. Respondents overwhelmingly agreed that products made from RVM-collected materials are more reliable and desirable. This shows that the impact of the RVM system goes beyond collection and sorting it contributes directly to the public's trust in the recycling loop.

Items such as reusable shopping bags, plastic furniture, bricks, and containers made from properly sorted recyclables are seen as higher in quality. Participants indicated that if the plastic is correctly collected and sorted at the source like it is in RVMs the resulting products are less likely to be contaminated, more durable, and potentially just as good as those made from virgin materials.

These findings also reveal a broader cultural shift: people are becoming more willing to accept and even prefer recycled products, provided they are clean and responsibly made. Some even expressed readiness to pay a premium if the product is eco-friendly. This signifies a healthy progression toward consumer participation in the circular economy, where users are not just passive recyclers but active contributors to sustainability.

Taken together, the data from Figures 1, 2, and 3 tell a consistent story. RVMs are not only the preferred method for plastic collection (Figure 1), they are also the most feasible solution for sorting (Figure 2), and they contribute to creating high-quality recycled products (Figure 3). These findings provide strong evidence that RVMs are an effective tool for sustainable waste management. As such, integrating RVMs into urban infrastructure could dramatically improve the efficiency, participation, and outcomes of recycling programs in both developed and developing countries.

3.2. The Impact of RVMs on Recycling Behavior

Plastic waste has become one of the most pressing global environmental issues, with millions of tons ending up in landfills, oceans, and ecosystems annually (Kaza et al., 2018). Traditional waste management approaches, such as curbside collection and drop-off centers, often suffer from inefficiencies in segregation, low public engagement, and contamination of recyclables. The study's findings reveal that Reverse Vending Machines (RVMs) offer a practical alternative, bridging the gap between waste generation and proper recycling through automation, accessibility, and incentive-driven mechanisms.

The preference for RVMs in this research is not coincidental. Respondents demonstrated a clear inclination toward RVMs as the most ideal method of both collection and sorting, underscoring the need for convenient and efficient systems. According to Van Giezen and Wiegmans (2020), RVMs provide a seamless integration of collection and sorting, drastically reducing the dependency on manual labor and minimizing contamination a key issue in recycling logistics. The results of the chi-square analysis in this study statistically confirm that RVMs are more effective than conventional methods in achieving these goals.

One of the reasons RVMs are so effective is because they remove the ambiguity from the recycling process. Traditional drop-off and buy-back systems often require individuals to understand complex sorting rules, which leads to mistakes and reduced participation. RVMs, however, use barcode scanning and AI-based spectroscopic analysis to instantly identify the type and quality of materials, ensuring accurate sorting at the point of collection (Zia et al., 2022). This automation reduces the burden on consumers and guarantees a cleaner input stream for recyclers.

Incentivization is another critical factor that sets RVMs apart. Studies show that reward-based recycling models significantly increase participation rates (Zhang et al., 2010). By offering tangible returns cash, coupons, or loyalty points RVMs motivate users across different socioeconomic backgrounds to contribute to the recycling process. The psychological principle of instant gratification, paired with environmental responsibility, forms a powerful combination that drives behavioral change. This aligns with the present study's findings, where users preferred RVMs not only for their technical efficiency but also for the perceived benefits they deliver.

Globally, countries that have adopted Deposit Return Schemes (DRS) powered by RVMs have seen drastic improvements in recycling rates. In Germany and Norway, return rates for beverage containers exceed 90% due to the widespread use of RVMs (TOMRA, 2024). This is in stark contrast to regions without such systems, where return rates typically linger below 50%. The adoption of RVMs within policy frameworks offers a replicable model for countries struggling with plastic waste management, particularly in urbanized areas where consumption is high and recycling infrastructure is limited.

Beyond collection and sorting, the study also emphasizes the downstream effects of efficient recycling systems. In Figure 3, participants indicate higher trust in the quality and utility of recycled products derived from RVM-sorted materials. This trust is vital in ensuring the success of a circular economy. If end-users believe that recycled goods are inferior or potentially harmful, their willingness to purchase or use them diminishes. However, when the collection and sorting processes are perceived as robust as in the case with RVMs consumer confidence rises, leading to greater market demand for recycled products (Singh & Walker, 2024).

This consumer trust also has implications for the design of public-private partnerships in waste management. Municipalities and corporations alike can collaborate in deploying RVMs in public areas such as malls, transportation hubs, and schools. CSR (Corporate Social Responsibility) initiatives can help fund the installation and maintenance of RVMs, while also promoting brand image. According to Puntillo (2023), companies that are actively engaged in visible sustainability practices tend to enjoy stronger consumer loyalty and public support benefits that extend beyond environmental metrics.

While RVMs are not without limitations such as high initial cost and the need for regular maintenance the study suggests that these challenges are surmountable. Local manufacturing of simplified RVM units, government subsidies, and crowdfunding for environmental tech are viable solutions. In fact, Mihai et al. (2022) proposed localized versions of RVMs using cheaper materials and open-source AI technology, making the system scalable in developing economies. This addresses a crucial point: for RVMs to be impactful globally, they must be adaptable and affordable.

The educational aspect should not be overlooked. The research reveals that despite the availability of infrastructure, lack of awareness about how to properly use RVMs or where to find them can limit their potential. This calls for robust communication and awareness campaigns, supported by local governments and media. Digital screens on RVMs can display usage instructions, environmental tips, and real-time feedback to users, reinforcing learning and engagement. Behavioral science supports this approach namely repetition, clarity, and feedback loops are key to long-term adoption of sustainable habits (Amato, 2013).

This study adds to a growing body of literature that positions Reverse Vending Machines as a transformative tool in addressing the plastic crisis. By combining automation, convenience, and incentives, RVMs can bridge existing gaps in public participation, sorting accuracy, and the circular flow of recycled goods. Their proven success in Europe and growing interest in regions like India suggest that RVMs are not just a technological novelty, but a strategic infrastructure solution. If scaled thoughtfully and supported by policy, RVMs may very well represent the future of sustainable urban waste management.

4. Conclusions

This study found that Reverse Vending Machines (RVMs) are strongly preferred by respondents as the ideal method for plastic waste collection and sorting. Quantitative analysis, supported by the chi-square test, revealed a statistically significant association between RVM use and improved waste management outcomes. The observed results confirm that RVMs not only streamline the recycling process but also enhance the quality of collected materials, reduce contamination, and lower operational costs in downstream processing.

From the discussion, it is evident that RVMs contribute positively to public participation by offering incentives and simplifying the recycling process. Their integration with digital tracking and reward mechanisms fosters consumer engagement while ensuring material traceability. Moreover, global success stories such as in Germany and Norway demonstrate that with proper infrastructure and education, RVMs can reach return rates exceeding 90%. These insights support the idea that RVMs are not just technological tools, but instruments for cultivating sustainable habits and long-term behavioral change.

However, this research has several limitations. The study focused on a limited geographic area (Hyderabad and Secunderabad), and the sample size, though adequate for preliminary analysis, may not fully represent broader demographic or regional variations across India. In addition, while the study emphasizes public perceptions and statistical correlations, it does not include a longitudinal analysis of RVM impact over time or real-world deployment case studies within India. Future research should explore the economic feasibility of large-scale RVM deployment in urban and rural contexts, the role of local manufacturers in reducing machine costs, and the integration of RVMs within formal waste management policy. Further investigation into behavioral barriers and the effectiveness of educational interventions would also help design more inclusive and impactful recycling systems.

References

Amato, J. A. (2013). Plastic: A Toxic Love Story. By Susan Freinkel (Boston: Houghton Mifflin Harcourt, 2011. 324 pp.). *Journal of Social History*, *46*(3). https://doi.org/10.1093/jsh/shs055

Athukorala, S. C., Hennayaka, H. M. A. L., Rathnayake, S. M. L. P., Hariluxman, M., Gamage, J. R., & Gopura, R. A. R. C. (2021). A Reverse Vending Machine for Sorting Yoghurt Cups and PET Bottles. *2021 Moratuwa Engineering Research Conference (MERCon)*, 333–338. https://doi.org/10.1109/MERCon52712.2021.9525682

Dodbiba, G., & Fujita, T. (2004). Progress in Separating Plastic Materials for Recycling. *Physical Separation in Science and Engineering*, *13*(3–4), 165–182. https://doi.org/10.1080/14786470412331326350

Gasde, J., Woidasky, J., Moesslein, J., & Lang-Koetz, C. (2021). Plastics recycling with tracer-based-sorting: Challenges of a potential radical technology. *Sustainability (Switzerland)*, *13*(1). https://doi.org/10.3390/su13010258

Hopewell, J., Dvorak, R., & Kosior, E. (2009). Plastics recycling: challenges and opportunities. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1526), 2115–2126. https://doi.org/10.1098/rstb.2008.0311

Kaza, S., Yao, L. C., Bhada-Tata, P., & Van Woerden, F. (2018). What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050. In *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*. https://doi.org/10.1596/978-1-4648-1329-0

Mihai, F. C., Gündogdu, S., Markley, L. A., Olivelli, A., Khan, F. R., Gwinnett, C., Gutberlet, J., Reyna-Bensusan, N., Llanquileo-Melgarejo, P., Meidiana, C., Elagroudy, S., Ishchenko, V., Penney, S., Lenkiewicz, Z., & Molinos-Senante, M. (2022). Plastic Pollution, Waste Management Issues, and Circular Economy Opportunities in Rural Communities. *Sustainability (Switzerland)*, *14*(1). https://doi.org/10.3390/su14010020

Mossman, S. (2022). Beyond Bakelite: Leo Baekeland and the Business of Science and Invention. *Ambix*, *69*(4). https://doi.org/10.1080/00026980.2022.2095717

Puntillo, P. (2023). Circular economy business models: Towards achieving sustainable development goals in the waste management sector—Empirical evidence and theoretical implications. *Corporate Social Responsibility and Environmental Management*, *30*(2), 941–954. https://doi.org/10.1002/csr.2398

Rasmussen, S. C. (2021). From Parkesine to Celluloid: The Birth of Organic Plastics. In *Angewandte Chemie - International Edition* (Vol. 60, Issue 15). https://doi.org/10.1002/anie.202015095

Rhees, D., & Meikle, J. L. (1998). American Plastic: A Cultural History. *Technology and Culture*, *39*(1). https://doi.org/10.2307/3107034

Schyns, Z. O. G., & Shaver, M. P. (2021). Mechanical Recycling of Packaging Plastics: A Review. In *Macromolecular Rapid Communications* (Vol. 42, Issue 3). https://doi.org/10.1002/marc.202000415

Shen, L., & Worrell, E. (2024). Plastic recycling. In *Handbook of Recycling* (pp. 497–510). Elsevier. https://doi.org/10.1016/B978-0-323-85514-3.00014-2

Singh, N., & Walker, T. R. (2024). Plastic recycling: A panacea or environmental pollution problem. *Npj Materials Sustainability*, *2*(1), 17. https://doi.org/10.1038/s44296-024-00024-w

Talsness, C. E., Andrade, A. J. M., Kuriyama, S. N., Taylor, J. A., & Saal, F. S. V. (2009). Components of plastic: Experimental studies in animals and relevance for human health. In *Philosophical Transactions of the Royal Society B: Biological Sciences* (Vol. 364, Issue 1526). https://doi.org/10.1098/rstb.2008.0281

Thompson, R. C., Olson, Y., Mitchell, R. P., Davis, A., Rowland, S. J., John, A. W. G., McGonigle, D., & Russell, A. E. (2004). Lost at Sea: Where Is All the Plastic? *Science*, *304*(5672). https://doi.org/10.1126/science.1094559

TOMRA. (2024). *Norway's deposit return scheme is world's recycling role model*. https://www.tomra.com/reverse-vending/media-center/feature-articles/norway-deposit-return-scheme

van Giezen, A., & Wiegmans, B. (2020). Spoilt - Ocean Cleanup: Alternative logistics chains to accommodate plastic waste recycling: An economic evaluation. *Transportation Research Interdisciplinary Perspectives*, *5*, 100115. https://doi.org/10.1016/j.trip.2020.100115

Wagner, B. E. (2011). *Leo Baekeland's Legacy – 100 Years of Plastics* (pp. 31–67). https://doi.org/10.1021/bk-2011-1080.ch004

Zhang, Y., Zhang, Y. B., Feng, Y., & Yang, X. J. (2010). Reduce the Plastic Debris: A Model Research on the Great Pacific Ocean Garbage Patch. *Advanced Materials Research*, *113–116*, 59–63. https://doi.org/10.4028/www.scientific.net/AMR.113-116.59

Zia, H., Jawaid, M. U., Fatima, H. S., Hassan, I. U., Hussain, A., Shahzad, S., & Khurram, M. (2022). Plastic Waste Management through the Development of a Low Cost and Light Weight Deep Learning Based Reverse Vending Machine. *Recycling*, *7*(5), 70. https://doi.org/10.3390/recycling7050070