



Plastic Waste Management: Opportunities and Challenges in Implementing Circular Economy in Gorontalo

Yanu Endar Prasetyo^{1*}, Budi Setiawan², Rudy H. Alam¹, Sari Seftiani¹, Tity Iriani Datau³, Ivana Butolo³ & Sri Dewi Jayanti Biahimo⁴

¹National Research & Innovation Agency (BRIN), Indonesia

²Statistics Indonesia (BPS), Indonesia

³Regional Planning, Research and Development Agency of Gorontalo Province, Indonesia

⁴IAIN Sultan Amai Gorontalo, Indonesia

Received : January 29, 2024

Revised : January 31, 2024

Accepted : February 2, 2024

Online : March 13, 2024

Abstract

Indonesia is known as the world's second-largest producer of plastic waste, and plastic pollution in the country is expected to continue increasing. The beverage industry in Indonesia is one of the fastest-growing sectors, contributing significantly to the rising volume of plastic waste, which has reached 490 thousand tons per year. Therefore, a comprehensive solution is needed to address this plastic waste crisis. One approach that can be taken by the Government and Local Governments throughout Indonesia is to promote a circular economy practice consisting of 5Rs: Reduce, Reuse, Recycle, Refurbish, and Renew. In a qualitative study conducted by the Population Research Center of BRIN and BPS in 2022, the issues of plastic waste in the Gorontalo Province and the policies undertaken by the government, non-governmental organizations (NGOs), businesses, and the community have been documented. This article will descriptively present the practices of plastic waste management in the Gorontalo Province, along with various obstacles and challenges. The research results indicate that a specific pattern of cooperation and collaboration between the Local Government, NGOs, and local businesses with extensive networks is necessary to drive a plastic waste-based circular economy in Gorontalo. Transforming the plastic waste disaster into an economically prosperous opportunity is not impossible with sufficient green literacy, political will, and genuine commitment from all parties involved.

Keywords *Plastic Waste, Circular Economy, Waste Bank, Waste Management, Gorontalo*

INTRODUCTION

Plastic waste has become a global issue (Browning et al., 2021). The world produced approximately 300 million tons of plastic in 2019 (OECD, 2022). Scientists estimate that by 2050, more plastic will be in the oceans than fish (Kurtela & Antolović, 2019). Based on data from the Indonesian Plastic Industry Association (INAPLAS) and Statistics Indonesia (BPS), plastic waste reaches 64 million tons annually in Indonesia. 3.2 million tons of plastic waste were dumped into the sea. As a result, Indonesia is known as the world's second-largest producer of plastic waste (Puspita et al., 2022). Much research in Indonesia shows that commercial fishes have microplastic in their stomachs due to the increasing volume of marine debris (Hastuti et al., 2019; Yona et al., 2022).

Plastic pollution in Indonesia is expected to continue to increase (Wang & Karasik, 2022). Currently, the beverage industry in Indonesia is one of the fastest-growing sectors. In the first quarter of 2019, the annual growth of the beverage processing industry reached 24.2%, second only to the garment industry. Therefore, a real solution is needed to address this plastic waste crisis. One approach that can be taken by the Government and Local Governments across Indonesia is to promote circular economy practices (Dollan et al., 2023). This article examines to what extent

Copyright Holder:

© Yanu, Budi, Rudy, Sari, Tity, Ivana & Sri. (2024)

Corresponding author's email: yanu005@brin.go.id

This Article is Licensed Under:



the circular economy approach is implemented and advocated by Local Governments in the Gorontalo province. What are the challenges of waste banks and Integrated Waste Management Facilities (TPS3R) in various regions of the Gorontalo Province, and its opportunities in developing the circular economy in the Gorontalo province?

LITERATURE REVIEW

The linear economic approach in waste management must be replaced by a circular economy paradigm, adhering to principles through elimination, reuse, and material circulation (Kaimal & Sajoy, 2020). This approach involves phasing out single-use products and packaging and redesigning products and packaging for durability, reusability, recyclability, repairability, refillability, rechargeability, and composability. In addition to the circular economy approach, the realization of waste as a raw material for the economy can also be achieved through the perspective of waste as an alternative energy source, such as waste-to-fuel (refuse-derived fuel, RDF), waste-to-electricity, or waste-to-heat implementations (Malinauskaite et al., 2017).

Circular economy principles in Indonesia are encompassed within the National Medium-Term Development Plan (RPJMN) 2020 – 2024, under the National Priority Agenda 1: Strengthening Economic Resilience for Quality and Just Growth, and National Priority Agenda 6: Building the Environment, Improving Disaster Resilience, and Climate Change. Under National Priority 6, the Circular Economy falls under the Low Carbon Development umbrella, a concerted effort to achieve a green economy focusing on five priority sectors. Three of the five Low Carbon Development sectors are closely related to circular economy principles: waste management, sustainable energy development, and green industry development.

In 2021, the Ministry of National Development Planning, in collaboration with the United Nations Development Programme (UNDP) Indonesia and the Government of Denmark, launched the report "Economic, Social, and Environmental Benefits of the Circular Economy in Indonesia." (Bappenas, 2021). According to the report, the circular economy has the potential to contribute an additional GDP of IDR 593-638 trillion by 2030. Furthermore, it could create 4.4 million green jobs (75% for women) by 2030. Additionally, approximately 126 million tons of CO₂-equivalent emissions could be reduced by 2030, with a waste reduction of 18-52% in priority sectors and a 6.3 billion m³ reduction in water usage if the circular economy is effectively implemented¹.

There are five sectors in Indonesia with significant potential to adopt the circular economy: food and beverages, textiles, construction, wholesale and retail (plastics), and electronics (Kementerian PPN/Bappenas, 2022). These sectors collectively represent almost one-third of Indonesia's GDP and employed over 43 million people in 2019. The 5Rs guide the circular approach: Reduce, Reuse, Recycle, Refurbish, and Renew (Franconi et al., 2022). Specifically for plastic waste, proper processing of recyclable plastic waste could yield a profit of IDR 16,379,472 per month from the production of 48 tons of plastic waste (Alexander et al., 2022).

RESEARCH METHOD

This study was conducted qualitatively through observation, interviews, and Focus Group Discussions (FGD). In-depth interviews were carried out with key actors in waste management representing Non-Governmental Organizations (NGOs) such as Burung Indonesia, Gorontalo Province, and Japesda Gorontalo; Government entities including the management of TPS3R Cahaya Ulanta in Bone Bolango Regency, TPS3R Desa Bulila, TPS3R KSM Ramadhani, and TPS3R Leato Selatan; and entrepreneurs, specifically waste collectors in the city of Gorontalo and Pahuwato.

¹ Ardiansyah, T. (July 21, 2019). *Sebegini Parah Ternyata Masalah Sampah Plastik di Indonesia*. CNBC. <https://www.cnbcindonesia.com/lifestyle/20190721140139-33-86420/sebegini-parah-ternyata-masalah-sampah-plastik-di-indonesia>

Focus Group Discussion (conducted on June 21, 2022) involved various stakeholders in waste management in the Gorontalo Province. The session included speakers from the Department of Environment and Forestry of Gorontalo Province, the Department of Public Works and Spatial Planning of Gorontalo Province, Academicians from the Regional and Urban Planning Program, Department of Architecture, Faculty of Engineering at the State University of Gorontalo (UNG), and the Industry and Environment Division, Gorontalo Chamber of Commerce, and Industry (KADIN Gorontalo).

FINDINGS AND DISCUSSION

In 2021, the waste generation rate in the Gorontalo Province is estimated to be 552.55 tons per day or 201,680 tons per year. Of the total waste generated, 65% is organic (biodegradable), and 35% is inorganic. The amount of plastic waste generated is approximately 60.78 tons per day (11%), or 22,184.8 tons annually. Plastic waste constitutes a significant volume of each waste entry into the Talumelito Landfill, accounting for 100-120 tons per day, of which 60% is plastic waste, including plastic bottles, bags, and other plastic materials. Therefore, a tangible solution is needed to address the critical issue of plastic waste, and one approach is being undertaken by the government, both at the provincial and municipal levels, through the implementation of circular economy practices (Subekti, 2023).

Table 1. Waste production in Gorontalo Province

No	City/Region	Waste production (daily)	Waste production (annually)
1	Gorontalo regency	159.8	58.327
2	Gorontalo city	146.49	53.471
3	Bone Bolango regency	68.13	24.866
4	Pahuwato regency	64.6	23.579
5	Boalemo regency	61.6	22.475
6	North Gorontalo regency	51.95	18.962
Total		552.57	201.68

Source: Department of Environment and Forestry of Gorontalo Province, 2022

From the monitoring results of marine waste in the Gorontalo Province, there is an apparent increase in the volume of plastic waste. For example, based on the monitoring results at Leato Beach in 2019, plastic waste accounted for only 2.49%, but in 2020, it increased to 23%. This increase is attributed to the impact of the flood disaster that struck Gorontalo City in 2020, causing the river currents to carry plastic waste from residential areas into the sea. Similarly, at Indah Beach, plastic-based waste increased from 12.04% in 2019 to 42% in 2020.

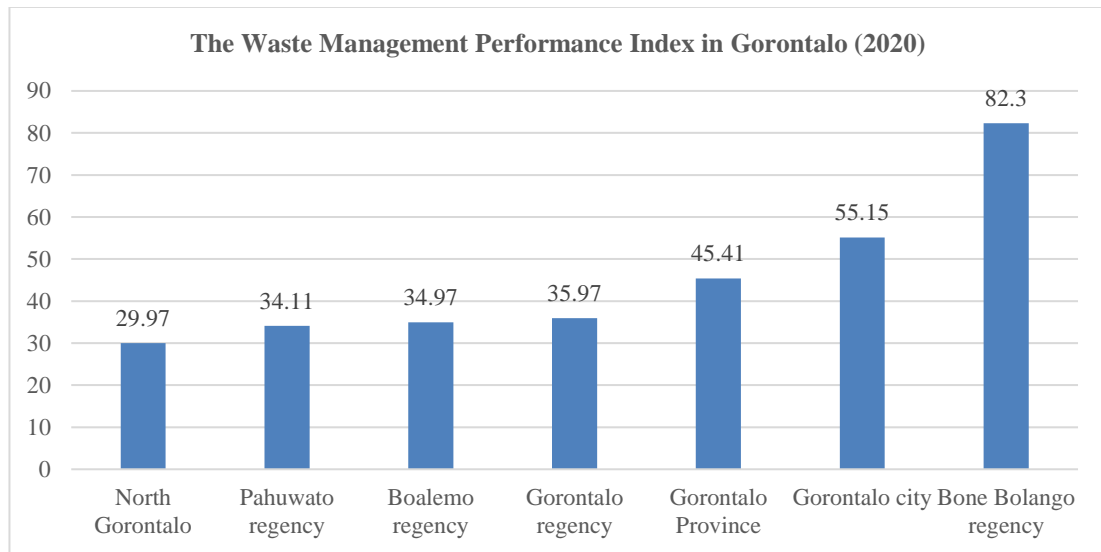


Figure 1. The Waste Management Performance Index in Gorontalo (2020)

The opportunities and challenges of waste bank and TPS3R management in the Gorontalo Province play a crucial role in waste reduction, processing, and sorting, particularly in the city of Gorontalo, which contributes most of the waste entering the Talumelito Landfill, accounting for 60-70% of the daily waste volume of 120 tons. Thus, support from TPS3R in Gorontalo City is essential. Data from 12 TPS3R facilities indicate that only 2 of them are actively engaged in waste sorting. The social, economic, and environmental benefits of plastic recycling in Gorontalo remain limited as there have been insufficient efforts to strengthen the active role in waste management, especially for plastic materials from producers and the community. This lack of active engagement hinders the transformation of waste into a more valuable resource.

Table 2. Problem and potential strategy for waste management in Gorontalo Province

No	Problem	Strategy & Solution
1	Waste management activities in districts/cities in achieving regional policy and strategy targets for 2017-2025 are not yet optimal.	<ul style="list-style-type: none"> Strengthening coordination and cooperation between Provincial and District/City Governments Increasing leadership, institutional, and human resource capacity in waste management efforts
2	The facilities and infrastructure available at the District/City Environmental Service still need to be improved. Only some districts/cities have a final waste processing site (TPA). Inadequate infrastructure capacity is a significant challenge. For instance, the waste volume in Pahuwato Regency, based on weigh-in data of waste entering the landfill, is approximately 350-450 tons per month. This amount is still significantly below the current machine production capacity (less than 10 tons per month).	<ul style="list-style-type: none"> Encourage districts/cities to provide facilities and infrastructure through Regional Revenue and Expenditure Budget funds and Special Allocation Funds from the Ministry of the Environment. Maximize the provision and function of TPST and TPS3R Implementation of waste handling technology that is environmentally friendly and appropriate.

No	Problem	Strategy & Solution
3	The role of the private sector has yet to be optimal in supporting waste management. Identifying products with potential acceptance by consumers in large quantities is essential, considering the abundance of raw plastic material types that are currently available but not absorbable by industries.	<ul style="list-style-type: none"> • Require the private sector/business to manage its waste independently. • Encourage the private sector/business to assist local governments and communities in managing waste through CSR programs. • Strengthening commitment and involvement of the business world through partnerships with provincial and district/city governments.
4	The budget allocation provided by the regional government for carrying out waste management has yet to be maximized. Also, the distance between the waste recycling facility and industries that accommodate its production results is considerable, resulting in high transportation costs and delivery durations. This circumstance hinders a significant enhancement in recycling activities.	<ul style="list-style-type: none"> • Strengthening the commitment of executive and legislative institutions to provide the budget.
5	There are no strict sanctions or deterrent effects for anyone who throws rubbish carelessly.	<ul style="list-style-type: none"> • Strengthening law enforcement
6	The community's awareness, role, and participation in managing waste (sorting and recycling) still needs to be improved.	<ul style="list-style-type: none"> • Strengthening community involvement through communication, information, and education. • Implementation and development of incentive and disincentive systems. • Establishment of an information system

Source: FGD notes (authors)

There are several actors and agencies that support and play a role in developing a circular economy in the Gorontalo province. First, manufacturers. As a producer of packaging as a source of waste, producers must be able to utilize recycling. This is in line with the Minister of Environment Regulation No. 75/2019 concerning a road map for reducing waste by producers. Second, household. As consumers, households need to sort waste and sell or save waste at waste banks. This is in accordance with a ministerial circular regarding the national movement to sort waste from homes. Third, the waste bank and TPS3R. They receive and distribute waste from households and the entire community. Fourth, the recycling industry. This party will receive and buy waste from the waste banks or waste collectors. They will use waste as raw material for the paper and plastic recycling industry.

Apart from TPS3R, the Waste Bank scheme can also be an alternative for managing plastic waste in Gorontalo. A collective inorganic waste management system that encourages the community to take an active role in it. This system will accommodate, sort, and distribute waste of economic value to the recycling industry so that the community gets environmental, social, and economic benefits. Waste banks "force" people to sort waste based on type. In this way, the waste bank system can be used as a tool for social engineering so that a better waste management system or order is formed in society. The legal basis for Waste Banks is contained in the Minister of Environment Regulation No. 13 of 2012, including waste bank requirements, working mechanisms, implementation, and implementers.

Waste Banks and Waste Collectors have similarities and differences. The two have in common that they both manage inorganic waste and try to reduce waste that goes to landfill. The difference is that Waste Banks usually have a long-term orientation, increasing customer output; the main goal is the environment, education, and changing people's mindset and behaviour. Meanwhile, waste collectors are usually short-term oriented, output increases in the amount of waste, the main goal is economic profit, and do not attempt to change people's thought patterns and behaviour.

Waste Bank Management has at least three challenges; the first is the lack of community motivation to sort waste. Second, there are minimal regulations related to waste management and implementation of regulations that are not yet in effect, and third, the economic value of waste is still too low. On the other hand, the opportunity for a waste bank is relatively large. As the waste recycling industry continues to develop, the waste bank concept is also considered sustainable, with a target of increasing the number of customers. The waste bank can be a medium for community organization that suits the character of the Indonesian people who like to organize and work collectively.

An alternative strategy to capitalize on this potential is selling plastic waste materials to the main factory (Surabaya). To optimize returns, it is crucial to categorize materials selectively, recognizing the varying qualities among plastics and other materials. Higher prices are often associated with white-coloured and glossy plastics, while factors like thickness and durability influence the rarity of certain materials. However, operational costs can sometimes outweigh the benefits, prompting collectors to store plastic in warehouses for extended periods. This delay allows them to wait until the market conditions are favourable to maximize profits. One significant challenge Gorontalo Province faces is the high transportation costs, which can erode the overall business profitability. Exploring alternatives or developing a strategic plan to establish waste production and recycling facilities is beneficial to address this issue.

Diversifying the application of recycled plastic is another avenue for improvement. For instance, transforming waste into bricks and paving blocks for road construction or developing technology to create agricultural tools, such as earth pillow wrapping blankets, can add value to recycling. Additionally, addressing emerging issues, such as the production of oils for vehicles and machinery, poses a unique challenge due to the massive fuel consumption in Gorontalo Province. In this context, it is essential to recognize that more than the current supply of materials may be needed to meet the demands of this expanding business sector. By addressing operational inefficiencies, exploring alternative strategies, and diversifying the applications of recycled materials, Gorontalo Province can unlock the full potential of its waste management and recycling industry, fostering economic development and sustainability.

CONCLUSIONS

In conclusion, the findings of this research reveal a concerning waste generation rate in the Gorontalo Province. The plastic waste influx into the Talumelito Landfill, particularly from Gorontalo, is alarming, accounting for 60-70% of the daily waste volume. The increase in plastic waste is evident in marine environments, exemplified by monitoring results at Leato Beach and Indah Beach, reflecting the broader environmental repercussions. The Waste Management Performance Index in Gorontalo indicates the pivotal role of waste bank and TPS 3R management in waste reduction, processing, and sorting. However, challenges persist, such as limited active engagement in waste sorting and inadequate social, economic, and environmental benefits from plastic recycling. The waste management sector faces challenges, including insufficient facilities, limited waste processing sites, and suboptimal private sector involvement.

The potential strategy table outlines critical issues in waste management and suggests strategies for improvement. Notably, coordination between government levels, infrastructure enhancement, law enforcement, and community engagement is crucial in overcoming these challenges. Furthermore, the study identifies several actors supporting circular economy development in Gorontalo, including manufacturers, households, waste banks, and the recycling industry. These entities play distinct roles in promoting sustainable waste management practices. The Waste Bank scheme emerges as a potential solution for plastic waste management, aligning with regulatory frameworks.

While challenges such as community participation, regulatory gaps, and low economic value persist, the waste bank concept offers an opportunity for sustainable waste management driven by increasing household participation and the potential for positive societal changes. The comprehensive analysis of waste management in the Gorontalo Province underscores the urgency of strategic interventions, collaboration between stakeholders, and implementing circular economy principles to mitigate the environmental impact of escalating plastic waste generation.

REFERENCES

- Alexander, I., Putri, M. M. W., Simatupang, R., Soepardjo, T., Maharani, G., Dachlan, A., & Sekarsari, D. (2022). *Plastic and Recycling Industry Outlook in Indonesia: An Assessment on Capacity and Capability Economic Growth Support Activity, September 2022*.
- Bappenas. (2021). *The Economic, Social and Environmental Benefits of a Circular Economy in Indonesia*. Ministry of National Planning and Development Indonesia, p. 205. <https://lcdi-indonesia.id/wp-content/uploads/2021/02/Full-Report-The-Economic-Social-and-Environmental-Benefits-of-a-Circular-Economy-in-Indonesia.pdf>.
- Browning, S., Beymer-Farris, B. & Seay, J. R. (2021). Addressing the challenges associated with plastic waste disposal and management in developing countries. *Current Opinion in Chemical Engineering*, 32, 100682. <https://doi.org/10.1016/j.coche.2021.100682>.
- Dollan, E., Ramadhan, B. D. K. & Abrina, N. (2023). Assessing the Outcomes of Circular Economy and Waste Management Partnerships between Indonesia and Denmark. *IAIC Transactions on Sustainable Digital Innovation (ITSDI)*, 5(1), 76–83. <https://doi.org/10.34306/itsdi.v5i1.609>.
- Franconi, A., Ceschin, F. & Peck, D. (2022). Structuring Circular Objectives and Design Strategies for the Circular Economy: A Multi-Hierarchical Theoretical Framework. *Sustainability (Switzerland)*, 14(15). <https://doi.org/10.3390/su14159298>.
- Hastuti, A. R., Lumbanbatu, D. T. F. & Wardiatno, Y. (2019). The presence of microplastics in the digestive tract of commercial fishes off pantai Indah Kapuk coast, Jakarta, Indonesia. *Biodiversitas*, 20(5), 1233–1242. <https://doi.org/10.13057/biodiv/d200513>.
- Kaimal, M. M. & Sajoy, P. B. (2020). Circular Economy - A Paradigm Shift for Sustainable Development. *Perspectives on Business Management & Economics*, 1(1), 132–141.
- Kementerian PPN/Bappenas (2022). *Stakeholder Mapping Report And Recommendations For The Diffusion Of Circularity Innovations In Supporting The Circular Economic Transition In Indonesia*. Strengthening the Implementation of a Circular Economy in Indonesia, (February).
- Kurtela, A. & Antolović, N. (2019). The problem of plastic waste and microplastics in the seas and oceans: Impact on marine organisms. *Ribarstvo, Croatian Journal of Fisheries*, 77(1), 51–56. <https://doi.org/10.2478/cjf-2019-0005>.
- Malinauskaitė, J., Jouhara, H., Czajczyńska, D., Stanchev, P., Katsou, E., Rostkowski, P., Thorne, R. J., Colón, J., Ponsá, S., Al-Mansour, F., Anguilano, L., Krzyżyńska, R., López, I. C., Vlasopoulos, A., & Spencer, N. (2017). Municipal solid waste management and waste-to-energy in the context of a circular economy and energy recycling in Europe. *Energy*, 141, 2013–2044. <https://doi.org/10.1016/j.energy.2017.11.128>.

- OECD (2022). *Global Plastics Outlook: Economic Drivers, Environmental Impacts and Policy Options*. Global Plastics Outlook, p. 201. https://www.oecd-ilibrary.org/environment/global-plastics-outlook_de747aef-en.
- Puspita, S. D., Sodri, A. & Utomo, S. W. (2022). Environmental Impact Assessment on Plastic Waste Recycling Business in Bengkulu City, Indonesia. *IOP Conference Series: Earth and Environmental Science*, 1111(1). <https://doi.org/10.1088/1755-1315/1111/1/012022>.
- Subekti, R. (2023). A Circular Economy-Based Plastic Waste Management Policy in Indonesia (Compared to China and EU). *Yustisia*, 12(2), 168–184. <https://doi.org/10.20961/yustisia.v12i2.72177>.
- Wang, Y. & Karasik, R. (2022). *Plastic Pollution Policy Country Profile: Indonesia*. Nicholas Institute for Environmental Policy Solutions. <https://nicholasinstitute.duke.edu/sites/default/files/projects/Plastic-Pollution-Policy-Country-Profile-Indonesia.pdf>.
- Yona, D., Evitantri, M. R., Wardana, D. S., Pitaloka, D. A., Ningrum, D., Fuas, M. A. Z., Prananto, Y. P., Harlyan, L. I., & Isobe, A. (2022). Microplastics in Organs of Commercial Marine Fishes from Five Fishing Ports in Java Island, Indonesia. *ILMU KELAUTAN: Indonesian Journal of Marine Sciences*, 27(3), 199-214. <https://doi.org/10.14710/ik.ijms.27.3.199-214>.