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POTENTIAL FOR MANAGING WASTE GROWTH BASED ON DIGITAL PLATFORM IN HULU SUNGAI TENGAH DISTRICT, INDONESIA

Saputra Mulyadi*, Mahreda Emmy Sri, Lilimantik Emmy, Mahyudin Rizqi Puteri

Postgraduate Program of Natural Resources and Environmental Management,
University of Lambung Mangkurat, Banjarbaru, Indonesia

*E-mail: mahredaemmysri@gmail.com

ABSTRACT

One of the causes of environmental pollution is the problem of waste. The more people in an area, the more waste will be generated. This study aims to analyze the potential for managing waste generation based on a digital platform in Hulu Sungai Tengah Regency. The study was conducted at the business location of the Mandiri Urban Garbage Bank, Bukat Village Council, Barabai District, Hulu Sungai Tengah Regency. The Council's Urban Waste Bank has complete legal aspects of its business, often participates in training and plays an active role in modern waste management based on digital platforms. The data analysis technique used descriptive method. and the Likers scale method. obtained from the results of the questionnaire. The results show that the potential for waste generation based on digital platforms in Hulu Sungai Tengah Regency uses Ratikita. id is a digital-based platform in modern waste management that follows technological developments. The total population in the service area (total population served) in 2021 is 130,475 people, so that the waste generation resulting from the load-count analysis method is 12.79 kg/person/month or equivalent to 0.43 kg/person/day. The results of recording the volume of waste entering the Telang TPA in 2021 are 20,306,089 Kg/year or equivalent to 55,663.12 Kg/day. Waste generation based on the balance of waste management performance in Hulu Sungai Tengah Regency in 2021 is 37,773.27 Tons/year or equivalent to 103,488.4 Kg/day. The percentage of waste composition in Hulu Sungai Tengah Regency (Year 2021) consists of 40.04% waste. organic waste, 24.91% plastic waste, 4.05% paper waste, 3.63% metal waste, and 1.05% cloth/textile waste, 1.24% leather rubber waste, 1.47% glass waste.

KEY WORDS

Garbage generation, digital platform, Ratikita.id, Hulu Sungai Tengah.

One of the causes of environmental pollution is the problem of waste. The more people in an area, the more waste will be generated. This continuous increase in the amount of waste is in line with the increasing quality of people's lives and the number of people or humans and is accompanied by advances in science and technology which also results in a shift in people's lifestyles that tend to be consumptive (Sari et al, 2012). Garbage is an object or material that is no longer used by humans so that it is thrown away. An increase in the volume of waste, if not accompanied by good management, will certainly have a negative impact on the decline in environmental quality.

Law No. 18 of 2008 concerning Waste Management, it is stated that waste is the residue of daily human activities or natural processes in the form of solid or semi-solid in the form of organic or inorganic substances that are biodegradable or non-biodegradable which are considered no longer useful and are disposed of into the environment. Garbage is basically a material that is wasted or disposed of from a source resulting from human activities or natural processes that have no economic value, it can even have a negative value because in handling it, either to dispose of it or to clean it requires a large enough cost. In addition, the characteristics of garbage are smelly; garbage can also cause diseases such as diarrhea (Gunawan, 2007).

The habit of littering is carried out by almost all circles of society, not only the poor, even those with higher education also do it because of the lack of knowledge about waste and its effects (Kartiadi, 2009). According to (Sahil, 2016), the factors that influence waste



management which are considered as system barriers are the distribution and population density, environmental characteristics, attitudes, behavior and culture in the community and socio-economic.

The problem of solid waste in Hulu Sungai Tengah Regency not only because of the increase in population, but also due to the low level of basic environmental services and facilities, especially in the field of waste services, which results in incomplete waste management, causing piles of garbage that are not transported every day. As many as 261,042 people produced 3,147 tons of waste/month and 104.9 tons/day. Law No.18 of 2008 concerning waste management emphasizes the need for changes in waste management patterns that rely on waste reduction and handling. Waste reduction can be done by limiting the accumulation of waste, recycling and reusing waste or known as 3R (Reduce, Reuse, and Recycle). The implementation of 3R activities in the community is still constrained, especially by the lack of public awareness to sort waste (Suryani, 2014; Yunita, Adriansyah and Amalia, 2021).

Waste processing innovation with the waste bank program is an innovation at the lower middle level to increase the income of the urban poor (Elza, Ekayani and Ismail, 2020; Suleman et al., 2021). Until now, Hulu Sungai Tengah Regency has not used the waste bank application system, so the director of the waste bank, Mr. Mulyadi Saputra, is very interested in introducing and inviting the people of Hulu Sungai Tengah Regency to use the waste bank application system to facilitate access to waste in the community through a digital platform based on smartphones. This study aims to analyze the potential for managing waste generation based on digital platforms in Hulu Sungai Tengah Regency.

MATERIALS AND METHODS OF RESEARCH

The study was conducted at the business location of the Mandiri Urban Garbage Bank, Bukat Village Council, Barabai District, Hulu Sungai Tengah Regency. The Council's Urban Waste Bank has complete legal aspects of its business, often participates in training and plays an active role in modern waste management based on digital platforms.

Sugiyono (2012) states that to determine the sample to be used in a study, there are various sampling methods. In this research, the sampling method used is purposive sampling method. The sampling method is through careful consideration and appropriate assessment so that the results are representative. The research sample is the Mandiri Urban Garbage Bank, Bukat Village Council, Barabai District, Hulu Sungai Tengah Regency, with consideration. The Council's Urban Waste Bank has complete legal aspects of its business, often participates in training and plays an active role in modern waste management based on digital platforms and successfully survives in the implementation of waste management in the COVID-19 pandemic situation and in the midst of other Waste Banks experiencing a decline in activities. Most accurately describes the situation of modern urban waste management business actors based on digital platforms. The data were obtained from interviews, observations, documentation and supporting data from the Hulu Sungai Tengah Regency Environmental Service

The data analysis technique used descriptive method, and the Likers scale method obtained from the results of the questionnaire. In the questionnaire there are questions that will be asked to respondents about community participation on the banks of the Levis River (2013).

RESULTS AND DISCUSSION

Source of waste is defined as the origin of waste generation. In Hulu Sungai Tengah Regency, including household waste sourced from home/kitchen activities and other household activities, household waste similar to household waste sourced from markets, shops, restaurants, companies and so on, and other sources of waste according to the source waste (for example, from agricultural waste, animal cages/abattoirs, clean water treatment plants, wastewater treatment plants and others).



According to SNI 19-2454-2002 concerning operational technical procedures for urban waste management, waste generation is the amount of waste that arises from the community in units of weight per capita per day, or expand buildings, or extend roads. Broadly speaking, it can be interpreted as the volume of waste generated by the community. The unit or units of waste generation are usually in Kg/person/day, to extend the road usually use liters/road length.

The amount of waste generated needs to be known, so that waste management can be carried out effectively and efficiently. The amount of waste generated will be related to the elements of waste management, including: (a) selection of equipment, such as containers, collection and transportation equipment; (b) transportation route planning; (c) facilities for recycling; and (d) the area and type of TPA. The amount of waste generated in Hulu Sungai Tengah Regency is influenced by several factors, including: (a) reduction in waste sources that have not been managed properly, this greatly affects the amount of waste generated; (b) not optimal/still minimal reduction of waste generation at waste sources; (c) poor community habits in handling waste (managing waste); (d) lack of regulations related to government policies such as regulations to reduce the use of packaging that is not environmentally friendly; and (e) Physical and geographical conditions (season, climate, highlands). An important factor in calculating the rate of waste generation is the population.

The total population of Hulu Sungai Tengah Regency in 2021 based on Hulu Sungai Tengah Regency in Figures for 2022 is 260,754 people. Hulu Sungai Tengah Regency is included in the medium city category (100,000 – 500,000 inhabitants). The criteria for the amount of waste generation based on city classification are 711,482.75 liters/day up to 840,843.25 liters/day with a weight of 181,104.7 Kg/day up to 206,976.8 Kg/day. It can be seen that the population growth rate in Hulu Sungai Tengah Regency in 2020-2021 which is 0.59 greatly affects the volume of waste generation. The waste generation of Hulu Sungai Tengah Regency for the period January 2021 to December 2021 based on the balance of the performance of the waste management performance of Hulu Sungai Tengah Regency in 2021 is 37,773.27 Tons/Year or equivalent to 103,488.4 Kg/day. The waste generation is still lower than the standard for medium-sized cities, the waste generation in Hulu Sungai Tengah Regency is 103,488.4 Kg/day while the lowest standard for medium-sized cities is 181,104.7 Kg/day.

As a comparison, the waste generated in Hulu Sungai Tengah Regency in 2021 is also calculated by conducting a survey of taking waste samples directly at the waste source. This collection is to find out the average amount of waste generated in liters/person/day or Kg/person/day. In 2019 a survey of collection and measurement of urban waste generation samples was carried out using SNI number 19-3964-1994, the results obtained were: (a) the average weight of waste measured for permanent houses = 0.315 Kg/person/day; (b) the average weight of waste measured for semi-permanent houses = 0.345 Kg/person/day; and (c) the average weight of waste measured for non-permanent houses = 0.235 Kg/person/day. The percentage of waste generation is 75% from residential and 25% from non-residential. The amount of urban waste generation in Hulu Sungai Tengah Regency = 0.398 Kg/person/day (rounded up to 0.4 Kg/person/day). The waste generation in Hulu Sungai Tengah Regency in 2021 (using the survey results of sampling and measuring urban waste generation in 2019) is 104,301.60 Kg/day (equivalent to 104.30 Tons/day = 38,070.08 Tons/year).

More 813.20 Kg/day of waste generation is generated between waste generation based on waste generation from waste sampling surveys directly at the source of waste and the balance of waste management performance in Hulu Sungai Tengah Regency in 2021. Waste generation is based on the balance of waste management performance in Hulu Sungai Tengah Regency. Sungai Tengah in 2021 amounted to 37,773.27 Tons/Year or equivalent to 103,488.4 Kg/day, while based on a survey of direct waste sampling at waste sources conducted in 2019, the waste generation in 2021 is estimated at 38,070.08 Tons/Year or equivalent to 104,301.60 Kg/day.

Estimated waste generation in Hulu Sungai Tengah Regency in 2021 is by the load-count analysis method which is based on the number of transport vehicles entering the Final



Processing Site (TPA) based on number, volume, and weight, and then the amount of municipal waste generation is calculated for a certain period. This load-count analysis method is more appropriate to see how big the percentage of final waste processing in Hulu Sungai Tengah Regency in 2021 after other waste handling (sorting/collection – transportation – processing) and waste reduction or to see how much waste is generated in the area. Hulu Sungai Tengah Regency that arrives or enters to be processed at the TPA. The results of recording the volume of waste entering the Telang TPA in 2021 are 20,306,089 Kg/year or equivalent to 55,663.12 Kg/day.

Table 1 – Average Daily Waste Collected

No	Types of Facilities	Criteria for the Ministry of PUPR (Kg/person/day)	Year 2014 (Kg/person/day)	Year 2019 (Kg/person/day)
1	Permanent House	0,350 – 0,400	0,154	0,315
2	Semi-Permanent Houses	0,300 – 0,350	0,247	0,345
3	Non-Permanent House	0,250 – 0,300	0,253	0,235

Source: Ministry of PUPR, BPLH District of Hulu Sungai Tengah 2014.

In 2021, there will be 9 sub-districts for waste transportation services. Garbage services in Haruyan Subdistrict are 5 villages, Batu Benawa Subdistrict is 5 villages, Hantakan Subdistrict is 4 villages, Batang Alai Selatan Subdistrict is 9 villages and 1 kelurahan, Barabai Subdistrict is 12 villages and 6 wards, South Labuan Amas Subdistrict is 5 villages and 1 sub-district, North Labuan Amas District as many as 6 villages, Pandawan District as many as 7 villages and North Batang Alai District as many as 6 villages. The total population in the service area (total population served) in 2021 is 130,475 people, so that the waste generation resulting from the load-count analysis method is 12.79 kg/person/month or equivalent to 0.43 kg/person/day.

Table 2 – Garbage Generation Kab. Upper Middle River 2021

No	Garbage Generation	Weight (Kg/day)
1	The balance sheet for the performance of waste management in Hulu Sungai Tengah Regency in 2021	103.488,40
2	Population development and waste sampling survey at waste sources 104,301.60	104.301,60
3	Metadata load-count analysis	55.663,12

Source: DLHP Hulu Sungai Tengah Regency in 2021.

The table above shows that, every day in 2021 around 55,663.12 Kg of waste goes to the final processing at the Telang TPA for landfill. 53.79% of waste generation based on the balance sheet of the performance of the waste management performance of Hulu Sungai Tengah Regency in 2021 goes to the Telang TPA. The composition of waste in Hulu Sungai Tengah Regency varies based on the source of the waste, the characteristics of community behavior as well as different economic conditions and the process of handling waste at the source of the waste. The average percentage composition consists of organic waste, plastic, and paper and others. These three always dominate the composition of waste in Hulu Sungai Tengah Regency. Mentioned in Iman, M., S. & Warmadewanthi, I. (2018), the percentage of waste composition in Hulu Sungai Tengah Regency (in 2021) consists of 40.04 % organic waste, 24.91% plastic waste, 4.05% paper waste, 3.63% metal waste, and 1.05% cloth/textile waste, 1.24% leather rubber waste, 1.47% glass waste.

According to SNI 19-3964-1995, the components of the composition of waste are physical components of waste such as food scraps, paper-cardboard, wood, fabric-textiles, rubber-leather, plastic, ferrous and non-ferrous metals, glass and others (e.g. soil, sand, stone and ceramics). The table above shows that the waste generation in 2021 in Hulu Sungai Tengah Regency is still dominated by household sources. Household waste comes from daily activities in the household (excluding feces and specific waste). Other sources of waste in Hulu Sungai Tengah Regency, namely in markets and other warehousing, offices,



roads/public facilities and others can be categorized as household waste as long as it is not feces or specific waste.

Table 3 – Waste Generation by Source in 2021

No	Source	Percentage (%)	Waste Generation (Kg/day)
1	Markets and other trades	42,67	44.158,50
2	Household	45,26	46.838,85
3	Offices	5,17	5.350,35
4	Roads/public facilities	3,88	4.015,35
5	Others	3,02	3.125,35
	Total	100,00	103.488,40

Source: DLHP Hulu Sungai Tengah Regency in 2021.



Figure 1 – Waste generation from residential areas, markets and shops
(Source: DLHP Hulu Sungai Tengah Regency, 2021)

The government of Hulu Sungai Tengah Regency realizes that the waste problem has become a serious problem. A comprehensive and integrated management system is needed from upstream to downstream. Waste management is all activities related to the control of waste generation, collection, transfer and transportation, processing and final processing/disposal of waste, taking into account environmental health factors, economy, technology, conservation, aesthetics, and other closely related environmental factors. with public response. According to Law Number 18 of 2008 concerning Waste Management, waste management is defined as a systematic, comprehensive, and sustainable activity that includes waste reduction and handling.

According to Law Number 18 of 2008 concerning Waste Management, waste management is carried out based on the principle of responsibility, the principle of sustainability, the principle of benefit, the principle of justice, the principle of awareness, the principle of togetherness, the principle of safety, the principle of security and the principle of economic value. Waste management aims to improve public health and environmental quality and make waste a resource. The Hulu Sungai Tengah Regency Government is tasked with ensuring the implementation of good and environmentally sound waste management with the following authorities:

- Establish policies and strategies for waste management based on national and provincial policies;
- Organizing waste management on the scale of Hulu Sungai Tengah Regency in accordance with the norms, standards, procedures, and criteria set by the Government;
- To provide guidance and supervision of waste management performance carried out by other parties;
- Determine the location of temporary shelters, integrated waste processing sites, and/or final waste processing sites;



- Monitoring and evaluating periodically every 6 (six) months for 20 (twenty) years on the final waste processing site with an open disposal system that has been closed; and
- Develop and implement a waste management emergency response system in accordance with its authority.

The old paradigm of waste management in Hulu Sungai Tengah Regency is conventional waste management which relies on the process of collection, transportation and final disposal. Until 2021, this paradigm has been changed by prioritizing the process of reducing waste and handling waste. This significant reduction and handling of waste is expected to reduce the need for management. In Hulu Sungai Tengah Regency, community participation in reducing and handling waste from the source is still relatively low, but these activities have started to appear, although not much. The composition of the waste in Hulu Sungai Tengah Regency, which is dominated by organic content, is a potential source of compost raw materials in which community involvement is still low. Waste reduction by the informal sector has begun to emerge which is part of urban waste management in Hulu Sungai Tengah Regency.

In Hulu Sungai Tengah District, waste reduction activities include: (a) limiting waste generation; (b) waste recycling; and/or (c) waste reuse. Meanwhile, waste handling activities include: (a) sorting in the form of grouping and separating waste according to the type, amount, and/or nature of the waste; (b) collection in the form of collection and transfer of waste from the source of the waste to a temporary shelter (TPS) or a 3R waste processing site (TPS3R), or an integrated waste processing site (TPST); (c) transportation in the form of carrying waste from the source and/or from TPS or from TPS3R or from TPST to the final processing place (TPA); (d) processing in the form of changing the characteristics, composition and amount of waste; and/or (e) final processing of waste in the form of safe return of waste and/or residue resulting from previous processing to environmental media.

Ratikita.id Digital Platform. Ratikita.id is a digital-based platform in modern waste management that follows technological developments that aim at unlimited services, price transparency and supporting features in waste data management. Ratikita.id was born on November 11, 2021 which was officially launched for use at the Dewan Urban Waste Bank. Ratikita.id is one of the waste bank innovations in facing the digitalization era or industry 4.0 so that people are more enthusiastic and enthusiastic about saving in a waste bank, Ratikita.id's digital innovation is a millennial movement that cares about waste that aims to digitize the waste business that has economic value. The platform adopts various digital applications that are currently developing. There are various features available in the application, including:

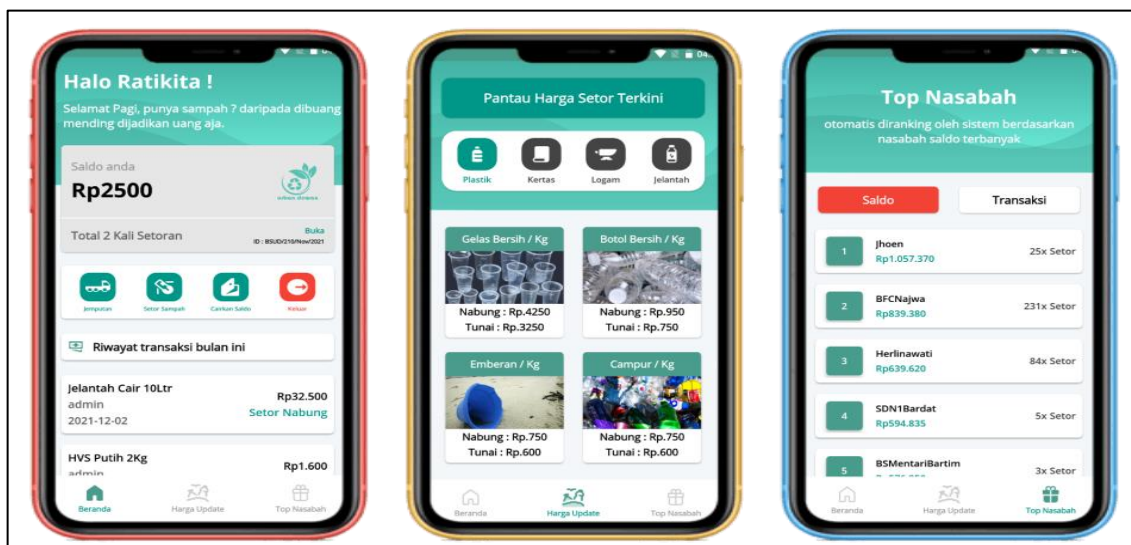


Figure 2 – Features of the Ratikita.id digital application



Starting with the balance feature, which displays the amount of money held based on the waste transactions that have been made. Then, there is also a pick-up feature that is used for customers who want to save. There is also a waste deposit and cash balance feature that displays a barcode and is useful for customers to save and withdraw their balance digitally. Furthermore, there is also an updated price feature that shows the monitoring of deposit prices for various types of waste with price variations.

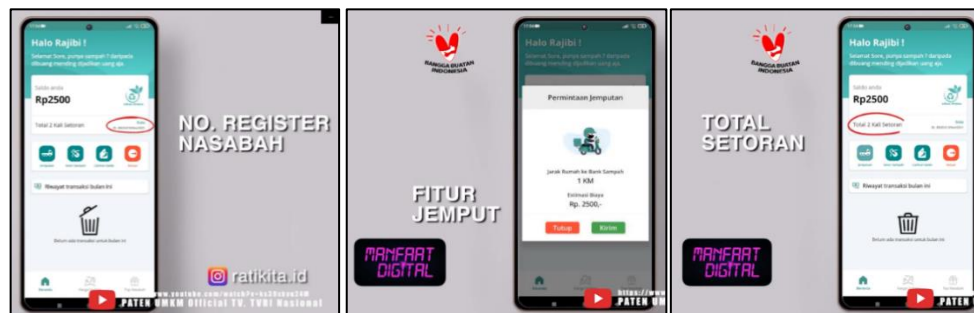


Figure 3 – Register feature, total deposit feature and pick-up feature

Waste reduction efforts are aimed more at the source of the waste. Waste reduction activities include limiting waste generation, recycling waste and/or reuse of waste. Waste generation restriction is an effort to minimize waste generation which is carried out from before the production of a product and/or product packaging until the end of the use of the product and/or product packaging. Examples of implementations that are trying to be implemented in Hulu Sungai Tengah Regency are:

- The use of goods and/or packaging that can be recycled and easily decomposed by natural processes, such as the use of banana leaves as a substitute for boxes or wrapping paper at meetings);
- Limiting the use of plastic bags, such as getting used to the use of tote bags made of purun or other non-disposable materials;
- Avoiding the use of single-use items and/or packaging, such as familiarizing yourself with the use of a tumbler.

Waste restrictions in Hulu Sungai Tengah Regency are still limited to appeals that have not yet turned into a formal legal policy in the form of a regional statutory regulation.

Garbage Handling. There are several patterns of waste collection in Hulu Sungai Tengah Regency, namely:

- Indirect individual pattern from house to house where collection tools in the form of pick-ups and 3-wheeled transportation equipment enter the housing complex or residential alleys reaching directly to the source of the waste;
- Direct individual pattern with dump trucks for roads and public facilities, this pattern is used for waste sources located on protocol roads;
- Direct communal pattern for markets and commercial areas, this pattern is by placing TPS or containers (communal containers) placed in market locations and commercial areas as needed, this pattern is also used for irregular settlements and/or collection tools difficult to reach waste sources individual;
- Indirect communal pattern for dense settlements, this pattern is used by placing TPS;
- Road sweeping pattern, this pattern of garbage collection is done by means of road sweeping waste is transported to the transfer location and then transported to the TPA.

The potential level of waste generation management based on digital platforms in waste management in the Upper Sungai Tengah district using planning, implementation, and evaluation is seen from active participation to inactive participation.

The results of the questionnaire with the category of very no role had a percentage level of 0%, no role had a percentage rate of 2.3%, less role had a percentage rate of 5.7%,



role played had a percentage level of 39.1% and very instrumental had a percentage rate of 52.9%. After analyzing the data to obtain the percentage of each respondent, it can be calculated the overall total of the respondent data above as below: The results of the respondent's questionnaire stated that the category variable had no role at all having a percentage level of 0.43%, the category not playing a role had a percentage rate of 6.25%, category less role has a percentage level of 14.91%, the category of playing a role has a percentage level of 51.83% and the very instrumental category has a percentage level of 26.66%. On average, the highest respondents answered the role category and the very role category as seen from the results of each respondent's answer in which the category played a role 51.83% and the category played an important role 26.66%.

CONCLUSION

The potential for waste generation based on digital platforms in Hulu Sungai Tengah Regency uses Ratikita.id is a digital-based platform in modern waste management that follows technological developments. The total population in the service area (total population served) in 2021 is 130,475 people, so that the waste generation resulting from the load-count analysis method is 12.79 kg/person/month or equivalent to 0.43 kg/person/day. The results of recording the volume of waste entering the Telang TPA in 2021 are 20,306,089 Kg/year or equivalent to 55,663.12 Kg/day. Waste generation based on the balance of waste management performance in Hulu Sungai Tengah Regency in 2021 is 37,773.27 Tons/year or equivalent to 103,488.4 Kg/day. The percentage of waste composition in Hulu Sungai Tengah Regency (Year 2021) consists of 40.04% waste. organic waste, 24.91% plastic waste, 4.05% paper waste, 3.63% metal waste, and 1.05% cloth/textile waste, 1.24% leather rubber waste, 1.47% glass waste.

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