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RESEARCH PAPER

Household and household-related waste generation and characteristics in rural areas: A case study in Tanjungsari Sub-district

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Abstract. Waste management issues in rural locations differ from those in metropolitan ones. Unmanaged waste has the potential to harm the rural environment. Understanding the generation and characteristics of household and household-related waste is the starting point for planning waste management. Accurate measurement of waste generation and characteristics helps optimize waste reduction and recycling efforts. Therefore, this study aims to measure the waste generation and characteristics in rural areas using the Indonesia National Standard 19-3964-1994 method. The survey team visited 60 samples of residential and non-residential properties in the Tanjungsari Sub-district for eight consecutive days. Based on the results, the waste generation was 0.34 kg person^{-1} day^{-1}. Organic waste (food waste, leaves, paper, and wood) accounts for the majority of garbage (81,34%), followed by inorganic materials (plastic, fabric, other materials, metal, and glass) at 15.66%, 1.86%, 0.91%, 0.12%, 0.11% respectively. The residential waste density is 196.1 kg m^{-3}, while in non-residential areas is 63.63 kg m^{-3}. Family size and income, living habits, and the type of economy or industry that develops have influenced the rural waste generation and composition. Rural waste management strategies need to consider organic waste as a raw material in composting or fermentation.

Keywords: waste generation; waste characteristics; rural areas; household waste; household-related waste

1. Introduction

Many countries continue to struggle with solid waste management. Economic and population growth generate more solid waste, which must be managed (Han et al., 2018). Rural communities, like cities, have waste management issues, but on a different scale. Indonesia has 83,820 villages (Badan Pusat Statistik, 2020a), yet rural waste service coverage is just 4.65% (Badan Pusat Statistik, 2020b). This condition causes rural communities that do not receive waste services to manage their waste independently and be environmentally unfriendly. Garbage in rural areas is generally burned, buried, and dumped openly (de Morais Lima & Paulo, 2018; Han et al., 2015; Nxumalo et al., 2020). Rural areas require appropriate solid waste management

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strategies to sustain the environment and maintain public health. However, it will be difficult for policymakers to design waste management if the generation and characteristics of solid waste are not accurately identified (Han et al., 2019; Li et al., 2021; Villalba et al., 2020).

Several studies have measured the generation and characteristics of solid waste in rural areas. They produce waste at different levels from urban areas (Mandawat, 2017; Patwa et al., 2020). Compared to urban areas, the level of waste generation in rural communities is smaller (Taghipour et al., 2016). Urban residents produce an average of 3.4 kg of solid waste per day (United Nations Human Settlements Programme, 2010). In comparison, rural areas in many countries have less than 0.6 kg of solid waste per day. Haridwar District in India, for example, produces an average of 0.18 kg capita^{-1} day^{-1} (Mandawat, 2017), in China at 0.521 kg capita^{-1} day^{-1} (Han et al., 2019), in Romania at 0.4 kg capita^{-1} day^{-1} (Ciuta et al., 2015), and in Iran at 0.588 kg person^{-1} day^{-1} (Astane & Hajilo, 2017). In addition, organic materials dominate the composition of rural waste. Garbage with high organic content and low recyclable waste is common in rural areas in China, Iran, Egypt, and India (Anwar et al., 2018; Han et al., 2019; Mandawat, 2017; Vahidi et al., 2017). Several factors caused differences in waste generation and characteristics in rural areas, such as household size and income (Li et al., 2021; Zhang et al., 2018), consumption culture, living habits (Han et al., 2018), and the type of economy or industry which develops in each rural area (Bilgili et al., 2019; Oribe-Garcia et al., 2015).

Gunungkidul Regency contains largely village administrative areas with an average economic growth of 5% since 2017 (Badan Pusat Statistik Kabupaten Gunungkidul, 2020a). This condition triggers changes in people's consumption patterns and leads to an increase in waste amount. According to *Dinas Lingkungan Hidup* or the Indonesian Department of Environment (2020), the Wukirsari Final Disposal Site has received 13,548,678 tons of waste in 2017 and an increase of 8% in 2019. The waste increase is not being complemented by improved waste management performance. Waste reduction and management in Gunungkidul Regency has only accommodated 8.93% of daily waste (Badan Pusat Statistik Kabupaten Gunungkidul, 2019). The local government encourages the community to reduce, reuse, and recycle waste through the Waste Bank program (Faradina et al., 2020). However, these efforts will be in vain if waste generation and characteristics data are unavailable, especially in rural areas, far from the city center. This is because the waste bank program planning begins with understanding how much and what types of waste are generated. Without this knowledge, the waste bank management plan will experience difficulties both in terms of processing operations and product sales. Han et al. (2019) stated that the key impediments to waste management planning in rural areas include a lack of empirical data on waste generation and characteristics. Paying more attention for a better understanding of waste generation and attributes is crucial, especially in increasing efforts to reduce waste and recycling (Han et al., 2019; Zhang et al., 2018). Therefore, this study aims to measure waste generation and characteristics in the rural areas of Tanjungsari Sub-district, Gunungkidul. The results will contribute to the existing data of the local governments in formulating appropriate waste management strategies and policies in rural areas.

2. Materials and Method

2.1. Materials

This study measures the waste generated by residential properties which is called household waste, and the waste generated by non-residential areas is called household-related waste. The units used to measure waste generation are kg person^{-1} day^{-1} for weight, and liters person^{-1} day^{-1} for volume, in accordance with Indonesia National Standard (INS) 19-3964-1994. The waste characteristics measured in this study were limited to only physical characteristics, namely the composition and density. The waste composition was divided into organic and inorganic waste. Organic waste consists of food scraps and leaves (Or), paper (Pr), and wood (Wd), while the inorganic waste is in the form of fabric (Fb), rubber (Rb), plastic (Pl), metal (Mt), glass

(Gs), and other waste. The units used to measure the waste composition are in weight % and the waste density in kg m^{-3} (Badan Standarisasi Nasional, 1994). The measurements equipment used in this research were a 50 kg digital scale, a volume measurement box measuring 20 × 20 × 100 cm, a 40-liter plastic bag, gloves, masks, stationery (Herianto et al., 2019), and disinfection solutions to prevent the transmission of the Covid-19 virus.

2.2. Method

This study takes place in Tanjungsari Sub-district of Gunungkidul Regency, which covers an area of 71.45 Km^2 and is home to 29,469 people (Badan Pusat Statistik Kabupaten Gunungkidul, 2020b). This location was selected based on the coastal area development of Tanjungsari Sub-district as a leading marine tourism destination. In this area, commercial facilities have developed, such as hotels, food stalls, shops, and markets (Masjhoer et al., 2020). Population expansion and the economy's reliance on tourism contribute to the burden of trash disposal. Garbage problems such as unlawful dumping by the side of the road and karst pits are exacerbated by the added load of waste from tourism activities and the lack of rural waste services. This study exclusively looks at the communities of Kemadang, Tepus, and Saptosari, which have famed beaches like Baron, Drini, and Krakal with severe solid waste management difficulties. Figure 1 depicts this.

The number of samples was determined using the stratified random sampling method in residential and non-residential groups (Trihadiningrum et al., 2017). The residential one was grouped based on family economic conditions, namely permanent, semi-permanent, and non-permanent residential. The non-residential was divided into shops, restaurants, hotels, markets, offices, and public facilities. Data on the number of residential and non-residential properties was obtained from the Central Statistics Agency publication (Badan Pusat Statistik Kabupaten Gunungkidul, 2020b). The residential sample was determined using formulas (1) and (2).

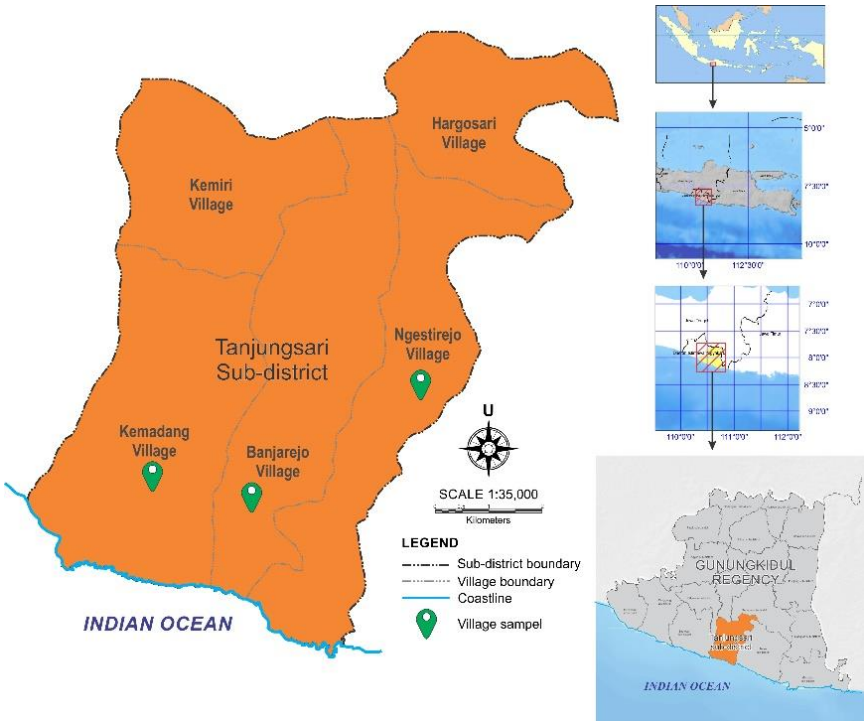

Figure 1. Research area and village samples

$$S=C_d\sqrt{P_s} \quad (1)$$

S is the number of samples (people), $\mathbf{P_S}$ is the number of populations in village samples (people), $\mathbf{C_d}$ is the housing coefficient (0.5).

$$K=\frac{S}{N} \quad (2)$$

K represents the number of family heads in village samples, and **N** is the number of people per family (5 people)

Non-residential samples, such as shops, offices, and markets, were determined using the same formula as residential samples, but with a coefficient changed to 1. The sample of hotels, restaurants, and other public facilities included at least one, or 10 % of the total number. See Table 1 for detail.

We conducted a door-to-door data collection in January 2021 during the Java-Bali Large-scale Social Restrictions (JBLSR). Before the survey, a team was formed and provided with training and strict health protocols for handling waste during a pandemic. The survey team, which was outfitted with personal protective equipment, visited the residential and non-residential samples for eight consecutive days. The team weighed plastic bags full of waste using a scale, and the volume of waste was measured using a volume box. After weighing, the waste was poured on the ground to be sorted by type. The team separately weighed organic and inorganic waste and then counted and measured each component of the waste composition. The waste type composition was determined using formula 3. Waste density was calculated by comparing the waste weight with the volume (see formula 4). Origin 2018 software was used for primary data processing. The processed data was then analyzed using quantitative descriptive methods. According to Vahidi et al. (2017), this method can briefly describe the essential characteristics of the sample for this type of research.

$$\text{Waste type composition (\%)}=\frac{\text{Waste type (kg)}}{\text{Total waste weight}}\times 100\% \quad (3)$$

$$\text{Waste density}\left(\frac{\text{kg}}{\text{m}^3}\right)=\frac{\text{Waste weight (kg)}}{\text{Waste volume (m}^3\text{)}} \quad (4)$$

Table 1. Number of samples

Household waste	Samples	Household-related waste	Samples
Permanent residence	19	Shops	22
Semi-Permanent residence	5	Restaurants	6
Non-Permanent residence	1	Hotels	2
Total	25	Markets	3
		Offices	1
		Public facilities	1
		Total	35

3. Result and Discussion

3.1. Waste generation

The measurements of 60 residential and non-residential samples showed that the average waste generation in Tanjungsari rural areas was 0.34 kg person^{-1} day^{-1} or 2.55 liter person^{-1} day^{-1} in volume (**Table 2**). This number falls within the category of small towns according to INS 19-3983-1995, which is in the range of 0.625-0.70 kg person^{-1} day^{-1}. Tanjungsari has a population of 29,469, resulting in ± 10 tons of waste that needs to be managed by the local government every

day. Compared to rural areas in various countries, the waste generation in Tanjungsari is higher than the average waste generated by rural areas in Haridwar District, India (Mandawat, 2017), but has lower than rural areas in China, Romania, and Iran (Ciuta et al., 2015; Darban Astane & Hajilo, 2017; Han et al., 2019).

The total household waste generation is 0.27 kg day^{-1} or 1.38-liter day^{-1}, almost four times the household-related waste generated by non-residential samples. Most household waste generation was from permanent residence, followed by semi-permanent, and the least was from non-permanent residence (see **Figure 2**). It indicates that the family's economic condition affects household waste generation. Li et al. (2021) and Zhang et al. (2018) stated that income and family size encourage household waste generation. This opinion is clarified by Han et al. (2018), who state that raising family income affects the increase in the consumption of food and other necessities in rural areas of developing countries. The household-related waste generation is

Table 2. Waste generation in Tanjungsari Sub-district

Sample group	Unit	Weight (kg)	Volume (liter)
Household waste			
Permanent residence	Person day $^{-1}$	0.13	0,74
Semi-permanent residence	Person day $^{-1}$	0.10	0,47
Non-permanent residence	Person day $^{-1}$	0.04	0,16
Household-related waste			
Shops	m^2 day^{-1}	0.028	0.44
Restaurants	m^2 day^{-1}	0.030	0.28
Hotels	Room day^{-1}	0.013	0.40
Markets	m^2 day^{-1}	0.001	0.01
Offices	m^2 day^{-1}	0.000	0.00
Public facilities	m^2 day^{-1}	0.002	0.03
Household waste generation		0.27	1.38
Household-related waste generation		0.074	1.17
Total waste generation		0.34	2.55

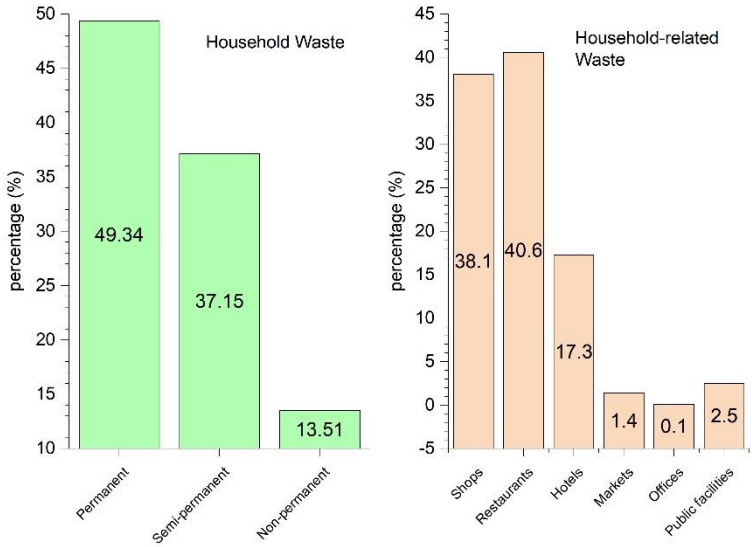

Figure 2. Waste generation of research samples

0.074 kg day^{-1}. Restaurants contribute the most to household-related waste, followed by shops, hotels, public facilities, markets, and offices (see **Figure 2**). Tanjungsari's growing tourism industry has fostered the expansion of commercial activity along the road to tourist sites. During the implementation of the JBLSR, commercial trading activities in Tanjungsari continue to operate, fulfilling the daily needs of residents for raw materials and food. Surprisingly, the market as a source of food raw materials generates very little waste. The market in Tanjungsari is only open twice a week, encouraging residents to buy more ready-to-eat food and goods from restaurants and shops. The policy during the pandemic only allows office activities to be carried out by half or even less than 50% of the total number of employees. As a result, waste generation in offices is the smallest among other non-residential waste sources.

3.2. Waste characteristics

Waste composition and density are the physical waste characteristics measured in this study. The waste composition in Tanjungsari rural areas essentially consists of organic waste. There were two types waste that were measured: Organic and inorganic waste. Organic waste was in the form of food waste and leaves (Or), paper (Pr), and Wood (Wd), while inorganic waste was in the form of Fabric (Fb), Rubber (Rb), Plastic (Pl), Metal (mt), Glass (Gs), and other materials. Accumulation of household and household-related waste in Tanjungsari resulted in 2.95 kg of organic waste and 1.1 kg of inorganic waste per day. Based on the calculation, food waste and leaves have the highest proportion with 72.92%, followed by plastic, paper, cloth, other materials, wood, metal, and glass sequentially at 15.66%, 8.29%, 1.86%, 0.91%, 0.13%, 0.12%, 0.11% (see **Figure 3**). The percentage of organic waste composition in Tanjungsari is not too far from that of rural areas in China, at 72.31% (Han et al., 2019). A smaller percentage with an average of 50.5% of organic waste is found in rural areas in Khosrowshah district, Iran, and Desoq District, Egypt (Anwar et al., 2018; Taghipour et al., 2016). Rural waste contains more organic waste than other types of waste. Patwa et al. (2020) argue that rural areas in various countries produce more than 50% of organic waste, and the remainder being inorganic waste. The lifestyle and culture of the community also influence the diversity of waste produced (Han et al., 2018). People in rural areas of Tanjungsari are accustomed to cooking using ingredients sourced from their farms and livestock. Because the variety of food raw resources is minimal, their consumption patterns are not as diversified.

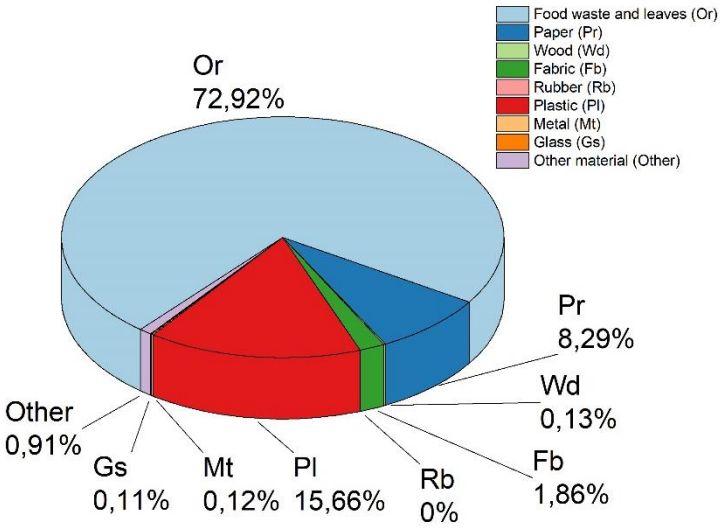

Figure 3. Waste composition in Tanjungsari rural areas

Most of the household waste generated by the residential sample was in the form of organic waste. Non-permanent residence entirely produced organic waste, while semi-permanent and permanent residence produced 86% and 90% of organic waste, respectively (see **Figure 4**). Food waste and leaves have the most considerable portion, accounting for 89.1%, based on the type of waste generated. Plastic and paper account for the majority of inorganic waste generated by the residential group, with 8.69% and 1.51%, respectively (see **Figure 5**). The absence of inorganic waste in non-permanent residential sample shows that the family economy affects the diversity of waste types produced. Factors such as household size and income influence waste characteristics (Li et al., 2021; Zhang et al., 2018). The highest level of family welfare in Tanjungsari Sub-district is in the stage of prosperous family II with a percentage of 61.01%, while the rest are still in the pre-prosperous family and prosperous family I stages (Badan Pusat Statistik Kabupaten Gunungkidul, 2020b). The level of welfare in Tanjungsari can illustrate that there are still impoverished pre-prosperous households struggling to meet basic needs. Their consumption patterns are limited, so the waste composition does not vary.

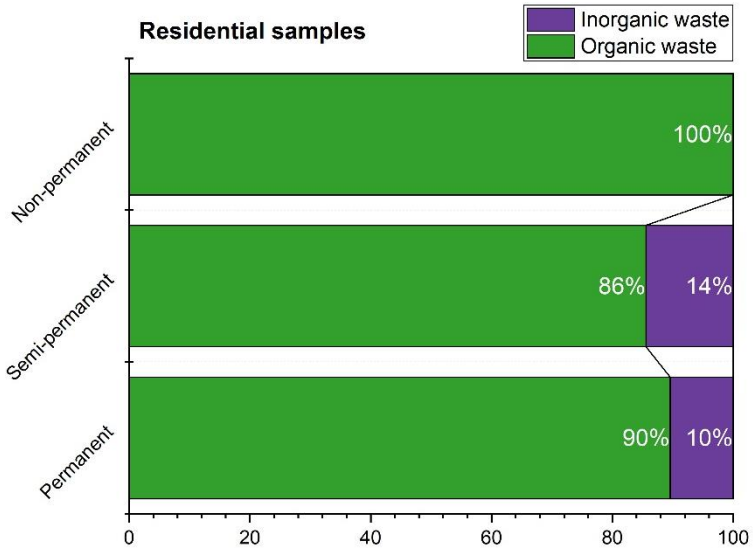

Figure 4. Waste composition based on residential samples

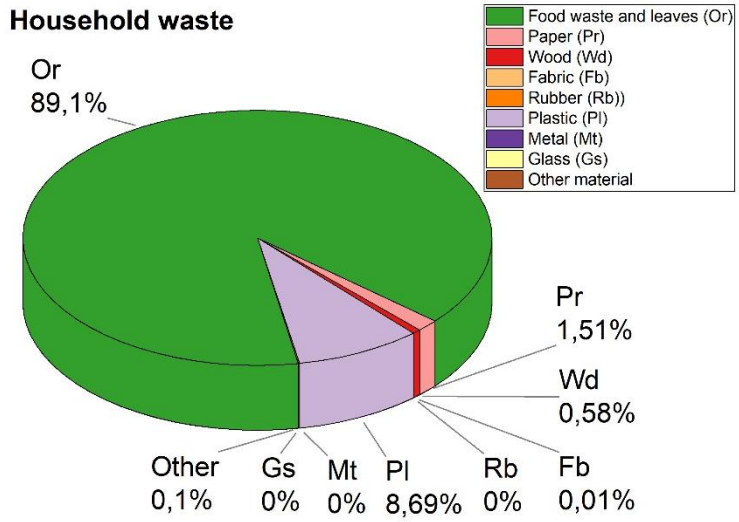

Figure 5. Household waste type

The non-residential sample group produced more inorganic waste than that the residential one. The majority of inorganic waste is generated by hotels, offices, public facilities, and shops. On the other hand, markets and restaurants produce mostly perishable waste (See **Figure 6**). Christensen & Fruergaard (2010) stated that food and organic waste is a significant part of restaurants, while paper and cardboard are components of commercial and institutional waste. Based on the waste type, food scraps and leaves produced by non-residential group are 68.51% on average, ollowed by plastic, paper, fabric, other materials, metal, glass, and wood at 17.56%, 10.13%, 2.36%, 1.13%, 0.16%, 0.14%, and 0.01% respectively. Various types of inorganic waste in commercial areas are common due to trading activities in shops, office equipment, and needs outside of household activities. The economic center and the type of industry will also affect the composition of waste in rural areas (Bilgili et al., 2019; Oribe-Garcia et al., 2015).

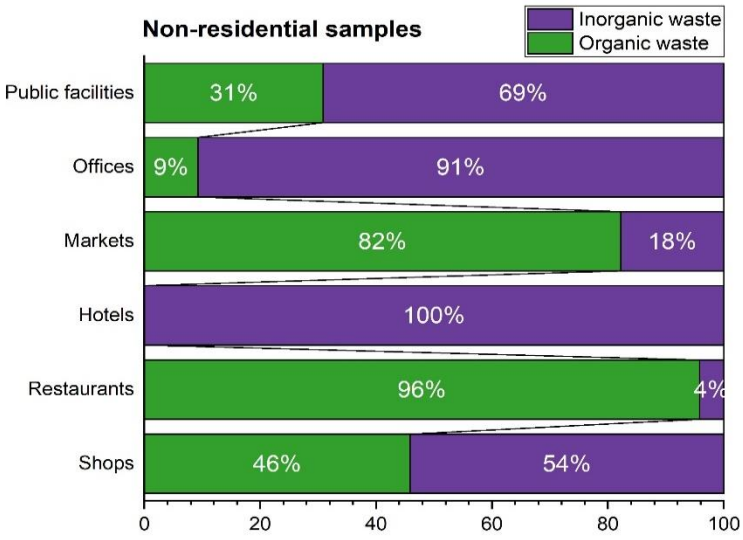

Figure 6. Waste composition based on non-residential samples

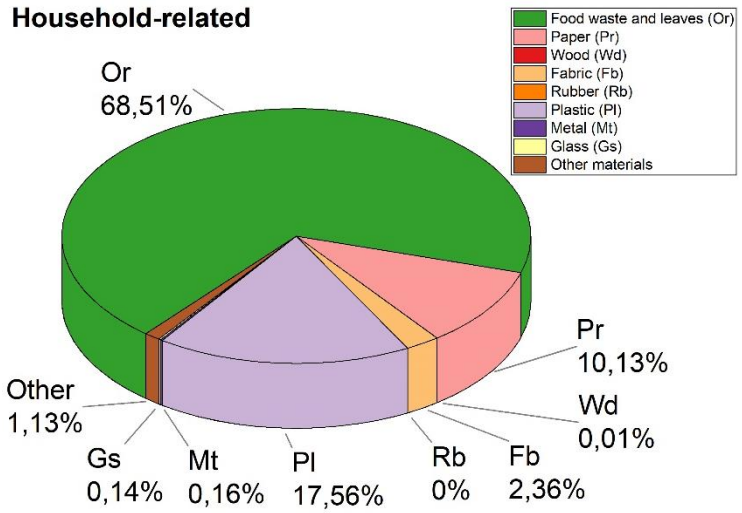

Figure 7. Household-related waste type

Data on waste composition in the Tanjungsari Sub-district can be used to determine the appropriate waste processing method. The abundance of organic waste in every waste source has

great potential to be processed as raw material for composting and eco-enzymes. The end product of the two organic waste processing procedures helps in soil fertilization. *Badan Pusat Statistik Kabupaten Gunungkidul* or the Gunungkidul Regency Central Bureau of Statistics (2020b) states that non-paddy rice, corn, soybeans, peanuts, cassava, sweet potatoes, green beans, and sorghum are among the crops grown in Tanjungsari Sub-district. The quality of these crops can be improved with organic fertilizers and eco-enzymes from organic waste. Another advantage of composting and eco-enzyme is that organic waste produced by the waste source does not enter the waste stream and ends up in landfills.

The household waste density has a different magnitude with household-related waste. The density of household waste is 196.1 $kg.m^{-3}$, whereas household-related waste is 63.63 $kg.m^{-3}$ (see **Figure 8**). The residential sample has a greater density when compared to the non-residential one. Waste density indicates that recycled waste materials in residential areas is minimally found compared to samples from non-residential areas. Restaurants, marketplaces, and other public establishments had the largest density of non-residential samples. Rural areas in Western China have low solid waste density because they contain large amounts of paper/cardboard and plastic or rubber (Han et al., 2019). Waste density is valuable information to estimate the optimal capacity for transportation equipment based on waste mass and volume. The provision of transport vehicles with a large density, such as compactor trucks, can increase the efficiency of transporting waste.

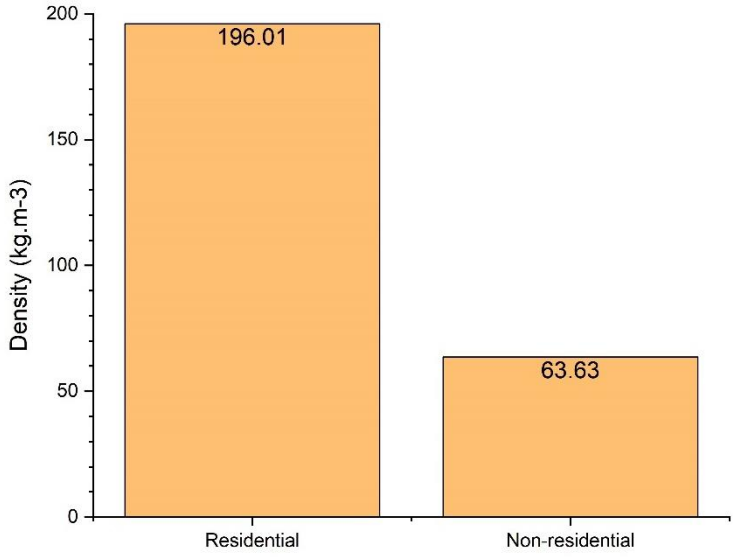

Figure 8. Household and household-related waste density in Tanjungsari Sub-district

4. Conclusion

Rural areas in Tanjungsari experience waste management challenges due to economic and population growth. Waste with less proper treatment can threaten environmental sustainability and public health. The waste reduction paradigm launched by the government cannot run optimally without understanding the generation and characteristics of waste. However, accurate waste generation and characteristics data for rural areas are still insignificant.

Based on the study, waste generation in Tanjungsari falls below the classification of small towns and is not significantly different from the rural areas in various countries. The waste composition, such as food scraps and leaves, dominates the waste generated, and the rest are plastic, paper, fabric, other materials, wood, metal, and glass, respectively. A large portion of organic waste than inorganic waste causes a higher value of waste density. These findings

strengthen the notion that rural areas have less waste generation than urban areas and produce mostly organic matter.

Waste generation and composition are essential for formulating a waste reduction strategy in Tanjungsari. Waste management must prioritized the most often generated waste component. Food scraps and leaves can be used as raw materials for fertilizers through the composting process and eco-enzymes through the fermentation process. In addition to reducing the volume of organic waste, the resulting product has economic value and can fertilize agricultural land. Therefore, further research is required to analyze organic waste's technical and economic feasibility.

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References

Anwar, S., Elagroudy, S., Abdel Razik, M., Gaber, A., Bong, C. P. C., & Ho, W. S. (2018). Optimization of solid waste management in rural villages of developing countries. *Clean Technologies and Environmental Policy*, *20*(3), 489–502. https://doi.org/10.1007/s10098-018-1485-7

Badan Pusat Statistik. (2020a). *Jumlah Desa/Kelurahan Menurut Provinsi, 2019*. https://www.bps.go.id/indikator/indikator/view_data_pub/0000/api_pub/bEVXU252SU9hTjBxWEU3Z2NpS1ZPQT09/da_02/1

Badan Pusat Statistik. (2020b). Statistik lingkungan hidup Indonesia 2020. In *BPS-Statistic Indonesia*. https://www.bps.go.id/publication/2020/11/27/5a798b6b8a86079696540452/statistik-lingkungan-hidup-indonesia-2020.html

Badan Pusat Statistik Kabupaten Gunungkidul. (2020a). *Kabupaten Gunungkidul dalam angka "Penyediaan data untuk perencanaan pembangunan"* (B. P. S. K. Gunungkidul (ed.)). BPS Badan Pusat Statistik Kabupaten Gunungkidul.

Badan Pusat Statistik Kabupaten Gunungkidul. (2020b). *Kecamatan Tanjungsari dalam angka 2020* (B. P. S. K. Gunungkidul (ed.)). BPS Badan Pusat Statistik Kabupaten Gunungkidul.

Badan Pusat Statistik Kabupaten Gunungkidul. (2019). *Dokumen masterplan pengelolaan persampahan Kabupaten Gunungkidul 2019-2038*.

Badan Standarisasi Nasional. (1994). Metode pengambilan dan pengukuran contoh timbulan dan komposisi sampah perkotaan. In *SNI 19-3964-1994*. Badan Standarisasi Nasional. https://doi.org/10.2989/16085906.2013.815406

Bilgili, M. S., Adar, E., Yildiz, S., & Sezer, K. (2019). Characterisation of wastes collected from beaches, coastlines, marine surface cleaning processes and ships: A case study of Istanbul. *Waste Management and Research*, *37*(6), 621–630. https://doi.org/10.1177/0734242X19838619

Christensen, T. H., & Fruergaard, T. (2010). Commercial and institutional waste. *Solid Waste Technology & Management*, *1*, 97–99. https://doi.org/10.1002/9780470666883.ch7

Ciuta, S., Apostol, T., & Rusu, V. (2015). Urban and rural MSW stream characterization for separate collection improvement. *Sustainability (Switzerland)*, *7*(1), 916–931. https://doi.org/10.3390/su7010916

Darban Astane, A. R., & Hajilo, M. (2017). Factors affecting the rural domestic waste generation. *Global Journal of Environmental Science and Management*, *3*(4), 417–426. https://doi.org/10.22034/gjesm.2017.03.04.007

de Morais Lima, P., & Paulo, P. L. (2018). Solid-waste management in the rural area of BRAZIL: a case study in Quilombola communities. *Journal of Material Cycles and Waste Management*, *20*(3), 1583–1593. https://doi.org/10.1007/s10163-018-0722-9

Dinas Lingkungan Hidup. (2020). *Data volume sampah masuk ke TPA Wukirsari, Baleharjo, Wonosari*.

Faradina, D., Maryono, M., & Warsito, B. (2020). The role of waste banks in reducing waste in Gunung Kidul Regency. *E3S Web of Conferences*, *202*(18), 1–8. https://doi.org/10.1051/e3sconf/202020206038

Han, Z., Dan, Z., Shi, G., Shen, L., Xu, W., & Xie, Y. (2015). Characteristics and management of domestic waste in a rural area of the Tibetan Plateau. *Journal of the Air and Waste Management Association*, *65*(11),

1365–1375. https://doi.org/10.1080/10962247.2015.1078859
Han, Z., Liu, Y., Zhong, M., Shi, G., Li, Q., Zeng, D., Zhang, Y., Fei, Y., & Xie, Y. (2018). Influencing factors of domestic waste characteristics in rural areas of developing countries. *Waste Management*, *72*, 45–54. https://doi.org/10.1016/j.wasman.2017.11.039
Han, Z., Ye, C., Zhang, Y., Dan, Z., Zou, Z., Liu, D., & Shi, G. (2019). Characteristics and management modes of domestic waste in rural areas of developing countries: a case study of China. *Environmental Science and Pollution Research*, *26*(9), 8485–8501. https://doi.org/10.1007/s11356-019-04289-w
Herianto, H., Maryono, M., & Budihardjo, M. A. (2019). Factors affecting waste generation: Household study in Palangka Raya City, Central Kalimantan. *E3S Web of Conferences*, *125*(201 9), 7–11. https://doi.org/10.1051/e3sconf/201912507007
Li, Y., Wang, L. en, Liu, G., & Cheng, S. (2021). Rural household food waste characteristics and driving factors in China. *Resources, Conservation and Recycling*, *164*, 105209. https://doi.org/10.1016/j.resconrec.2020.105209
Mandawat, P. (2017). Characterization and quantization of solid waste in Ganga Villages of Haridwar. *International Journal of Advance Research, Ideas and Innovations in Technology*, *3*(6), 558–562.
Masjhoer, J. M., Retawimbi, A. Y., & Sari, Y. S. (2020). Participation of local restaurants in solid waste management in South Coast of Gunungkidul Regency, Indonesia. *Journal of Community Based Environmental Engineering and Management*, *4*(1), 1–8. https://doi.org/10.23969/jcbeem.v4i1.1978
Nxumalo, S. M., Mabaso, S. D., Mamba, S. F., & Singwane, S. S. (2020). Plastic waste management practices in the rural areas of Eswatini. *Social Sciences & Humanities Open*, *2*(1), 100066. https://doi.org/10.1016/j.ssaho.2020.100066
Oribe-Garcia, I., Kamara-Esteban, O., Martin, C., Macarulla-Arenaza, A. M., & Alonso-Vicario, A. (2015). Identification of influencing municipal characteristics regarding household waste generation and their forecasting ability in Biscay. *Waste Management*, *39*, 26–34. https://doi.org/10.1016/j.wasman.2015.02.017
Patwa, A., Parde, D., Dohare, D., Vijay, R., & Kumar, R. (2020). Solid waste characterization and treatment technologies in rural areas: An Indian and international review. *Environmental Technology and Innovation*, *20*, 101066. https://doi.org/10.1016/j.eti.2020.101066
Taghipour, H., Amjad, Z., Aslani, H., Armanfar, F., & Dehghanzadeh, R. (2016). Characterizing and quantifying solid waste of rural communities. *Journal of Material Cycles and Waste Management*, *18*(4), 790–797. https://doi.org/10.1007/s10163-015-0365-z
Trihadiningrum, Y., Laksono, I. J., Dhokhikah, Y., Moesriati, A., Radita, D. R., & Sunaryo, S. (2017). Community activities in residential solid waste reduction in Tenggilis Mejoyo District, Surabaya City, Indonesia. *Journal of Material Cycles and Waste Management*, *19*(1), 526–535. https://doi.org/10.1007/s10163-015-0440-5
United Nations Human Settlements Programme. (2010). Solid waste management in the world's cities – water and sanitation in the world's cities 2010. In *United Nations Human Settlements Programme (UN-HABITAT)*. Earthscan. https://doi.org/10.1108/meq.2010.08321fae.003
Vahidi, H., Nematollahi, H., Padash, A., Sadeghi, B., & RiyaziNejad, M. (2017). Comparison of rural solid waste management in two central provinces of Iran. *Environmental Energy and Economic Research*, *1*, 195–206. https://doi.org/10.22097/eeer.2017.47246
Villalba, L., Donalisio, R. S., Cisneros Basualdo, N. E., & Noriega, R. B. (2020). Household solid waste characterization in Tandil (Argentina): Socioeconomic, institutional, temporal and cultural aspects influencing waste quantity and composition. *Resources, Conservation and Recycling*, *152*, 104530. https://doi.org/10.1016/j.resconrec.2019.104530
Zhang, H., Duan, H., Andric, J. M., Song, M., & Yang, B. (2018). Characterization of household food waste and strategies for its reduction: A Shenzhen City case study. *Waste Management*, *78*, 426–433. https://doi.org/10.1016/j.wasman.2018.06.010