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70 ABSTRACT Article History : Keywords 1: Solid waste has always been a problem for developing countries. In Bandar Lampung, the traditional market is the second largest contributor of solid waste, after households. Data for Traditional Market Solid Waste (TMSW) composition and generation rate in Bandar Lampung is rarely found, even though, data is needed to write the policy for TMSW management and its recycling potential. This research aims to provide data on TMSW composition, generation rate and characteristic in Bandar Lampung, also its recycling potential. The sample from 10 of 31 traditional markets in Bandar Lampung is collected for 8 consecutive days in morning and afternoon. Then, the sample was processed to obtain its composition, generation and density. 48.06% of TMSW compositions is donated by vegetable. Meanwhile, metal is rarely found in traditional markets, with only 0.37%. The average density of TMSW is 180.11 kg/m<sup>3</sup>, while Kangkung Market has the highest density with 237.84 kg/m<sup>3</sup> and Cimeng Market has the lowest TMSW density with 123.07 kg/m<sup>3</sup>. The generation rate of TMSW is 53,602.35 kg/day. Biodegradable wastes from traditional markets in Bandar Lampung, with 53% water contents, can be potentially recycled by composting and/ or anaerobic digestion because of its economic value and characteristic. Characterization of Traditional Market Solid Waste (TMSW) and Its Recycling Potential (Case Study: Traditional Markets in Bandar Lampung)

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<sup>3</sup>Department of Agricultural Engineering, Faculty of Agricultural, Lampung University, Lampung, INDONESIA. 1. INTRODUCTION Solid waste is materials with little or no value for human being (Pitchel, 2014). Globally, in 2012, the generation rate of solid waste in a day was 1.2 kg per capita and it can be estimated up to 1.42 kg per capita in 2025 (Hoorweg & Bhada-Tata, 2012). The generation of solid waste grows rapidly and has become a major problem in many countries (Aye & Widjaya, 2006). Based on data from the Ministry of Environment Republic of Indonesia (2021), in 2021, the generation rate of

solid waste in Indonesia reached more than 32.7 million tons, where in Bandar Lampung

City, Lampung Province, Received : 3 February 2022 Received in revised form : 21 March

2022 Accepted : 21 March 2022 Recycling Solid Waste Management Traditional Market

Solid Waste Waste Characterization \*Corresponding Author:

muhammadhaviz@eng.unila.ac.id Vol. 11, No. 1 (2022) : 70 - 78 DOI :

<http://dx.doi.org/10.23960/jtep-l.v11.i1.70-78> 71 Jurnal Teknik Pertanian Lampung Vol. 11,

No. 1 (2022) : 70-78 reached 276.649,16 tons and 19% of it, comes from the traditional

market or the second largest after households. Solid waste from the traditional market in

Indonesia is directly managed by the local government (Sukresno et al., 2019). Most local

governments do not handle the solid waste by 3R activities (reduce, reuse and recycle)

optimally and rarely use waste sorting as the first step before the next treatments (Raharjo

et al., 2019). Handling solid waste by open burning or collecting and dumping to landfill is

commonly used by local government in Indonesia (Raharjo et al., 2017, Hartono et al.,

2015) Open dumping method will result in a bad impact on the environment and mankind

for long term (Boonthavornsatien & Wiwattanadate, 2019). In open burning method, any

material is openly burnt without proper duct or stack (Kumari et al., 2019). The product

from this method will directly emit into the ambient and can result global warming (Das et

al., 2018; Haviz et al., 2021). It serves as of pollutants like <sup>14</sup>Carbon Monoxide (CO),

Nitrogen Oxide (NO<sub>2</sub>), Sulphur Dioxide (SO<sub>2</sub>) and many particulate matters (Reyna-

Bensusan et al., 2018). Open dumping method provides many impacts for environment and

mankind. Water and soil contamination also are the products from open dumping

method. It makes the area around the landfill become toxic (Mohan & Joseph, 2021). Data

from Traditional Market Solid Waste (TMSW) in Bandar Lampung, especially composition

and generation rate, is barely available. It is needed by researcher, local government and

others as a reference for various activities. This research aims to provide data for solid

waste composition, density and generation rate from traditional markets in Bandar

Lampung, Lampung, Indonesia. Thus, its recycling potential can be designed for more

optimal local TMSW management. 2. MATERIALS AND METHODS This research has

been located in 10 of 31 traditional markets in Bandar Lampung, Lampung Province, Indonesia. The samples were a part of the solid waste population that can be represented with respective consideration (Nyampundu et al., 2020). Method for sampling process referred to Indonesian Government Standard, SNI 193964-1994 (1994) on "Method of Collection and Measurement of Waste Generation and Composition". The sampling process was done for 8 (eight) consecutive days, in the morning (6 A.M.) and afternoon (6 P.M), where tool for this sampling process was a container with dimension 0.58 m x 0.42 m x 0.36 m or 88 liters of volume. Figure 1. Research locations (red dots) Haviz et al. : Characterization of Traditional Market Solid Waste ... 72 Variables in this research consist of Traditional Market Solid Waste (TMSW) composition, density and generation rate (Surya & Ariefahnoor, 2020). All of the variables have to consider the volume of the temporary solid waste collector in each market (Devi & Mugilvannan, 2018). The formula for determining TMSW composition, density and generation rate can be shown in equation 1-3 respectively. Furthermore, after all the research variables are obtained, it is continued with providing the potential recycling facilities for TMSW in Bandar Lampung before dumping it into the landfill.

$$GR = \text{volume of collector(m}^3\text{)} \times \text{waste density (kg/m}^3\text{)}$$

(3) Where WCS is waste composition from sample (% weight), WD is waste density from sample (kg/m<sup>3</sup>), and GR is Generation rate/day (kg/day).

### 3. RESULTS AND DISCUSSION

Temporary solid waste collectors should be considered for determining the generation rate of traditional market solid waste (Oloo & Awuor, 2019). Every market has a different volume of the temporary solid waste collector (Sarnobat et al., 2019). Table 1 shows the dimension of the temporary solid waste collector in a different condition. The temporary solid waste collector is rarely found in empty or full condition. There is an excess about 0.05-0.5 m of height in every temporary solid waste collector. Figure 2 shows the waste-collecting and sortings from temporary solid waste collectors in the traditional market. TMSW was collected from four different spots in a temporary solid waste collector (Al Anas et al., 2021). Then, TMSW was sorted based on its characteristic. Table 1. Volume of temporary solid waste collector

No.	Location	Empty Volume (m <sup>3</sup> )	Average Excess (m <sup>3</sup> )
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Total Volume (m<sup>3</sup>) 1 Tamin 9.24 4.62 13.86 2 Rajabasa 10.24 5.12 15.36 3 Gudang Lelang 14.84 7.42 22.26 4 Untung 12.00 3.00 15.00 5 Koga 22.78 0.00 22.78 6 Cimeng 12.24 6.12 18.36 7 Kangkung 11.52 3.60 15.12 8 Tugu 8.33 4.16 12.49 9 Way Halim 6.83 3.41 10.24 10

Gintung 2.21 1.11 3.32 (1) (2) 73 [Jurnal Teknik Pertanian Lampung Vol. 11, No. 1 \(2022\) :](#)

70-78 Figure 2. (a) Collecting the sample (b) Waste sorting The average of TMSW composition for eight consecutive days sampling in the [morning and afternoon](#) can be shown in Table 2 and subsequently : Table 2. Average weight and characteristic [of solid waste](#) from sampling process From Table 2, TMSW is dominated by vegetables with more than 48% during the sampling process in eight consecutive days; and, more than 75% [of traditional market solid waste](#) is organic waste, which means solid waste from the traditional market has the potential to be reuse and recycled in the future. Figure 3 shows

the percentage of TMSW composition in the pie diagram. 3.1. TMSW density Table 3

shows [the average density of solid waste](#) from 10 [traditional markets in Bandar Lampung,](#)

Indonesia, with sampling apparatus' dimension is 0.088 m<sup>3</sup> or 88 liters of volume. From

Table 3, [the highest density of TMSW is in Kangkung Market with 237.84 kg/m<sup>3</sup>,](#) while

Cimeng [Market is the lowest with 123.07 kg/m<sup>3</sup>. The average density of TMSW from 10](#)

traditional markets [is 180.11 kg/m<sup>3</sup>.](#) 3.2. [Generation Rate of TMSW](#) The generation rate of

[TMSW](#) can be determined by multiplying total weight of the temporary solid waste

collector with TMSW density and from the sampling process. Haviz et al. : [Characterization](#)

[of Traditional Market Solid Waste ...](#) 74 Table 4 shows [the generation rate of TMSW](#) from

10 [traditional markets in Bandar Lampung.](#) Figure 3. Percentage of TMSW composition in

[Bandar Lampung, Indonesia](#) Table 3 . [Average density of TMSW](#) from the sampling

process Table 4. [Generation rate of TMSW](#) from sampling process No. Location Weight

(kg) Density (kg/m<sup>3</sup>) 1 Tamin 18.89 214.66 2 Rajabasa 15.49 176.02 3 Gudang Lelang 14.61

166.02 4 Untung 17.53 199.20 5 Koga 17.73 201.48 6 Cimeng 10.83 123.07 7 Kangkung

20.93 237.84 8 Tugu 12.60 143.18 9 Way Halim 13.70 155.68 10 Gintung 16.19 183.98

Average 15.89 180.11 No. Location Generation Rate (kg/a half day) Generation Rate

(kg/day) 1 Tamin 2975.19 5950.38 2 Rajabasa 2703.67 5407.33 3 Gudang Lelang 3695.61

7391.21 4 Untung 2988.00 5976.00 5 Koga 4589.71 9179.43 6 Cimeng 2259.57 4519.13 7

Kangkung 3596.14 7192.28 8 Tugu 1788.32 3576.64 9 Way Halim 1594.16 3188.33 10

Gintung 610.81 1221.63 Total 26801.18 53602.35 Average 2680.12 5360.24 75

Jurnal Teknik Pertanian Lampung Vol. 11, No. 1 (2022) : 70-78 From Table 4, average generation

rate of TMSW is 5,360.24 kg/day. Every traditional market in Bandar Lampung, has the potential to produce solid waste from morning to evening or vice versa up to 2,680.12

kg/day. Afterall, the total TMSW produced from 10 traditional markets in Bandar Lampung

can be estimated as 53,602.35 kg/day. 3.3. Characteristic of TMSW in Bandar Lampung

Characterization of TMSW can be divided into two types, organic and inorganic. Inorganic

wastes, such as metal, glass and miscellaneous types, can't be decomposed (Iryani et al,

2019). Table 5 shows the characteristic of TMSW. Vegetables, fruit, and nappies have high

water content. Besides water content within the waste itself, vegetables, fruit, and nappies

have a good ability to absorb the water from their surrounding (Yuliandari et al, 2019).

Table 5. Characteristic of TMSW in Bandar Lampung 3.4. Recycling Potential Burning and

incinerating are often found as solid waste treatment in Indonesia. Those processes need

fire to ignites gas methane from solid waste (de Vega et al., 2008). Organic matters are

decomposed during it. Furthermore, landfilling or open dumping is the most common solid

waste treatment in Indonesia (Santosa & Sujito, 2021). Wet solid wastes, except nappies,

vegetable, fruit, paper and wood, are more easily biodegradable, while others are non-

biodegradable (Chaerul & Dewi, 2020). Dry waste including paper, glass, plastic bottle, and

metal can be categorized as dry waste, that can be recycled into other products (Raharjo

et al., 2018). The reasonable recycling facility for TMSW in Bandar Lampung, Indonesia,

before dumping it to landfill are Solid Waste Bank (SWB), Integrated waste treatment

facility (TPST), and 3R waste treatment facility (TPS 3R) (Elemile et al., 2019; Wilson et al.,

2006; Raharjo et al., 2019). The technology to process TMSW is shown in Table 6.

Composting and/or anaerobic digester are used to recycle the biodegradable waste and

sellable waste can be sold to the customer, through the waste collector (people and/or

factory) (Ma'arif et al., 2018; Patel et al., 2019). The regulation about recycling activities, TPS

3R, TPST and SWB, are regulated by the government of the Republic of Waste Type Wet  
 Weight (%) Water Content (%) Ash Content (%) Dry Weight (%) DOCi (% in dry weight)  
 DOCi (% in wet weight) Vegetable 61.96 53.50 11.77 34.73 32.26 0.11 Fruit 58.77 53.03  
 11.80 34.00 32.12 0.12 Paper 4.65 35.36 3.06 61.58 44.00 0.27 Wood 0.94 11.66 5.2 83.14  
 50.00 0.41 Textile 6.77 13.33 0.34 86.36 29.30 0.25 Rubber 0.07 40.00 - 60 39.00 0.23  
 Nappies 4.19 54.16 2.03 43.81 60.00 0.26 Metal 0.78 4 - - - - Plastic 14.47 - - - - Glass 3.36  
 - - - - Misc - - - - - Haviz et al. : Characterization of Traditional Market Solid Waste ...

76 Indonesia (2012). Recycling activities should be started from the community, in this case  
 merchant in every traditional market and arranged by the local government (Arifin, 2018;  
 Patel et al., 2019). Table 6. Proposed TMSW recycling facilities and technologies 4.

CONCLUSIONS Waste from traditional markets in Bandar Lampung Indonesia is  
 dominated by vegetable, with 48.06% of the waste composition. Meanwhile, metal is rarely  
 found in traditional markets, because of its valuability. Metal can be directly resold to waste  
 collector as sellable waste. The average density of TMSW is 180.11 kg/m<sup>3</sup>, while Kangkung  
 Market has the highest TMSW density with 237.84 kg/m<sup>3</sup> and Cimeng Market has the  
 lowest TMSW density with 123.07 kg/m<sup>3</sup>. The generation rate of TMSW is 53,602.35  
 kg/day, where the temporary solid waste collector is emptied twice a day, morning and  
 evening. Biodegradable wastes, including vegetables and fruit has more than 53% water  
 content, and it is the potential to be recycled by composting and/or anaerobic digester.

Metal, plastic and paper can be categorized as sellable waste. They can be sold in various  
 forms and at a reasonable price after going through a few processes. REFERENCES Al

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