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Characteristic of Tourism Solid Waste of Harau Valley, West Sumatra

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Abstract. Harau Valley Tourism Region is one of the three leading tourist attractions in Lima Puluh Kota Regency. The number of visitors to the Harau Valley Tourism Area has increased every year which will also have an impact on the increase in the amount of waste generated in this region. The Harau Valley tourist area does not yet have solid waste data. Basic data is needed to plan a waste management system in an area. Based on this, research is needed regarding the generation, composition and potential of waste recycling in the Harau Valley Tourism Area. The research method used is direct measurement in the field with reference to SNI 19-3964-1994. Based on the research that has been done, the generation unit is 0.158 kg/cap./day in weight units and 3.053 Lit/cap./day in volume units. The waste composition consisted of food waste (34.29%), paper (8.39%), plastic (16.43%), textiles (1.12%), rubber (0.07%), yard waste (17.05%), wood (12.74%), glass (3.08%), non-ferrous metals (0.92%) and others (5.91%). Recycling potential for food and yard waste (77.26%), plastic (70.23%), paper (56.21%) and glass (95.69%) is recommended to apply composting method for compostable waste, while for other recyclable waste can apply collection, separation, cleaning, and packing before selling in nearby shanties.

1. Introduction
Harau Valley is one of the leading tourist attractions in West Sumatra, located in Lima Puluh Kota Regency. Initially this attraction was part of the Harau Valley Nature Reserve, then designated as the Harau Valley Tourist Park based on Minister of Agriculture Decree No. 478 in 1979 with an area of 27.5 hectares. Based on a joint agreement with the Provincial Head of Region with the regencies and cities in West Sumatra in 2006, this area designated as a Tourism Development Area. Meanwhile, Regional Regulation No. 7 of 2012 concerning the Lima Puluh Kota Regional Spatial Plan [1], it was stated that the Harau Valley Tourism Area is one of the three leading tourist attractions in the Lima Puluh Kota Regency.

The number of tourists visiting the Harau Valley Tourism Area always increases every year. The number of tourists visiting Lima Puluh Kota Regency in 2017 was 303,990 people with an average daily visit of ± 630 people [2]. However, the high level of tourist visits and activities were not accompanied by a good waste management plan from the local government. As a result, waste management in the Harau Valley tourist area is still not well practiced, this can be seen from the
availability of inadequate facilities and infrastructure to accommodate the quantity of waste generated from this tourist area. In addition, the lack of public and visitor awareness of environmental cleanliness results in the large amount of litter dumped in the Harau Valley Area, Lima Puluh Kota District. This will certainly affect the beauty, public health and disrupt the quality of the surrounding soil and groundwater.

Tourism activities are growing rapidly in the world. The development of tourism contributes impacts on the surrounding environment, positively and negatively. Positive impacts such as the local employment and the income from tourism can build regional infrastructure. Negative impacts include waste problems, air pollution, water pollution and damage of natural environment on tourist destination. Some studies focus on solid waste management in the tourism area has took places on some countries includes Kashmir [3], Cyprus [4], Spain [5], Vietnam [6], Romania and Italy [7], and Indonesia.

Based on the survey results, the waste management system in the Lembah Harau Tourism District of Lima Puluh Kota is still not good. This showed from the habits of the people who manage waste using the old paradigm method, namely collecting, transporting and disposing. Therefore, it is necessary to plan a waste management system in the Lembah Harau Tourism District of Lima Puluh Kota in an environmentally sound manner. Before a waste management plan is designed the Lembah Harau Tourism Area, Lima Puluh Kota Regency, it is necessary to carry out measurements, analysis of the generation, composition, and potential of waste recycling generated from the Harau Valley Tourism Area. With the implementation of an environmentally friendly waste management system in the Harau Valley Tourism Area, the amount of waste generation transported to the landfill will be reduced, and can create and maintain cleanliness and beauty conditions that will affect the sustainability of the Harau Valley tourist attraction.

2. Methodology
The research stages are as follows: 1) preparation, including studies and related literature to deepen and sharpen the basic theories relating to tourism waste management systems; 2) secondary data collection, secondary data is data obtained from agencies related to research, such as: Map of the area according to RTRW, existing technical and non-technical aspects and number of visitors; 3) primary data collection, data was taken through direct measurements in the field such as: generation, composition and potential of waste recycling; Sampling for primary data is carried out for 8 consecutive days referring to SNI 19-3964-1994 [16]. Sampling was carried out in the Harau Valley Tourism Area. The location and number of sampling points can be seen in table 1.

Solid Waste Generation
Waste generation can be expressed in units of weight (kg / person / day, kg / m² / day) and volume units (liters / person / day, liter / m² / day). To get a more representative calculation, sampling was carried out for 8 consecutive days at 24 sampling points spread in the Harau Valley Tourism Area.

\[
\text{Generation formula:} = \frac{\text{weight or volume of waste (kg) area or number of waste producer (m² or person)}}{1}
\]

Solid Waste Composition
The first thing to do to calculate the composition of waste is to separate waste based on its components, namely dry waste and wet waste. Percentage of composition is the weight of each waste component divided by the total weight of the overall waste. Furthermore, the data can be used to calculate the potential for waste recycling based on the source and based on the components forming the waste.

Table 1. Location and number of sampling
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| No  | Facility          | Number of facility | Number of Sample |
|-----|-------------------|--------------------|------------------|
| 1   | Restaurant        | 4                  | 1                |
| 2   | Shop              | 130                | 13               |
|     | Food              | 10                 | 1                |
|     | Accessories       | 15                 | 2                |
| 3   | Waterfall area    | 3                  | 1                |
| 4   | Camping Area      | 2                  | 1                |
| 5   | Parking area      | 2                  | 1                |
| 6   | Garden            | 3                  | 1                |
| 7   | Mosque            | 3                  | 1                |
|     | Toilet            | 3                  | 1                |
|     | Homestay          | 3                  | 1                |
|     | **Total**         | **178**            | **24**           |

Composition formula (% weight): \[ \text{Composition formula} = \frac{\text{weight of waste component (kg)}}{\text{total weight of waste (kg)}} \times 100\% \] (2)

**Solid Waste Recycling Potency**

Recycling potency of solid waste determines by further sorting of waste which classify its into recyclable and non-recyclable wastes. The percentage of recyclable waste defines the recycling potency.

Waste recycling potential formula (%): \[ \text{Waste recycling potential formula} = \frac{\text{weight of the recyclable waste}}{\text{total weight of waste}} \times 100\% \] (3)

3. Results and Discussions

3.1. Waste generation

From this study, the average solid waste generation in the Harau Valley Tourism Area is 0.158 kg/cap./d for weight units and 3.053 Lit/cap./d in volume. The details of the generation of waste from each source of waste can be seen in Table 2.

By obtaining waste generation based on area, the calculation of waste generation unit is based on visitors by dividing waste generation that has been obtained by the average number of visitors per day. This was done because:

1. Visitors who are producers of waste in the tourist area produce not only one source of facilities, but can also produce garbage at two or more facility sources, so that the waste generation unit data per source cannot represent all the waste generated by visitors.
2. Based on the analysis of the number of waste generation results of the multiplication unit of waste generation with the number of visitors and or the area of the waste producing area, the generation of waste generated by the number of visitors, is smaller than by area.

The average solid waste generation unit in the Harau Valley Tourism Area is 3.053 Lit/cap./d or 0.158 kg/cap./d.

Table 2. Solid waste generation

| Facility  | Area (m²) | Generation per unit (kg/m²/d) | Generation (kg/d) |
|-----------|-----------|------------------------------|-------------------|
| Shops     | 1,000     | 0.086                        | 86.341            |
| Garden    | 1,000     | 0.003                        | 2.906             |
3.2. Waste composition
The composition of waste in the Harau Valley Tourism Area is different which consists of wet waste, dry waste and others. The largest composition of waste generated from the Harau Valley Tourism Area is leftover food waste with a percentage of 34.29%. This is because this area is dominated by food traders. The composition of waste in the Harau Valley Tourism Area can be seen in Table 3.

| Components           | weight (kg/day) | %   |
|----------------------|-----------------|-----|
| Food waste           | 11.653          | 34.29 |
| Paper                | 2.851           | 8.39 |
| Plastic              | 5.583           | 16.43 |
| Textile              | 0.382           | 1.12 |
| Rubber               | 0.024           | 0.07 |
| Yard waste           | 5.796           | 17.05 |
| Wood                 | 4.329           | 12.74 |
| Glass                | 1.046           | 3.08 |
| Non Ferrous metal    | 0.314           | 0.92 |
| Other                | 2.009           | 5.91 |
| **Total**            | **33.977**      | **100.00** |

3.3. Recycling potential
Calculating the potential for recycling is useful for determining what processing will be carried out at the Solid waste treatment station. The potential of recycling waste in the Harau Valley Tourism Area is quite good, for the highest potential for recycling compostable waste with a percentage of 41.31% of the total garbage available. Details of recycling potential can be seen in Table 4.

| Composition                      | (kg)   | Percentage | Recyclable | Non-recyclable |
|----------------------------------|--------|------------|------------|----------------|
| Food waste and yard waste        | 17.449 | 77.26      | 22.74      |                |
| Plastic                          | 3.096  | 70.23      | 29.77      |                |
| Paper                            | 1.605  | 56.21      | 43.79      |                |
| Metal                            | 0.314  | 0.00       | 100        |                |
| Glass                            | 1.046  | 95.69      | 0.31       |                |
| Rubber                           | 0.024  | 0.00       | 100        |                |
3.4. **Recommendation for solid waste processing**

In order to reduce waste transport into landfill, it is recommended to apply composting technology for food and yard waste, while other recyclable wastes such as plastic, paper, and glass, it can apply process of collection, separation, cleansing, and packing, before selling into nearby shanties. Furthermore, it will need special station or building such as recycling centre in the tourism area.

4. **Conclusion**

The average solid wastegenerationunit in the Harau Valley Tourism Area is 3.053 Lit/cap./day or 0.158 kg /cap./day. The composition of waste consist of food waste (34.29%), paper (8.39%), plastic (16.43%), textiles (1.12%), rubber (0.07%), yard waste (17.05%), wood (12.74%), glass (3.08%), non-ferrous metals (0.92%) and others (5.91%). Recycling potential for food and yard waste (77.26%), plastic (70.23%), paper (56.21%), and glass (95.69%). For processing option it is recommended to apply composting method for compostable waste, while for other recyclable waste can apply collection, separation, cleansing, and packing before selling into nearby shanties. For further study, this recommendation can be used as the basis for planning the solid waste managementsystem for infrastructures and non technical aspect of Harau Valley.

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