Household Hazardous Waste Identification in Rural and Urban Areas (Case Study: Belotan Village, Magetan and Cikarang Baru Housing, Bekasi, Indonesia)

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Abstract. Many household products contain hazardous material, and after the expiration, they become household hazardous waste. Household hazardous waste that discharged into the environment can have negative impacts on health and the environment. This study aimed to identify household hazardous waste in urban and rural areas. Waste identification carried for eight days to 60 households in the rural area and 55 households in the urban area. This study's results indicate that household hazardous waste accounts for 5.30% (rural areas) and 8.22% (urban areas) in the municipal solid waste stream. Household hazardous waste in the rural area dominated by sanitation (35.97%) and household cleaning products (18.73%). In comparison, household hazardous waste in urban areas dominated by sanitation (64.80%) and household cleaning products waste (15.81%). Economic factors and lifestyle are factors that influence a different household hazardous waste generation in urban and rural areas.

Keywords: Household hazardous waste, rural areas, urban areas.

1. Introduction

Many products used in the household contain hazardous and toxic substances, and when their lifetime is over, they will become household hazardous waste. Like other hazardous waste, household hazardous waste also contains harmful materials to the environment and health. For example, pesticide package waste containing organophosphates, carbamates, which can explode quickly, is highly toxic, disrupts the central nervous system, dizziness, fatigue, headaches, etc. (Galvin et al., 2008). Therefore household hazardous waste must be managed so that it does not harm human health and the environment because of its nature and characteristics (Slack et al., 2005). Hazardous waste management in Indonesia has explicitly regulated in PP No. 101 of 2014. Article 3, paragraph 1 of the regulation states that everyone who causes hazardous waste is obliged to carry out the management of the hazardous waste it produces. This regulation shows that every household that produces household hazardous waste included. However, in reality, many households do not manage their hazardous waste (Fikri et al., 2015). This study aims to identify and analyze the factors that influence household hazardous waste in rural and urban areas. The object of this research study is Cikarang Baru Housing, Bekasi, as the representation of the urban area and Belotan Village, Magetan, as the representation of the rural area. The selection of study objects in two different regions, namely urban and rural, was carried out to obtain comparisons of different waste identification results to know what factors influence the generation of household hazardous waste.
2. Methodology

2.1. Study Object

Bolotan Village is located in Magetan Regency, Indonesia, and is a rural area with the majority of the community working as farmers, ranchers, and farm laborers. Most of the areas in the Bolotan villages are agricultural and plantation land. Cikarang Baru Housing is located in Bekasi Regency and is near the JABABEKA industrial area, one of the largest industrial estates in Indonesia. The location of Cikarang Baru housing is in Bekasi Regency, one of the megapolitan areas in Indonesia.

2.2. Sample

Sample calculation in this study carried out using the formula from Slovin, (1960) as follows:

\[ \text{Number of Sample} = \frac{N}{1+N.e^2} \]  

Where (N) is the total population and (e) is the margin of error.

After calculating using a degree of confidence of 90%, the number of research samples for urban areas was 54,955 households or 55 households. The total sample of rural areas was as many as 63,636 households or 65 households. This data will then be used in the survey and waste identification stage.

2.3. Survey

The survey conducted to determine the socioeconomic conditions of the community and then used to analyze the factors that influence the conditions of waste in each region. In this study, socioeconomic conditions seen from gender, age, level of education, employment, and income per month. The total income is classified based on the Minimum Work Wage in each region and divided into three groups (Table 1).

| Category | Monthly Income          |
|----------|-------------------------|
|          | Urban Area              | Rural Area                    |
| High     | > Rp. 6.000.000,00      | > Rp. 3.000.000,00             |
| Middle   | Rp. 4.000.000,00 - Rp. 6.000.000,00 | Rp. 2.000.000,00 - Rp. 3.000.000,00 |
| Low      | < Rp. 4.000.000,00      | < Rp. 2.000.000,00             |

In addition to knowing the socioeconomic condition, a survey also conducted to determine the use of hazardous household products in the last month. This data used to complete the waste identification data, which is carried out through sampling to enable waste data that does not appear in the identification process.

2.4. Waste Identification

Waste identification was carried out using SNI 19 3964 1994 references and carried out for eight days in each region. The waste identified is domestic household waste; overall, both hazardous and non-hazardous waste so that the proportion of household hazardous waste can see from the total waste generation. In Magetan, researchers distributed plastic bags to respondents to collect their rubbish in one day, while in Cikarang, researchers took waste from residents’ trash cans in front of their homes. This difference is due to different waste conditions in the two regions. After the waste was collected, then a total weighing was carried out, then sorted and weighed according to each type and recorded. The categorization of waste refers to the research of Otoniel, et.al, (2007).

3. Result

3.1. Waste Generation

The process of identifying household waste took eight days for 65 families or 271 people in Magetan generated 472.02 kg of the waste generation with waste generation values reaching 0.211 kg/person/day. Whereas the identification of waste made to 55 households or as many as 197 people in
Bekasi produced 420.42 kg of the waste generation with a generation value of 0.267 kg/person/day. Waste generation in these two regions has similarities, which is dominated by organic waste (Table 4). However, there are differences in the composition of organic waste from these two regions. In addition to food waste and yard waste, organic waste in Magetan also composed of wood waste and plant fibers. This difference is due to different economic conditions in the two regions (Table 5). Many people in Magetan who work as farmers cause them to have plant fiber waste from the leftovers managing their yields. Also, there is a significant difference in the percentage of inorganic waste. Inorganic waste in urban areas (14.44%) has a higher value than the amount of inorganic waste in rural areas (5.50%), especially plastic waste and tetra pack packaging waste. The consumptive pattern of urban society is a factor influencing this difference.

![Fig. 1. Graph of Non-hazardous domestic waste composition (% weight unit)](image)

### 3.2. Household Hazardous Waste

#### 3.2.1. Magetan

From the overall solid waste generation in Magetan, there are 5.30% household hazardous waste with the value of household hazardous waste generation reaching 11.21 g/person/day. Household hazardous waste in Magetan dominated by sanitation (35.97%), chemicals for agriculture (18.65%), and household cleaning products (18.73%).

Chemicals for agriculture category dominated by insecticide and pesticide waste has a tremendous amount because many people in Magetan have fields or gardens and work as farmers, so they use insecticides and pesticides to manage their fields and gardens. In contrast, household cleaning products have a high percentage because they are always in every home and used every day so that the waste product widely found.

#### 3.2.2. Bekasi

In Bekasi, there are 8.22% of household hazardous waste from the overall solid waste generation, with the value of household hazardous waste reaching 21.93 g/person/day. Household hazardous waste in Bekasi dominated by sanitation (64.80%) and household cleaning products (15.81%). A large number of household cleaning products caused by household cleaning products used every day by the community. It causes product lifetimes to be faster so that it can be easily identified compared to another household hazardous waste such as batteries, insect killers, etc.
In the identification process, some products that have a small percentage even though many people use the product are due to limited identification time and a long product lifetime, so there is a possibility that the use of hazardous products has not yet expired within the identification period. A survey was conducted on hazardous household products in the last 30 days to obtain complete household hazardous waste data.

Table 2. Use of hazardous products in the past month

| Category                  | Quantity (%) | Rural       | Urban       |
|---------------------------|--------------|-------------|-------------|
| **Home Cleaning Product** |              |             |             |
| Detergent                 | 100,00       | 100,00      |             |
| Dishwashing Detergent     | 100,00       | 100,00      |             |
| Laundry Aids              | 4.62         | 34.55       |             |
| Bleach                    | 47.69        | 34.55       |             |
| Fabric Softener           | 80.00        | 85.45       |             |
| Soap Bars                 | 75.38        | 69.09       |             |
| All-Purpose Cleaners      | 53.85        | 38.18       |             |
| Wood Protectors           | 13.85        | 0.00        |             |
| Air Fragrance             | 27.69        | 50.91       |             |
| **Automotive Maintenance**|              |             |             |
| Lubricants                | 80.00        | 38.18       |             |
| **Battery**               |              |             |             |
| Battery                   | 100.00       | 81.82       |             |
| **Medicine**              |              |             |             |
| Pill                      | 44.62        | 61.82       |             |
| Syrup                     | 21.54        | 61.82       |             |
| Lotion                    | 100.00       | 38.18       |             |
| Suppositories             | 0.00         | 3.64        |             |
| Food Supplements          | 7.69         | 41.82       |             |
| **Medical Waste**         |              |             |             |
| Latex Gloves              | 1.54         | 1.82        |             |
| Gauze                     | 0.00         | 9.09        |             |

Based on the survey results of the use of hazardous household products in the last 30 days that have carried out, that there are some differences such as the use of automotive care products and pesticide products. Table 5 shows that the use of lubricants in Magetan reaches 80%, while in Bekasi, the use of lubricants only reaches 38.18% of respondents. Differences also occur in the use of pesticides, where the use of pesticides in Magetan reaches 100%, while respondents in Bekasi do not use pesticides at all. Then for the use of insecticide products in both regions has a nearly equal value where there are 70.77% of respondents in the village and 72.73% of respondents in the city use insecticides. Even though it looks almost the same, there is a very significant difference between the two where the type of insecticide used by rural communities is an insecticide for agriculture. In contrast, the type of insecticide used by urban communities is to eradicate insects in the house.
Table 3. Socio-Economic Condition

| Category | Total (%) | Category | Total (%) | Category | Total (%) |
|----------|-----------|----------|-----------|----------|-----------|
| Level of education | Rural | Urban | Profession | Rural | Urban | Income | Rural | Urban |
| Not yet | 7.89 | 11.17 | Farmer | 27.24 | 0.00 | High | 20.00 | 58.18 |
| Primary | 35.84 | 11.68 | General | 7.17 | 30.96 | Middle | 13.85 | 38.18 |
| Junior high school | 17.20 | 7.11 | Employees | Housewife | 12.90 | 20.81 | Low | 66.15 | 3.64 |
| Senior high school | 31.90 | 51.27 | Enterpreneur | 10.75 | 5.58 | |
| Diploma | 0.00 | 5.08 | Civil servants | 2.51 | 0.00 | |
| Bachelor | 5.73 | 13.20 | Others | 5.02 | 1.02 | |
| Master | 0.00 | 0.51 | Jobless | 34.41 | 41.62 | |
| No | 1.43 | 0.00 | |

Overall, differences in the identification result in rural and urban areas caused by different economic and lifestyle factors in the two regions (Table 3). Differences in economic factors cause different lifestyles between rural and urban communities so that there are differences in household hazardous waste generated. The most apparent difference seen in the category of chemical for agriculture waste where pesticide waste in rural areas has a more significant percentage than in urban areas. Because most rural people work as farmers while in the urban, no one works as a farmer. Another example is the results of a survey of lubricants, where 80% of rural residents claimed to use lubricants in the last 30 days in their home, while only 38.18% of urban residents who use it lubricants in the last 30 days in their homes. The reality on the ground shows that many villagers use vehicle lubricants in their homes because they prefer to take care of their vehicles rather than take them to the garage because of the cost factor. In contrast, the city community prefers to entrust their vehicle maintenance to the workshop.

3.3. Comparasion With Other Regions

Before this research conducted, there were several studies on the identification of household hazardous waste both at home and abroad. According to table 4, Magetan, Indonesia has the most significant percentage of chemical waste for agriculture than in other regions. It is because Magetan, Indonesia, is the only rural area with the majority of people living as farmers. Although Cuitzeo Basin, Mexico, is a rural area, Cuitzeo Basin, Mexico, has lower chemical waste for agriculture than Magetan, Indonesia, because the people in Cuitzeo Basin, Mexico, are not as many farmers as Magetan, Indonesia. The location of the Cuitzeo Basin, Mexico, which is still close to the United States, causes many Cuitzeo Basin people to migrate to the United States for work and education. It impacts the percentage of household hazardous waste generated due to changes in consumption patterns and people's lifestyles in the Cuitzeo Basin (Buenrostro et al., 2007).

Table 4. Comparison with the composition of hazardous household waste in other regions

| Category | Magetan, Indonesiaa | Bekasi, Indonesiaa | Shuzou, Chinab | Mexicoa | Cuitzeo Basin, Mexicoa | Morelia, Mexicoa |
|----------|---------------------|--------------------|----------------|--------|-----------------------|-----------------|
| Home Cleaning | 18.73 | 15.81 | 21.33 | 19.50 | 38.60 | 34.90 |
| Automotive Care | 1.50 | 0.82 | 2.67 | 8.90 | 2.80 | 6.10 |
| Battery | 0.88 | 2.02 | 11.14 | 15.70 | 5.20 | 2.80 |
| Medicine | 5.28 | 4.58 | 17.67 | 8.40 | 9.90 | 15.00 |
| Medical Waste | 0.54 | 0.00 | - | - | - | - |
Bekasi, Indonesia has the highest percentage of household hygiene waste products than other regions, which are urban areas such as Suzhou, China; Morelia, Mexico; and Mexicali, Mexico. The percentage of hazardous household waste in each region is influenced by several driving factors that may differ from one region to another. For example, in Bekasi, Indonesia is influenced by economic and lifestyle factors. It is different from what happened in Suzhou, China, wherein Suzhou, China, one of the factors affecting the generation of household hazardous waste generated is climate and culture. The identification of hazardous household waste in Suzhou carried out in the winter, and a "China Blossoming" festival would be held, causing many people to clean their homes to welcome relatives who would come to participate in the festival. Many people bought heating equipment. This condition causes the waste of home cleaning products to have a high value (Binxian Gu et al., 2014).

In contrast to Suzhou, the generation of household hazardous waste in Mexicali, Mexico, is influenced by consumption patterns and lifestyle factors. Ease of access to buying various products and the number of products at relatively low prices caused many people in Mexicali, Mexico, to buy products with high quantities but have a short usage time (Buenrostro et al., 2007). Factors of consumption patterns and lifestyles also influence household hazardous waste generation in Morelia, Mexico (Otoniel et al., 2008).

4. Conclusion

a) Waste identification carried out for eight days to 65 households in Belotan village, Magetan produces 472.02 kg with waste generation reaching 0.211 kg/person/day. In contrast to the identification of 55 households in Cikarang Baru Housing, Bekasi produces 420.42 kg with a waste generation reaching 0.267 kg/person/day.

b) In the Belotan village, Magetan, there is 5.30% household hazardous waste with a household hazardous waste generation reaching 11.21 g/person/day. It dominated by sanitation, chemical for agriculture waste (in the form of bottles and sachets), and home cleaning product waste (in the form of small sachets and some in large sachet packaging).

c) In Cikarang Baru Housing, Bekasi, there is 8.22% of the household hazardous waste with household hazardous waste generation reaching 21.93 g/person/day. It dominated by sanitation, and home cleaning product waste in the form of bottles, spray bottles, large sachets, and small sachets.

d) Household hazardous waste generation influenced by several factors, including economic and lifestyle factors.

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