The role of the informal sector of waste management

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Abstract. Garbage, on the one hand, is an environmental problem, but on the other hand, it can give the potential economically. One indication of it there are IS activities that collect certain types of waste as recycled materials and then sold to the recycling industry. This research aims to determine the role of IS of solid waste management (SWM) in Bandung municipality. The study used mixed method research, which is a combination of qualitative and quantitative. The results of this study concluded that the estimated number of scavengers as IS in Bandung municipality is about 3990 people, and contributed to the reduction of waste about 6.8% of the total solid waste generation. As economically, the average income of IS is IDR 1 million/person/month. Considering the role of IS both in SWM contexts and in economic contexts, the government must be to make a policy to integrate the IS with SWM. Base on the AHP methods, this study recommended that to integrated IS of SWM can be developed by facilitating them at TPS/TPS 3R. The implication of the strategy that the existence of IS will be more organized and reduce waste generation to the maximum.

1. Introduction

SWM is a still serious problem in various cities in the world. At present, the problem of waste is not only a health and environmental problem but also has become a social and economic problem [1]. Related to environmental problems, it is clear that waste which not managed properly, it will cause environmental pollution. Regarding the social aspect, waste has become a special attraction for unemployed people to make a living so that informal business groups emerge, where they are generally immigrants whose residence status is unclear so that it becomes a separate problem. Regarding economic aspects, waste has become a commodity that can be traded both as a recycled material and a material cycle.

The economic potential of waste is attractive to be studied further, especially after the regulation of Law No. 18 of 2008 concerning Waste Management, where the aims of waste management not only environmental and health purposes but also makes waste as a resource. The use of waste as a resource has been carried out by many communities both for organic waste and for inorganic waste which is recycled material. For the type of inorganic waste which is a recycled material today, many actors make it a business activity which became known as the informal sector (IS). The existence of IS in waste management is a common phenomenon in developing countries, where they collect certain types of waste as recycled raw materials [2]. The presence of IS in the midst of the community, especially in
urban areas is also inseparable from the urbanization and unemployment problems in urban areas because garbage by them can be a solution to earn a living [2].

Previous research has shown that IS activities generally is an established group and business network. Scavenger, the main actor of IS, is divided into three groups: (a) mobile scavengers, (b) TPS scavengers, and (c) TPA scavengers. Usually, these scavengers are under the coordination of collectors, who collect and buy material from scavengers [3]. In general, scavengers are migrants, and their presence is often considered a social problem, because they do not have a permanent residence, and live in empty places in the city [4]. Other characteristics of the IS are unregistered businesses, not regulated, working individually or in groups or small business groups [3]. Is also synonymous with businesses with labor-intensive systems with low income and simple technology, also often considered a dirty and disgusting business [2].

In previous studies, it has not been studied how the characteristics of the IS business specifically, how much potential can be generated from IS activities in the collection of waste as recycled material, as well as how much potential for reducing waste from these activities. The three points that are the main objectives of the research are very strategic things, especially for the city government to make policies on how to integrate IS in waste management.

2. Methods
The study used a quantitative and qualitative approach (mix method), where the population divided into two groups: IS group with scavengers as sampling units, and expert groups with representative sampling units from the government, legislative members, academics, NGOs, and practitioners. Collection data for problem one and two conducted by distributing questionnaires to scavengers in the Bandung Municipality. The sampling unit for this study was scavengers consisting of mobile scavengers, TPS scavengers, and junkers. Sampling was done using cluster random sampling method, with the number of samples calculated using the Solvin formula as stated in [5]:

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n = \frac{N}{1+N\alpha^2}
\]

Where: \( n \) = number of samples, \( N \) = population scavenger, \( \alpha \) = significant level. If the number of scavengers in Bandung in 2017 is 3990 scavengers projected from 2008 is about 3648 scavengers as baseline data [6], the scavenger growth rate is 10% per year, with a significant level of 5% the number of samples taken is: 364 scavengers.

Meanwhile, for problem 3, the policy determination related to IS involvement in waste management will be carried out using the Analytical Hierarchy Process (AHP) method. AHP is an approach to decision making that is designed to help solve complex problems with many criteria and involves many variables [7]. In the AHP method, the following steps:

- Define the problem and detail the desired solution;
- Create a hierarchical structure from a comprehensive managerial point of view (from the top level to the level where it is possible to intervene to solve the problem);
- Make a pairwise comparison matrix for the contribution or influence of each relevant element on each important criterion that is level above it. In this matrix, element pairs are compared concerning a criterion at a higher level. In comparing the two elements, most people prefer to give a consideration that shows dominance as an integer. This matrix has one place to enter the number and another place to enter its reciprocal value. So if one element does not contribute more than the other elements, the other elements will contribute more than that element. This number is entered in the appropriate place in the matrix and its inverse value in the other place. According to the agreement, an element on the left examined regarding its dominance over an element at the top of the matrix;
• Get all the considerations needed to develop a matrix tool in step three. If many people participate, the task of everyone can be made simple by allocating the right effort. Multiple considerations can be synthesized using their geometric averages;
• After collecting all paired comparison data and entering the inverse values along with number 1 entries along the main diagonal, the priority is sought, and consistency is tested;
• Perform steps 3, 4 and 5 for all levels and clusters in the hierarchy;
• Use hierarchical (synthesis) compositions to weight priority vectors with criteria weights, and add up all weighted priority entries that are related to the priority entries of the next lower level, and so on. The result is a comprehensive priority vector for the lowest hierarchy level. If the result is several fruits, the average arithmetic value can be taken;
• Evaluate consistency for the entire hierarchy by multiplying each consistency index with the priority criteria concerned and adding up the results. This result is divided by similar statements that use a random consistency index, which corresponds to the dimensions of each matrix.
• In the same way, every random consistency index is also weighted based on the priority of the criteria in question, and the results are summed. Hierarchy consistency ratio must be 10% or less. If not, the quality of the information must be improved, for example by improving how to use questions when making pairwise comparisons. If the action still fails to improve consistency, there is a possibility that this problem is not adequately structured, i.e., similar elements are not grouped under a meaningful criterion. If so, it is necessary to go back to step 2 even though only the parts of the problem of the hierarchy need to be corrected.

3. Result and discussion

3.1. General characteristic of IS
The IS activities play a role in reducing waste that which disposed to the landfill, but their activities not integration in city waste management. Although there are no specific institutions related to the activities of IS actors they have formed separate business networks and are relatively organized even though they are considered illegal by the government.

In carrying out its activities, IS generally form an established business network. The most upstream actors are scavengers. In general, scavengers who collect garbage in the city of Bandung are divided into two groups: (a) mobile scavengers, which is collecting garbage from house to house by taking the garbage in the garbage container in front of the house, roadside or public place, and (b) waste collectors usually collecting garbage at TPS. After that, the scavengers sold material to the collector, and then collector sold to the agent. The agent usually only receive more specific types of waste material, such as PET plastic, paper, metal, and glass. After treatment in the agent then sold to the recycling industry. The mechanism of the IS business work shown in figure 1.

3.2. IS performance in reducing waste
Quantitatively, the performance of recycled waste collection by IS, junkers is relatively higher than scavengers, which is an average of 59.3 kg/person/day. Meanwhile, the performance of scavengers in TPS averaged 36.6 kg/person/day, and mobile scavengers (non-TPS) averaged 36.3 kg/person/day. The junkers get far more when compared to other scavengers because they usually have "subscriptions" with the source of waste, and they collect recycled material waste by buying. Meanwhile, the scavengers collect what garbage is in a garbage container and is free. Base on the type, the most collected waste is paper waste, especially cardboard. The actors who collected the most types of paper/cardboard were also craftsmen who were 26.7 kg/person/day (table 1).
Based on the results of the survey, there is a significant role in the activities of IS in waste management in Bandung municipality. The number of scavengers at the time of the survey was estimated at 3990 people [1], (not including collector and agent with the amount of recycling material managed around 7.74% of the total solid waste generation. However, it produces a residue of around 3,434 tons/year or 0.6% of the total solid waste generation, with a total overall revenue potential of IDR 47.8 billion/year, or an average scavenger income of IDR 12 million/person/year or IDR 1 million / person/month. Based on these data, the role of scavengers in waste reduction is significant, as well as in driving economic activities from the utilization of waste.

Even though the informal sector plays an essential role in reducing waste and reducing unemployment, the existence and activities also have the potential negative impacts if not properly regulated. Regarding waste management performance, in addition to helping reduce waste, it also produces potential contamination, namely from residues (low-value recycled waste) that are disposed of carelessly. The potential of residue produced is around 30% of the total waste collected [8], or around 3,434 tons/year or 0.6% of the total solid waste generation. Also, socially because generally, the informal sector actors come from outside the city, their

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**Table 1. Recycling performance of waste recycling by the IS.**

| Kind of material       | Average waste collected (kg/person/day) |
|------------------------|----------------------------------------|
|                        | TPS Scavengers | Non-TPS Scavengers | Junkers | Total |
| Plastic                | 15.1          | 11.3              | 18.4    | 44.8  |
| Paper/card board       | 11.2          | 12.8              | 25.4    | 49.4  |
| Metal                  | 4.4           | 5.4               | 8.7     | 18.4  |
| Glass/bottle           | 6.1           | 6.8               | 6.8     | 19.7  |
| **Total**              | **36.7**      | **36.3**          | **59.3**| **132.2** |
| **Average**            | **36.7**      | **47.8**          |         |        |
place of residence is not settled tends not to have a clear population identity which is prone to potential security disturbances. For this reason, the presence of the informal sector is often viewed negatively by the surrounding community.

3.3. Integrate IS in waste management

Based on the description above, to maximize the role of scavengers in waste management, it is necessary to make policies on how to integrate IS in waste management. To develop the policy, a survey is carried out by distributing questionnaires to respondents and then processed using the AHP method. This hierarchy of decisions describes the objectives, criteria and alternative policies that are possibly related to the existence of the informal sector in the waste management system shown in figure 2.

![Figure 2](image)

**Figure 2.** Decision hierarchy.

Based on the scoring results, the policy choices with the highest score are the IS facilitated at TPS/TPS 3R.

The collection of recycled waste at this time is not only carried out by IS but also by the waste bank as a community-based activity. For this reason, the city government needs to regulate the business mechanism between the IS and the waste bank to realize the integrated recycling system. The mechanism of integrated IS and waste bank in city recycling system as shown in figure 3.

![Figure 3](image)

**Figure 3.** Integration IS and wastes bank in city recycling system.
4. Conclusion
The role of the IS in waste management turned out to be very important especially in helping waste reduction activities through recycling activities as mandated in Law No. 18 of 2008 concerning Waste Management. The informal sector contribution in waste reduction is 6-7% of the total waste generation. Even though it has a positive role, it turns out that informal sector activities also have a negative impact on both ecologically, namely by managing bad of residues and socially. For this reason, integration of the informal sector business in waste management needs to be done. Based on the results of the survey and processing with the AHP method the policy of integrating the IS in waste management is facilitated in TPS/TPS 3R.

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