Determining Factors of Community Participation in Waste Bank

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Abstract. The study aims to analyze the factors affecting community involvement in the waste separation and reduction through waste bank for low participation through benefits offered to its member. Logistic regression was used for the analysis, and there were 26 dependents variables applied to the analysis. The result showed that six variables, i.e., age, occupation, participation in social activities, knowledge of sustainable development, distance from HH to WB, and availability of dissemination of 3R, affect people’s motivation to be member and actively involved in waste reduction through the waste bank. All variables except distance are proportional to the motivation of the community to participate in waste bank. The attained model is used to calculate the probability of community participation in waste banks afterward. Using different conditions, where variables are set with values of zero and one representing absence and availability of related variables, respectively various probability values come out ranging from 0% to 94.8% which is the highest probability value if all significant factors are available.

1. Introduction

Solid waste management (SWM) is becoming one of the concerns in environmental issues since it affects people’s living conditions worldwide. In developing countries, where SWM is commonly unsustainable, more attention is required [1]. Illegal dumping, open burning, and open dumping are examples. Illegal dumping causes water and soil pollution for heavy metals contamination [2], while open burning emits gaseous pollutants such as carbon dioxide (CO2), carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), and (Particulate matter (PM10) affecting the atmosphere [3]. Furthermore, an open dumpsite leads to waste scavenging, giving scavengers working there the health risk [4]. Open dumping also contributes solid waste into surface water flowing to the sea, increases the volume of debris in the ocean globally, and boosts environmental pollution [5]. Therefore, SW mismanagement is the cause of severe and various environmental and social impacts, which do not allow improvements in sustainable development.

Previous studies reported innovative and promising solutions for better SWM in third-world countries. For instance, organic waste redemption programs for biogas generation and fertilizer [6] waste-to-energy (WtE) technologies [7], WtE combined with recycling of recyclable material [8], biomass-based briquettes production [9], empowerment of waste pickers with legal incentives [10] and
waste bank [11]. Still, challenges exist for formal collection, treatment, and final disposal improvement [12].

The government of Indonesia (GoI) has enacted Waste Law 18/2008, banning the practices of environmentally unfriendly SWM to reduce the effect of mismanagement SWM on the environment. Along with the improvement of SWM, GoI set the target of 30% waste reduction 2030 and by enacting regulation No. 81/2012 on reducing, reuse, and recycling (3R) of domestic waste. 3R can be implemented on a community scale enabling the local community to play a role in reduce waste. A small-scale waste recycling system is an example of community participation in 3R [13] as well as the waste bank (WB) [11].

The WB is widely implemented in some Southeast Asian countries, including Indonesia [13]. WB is a reasonable solution for waste reduction in Indonesia since it promotes community participation. The number of WBs in Indonesia is continuously increasing. In 2018, there are 7488 waste banks nationwide. However, the participation rate increases slowly cause inefficiency. Recent studies showed that many WBs in Indonesian cities are inactive or even shut down. In East Java Province, the activity rate is approximately 48.2%, representing that less than half of registered WB is active. [14] founded that there was a significant positive correlation between environmental knowledge and people’s attitudes and participation in the waste bank. However, there is a lack of research at the national level focusing on the factors affecting the community’s motivation to be involved in waste reduction through WB. Therefore, this paper aims to investigate potential correlates of community participation in WB and three factors, i.e., situational characteristic, psychological factor, and technical factor.

2. Method

2.1. Case study location and period

The study took place in a settlement area (Kelurahan), having 687 households (HHs) in Surabaya City. A Preliminary study of the locations of WBs was started before selecting the research object (WB and its service area) to ensure the appropriate WB, which potentially provides services to enough households surrounding. The characteristic of selected WB was identified including its performance to provide waste collection and buying. Meanwhile, households were the target for questionnaires to collect the data for regression. Currently, only 46 HHs are registered and participate actively as a member of WB through the relatively good access to the WB.

The study was conducted from November 2020 to March 2021 started by preparing the primary survey, including observation and questionnaire distribution. The primary survey took about a month to collect required data at the household level, while the second survey was conducted along with the primary one. The questionnaire focused mainly on data related to the household’s social, economic, and demographic background.

2.2. Data collection and analysis

A Survey for public participation was conducted to collect the data required for the analysis. Using Slovin’s formula, there are 253 households as samples in the study chosen randomly within the 1 km radius since all households within this radius have the same opportunity to participate as WB’s members. The average distance of the active member’s house is 650 m used for the reference. Meanwhile, the radius of 1 km was used as people tend to participate voluntarily in an organization [16]. These samples were identified according to one response variable and 26 predictor variables used in this study (Table 1). Environmental attitude is the response variable affected directly by three parameters representing situational characteristics, psychological, and technical factors.
Table 1. Variables for the regression analysis.

| No | Parameter                        | Variable                        | Sub-variable                                                                 | Source |
|----|----------------------------------|---------------------------------|-------------------------------------------------------------------------------|--------|
| 1  | Environmental attitude           | Participation in WB            |                                                                               | [15]   |
| 2  | Situational characteristics      | Behavioral context             | Availability of waste bin (X₁)                                               | [17]   |
|    |                                  | Individual characteristics     | Social and demographic background                                            | [14]   |
|    |                                  |                                 | Age (X₂)                                                                      | [15]   |
|    |                                  |                                 | Occupation (X₃)                                                               |        |
|    |                                  |                                 | Income (X₄)                                                                   |        |
|    |                                  |                                 | Education (X₅)                                                                |        |
|    |                                  |                                 | Size of household (X₆)                                                        |        |
|    |                                  |                                 | Participation in organization (X₇)                                             |        |
|    |                                  |                                 | Participation in social activities (X₈)                                        |        |
|    |                                  | Individual knowledge and experience of the behavior | Knowledge about environment | [15] |
|    |                                  |                                 | Global warming (X₉)                                                           |        |
|    |                                  |                                 | Ozone depletion (X₁₀)                                                         |        |
|    |                                  |                                 | Water pollution (X₁₁)                                                         |        |
|    |                                  |                                 | Knowledge about waste management                                             |        |
|    |                                  |                                 | Domestic waste production (X₁₂)                                               |        |
|    |                                  |                                 | Waste disposal (X₁₃)                                                          |        |
|    |                                  |                                 | Waste problems (X₁₄)                                                          |        |
|    |                                  |                                 | Knowledge about policy                                                       |        |
|    |                                  |                                 | Sustainable development (X₁₅)                                                 |        |
|    |                                  |                                 | National environmental program (X₁₆)                                          |        |
|    |                                  |                                 | Source of information (X₁₇)                                                   |        |
| 3  | Psychological factors            | Awareness about waste issues   |                                                                               | [15]   |
|    |                                  | (X₁₈)                           | Motivation to overcome waste problems (X₁₉)                                   |        |
|    |                                  | Acceptance of related norms     |                                                                               |        |
|    |                                  | (X₂₀)                           | Opinion about waste problems (X₂₁)                                            |        |
|    |                                  | Willingness to act (X₂₂)        |                                                                               |        |
|    |                                  | Sense of belonging (X₂₃)         |                                                                               |        |
| 4  | Technical Factor                 | Distance from house to WB (X₂₄) |                                                                               | [16]   |
|    |                                  | Influencer (X₂₅)                |                                                                               |        |
|    |                                  | Dissemination of 3R (X₂₆)       |                                                                               |        |

2.3. The Empirical Model

The motivation of a household to participate in an informal organization like WB can be measured using different approaches depending on the local context, considering the type of targeted output and explanatory variables. In this study, a dichotomous dependent variable was used along with some categorical and numerical explanatory variables. Henceforward, probability calculation was undertaken to assess the willingness of people to participate in waste reduction WB.
3. Results and discussion

3.1. Characteristics of the Households

Public awareness of the potential benefits and public knowledge of waste management may affect the public willingness to participate in waste management [18]. Therefore, a detailed portion of the questionnaire was assigned to attain data related to public attitude and behavior, including respondents’ public awareness about waste reduction through WB and its pros and cons. As explained before, the decision of a household to participate in WB was demonstrated as a dichotomous variable having the value of 1 if a household agrees to participate and 0 if-else. Initially, all samples are asked about it to get the rough value of public acceptance of WB, and the result was that 95% of samples have interest to participate as a member of WB, while the rest do not have for some reasons, i.e., time-consuming, lack of knowledge of 3R and waste separation, and ignorance of nearby WB. The results of statistical calculation for explanatory variables applied to the model are presented in Table 2. The next step was regression analysis using the data from questionnaires answered by 253 HHs, indicating a 100% survey participation rate.

| N o | Variable | Percentage (1) | N o | Variable | Percentage (1) |
|-----|----------|----------------|-----|----------|----------------|
| 1   | Availability of waste bin (=1, if Yes) | 57% | 14 | Knowledge Waste problems (=1 if Yes) | 83% |
| 2   | Age (=1, if Productive) | 97% | 15 | Knowledge Sustainable development (=1 if Yes) | 30% |
| 3   | Occupation (=1, if permanent) | 84% | 16 | Knowledge National environmental program (=1 if Yes) | 56% |
| 4   | Income\(^a\) (=1 if > rwm) | 33% | 17 | Source of information (electronic – printed) | 53% |
| 5   | Education (=1 if higher education) | 13% | 18 | Awareness about waste issues (=1 if Yes) | 95% |
| 6   | Size of household (=1 if extended) | 13% | 19 | Motivation to overcome waste problems (=1 if Yes) | 78% |
| 7   | Participation in organization (=1 if Yes) | 8% | 20 | Acceptance of related norms (=1 if Yes) | 84% |
| 8   | Participation in social activities (=1 if Yes) | 26% | 21 | Opinion about waste problems (=1 if Yes) | 84% |
| 9   | Knowledge Global warming (=1 if Yes) | 85% | 22 | Act for waste problem solution (=1 if Yes) | 71% |
| 10  | Knowledge Ozone depletion (=1 if Yes) | 57% | 23 | Sense of belonging (=1 if Yes) | 96% |
| 11  | Knowledge Water pollution (=1 if Yes) | 95% | 24 | Distance from house to WB (=1 if < 650 m) | 38% |
| 12  | Knowledge Domestic waste production (=1 if Yes) | 82% | 25 | Significance of Environmental cadre (=1 if Yes) | 34% |
| 13  | Knowledge Urban waste production (=1 if Yes) | 54% | 26 | Experiencing dissemination of 3R (=1 if Yes) | 44% |

\(^a\) Regional wage minimum

The age of respondents is an essential variable in the decision-making of participation in waste recycling. Recent studies observed the relationship between age and public attitude and behavior, and the result was equivocal. Some papers stated that people between 36 and 65 years old are willing to recycle, while older people are more opposed to recycling [19,20]. Furthermore, income reflected by occupation has a positive and significant correlation with the willingness to participate [21,22].
Education enabling knowledge enhancement is another potential factor, and it has a positive relationship with the willingness to participate [22].

3.2. Determinant factors of household’s decision for WB participation

The results of the statistical test applied to all variables are presented in Table 3. The results show that all values meet the required values. Following the test in Table 3, further statistical analysis was conducted. The binary logistic regression confirms that the model was fit and very significant, coming to the following result of Nagelkerke R Square values and predicted model values of 0.845 and 94%, respectively. These values indicate that the dependent variable is 84.5% influenced by the independent variable used in the study, and the model has an accuracy rate of 94%.

Table 3. Results of the statistical test.

| Statistical test   | Tool                      | Critical value                              | Result (x)          |
|--------------------|---------------------------|---------------------------------------------|---------------------|
| Validity           | Corrected Item-Total      | \( x > 0.124 \) (\( \alpha=0.05 \))       | All variables have value > 0.124 |
| Reliability        | Cronbach’s Alpha          | \( 0.40 < x \leq 1.00 \) (medium to very high reliability) | 0.867               |
| Significance       | Omnibus Test              | \( x < 0.05 \)                              | 0.000               |
| Goodness of Fit    | Hosmer and Lemeshow test  | Significance \( \geq 0.05 \)                | 0.06                |

Logistic regression analysis assesses independent variables’ relationship with participation in WB. The logistic regression model has a constant value of -68.045. Logistic regression analysis identified six significant factors associated with WB participation: age, occupation, participation in social activities, knowledge of sustainable development, distance from HH to WB, and availability of dissemination of 3R. The model of public acceptance on WB is presented in Equation 1:

\[
g(x) = -68.05 + 6.71 X_2 + 2.91 X_3 + 2.62 X_9 + 1.64 X_{16} - 2.16 X_{24} + 3.09 X_{26} \tag{1}
\]

The overall model was significant, with the value of adjusted R\(^2\) of 84.7%, which is relatively high for a model addressing prediction on human response toward waste reduction initiatives. The probability that people will participate in waste reduction through WB is calculated by assuming that all significant factors variables are available, and the result is 0.948. The value indicates that 94.8% of HHs in the study area are willing to participate in WB. A high value of participation is expected in this research since it may contribute to the success of the waste reduction program through WB.

4. Conclusion

This work proposed an explanatory model representing the relationship between 26 independent variables and public participation in waste reduction through the waste bank. Logistic regression analysis was used to define variables directly affecting people’s willingness to be a member of a waste bank. Regression analysis concluded that six independent variables, i.e., age, occupation, participation in social activities, knowledge of sustainable development, distance from household to waste bank, 3R dissemination program, are significantly bear on the participation in the waste bank. The probability that people will participate in the waste bank is 94.8% if all factors drive. The attained model can be beneficial for local authorities to determine related policies and use the waste bank to support the decision to increase domestic waste reduction. However, other variables i.e., gender of head family and dwelling type can be observed in the next related research.
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