Participation of Government, Community, Public Sector, and Mass Media Towards Waste Bank on Recycling Activity using Regression Analysis

Hayati Mukti Asih
Industrial Engineering Department, Faculty of Industrial Technology, Universitas Ahmad Dahlan, Indonesia

Abstract- Indonesia came up with the regulation UU No. 18/2008 which changed the paradigm from waste dumping to recycling. Currently, Indonesia is the second largest country that dumping the plastic waste into the world's oceans. It is about 3.22 million metric tons of plastic waste was thrown into ocean around Indonesia annually. On the other hand, China has tossed plastic waste into the ocean about 8.82 million metric tons. The goal of this study was to examine the participation of government, community, mass media, and public sector on waste recycling activity by using regression analysis. The research was focused on waste banks in Brontokusuman, Yogyakarta, Indonesia and the questionnaires were distributed to communities on the study area. The results showed that the participation of government has more influence on waste recycling activity than the community, mass media, and the public sector. Furthermore, this study suggested four strategies to support government participation and they include increasing funding for household waste management, intensifying training on recycling household waste, stepping up information dissemination through mass media and campaign, and creating a policy or regulation related to waste recycling activity.
Keywords: Waste bank; regression analysis; recycling activity

INTRODUCTION

Municipal waste plastics are raising some alarming issues concerning waste processing. In fact, there is a small amount of municipal waste plastic that was recycled. But, more than 50% of industrial waste plastic were thrown in landfills, then the remaining waste, a half was burnt and a half was recycled [1].

The regulation of Indonesia, UU No. 18/2008, changes the paradigm from waste dumping to waste recycling. UU No. 18/2008 rules that the municipal solid waste should be managed by reduction and handling. Reduction means decreasing the generation of solid waste, recycle it, or/and reuse it. On the other hand, handling the waste means the waste separation, collection, transportation, treatment, and landfill [2]. However, recycling waste is able to provide the benefit in term of social and economic for the communities [3]. In addition, recycling can be resource recovery which is an important parameter for management of MSW and also waste reduction can conducted well through recycling the waste itself [4].

From the previous researches, mostly they concerned about the participation of the community towards waste management. Dhokhikah et al. [5] examined the household solid waste reduction through community participation in Indonesia, especially in Surabaya by using the regression method. This study suggested to intensify the training, information dissemination, number of eco-friendly units and maximize the presence of waste bank and its function. In addition, Singhirunnusorn et al. [6], on managing the solid waste, the knowledge, attitude, and behavior of people on the environment can influence their awareness on waste recycling activity.

Then, Raharjo et al. [3] developed some alternatives that could support solid waste bank activity in improving the amount of recycling the waste. In practice, local MSW management in Padang city, Indonesia can be integrated in a system of solid waste bank in order to improve the people participation in separation, collection and recycling of generated solid waste. Phu et al. [7] also developed five recycling alternatives according to the status and intention of waste management practices of the hotels in Hoi An city, Vietnam and the hierarchical structure of recycling. Therefore, the recycling strategies such as maximization of waste separation at source, the rules of waste promulgation, and the improvement of motivations in managing the waste could be suggested. Ho and So [8] proposed a model in supporting Guamanian develop a lifestyle that give a better environmental friendlier. The results show that the higher number of users' access to the media with a sustainability message, the more impact on the behavior's Guamanian that pro-environment.

Regression method was employed to measure the relationship between dependent and independent variables. There are many researchers studied about it. Bandara et al. [9] studied the relationship among the assessment of property`s tax value, total number of families member in a household, total number of employed members in a household, and the number of motor vehicles owned by a household towards the amounts of per capita organic waste, generated per day in kilogram by developing regression analysis. Then, Fumo and Biswas [10] developed regression method for estimation of residential energy consumption. In addition, Abdulredha et al. [11]

*Corresponding Author: Hayati Mukti Asih, Email: hayati.asih@ie.uad.ac.id
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developed multiple regression analysis to estimate the generation of solid waste by hospitality industry during major festivals. The parameters that are identified as influencing municipal solid waste generation rate are number of beds, hotel size, occupancy rate, municipal solid waste collection frequency, the area of hotel, and number of employees/ staffs. Next, Awasthi et al.[12] developed linear regression to define the relationship of e-waste amount, population, and economic growth in 28 European countries during the year of 2009-2014. This research examined six case-studies such as GDP PPS and collected amount, gross domestic product (GDP) at purchasing power standard (PPS) and reuse & recycling amount, population and collected amount, population and reuse & recycling amount, GDP at PPS per capita and collected amount per capita, GDP at PPS per capita and reuse & recycling amount per capita.

Then, Boumanchar et al. [13] proposed multiple regression and genetic programming method to develop empirical models for the estimation of MSW higher heating value (HHV) from ultimate analysis. In addition, Ghinea et al. [14] presented prognostic tool and regression analysis to forecast municipal solid waste generation. The number of residents, population age, urban life expectancy, total municipal solid waste were employed as input variables in prognostic models in order to estimate the amount of solid waste fractions.

There are still few types of research related to the participation of community, government, mass media, and public sector in managing the waste. In Yogyakarta, many waste banks conducted recycling activity. Each waste bank was operated by local communities. Recycling becomes the most emerging activity because of the financial benefit. This research was conducted on waste banks in Brontokusuman, Yogyakarta, Indonesia. One of the potential recycled products is ecobrick. Ecobrick is one way of handling plastic waste by packing clean and dry plastic into a plastic bottle until the specified density.

Currently, the problem was the difficulties of the waste banks to be independent. The members of waste banks were still lack of funding, knowledge, and information on managing the waste. Therefore, this research propose the relationship of the participation of government, community, mass media, and public sector towards waste bank on recycling activity by using regression analysis.

This paper is divided into four sections. The first section is Introduction. Then, section 2 is methodology of this research. After that, section 3 is results and discussion. Finally, the last section is conclusion.

METHODS

The survey was conducted to study the current condition of waste banks for people around. In addition, a regression method was employed to analyze the relationship among variable of response and one or more variables of predictor. The objective of this study is to analyze the relationship of the participation of community, government, mass media, and public sector toward waste bank on recycling activity.

The research design for this study has several steps that can be seen in Fig. 2. The steps are as follows.

1. Problem formulation is initial step in conducting this research. In this step, the survey had been conducted to study the problems of waste recycling activity in the waste banks in Brontokusuman, Yogyakarta.
2. Literature review is an exploratory tool to improve the knowledge on waste recycling activity and regression method. The literature review was divided into two, i.e. systematic literature review paper and technical paper, that are provided in books, journals, conference papers, etc.
3. Data collection is the survey and questionnaires were distributed in the research area. The respondents are the member of the waste banks in Brontokusuman, Yogyakarta.
4. Data analysis. In this step, the data that has been collected was analyzed. The data must be tested before developing regression model. It includes linearity and additivity of relationship between dependent and independent variables, statistical independences of the errors, homoscedasticity of the error, and normality of error distribution.
5. Regression Analysis. This step is conducted to measure the relationship between two variables in order to get mathematical model. This model can be used to predict the dependent factor that will be obtained when independent factors change. In addition, residual analysis is conducted to validate the developed mathematical model. This is the difference between the value of the actual dependent variable and the predicted value.
6. Documenting and reporting. This step involved documenting and reporting the data as well as producing a progress report. It is useful to understand how this research works because it includes review of the final formulations.

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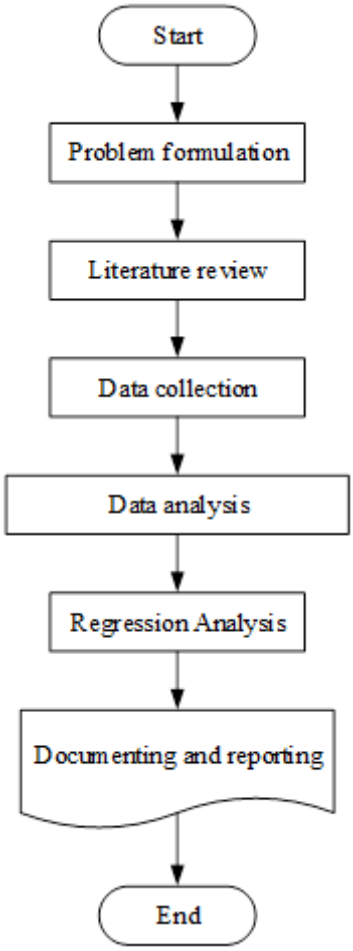

Figure 1. Research Design

Regression Analysis

Regression analysis is a method that able to provide a functional correlation among variables of response or dependent towards variables of explanatory, predictor, or independent. If there is only a response variable that is considered, the regression analysis is entitled with simple linear regression. On the other hand, if there are two or more variables of response, the regression analysis is entitled with multiple linear regression.

Simple Linear Regression

The equation of simple linear regression can be formed as follows:

$$Y = \beta_0 + \beta_1 X + \varepsilon \quad (1)$$

where Y is the variable of response, while X is the variable of predictor, β_0 and β_1 are the coefficients or parameters of regression, and ε is an error that describe the differences between the estimation data from the result of Eq. (1) and the observed data.

Next, the estimation data can be expressed as follows:

$$\hat{Y} = \beta`_0 + \beta`_1 X \quad (2)$$

where $\hat{Y}$ is the estimated value and $\beta`_0$ and $\beta`_1$ are the prediction of regression coefficients. The discrepancy between fitted and predicted values is the fitted values means the problem or the case where the values that is employed for the variables of predictor correspond to one on the n observations of the observed data required to find $\beta`$, but the estimated values are provided for any set of values of the predictor variables different to the observed data.

Multiple Linear Regression

Unlike simple linear regression, multiple linear regression or some references called univariate multiple regression is the generalization of the simple linear regression model. The difference is the number of predictor variable. The multiple linear regression model was employed more than one predictor variable.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta p Xp + \varepsilon \quad (3)$$

where Y is the response variable, X_1; X_2; …Xp are the predictor variables with p as the number of variables, β_0; β_1; … β_p are the regression coefficients, and ε is an error to account for the discrepancy between predicted data and the observed data. The predicted value form of Eq. (3) is

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$\hat{Y} = \beta`_0 + \beta`_1 X_1 + \beta`_2 X_2 + \ldots + \beta`pXp$ (4)

where $\hat{Y}$ is the fitted or predicted value and $\beta`$ are prediction of the regression coefficients.

This research developed multiple linear regression to evaluate the relationship of the participation of government, community, mass media, and public sector towards waste bank on recycling activity.

Data Collection and analysis

The questionnaires was distributed to the members of waste banks in Brontokusuman, Yogyakarta. Furthermore, data from the questionnaires were compiled and processed by binary logistic regression. The respondents' characteristics are shown in Table 1. Mostly the respondents are female with the age is above 50 years old and salary is around Rp 500.000 to Rp 1.500.000. Then, 48.48% is senior high school for the educational background.

Table 1. The respondents' characteristics

No	Characteristic	Percentage
1	Gender	
	Male	6.06%
	Female	93.94%
2	Age	
	<20 years old	0%
	20-30 years old	3.03%
	31-50 years old	45.45%
	>50 years old	51.52%
3	Educational background	
	Preliminary school	3.03%
	Junior high school	3.03%
	Senior high school	48.48%
	Diploma	12.12%
	Bachelor degree	33.34%
	Postgraduate	0%
4	Salary	
	Rp 500.000 - Rp 1.500.000	51.52%
	Rp 1.500.001- Rp 2.500.000	21.21%
	Rp 2.500.001 - Rp 3.500.000	24.24%
	> Rp 3.500.000	3.03%

Data were analyzed by defining the predictor variables such as community, government, mass media, and public sector. The predictor variables were the following:

1. Participation of community (X1) – it includes age, gender, educational background, and salary. This variable had two categorical variable, X1 = 1 if age, or gender, or educational salary, or salary does not influence the respondents in waste recycling activity; and X1 = 2, otherwise.
2. Participation of government (X2) – it includes funding, training, socialization, and regulation/policy. This variable had two categorical variable, X2 = 1 if funding, or training, or socialization, or regulation/policy does not influence the respondents in waste recycling activity; and X2 = 2, otherwise.
3. Participation of mass media (X3) – it includes funding, training, and socialization. This variable had two categorical variable, X3 = 1 if funding, or training, or socialization does not influence the respondents in waste recycling activity; and X3 = 2, otherwise.
4. Participation of public sector (X4) – it includes funding, training, and socialization. This variable had two categorical variable, X4 = 1 if funding, or training, or socialization does not influence the respondents in waste recycling activity; and X4 = 2, otherwise.

Additionally, the response variable was waste bank on recycling activity (Y). It is activity of respondents to create unique handcrafted goods from recyclable waste, such as ecobrick. It can be seen on Figure 2.

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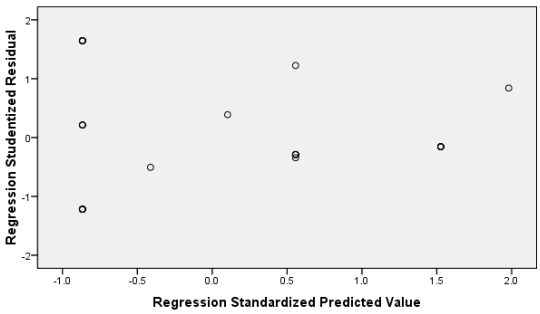

Figure 2. The diagram of participation of community, government, mass media, and public sector in waste recycling activity

Hence, the hypothesis of this research could be formulated as follows.
H1: The participation of community has a positive impact towards waste recycling activity.
H2: The participation of government has a positive impact towards waste recycling activity
H3: The participation of mass media has a positive impact towards waste recycling activity
H4: The participation of public sector has a positive impact towards waste recycling activity

RESULTS AND DISCUSSION

To conduct regression method, SPSS 17.0 software was employed. The data firstly was analyzed using scatter plot to test heteroskedastic. This test was conducted to know whether there's constant variance from all residual. The scatter plot graph was drawn between standardized predicted value (ZPRED) and standardized residual (SRESID). The x-axis shows the response variable and the y-axis presents the predictor variables. Fig. 2 presents the result of heteroskedastic test. It shows the data is random which means there is no heteroskedastic for regression model of response variable waste recycling activity.

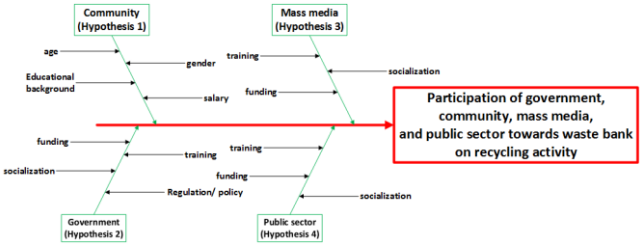

Figure 2. The diagram of participation of community, government, mass media, and public sector towards waste banks on recycling activity

Table 2 presents the result of linear regression for response variable waste recycling activity. The calculation is conducted by using SPSS 17.0 statistical software. The regression model of waste bank on recycling activity was as follows:

Y = 0.851 + 0.427 Community + 0.912 Government + 1.103 Mass media + 0.237 Public sector

Then, it also can be analyzed from the t test in Table 2. The participation of government has a positive impact towards waste bank on recycling activity. It is because of t calculated (2.513) is higher than t table (1.65). On the other hand, the participation of community, mass media, and public sector has a negative impact on towards waste bank on recycling activity. The t calculated is lower than t table which is 0.909, 1.423, and 0.290 for community, mass media, and public sector, respectively. Hence, the hypothesizes are rejected.

Table 2. Results of linear regression for response waste bank on recycling activity

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Standard Error	Beta		
(Constant)	.851	.178		4.780	.000
Community	.427	.470	.113	.909	.372
Government	.912	.363	.368	2.513	.019
Mass Media	1.103	.775	.468	1.423	.167

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Public sector	.237	.817	.102	.290	.774

The waste bank in Brontokusuman, Yogyakarta, Indonesia currently has function as a bank accepting the waste that can be recycled from the community around the waste bank. This community has a role as customer. Then, the waste bank can be as an organization that able to increase the community's knowledge in managing the waste through environmental campaign and training.

The participation of government has big roles in influencing the community towards waste bank on recycling activity, such as funding, training, socialization, and regulation/policy. Therefore, this study proposes four strategies to support the waste bank on waste recycling activity. There are:

Funding. One of the major challenges is that the installation of highly effective waste treatment tools, such as incineration facilities. These tools is expensive, some cities in the developing countries are hard to afford to use these effective techniques to decrease the amount of their municipal solid waste (MSW) [15]. The government should increase funding for household waste management. For instance, it could help the community on buying the tools for waste recycling activity (like producing ecobrick as seen in Fig. 1), such as scissor, glue, etc.

Training. The government should improve the trainings for the waste recycling activities to community around waste banks. The training of waste recycling activities can transfer the knowledge of how to handle and recycle the waste. In addition, the environmental cadres could be motivators and guide the community for waste recycling activity. The environmental cadres are not the ones who from outside the waste banks, but also local residents and local community leaders that have more knowledge on handling the waste.

Socialization. The government should intensify the information dissemination through mass media and campaign. This information could improve the community's knowledge on managing the waste.

Regulation/policy. The regulation/policy from government should be reviewed or added about waste recycling activity. In Thailand, the government published a "Plastic Debris Management Plan 2017–2021", which includes some approaches, for instance promotions and introduction of eco-packaging design and eco-friendly plastic substitution, development of material flow for plastic containers and packaging storage, implementation of the 3Rs (reduce–reuse–recycle) strategy for plastic debris management, and the promotion of education for relevant stakeholders in the field of plastics and its alternative materials [16-18].

CONCLUSION

This research is to examine the participation of government, community, mass media, and public sector towards waste bank on recycling activity by using regression analysis. The research was focused on waste banks in Brontokusuman, Yogyakarta, Indonesia.

The objective of this study is to analyze the relationship of the participation of community, government, mass media, and public sector towards waste bank on recycling activity. The result showed that the participation of government has positive impact on waste recycling activity on that study area, rather than the participation of community, mass media, and public sector. Furthermore, four strategies to achieve the goal of government participation on waste recycling activity are increasing funding for household waste management, intensifying training on recycling household waste, stepping up information dissemination through mass media and campaign, and creating a policy or regulation related to waste recycling activity.

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REFERENCES

1. T. Kasakura, R. Noda, and K. Hashindo, Trends in waste plastics and recycling, Journal of Material Cycles Waste Management, vol. 1, pp. 33–37, 1999.
2. Ministry of Environment, UU No. 18/2008, 2008.
3. S. Raharjo, T. Matsumoto, T. Ihsan, and I. Rachman, Community-based solid waste bank program for municipal solid waste management improvement in Indonesia : a case study of Padang city, Journal of Material Cycles Waste Management, vol. 19, no. 1, pp. 201–212, 2015.
4. R. Rana, R. Ganguly, and A. Kumar, Life-cycle assessment of municipal solid-waste management strategies in Tricity region of India, Journal of Material Cycles Waste Management, vol. 21, no. 3, pp. 606–623, 2019.
5. Y. Dhokhikah, Y. Trihadiningrum, and S. Sunaryo, Community participation in household solid waste reduction in Surabaya, Indonesia, Resources, Conservation & Recycling, vol. 102, pp. 153–162, 2015.
6. W. Singhirunnusorn, K. Donlakorn, and W. Kaewhanin, Household Recycling Behaviours and Attitudes toward Waste Bank Project : Mahasarakham Municipality, Journal of ASIAN Behavioural Studies, vol. 2, no. 5, p. 17, 2017.
7. S. Phu, T. Fujiwara, M. Hoang, V. Pham, and M. Tran, Waste separation at source and recycling

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Article History: Received: July 02, 2019, Accepted: Sep 27, 2019

potential of the hotel industry in Hoi An city , Vietnam, Journal of Material Cycles Waste Management, vol. 21, no. 1, pp. 23–34, 2019.
8. K. K. W. Ho and S. So, Towards a smart city through household recycling and waste management: a study on the factors affecting environmental friendliness lifestyle of Guamanian, International Journal Sustainable Real Estate and Construction Economics, vol. 1, no. 1, pp. 89–108, 2017.
9. N. J. G. J. Bandara, J. P. A. Hettiaratchi, S. C. Wirasinghe, and S. Pilapiiya, Relation of waste generation and composition to socio-economic factors : A case study, Environmental Monitoring and Assessment, vol. 135, no. 1–3, pp. 31–39, 2007.
10. N. Fumo and M. A. R. Biswas, Regression analysis for prediction of residential energy consumption, Renewable and Sustainable Energy Reviews, vol. 47, pp. 332–343, 2015.
11. M. Abdulredha, R. Khaddar, D. Jordan, P. Kot, A. Abdulridha, and K. Hashim, Estimating solid waste generation by hospitality industry during major festivals : A quantification model based on multiple regression, Waste Management, vol. 77, pp. 388–400, 2018.
12. A. Awasthi *et al.*, Modelling the correlations of e-waste quantity with economic increase, Science of The Total Environment, vol. 613–614, no. February 2018, pp. 46–53, 2018.
13. I. Boumanchar *et al.*, Municipal solid waste higher heating value prediction from ultimate analysis using multiple regression and genetic programming techniques, Waste Management and Research, pp. 1–12, 2018.
14. C. Ghinea *et al.*, Forecasting municipal solid waste generation using prognostic tools and regression analysis, Journal of Environmental Management, vol. 182, pp. 80–93, 2016.
15. T. Sekito, T. Prayogo, C. Meidiana, H. Shimamoto, and Y. Dote, Estimating the flow of recyclable items and potential revenue at a waste bank : the case in Malang City, Indonesia, Environment, Development and Sustainability, pp. 1–17, 2018.
16. O. Wichai-utcha and N. Chavalparit, 3Rs Policy and plastic waste management in Thailand, Journal of Material Cycles and Waste Management, vol. 21, no. 1, pp. 10–22, 2019.
17. Zakirova, Venera G., et al. Methodology of Teaching Graphic Methods for Solving Problems with Parameters as a Means to Achieve High Mathematics Learning Outcomes at School. EURASIA Journal of Mathematics, Science and Technology Education 15 (2019): 9.
18. Damyad, Mohammad Hassan, Davoud Jafari, and Hamed Kazemipour. Codify a trihedral inventory control model in terms of inflation in state of non-allowed shortage for an incorruptible commodity. UCT Journal of Research in Science, Engineering and Technology 4.04 (2016): 1-8.
19. Prasenjit Mondal, Shravanthi Nannapu, Pooja Adi, Swapna Naredla, Harish Peruka (2016) A Review On Duopa–A New Antiparkinsonian Combination As Enteral Suspension. Journal of Critical Reviews, 3 (2), 1-5.

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