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DESIGN OF THE MANAGEMENT MODEL OF URBAN HOUSEHOLDS SOLID WASTE GENERATION

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ABSTRACT

One of the global problems related to the future of cities is the environmental problem, namely the amount of municipal solid waste. From this waste, several issues arise in various aspects, such as health, aesthetics, and social and environmental problems. So that focused research is carried out on the management of urban solid waste produced by households. The research objective is to design a conceptual model and determine the variables and indicators that affect the generation of urban household solid waste and determine what prevention can be done. The model intended consists of 5 variables and 17 indicators. Data was collected based on a survey method with a closed questionnaire distributed to 120 respondents aged ≥ 17 years and residing in Yogyakarta. Analysis of the model and variable relationships was carried out based on the Structural Equation Modeling (SEM) method with the help of AMOS 24 software. The results showed that the designed model was valid. Socioeconomic variables, KAP level, waste reduction, and seasonality are direct predictors determining waste generation behavior. Socioeconomic variables are also direct predictors of KAP level and seasonal variables, and KAP level variables are direct predictors of waste reduction and seasonal variables.

Keywords: Urban Solid Waste, Management, Conceptual Models, SEM

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1. Introduction

One of the global problems related to the future of cities is the environmental problem, namely the amount of municipal solid waste. The amount of waste generation as an essential product of urban lifestyle grows faster than the rate of urbanization (Gusti et al., 2015). There are two types of factors that cause environmental damage, namely 1. Environmental damage is caused by natural factors such as natural disasters, and 2. Human factors cause environmental damage. Humans have a significant role in determining the sustainability of life (Haris & Purnomo, 2017). According to the World Health Organization (WHO), waste is defined as something that is no longer used, no longer used, no longer liked, or thrown away from human activities and does not happen by itself.

Meanwhile, according to McDougal et al. (2003), waste as waste material must be managed properly not to disturb and damage the environment. Garbage refers to something that has no value/use from the results of human activities. The distribution of waste based on its form includes solid, liquid, and gas waste. Liquid waste is all waste in liquid and other waste materials that are suspended or dissolved in water. Gas waste is disposed of into the air, containing chemical elements such as O2, N2, NO2, and other chemical elements. This can reduce air quality if it is in excess.

Meanwhile, solid waste is an unwanted solid material that is the result of human activity. Solid waste is the most common waste found in the environment and is a challenge in developing countries (Christensen et al., 2011; Bassi et al., 2017). The most solid waste producers are households and city services (Verma et al., 2016; Laor et al., 2018; Janmaimool, 2017)

From this waste, several problems arise in various aspects, such as health, aesthetics, and social and environmental issues. Based on the literature review carried out, this research focuses on generating municipal solid waste produced by households. According to Kumar & Samadder (2017), it is stated that in recent years solid waste management in most cities of the world has presented complex problems.

Waste originating from households has a negative impact, especially on public health. Waste management carried out by the government includes several activities, namely waste generation, storage, collection, transfer and transport, processing, and disposal. Based on the opinion of Robinson (1986) and Sharma et al. (2013), waste management only consists of 4 activities, namely waste generation, storage, collection, transfer and transport, processing, and disposal. The development of studies on waste management during the last five years provides information that city solid waste generation in households needs to be handled properly. The study on the research conducted is focused on the generation of solid waste.

The problem faced is how solid waste management can be carried out. Sustainable waste management must be the concern of everyone, from children to adults, rich or poor. The formation of sustainable waste management behavior towards sustainable development can be a role model for sustainable waste management behavior in the family and the environment. Furthermore, it is necessary to identify variables and indicators that influence municipal solid waste generation from households. Besides, what factors can prevent the generation of household solid waste and facilities that can prevent solid waste? The relationship between the variables that affect sustainable waste management is a problem that we want to find in this study. Thus, a conceptual model is needed, an effort to reduce waste by implementing various government policies.

2. Research Methods

This research was conducted in the city of Makassar, Indonesia. The focus of the study in this study is to identify variables and indicators that affect household municipal solid waste generation using the Amos 24 software as an analysis tool.

2.1. Type of Data

2.1.1. Primary Data

Primary data in this study were obtained directly from the research object by distributing questionnaires in Makassar City. The preliminary

data needed in this study are variables that affect the generation of urban solid waste.

2.1.2. Secondary Data

Secondary data is supporting data from primary data, namely data or sources obtained from reading materials. Secondary data in this study were obtained from company documentation data, reference books, and other information related to research.

2.2. Data Processing and Analysis Methods

The data processing used in this research is to use the Structural Equation Modeling (SEM) approach through the Amos 24 tool. The data collected is in the form of information related to household knowledge, attitudes, and practices regarding waste prevention generation in municipal solid waste management, waste generation, socioeconomic. And waste minimization.

Based on the information obtained, a conceptual model is compiled as follows:

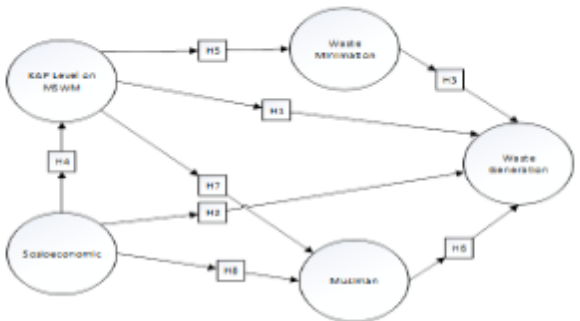

Figure 1. Conceptual Model

3. Results and Discussion

This study consisted of 5 latent variables (4 endogenous latent variables, one exogenous latent variable) and 17 indicators. Endogenous variables are KAP level, waste minimization, seasonality, and waste generation. Meanwhile, socioeconomic is an exogenous variable. The development of a conceptual model to fold the five variables above has never been done. Validation must be done in developing a conceptual model.

Before taking data, a test item was conducted by distributing questionnaires to 50 respondents to determine the questions' validity. Based on the test results, the question items were processed on the validation with Ms. Excel, obtained 17 questions that were declared valid because R count> R table. The value of the R table for the number of data 50 is 0.2787. Furthermore, after all the questions are declared valid, simple questionnaires can be distributed to respondents, namely 120 respondents who are ≥ 17 years old and live with their family in Makassar City through google form.

Furthermore, after the questionnaire data that has been validated is used as research data, it is processed using the AMOS application program. Again, testing the evaluation of structural model assumptions is carried out. The tests carried out in evaluating the structural model assumptions are data normality, evaluation of outliers, evaluation of multicollinearity and singularities, validity and reliability tests, and estimation of parameter values.

The data normality test was performed using the critical ratio skewness value criteria of ± 2.58 at the 0.01 significance level. Based on data processing results, multivariate data fulfill normal assumptions because the value is 2.416, which is in the ± 2.58 range, so that the data used is declared normal.

The outlier test is used to find out whether there is an indication of data that is of extreme value or not. The detection of multivariate outliers is done by taking into account the value of the Mahalanobis distance. The criteria used were based on the Chi-Square value at 111 degrees of freedom, namely the number of indicator variables at the significance level of p <0.001. Mahalanobis distance value (111, 0.001) = 162.788. This means that all cases that have a Mahalanobis distance greater than 162,788 are multivariate outliers. Based on the outlier test, there is no value above 162.788, and it can be concluded that there are no outliers in the data.

Multicollinearity and singularity evaluation can be seen from the matrix sample correlation between variables. Based on the matrix sample correlation between variables, it can be seen that none of them has a value above 0.90, so that it can be stated that there is no multicollinearity and singularity.

The valid test of an indicator can be seen if the loading factor is above> 0.50, then the indicator is considered valid. Based on the results of data processing carried out, all indicators have a loading factor above 0.50. Reliability test can be seen in two ways, namely composite (construct) reliability and variance extracted. The cut-off value of construct reliability is at least 0.70, while the cut-off value for variance extracted is at least 0.50. Based on the data processing results, all variables have a value of construct reliability above 0.70, and the extracted variance is above 0.50.

A model feasibility test is done by measuring the value Goodness of Fit using parameters including Chi-Square, probability, RMSEA, GFI, AGFI, TLI, and CFI. Based on the results of data processing using Amos, the Chi-Square value was 123.286, a probability value of 0.149, and RMSEA value of 0.034, a GFI value of 0.900, and an AGFI value of 0.858, a TLI value of 0.981, and a CFI value of 0.985. So that based on the value obtained, it can be concluded that the research model is feasible to use. Then it can be continued testing the proposed hypothesis. Hypothesis testing analysis provides the following results:

1. Relationship between KAP and Waste Generation

The estimated parameter value of the standardized weight coefficient is 0.285, and the C.R value is 2.393. This shows that the relationship between KAP and waste generation is positive. Testing the relationship between the two variables shows a probability value of 0.017 ($p < 0.05$), so that (H1), which says "KAP affects Waste Generation," is supported and can be stated if there is an influence between KAP on waste generation. Diazruiz et al. (2017) noted a relationship between KAP in municipal solid waste management and waste generation. This is because public knowledge, attitude, and practice will influence waste production and waste composition. The public prefers to buy goods they need rather than what they want.

2. Socioeconomic Relationship to Waste Generation

The estimated parameter value of the standardized weight coefficient is 0.191, and the C value is 2.455. This shows that the socioeconomic and waste generation relationship is positive. Testing the relationship between the two variables shows a probability value of 0.014 ($p < 0.05$), so that (H2), which reads "Socioeconomic effect on Waste Generation," is supported and can be stated if there is an inter socioeconomic influence on waste generation. According to Khan et al. (2016), Kumar et al. (2017), Talalaj et al. (2015), Jaligot et al. (2018), Jouhara et al. (2017), and Edjabou et al. (2018) in their research that has been conducted states that there is a significant relationship between socioeconomics and waste generation. This is because the household consumption pattern is directly related to an increase in income, which results in changes in the composition and quantity of household waste (Khan et al., 2016).

3. The Relationship between Waste Minimisation and Waste Generation

The estimated parameter value of the standardized weight coefficient is 0.533, and the C.R value is 2.274. This shows that the relationship between waste minimization and waste generation is positive. Testing the relationship between the two variables shows a probability value of 0.023 ($p < 0.05$), so that (H3), which says "Waste Minimisation affects Waste Generation," is supported and can be stated if there is an influence between waste minimization on waste generation. There is also a relationship between waste minimization and waste generation. In this case, waste minimization consists of reduce, reuse, and recycle (Wan et al., 2018; Gallardo et al., 2016). This study only uses two indicators because the recycle indicator is not well understood by households. There are indications of an increase or decrease in waste generation and reduce and reuse behavior.

4. Socioeconomic Relationship to KAP

The estimated parameter value of the standardized weight coefficient is 0.349, and the C.R value is 3.890. This shows that the socioeconomic relationship and KAP are positive. Testing the relationship between the two variables shows a probability value of 0.000 ($p < 0.05$), so that (H4), which says "Socioeconomic influence on KAP," is supported and can be stated if there is an inter socioeconomic influence on KAP. According to Laor et al. (2018), Babaei et al. (2015), and Ifegbesan et al. (2016), there is a relationship between socioeconomic and KAP levels of waste prevention on MSWM. This is seen because knowledge will be influenced by education. Attitudes and practices can also be affected by occupation and socioeconomic background and

Shorofi and Arbon (2017). Together with Mangiri et al. (2017), demographic factors such as age, marital status, education, and occupation significantly influence KAP.

5. Relationship between KAP and Waste Minimization

The estimated parameter value of the standardized weight coefficient is 0.613, and the C.R value is 5.755. This shows that the relationship between KAP and waste minimization is positive. Testing the relationship between the two variables shows a probability value of 0.000 ($p < 0.05$), so that (H5), which says "KAP affects Waste Minimization," is supported and can be stated if there is an influence between KAP on waste minimization. Households have an important role in waste minimization. Changes in attitudes and practices in household purchases are strongly influenced by the level of knowledge that affects waste minimization. Households can buy reusable products (Vrieling et al., 2019). The same opinion was conveyed by Mattar et al. (2018), households contribute significantly to a country's food waste problem through their behavior and beliefs. Their findings suggest that various household characteristics and food-related behaviors, attitudes toward recycling, and other beliefs influence the generation of food waste in urban and rural communities in developing countries.

6. Seasonal Relationship to Waste Generation

The estimated parameter value of the standardized weight coefficient is 0.154, and the C.R value is 2,260. This shows that the seasonal relationship and waste generation are positive. Testing the relationship between the two variables shows a probability value of 0.024 ($p < 0.05$), so that (H6), which says "Seasonal affects Waste Generation" is supported and can be stated if there is an inter-seasonal influence on waste generation. Zeng et al. (2005) have identified holiday activities, special summer events, and transitions in student populations as key factors that may influence seasonal variations in household waste composition and mass.

7. Relationship between KAP and Seasonality

The estimated parameter of the standardized weight coefficient value is obtained by 0.290, and the C.R value is 1,988. This suggests that the KAP and Seasonal relationships are positive. The relationship testing of the two variables shows a probability value of 0.047 ($p<0.05$), so that (H7), which reads "KAP affects Seasonal," is supported and can be expressed if there is an influence between KAP on seasonality. According to Principato (2018), household food waste is determined by consumer attitudes and behaviors throughout various stages from planning, food purchase, storage, preparation, consumption to final disposition. And Rafiee et al. (2018) stated that religious holidays, national holidays, and other holidays resulted in the quantity of waste produced.

8. Socioeconomic Relationship to Seasonality

The estimated parameter value of the standardized weight coefficient is 0.391, and the C.R value is 2.981. This shows that the socioeconomic and seasonal relationship is positive. The test of the relationship of the two variables showed a probability value of 0.003 ($p<0.05$), so that (H8), which reads "Socioeconomic effect on Seasonal," is supported and can be started if there is an influence between socioeconomic on seasonal. Edjabou et al. (2018) state that the size of households significantly affects the onset of waste. In addition, it states there is a significant difference between seasonal variations with mass and the composition of waste. But the group of household waste can change significantly between seasons.

4. Conclusions and Suggestions

4.1. Conclusions

1. The relationship between exogenous and endogenous variables in conceptual models hypothesized is known from the signification of each hypothesis through the value of p-value. Based on the hypothetical results, it is shown that:

a. There is an influence between KAP and Waste Generation with a value of 0.491

b. There is an influence between the Socioeconomic and Waste Generation with a value of 0.535

c. There is an influence between Waste Minimation and Waste Generation with a value of 0.515

d. There is an influence between socioeconomic and KAP with a value of 0.407

e. There is an influence between KAP and Waste Minimization with a value of 0.781

f. There is an influence between Seasonal and Waste Generation with a value of 0.271

g. There is an influence between KAP and Seasonal with a value of 0.249

h. There is an influence between socioeconomic and seasonal with a value of 0.455

2. Prevention of municipal solid waste generated by households can be done by increasing the level of KAP to prevent waste generation. Changes in attitudes and practices in household purchases are strongly influenced by the level of knowledge that affects waste minimization and waste generation. As well as implementing reduce and reuse behavior in materials from household activities.

3. Thus, it can be stated that the conceptual model can be accepted and accounted for. Based on the research results, it can be concluded that the conceptual model related to waste generation is said to be feasible to use. This is supported by the variables that make up the conceptual model. These variables are socioeconomic, KAP, waste minimization, seasonality, waste generation. Each variable has indicators that support the research being carried out. To test the variables and indicators by the research model, tests are carried out using the AMOS application program by testing the validity and reliability, normality, outliers, multicollinearity and singularity, and feasibility of the model (Goodness-of-Fit) and hypotheses. The test results show that the conceptual model's variables and indicators are feasible because they meet the model's eligibility criteria.

4.2. Suggestions

Subsequent research adds another variable in identifying urban household solid waste generation, which is followed by indicators that support these variables to increase knowledge about the generation of urban household solid waste.

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