Analysis of variables that influence formation of waste management institutions in Indonesia

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Abstract. One of the Sustainable Development Goals main objective is clean water and sanitation. It can be implemented by applying the 3R (Reduce, Reuse, Recycle) concept in waste management. One of the villages in West Bandung Regency which is expected to be able to apply the 3R concept in waste management is Kiangroke Village. The application of this concept that began about 3 months ago by forming a garbage collector. The formation of waste management institutions in that village is expected to be realized in the future. So that, it can provide economic value to the village. For this reason, it is necessary to analyze the variables that affect formation of waste management institution in Kiangroke Village. The objectives of this study are: identification of variables that affect formation of waste management institution and mapping the relationships between variables. The data collection method was carried out through a questionnaire. There were 10 variables considered in the research based on the Focus Group Discussion. The analysis method is the Micmac analysis. Based on the analysis, it was found that the most influential and most dependent variables included the role of the village government, the role of the environmental awareness group, availability of facilities and infrastructure, and the budget availability. Based on this, it is necessary to have an institutional waste manager accompanied by the availability of facilities, infrastructure, and budget.

1. Introduction

One of the SDG’s main objectives is clean water and sanitation. One of the problems of sanitation is the problem of waste. At present, the problem of waste is not only faced in urban areas but has become a problem in rural areas. It can be implemented by applying the 3R concept in waste management. Solid waste management cannot be separated from institutional roles. Waste management basically involves stakeholders. Based on Damanhuri and Kurian, in 3R-based waste management (Reduce / reduce waste to prevent landfill, Reuse / reuse goods that have been used and Recycle / recycle waste into goods of economic value), stakeholders consist of waste-producing communities, NGOs, private parties, local governments and the central government. Each of these stakeholders has a role in waste management.

Public participation in waste management and waste minimization in developing countries, has received little attention. Examining from political and economic perspectives, previous researchers were interested in scavengers or junk buyers (the door to door collectors for recyclables) as a special group (Beukering; Digregorio; Furedy; Huysman; Sicular). Muller research explained that some of the stakeholders who play a key role in waste management apart from the civic authorities are households,
community-based organizations, micro and small enterprises, waste pickers, itinerant waste buyers, and NGOs.

Research on waste management uses many methods. However, research that uses FGD as a method of determining the variables that influence waste management and using micmac analysis in analyzing the driver power and the dependence of each variable. Chandramowli$^9$ and Rajesh$^{10}$ explained that Micmac analysis helps researchers to better understand the role of an activity in a system and how to manage that activity.

One of the villages in West Bandung Regency which is expected to be able to apply the 3R concept in waste management is Kiangroke Village. The application of this concept that began about 3 months ago by forming a garbage collector. The formation of waste management institutions in that village is expected to be realized in the future. So that, it can provide economic value to the village. In order for a waste management institution to be formed according to expectations, it is necessary to identify the variables that influence the waste management. The aims of the study are: identification of variables that affect waste management and mapping the relationships between variables. Results from this study will provide inputs to village government for formation waste management institutions in Kiangroke Village.

2. Methodology
This research was conducted in Kiangroke Village by involving various stakeholders. The data collection method has been used Focus Group Discussion (FGD) and questionnaires. FGD was used to determine the variables that influence the formation of waste management institutions. While, the questionnaire has been used as an assessment tool to assess which variables are most influential in the formation of a waste management agency. The respondents were stakeholders in Kiangroke Village including village government, waste management officer, Sabilulungan Bersih team, Village-Owned Business Entity, Family Welfare Empowerment, Youth Organization, and Facilitator of the Bandung Regency Sanitation Department. They were 16 peoples involve on FGD. The research variables were the role of village government, the role of environmental awareness groups, the availability of facilities and infrastructure, village regulations on waste management, budget availability, quality of human resources, the existence of counseling, the existence of cooperation, the role of academics, and the role of waste entrepreneurs. To analyze driving power and the dependence power of the variables driving the formation of waste management institutions has been used MICMAC Analysis (Matrice d'Immactact croises-multiplication appliqué an classment). The analysis has been carried out by processing the results of the questionnaire that each stakeholder evaluates based on their current role.

3. Results and discussion

3.1. The most influential variable on formation of waste management institutions in Kiangroke Village
Based on Micmac analysis, the most influential variable on formation of waste management in Kiangroke Village is the role of village government. This is due to the fact that the existence of village regulations on waste management which had been running for 1 month prior to the first FGD activity was driven by the role of village government, especially the village head who provided capital in the waste management operations. The next variable that was most influential was the existence of an environmental awareness group in Kiangroke Village, which was the waste management task force group. The following is the sequence of variables that influence the management of 3R waste in Kiangroke Village.
Table 1. Influential variables in formation of waste management institutions in Kiangroke Village based on micmac analysis.

| Ranking | Variables                                      | Score |
|---------|-----------------------------------------------|-------|
| 1       | role of the village government (VG)           | 11    |
| 2       | role of the environmental awareness group (EAG)| 10    |
| 3       | availability of facilities and infrastructure (FI) | 7     |
| 4       | village regulations on waste management (RWM) | 7     |
| 5       | budget availability (BA)                      | 7     |
| 6       | quality of human resources (HR)               | 5     |
| 7       | the existence of counseling (CSL)             | 3     |
| 8       | cooperation (COOP)                            | 0     |
| 9       | the role of academics (ACAD)                  | 0     |
| 10      | the role of waste entrepreneurs (WE)          | 0     |

The above table arranged from variables that are very influential to less influential. Based on the above table, there are 3 variables that are less influential in waste management in Kiangroke Village, namely: the existence of cooperation, the role of academics, and the role of waste entrepreneurs. Collaboration with other parties and in particular with solid waste entrepreneurs has not been established in this village. Likewise, the role of academics does not yet exist and only exists in the form of community services. So that in the waste management in Kiangroke Village, it is necessary to have the role of academics as an input provider, especially in the formation of waste management institutions so that it is economically valuable and can be used as one of the businesses managed by village-owned business entity.

3.2. Influential variables and their dependence on formation of waste management institutions in Kiangroke Village

Based on the results of Micmac analysis, there were several variables that have a direct influence on formation of waste management institutions. The mapping can be seen based on the following quadrant results.

![Figure 1. Mapping of the variables that influence and dependence towards waste management in Kiangroke Village.](image-url)
Based on the above picture, quadrant 1 is the most influential variable and has less dependence on other variables, including the village regulations on waste management (RWM). Quadrant 2 is the most influential and most dependent variables including role of the village government (VG), role of the environmental awareness group (EAG), availability of facilities and infrastructure (FI), and budget availability (BA). Quadrant 3 is the least influential and most dependent variable, including no variables. Quadrant 4 is a variable that is less influential and less dependent on other variables, including the quality of human resources (HR), the existence of counseling (CSL), the existence of cooperation (COOP), the role of academics (ACAD), and the role of waste entrepreneurs (WE).

In line with the above, based on the results of the analysis illustrated in graphical form that the variables that have a very strong direct influence are the role of the village government (VG), the role of the environmental awareness group (EAG), and the existence of facilities and infrastructure (FI). The following graph is the direct effect of waste management activities in Kiangroke Village:

![Figure 2. Direct influence graph.](image)

Based on the third iteration, the final classification of variables that affect the formation of waste management institutions in Kiangroke has changed. The first order of variables that most influences were the role of village officials and the role of environmentally conscious groups. However, the budget availability and the availability of facilities and infrastructure has changed. Initially the infrastructure in third place turned into fifth. Vice versa, the budget availability came in third. It was caused by the budget was indeed the determining variable after the role of village government and the cleanliness task force in Kiangroke Village. With the role of the Village Head who provided capital in waste management in Kiangroke Village, to the activities of the second FGD conducted, it provided evidence that the development of waste management activities that were carried out no longer needed capital. But on the contrary, currently carried out by the task force was able to finance the waste management activities they did. The following table and graph illustrate the changes in the order of variables that influence the formation of waste management institutions in Kiangroke:
Table 2. The order of variables that influences after the third iteration.

| Rank | Variables                                      |
|------|------------------------------------------------|
| 1    | role of the village government (VG)            |
| 2    | role of the environmental awareness group (EAG) |
| 3    | budget availability (BA)                       |
| 4    | village regulations on waste management (RWM)  |
| 5    | availability of facilities and infrastructure (FI) |
| 6    | quality of human resources (HR)                |
| 7    | the existence of counseling (CSL)              |
| 8    | the role of academics (ACAD)                   |
| 9    | cooperation (COOP)                             |
| 10   | the role of waste entrepreneurs (WE)           |

Based on the results of the analysis above, budgeting in waste management needs important attention. Because all this time waste management has never been budgeted in the village expenditure and expenditure budget. In addition, the role of academics, cooperation with waste entrepreneurs must also be done to provide added value in waste management. Thus, with the existing village-owned business entity, it can be added to its function as a waste manager, which consists of several elements including the garbage transport officer, youth organization, Family Welfare Empowerment, and the Clean Sabilulungan team. Below is the proposed institutional form based on the institutions that already exist in the village and the variables that influence the formation of waste management institutions.

Figure 3. Process of changing sequences of direct variables based on third iteration.

Figure 4. Proposed form of institutional waste management.
4. Conclusions
Based on the research that the role of the village government, the role of groups concerned about the environment, the availability of facilities and infrastructure, and the budget availability are important in the formation of waste management institutions. However, the role of academics and waste entrepreneurs must also receive attention so that waste management can be sustainable.

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