Institute for Advanced Science,
Social and Sustainable Future

MORALITY BEFORE KNOWLEDGE

Community participation in sustainable solid waste management at the household level

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ABSTRACT

Background: Solid waste in Depok City turns into an urgent problem due to the increase of solid waste production and the limited capacity of the Final Disposal Facility. **Methods:** The approach used in this research is quantitative, with combination of quantitative and qualitative method, and multiple linear correlation and regression analysis. **Findings:** The results represented that the majority of Depok Villagers or 38% of them have high level of participation, 30% with moderate level, 7% with low level, and 25% have no participation at all. Internal and external factors simultaneously have a significant effect on the level of community participation in waste sorting activities in the household level. Partially, the contribution of internal factors including awareness level (5,340/0) and external factors including the role of driving actors (15.1%), direct benefit rate (22.1%), and availability and accessibility of the means (35.2%) had a significant effect the level of community participation in solid waste sorting activities in the household level in Depok Village. The level of participation in solid waste sorting activities in the household level is significantly related to waste reduction in Depok Village. It can be concluded that the level of community participation in Depok Village is considered as high, it is because most of organic wastes have been handled by Waste Processing Unit (43.6%), while the inorganic wastes have been handled by the waste bank (24.2%). **Conclusion:** The low level of community participation in waste sorting activities in Depok Village at the household level has potentially inhibited sustainable waste management. Then, availability and accessibility of the means as the greatest influencing factor and community participation has contributed to waste reduction in Depok Village by therefore it supports sustainable waste management. **Novelty/Originality of this article:** Empowers individuals to reduce, reuse, and recycle, fostering environmental responsibility and enhancing local resilience.

KEYWORDS: community participation; solid waste; sustainable waste management; waste reduction; waste sorting activities.

1. Introduction

Population growth, economic growth, urbanization, and changes people's lifestyles have led to a rapid increase in waste generation in developing countries, especially in urban areas (Aja & Al-Kayiem, 2013). The existence of large amounts of waste generation if not handled properly can cause problems, this occurs because the imbalance between generation and management capacity has the potential to pollute air, land, and water (Al-Khatib et al., 2009). Based on Indonesian waste statistics in 2015, the estimated total waste generation from its sources (residential and non-residential) in Indonesia reached 64 million tons/year (Badan Pusat Statistik, 2017) and is predicted to increase by 2-4% each year if there is no reduction at the source (Al-Khatib, 2010).

In order to address the current national waste problem, the government has issued Presidential Decree No. 97 of 2017 concerning the National Waste Management Policy and Strategy. This policy contains national targets for the handling system (sorting, collecting, transporting, processing, and final processing of waste) and waste reduction (through the approach of limiting waste generation, recycling, and reuse) to be achieved in 2017-2025. These targets include waste reduction that is increasing every year, as well as waste management that will increase until 2019 but decrease from 2020-2025. This policy is aimed at reducing and increasing (recycling and recovery of waste, including converting waste into resources and energy with a target of 30% reduction and 70% handling by 2025 (Bappenas, 2013).
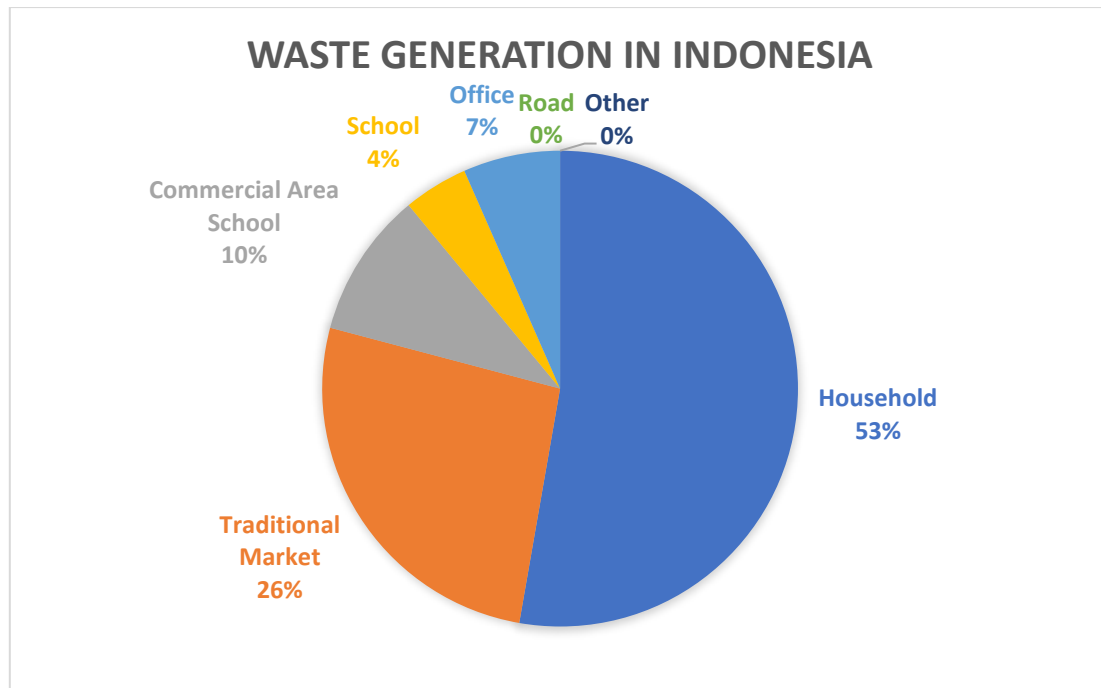

Fig. 1. Sources of waste generation in Indonesia

Based on Figure 1., the largest source of waste in Indonesia or 48% is households. Regarding waste management, only 69% of waste is processed in landfills, 8% is composted and recycled, 9% is buried, 5% is processed by incinerators, and 9% has not been managed. Based on these data, it can be understood that waste needs great attention because waste that is not managed properly at the stages of storage, collection, transportation, processing and final processing has the potential to cause negative impacts on the environment, including health and safety, such as the emergence of pollution (Babaei et al., 2015; Bogner et al., 2008). Methane is the second most important greenhouse gas after Carbon Dioxide, the largest source of which comes from anaerobic decomposition of organic waste in landfills (Botetzagnas et al., 2015). Another negative impact of waste is that it can disrupt health, where infectious waste, toxins, and pollutants are even present in the scope of waste in residential areas (Chen et al., 2009). Waste management indirectly contributes to reducing GhG emissions through material conservation/recycling and resource efficiency (Craig et al., 2002). The processing system at the landfill/*tempat pembuangan akhir* (TPA) is mostly or 55% open dumping system and 4596 is controlled/sanitary landfill system (Cunningham, 2012). Waste management that cannot be carried out by the government is also a problem, where the handling is carried out by the community but unfortunately it is not carried out properly, for example waste burning (Dhokhikah et al., 2015).

Every day, the average amount of waste generated in Depok reaches 1,286 tons, with the amount managed reaching 146 tons, 600 tons dumped in the landfill, and 551 tons of unmanaged waste (Espaldon & Baltazar, 2004). Based on these conditions, it provides an illustration that waste management is not enough only at the landfill (downstream) but

must be at the household level (upstream). Handling at the household level is very important considering that 62.7% of waste sources in Depok are households (Frimawaty, 2012). The existing challenge is that people are relatively reluctant to sort household waste, which results in many Waste Management Units/*Unit Pengelolaan Sampah* (UPS) being overloaded because they are unable to accommodate unsorted waste (Henry et al., 2006). Community participation in waste sorting in Depok is still a problem because the majority of Depok residents or 67.47% have not participated in sorting (Guerrero et al., 2013). The Depok City Department of Cleanlines and Environment (Department of Forestry and Environment) has been mobilizing the community to participate in sorting waste through the Depok Memilah Movement since 2012, which aims to encourage the community to sort waste, with housewives as the main target. Household waste sorting is expected to be able to control the negative impacts of waste on the environment and the scarcity of natural resources because it has the function of separating recycled materials (Huntley, 2010; Inglezakis & Moustakas, 2015). Community participation is the key to achieving waste management goals (Joseph, 2006; Kawai & Tasaki, 2016).

Waste sorting can reduce the amount of waste processed at the landfill/*tempat pembuangan akhir* (TPA) if supported by increasing waste that can be assimilated or recycled. This is because sorting allows waste assimilation through recycling activities and can even support the sustainability of a city (Magutu & Onsongo, 2011). Waste sorting is closely related to community participation. The level of community participation determines the success of recycling activities in particular and waste management in general, as well as reducing the need for landfills due to waste reduction (Morelli, 2011). These factors include internal and external factors that exist in each individual in the community (Mukherji et al., 2016). One of the sub-districts in Depok City that experienced problems with waste sorting participation because 73.82% of residents of this sub-district had not sorted waste (Nguyen et al., 2015). Depok Village is the first sub-district to carry out household waste sorting activities in this sub-district and even in Depok City. Therefore, a scientific study is needed that describes community participation in household waste sorting activities in Depok Village.

2. Methods

2.1 Research approach

This study uses a quantitative approach. The research method used is a combination of quantitative and qualitative methods (mix method). Quantitative methods are used to collect data through questionnaires while qualitative methods use interviews with the community and driving actors who play a role in encouraging the community to participate in waste sorting activities to support quantitative data.

This research was conducted over a period of 4 months, namely from July to November 2017. The research was conducted in Depok Village, Depok City, West Java. Depok Village was chosen because this village was the first area to carry out waste sorting in Depok City. The research location was in citizens association/*rukun warga* (RW) 03, neighborhood association/*rukun tetangga* (RT) 10, citizens association/*rukun warga* (RW) 06 neighborhood association/*rukun tetangga* (RT) 01, 02, and 03, citizens association/*rukun warga* (RW) 21 neighborhood association/*rukun tetangga* (RT) 01 and 02.

2.2 Research data

2.2.1 Data collection

The primary data collection method in this study was carried out by using research instruments in the form of questionnaires and in-depth interviews. Questionnaire: The questionnaire collection was carried out on housewives who carry out waste sorting activities or who do not carry out household waste sorting activities. The respondents

numbered 81 people consisting of 31 people in citizens association/*rukun warga* (RW) 03, 27 people in citizens association/*rukun warga* (RW) 06, and 23 people in citizens association/*rukun warga* (RW) 21. The questionnaire can be said to be valid if the Pearson Product Moment correlation coefficient is 0.3 and the significance value is 0.05 (Siregar, 2014). Rehabilitation tests are carried out using the Alpha Cronbach technique. The questionnaire can be said to be reliable if the rehabilitation coefficient value is 0.6 (Siregar, 2014). In-depth interviews: In-depth interviews were conducted with the informant population in a structured manner using interview guidelines.

2.2.2 Data collection and processing methods

Categorization of formal education level was carried out based on data from the Population and Civil Registration Service (2017) while income data was carried out based on Indonesian Central Bureau of Statistics/*Badan Pusat Statistik Indonesia* (BPS) data. The scores obtained were classified based on the results of the scale interval calculation. The scale interval is determined in the following way:

Scale interval = highest scale value (times) number of question items- (lowest scale value [times] number of question items number of desired category classes   (Eq. 1)

Each collection and processing of each variable, namely: Formal education level data: The education category refers to Law Number 20 of 2003 concerning the National Education System. This regulation divides education levels into three categories, as seen in table 1. Based on these categories, in this study for entrepreneurs whose last education was up to graduating from junior high school is included in the low category, if their last education was up to graduating from high school and D3 is included in the medium category, and if they graduated from diploma, bachelor's, master's, specialist or doctorate then it is included in the high category. The undergraduate-graduate education level is included in the high category because the majority of Depok residents have a high school education.

Table 1. Categorization of education levels

No	Category	Education	Score
1.	High	Vocational School, Undergradute, and Graduate	3
2.	Medium	Senior High School	2
3.	Low	No School-Junior High School	1

Informal education level data: The assessment of informal education level uses the Guttman scale. The Guttman scale was chosen because it wanted to get a firm answer to a problem (Sugiyono, 2012). The questions use the Guttman model which divides the answers into yes and no. The answer "Yes" is given a value of I and "No" is given a value of 0.

Table 2. Categorization of questionnaire answers and scoring methods for informal education

No	Category	Keywords	Score
1.	High	Participating in counseling, waste sorting training, organic waste processing training, and inorganic waste processing training.	3-4
2.	Medium	Attending counseling and one of the trainings	2
3.	Low	Not attending counseling and training and/or attending counseling or one of the trainings	0-1

Data on the level of understanding: Analysis of the level of understanding is carried out by scoring the respondents' answers to determine the level of understanding category, scoring is carried out by calculation using the usual survey method. The questions in the questionnaire are based on literature studies and socialization materials delivered by the Depok waste bank administrators to the Depok community. Correct answers will be given a score of 1 and incorrect answers will be given a score of 0.

Table 3. Scoring method of questionnaire answers for level of understanding

No	Category	Keywords	Score
1.	High	Understanding the meaning and best sources of sorting, classification of waste types, and follow-up actions that can be taken on waste types.	8-11
2.	Medium	Understanding the concept and best sources of sorting, understanding some of the classifications of waste types and some of the follow-up actions that can be taken on waste types.	4-7
3.	Low	Not understanding/understanding a small part of the meaning and best sources of sorting, classification of waste types, and follow-up that can be done on waste types	0-3

Income level data: Income level analysis is measured through calculations from the answers given in the questionnaire. Income is divided into 3 categories based on the income level category that has been given in the questionnaire. Income IDR is categorized as low income because the amount is smaller than the Regional Minimum Wage/*Upah Minimum Regional* (UMR) of Depok City (3,300,000 IDR). Income 3,300,001-13,625,000 IDR is categorized as medium income in the range of UMR and average income/capita in Depok City (13,625,000 IDR). This income> 13,625,000 is categorized as high income.

Table 4. Categorization of income levels

No	Category	Income/Month	Score
1.	High	>13,625,000 IDR	3
2.	Medium	3,300,001-13,625,000 IDR	2
3.	Low	<3,300,000 IDR	1

Level of role of driving actors: Analysis of the level of role of driving actors is carried out using Guttman assessment through the assessment of the role of cadres in educating the community regarding household waste sorting activities. Research using the Guttman scale is carried out to obtain a firm answer to a problem being asked (Sugiyono, 2012). Scoring on the measured variables has two intervals, the answer "Yes" is given a value of 1 and "No" is given a value of 0. The criteria values for each category can be seen in Table 5.

Table 5. Scoring method for questionnaire answers for the level of driving actor role

No	Category	Keywords	Score
1.	High	Inviting people to sort at home and following up after the waste has been sorted, reprimanding people if they do not sort or do not follow up, and providing education and training on sorting and processing waste within several months.	6-8
2.	Medium	Encourage sorting at home and follow up after the waste has been sorted, reprimand the community if they do not sort or do not follow up, and do not provide counseling or training on sorting and processing waste in the last few months.	3-5
3.	Low	Not or only inviting people to sort at home and follow up after the waste has been sorted, not reprimanding the community if they do not sort or do not follow up, and not providing information and training on sorting and processing waste in the last few months.	-2

2.4 Data presentation

The results of the data analysis are presented in the form of descriptive narratives, images, and tables. Analysis in narrative form to explain the results of data processing. Tables are used to facilitate data presentation and analysis of the table. Images to visually explain the results of the study. Tables are obtained from the results of processing and secondary data, while images are obtained from the results of processing and personal documentation obtained. The research objective matrix with the methods used can be seen in Table 6.

Table 6. Research objective matrix with the methods used

No	Research Purposes	Methods: Collecting Data	Methods: Data Processing	Methods: Data Analysis
1.	Analyzing the level of community participation in household waste sorting activities in Depok Village	Questionnaire Guidelines Interview	Frequency Percentage and graph	Descriptive Statistical Analysis
2.	Analyzing the influence of internal factors (level of education, level of understanding, and level of income) and external factors (level of role of driving actors, level of direct benefits, and availability and accessibility of facilities) on the level of community participation in household waste sorting activities in Depok Village.	Questionnaire Guidelines Interview	Simultaneous and partial analysis	Interval Successive Methods and Multiple Linear Regression Analysis
3.	Analyzing the relationship between the level of community participation in household waste sorting activities and waste reduction in Depok Subdistrict	Measurement of daily household waste generation	Tabulation and Graphs	Correlation analysis and descriptive statistical analysis

3. Result and Discussion

3.1 Level of community participation in household waste sorting activities

Waste sorting is a form of community-based waste management. As O'Connel (2011) argues, community-based waste management reflects the decision to undertake this because the decision and approval of the community are fully carried out, and the responsibility for implementing and maintaining matters related to these activities is carried out by the community (Petts, 2000). The level of participation referred to in this study is the implementation of sorting household waste at home and the follow-up on waste expected by the environment after the waste is sorted (Plepienen et al., 2016). This study divides the level of participation into four categories: no participation, low participation, moderate participation, and high participation. The distribution of respondents in each category is depicted in Fig 2
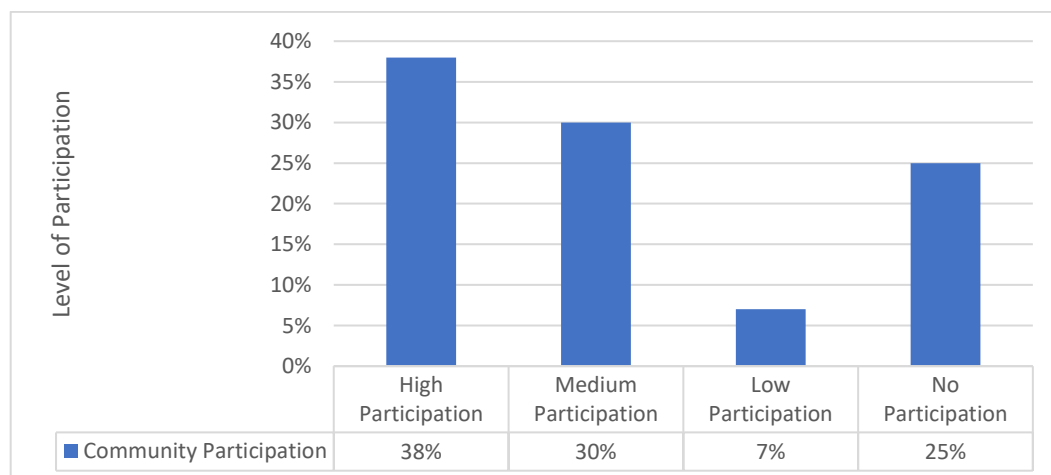

Fig 2. Overall level of community participation in household waste sorting activities

Based on the analysis of the location of the three regions, the residence, most of the respondents who were included in the category of non-participation (45%), low participation (83.33%), and moderate participation (50%) lived in citizens association/*rukun warga* (RW) 03. Most of the respondents who participated highly were respondents who lived in RW 06 (48.39%) and followed by respondents who lived in RW

21 (32.26%). Specifically per region, the majority of respondents in RW 03 were included in low participation while respondents in RW 06 participated highly. Meanwhile, in RW 21, the majority of respondents did not participate. This is confirmed by the following interview results:

> "I often forget to sort my trash, even though I know I'm supposed to. I'm also confused about where to put it. My house is small, and if I separate it all, I'll need a place to put it. I didn't get a bucket to share, even though my neighbors did, so I had no place to separate the trash." (D, Resident of RW 03)

> "I hate it. My children and I used to be very diligent about sorting our trash, sorting wet and dry, and selling the dry waste at the waste bank. But the records were unclear at the time, and the money hasn't been paid out yet. So I'm disappointed and don't want to sort it anymore." (R, Resident of RW 06)

People will be more motivated to sort their waste if they have facilities and proper management of the facilities, which facilitates follow-up after sorting, is crucial. Another reason is a lack of desire to sort waste. This reluctance is driven by busy schedules. This is reflected in the following interview excerpt:

> "I don't want to, sis, and I don't have time, I often have activities outside, because I work too..." (M, Resident of RW 21).

Based on the results of interviews and observations by researchers, the Depok City Environmental Agency/*Dinas Kehutanan Dan Lingkungan Hidup* (DKLH) provided information on the classification of waste types according to their nature: organic, inorganic, residual, and hazardous materials (B3). This was done through efforts to increase understanding through outreach/education, training, provision of facilities, incentives, and disincentives (Procter & gambie, 2005). This is as illustrated in the following interview excerpt:

> We provide counseling and materials on what sorting is, what to do with the waste after it has been sorted, we also provide training in coordination with sub-district coordinators and so on, through bucket parties as well, we provide buckets for each house and communal buckets for each RT." (K, Head of Cleanliness and Partnerships).

Respondents who combined their organic waste with residue were in RW 03 and 06 (areas where there were communal organic waste bins), while those who combined inorganic waste with residue lived in RW 03, 06, and 21. Based on the results of in-depth interviews, the combination of sorted organic waste for disposal through combining with residual waste was due to the location of the communal organic waste bins being considered quite far by the respondents, as quoted below:

> "The trash can is far away, sis, it's a hassle, even though it's been separated, but let the trash collector collect it." (T, resident of RW 03)

> Another respondent also stated: "Sometimes I'm lazy, the bucket is a bit far away, so I throw it all together." (F, Resident of RW 06)

Meanwhile, the mixing of sorted inorganic waste with residual waste was due to respondents' inability to visit the waste bank due to their activities and the bank's operating hours, which are weekdays. This is as explained in the following interview excerpt:

> *"I didn't have time to go to the waste bank. It's for the public, but it's not a holiday, and it's only open for a short time. So, I have things to do every day, so I can't." (M, resident of RW 21).*

The availability of waste banks has an important position to facilitate the community because the results of research by Dhokhikah et al., (2015), the existence of waste banks and increasing their function a strategy to increase community participation.

3.2 The influence of internal and external factors on the level of community participation in simultaneous household waste sorting activities

3.2.1 The influence of internal and external factors on the level of community participation in simultaneous household waste sorting activities simultaneously

In order to analyze the influence of internal and external factors simultaneously, table 7 shows the coefficients and significance of the variables for each internal and external factor.

Table 7. Coefficient and significance of influence

No	Independent Variable	Coefficient	Significance
l.	Formal Education Level	-1.13	0.123
2.	Informal Education Level	0.78	0.255
3.	Level of Understanding	1.81	0.025
4.	Income Level	0.51	0.316
5.	Level of Role of Driving Actor	1.37	0.041
6.	Direct Benefit Level	0.62	0.023
7.	Availability and Accessibility of Rides	0.72	0.000

The regression equation has a coefficient of determination (R^2) of 0.521, which means that 52.1% of the variation in the participation rate can be explained by variations in the seven independent variables consisting of internal factors (level of formal education, level of informal education, level of understanding, level of income) and external factors (level of the driving actor's role, level of direct benefits, and availability and accessibility of facilities). The remaining 47.9% is explained by other factors not included in this study. The value of the multiple correlation coefficient R is 0.722, which indicates that there is a strong relationship between internal and external factors together (level of informal education, informal education, understanding, income, the role of driving actors, direct benefits, and facilities) on the participation rate. This hypothesis was then tested using a significance level of 5%. Based on the results of statistical calculations, it was found that the sig value = 0.000 < 0.05, which means that Ho is rejected or the conclusion is that the internal factor variables (level of formal education, level of informal education, level of understanding, level of income) and external factors (level of the role of driving actors, level of direct benefits, as well as the availability and accessibility of facilities together have a significant effect on the level of community participation in household waste sorting activities.

$$Y = B0 + blXl + b2X2 + b3X3 + b4X4 + b5X5 + b6X6 + b7X7 \qquad \text{(Eq. 2)}$$

Based on the existing regression equation, the following is known: the constant value is -9.522. The coefficient value for formal education is -1.134, meaning that on average, every one-level increase in formal education will decrease the level of community participation in household waste sorting by 1.134. The coefficient value for informal education is 0.787, meaning that on average, every one-level increase in informal education will increase the level of community participation in household waste sorting by 0.787. The coefficient value for understanding is 1.814, meaning that on average, every one-level increase in understanding will increase the level of community participation in household waste sorting by 1.814.

The coefficient value for income level is 0.513, meaning that on average, every one-level increase in income will increase the level of community participation in household waste sorting by 0.513. The coefficient value of the driving actor's role level is 1.378, meaning that on average, every increase of I level of the driving actor's role level will increase the level of community participation in household waste sorting activities by 1.378. The coefficient value of the direct benefit level is 0.629, meaning that on average, every increase of I level of direct benefit will increase the level of community participation in household waste sorting activities by 0.629. The coefficient value of the availability and accessibility of facilities is 0.720, meaning that on average, every increase of 1 level of the availability and accessibility of facilities will increase the level of community participation in household waste sorting activities by 0.720.

3.2.2 The influence of internal and external factors on the level of community participation in partial household waste sorting activities partial

Formal education level: Respondents' education levels are grouped into three categories, namely low education, those who did not attend school, did not graduate from elementary school, graduated from elementary school, and graduated from junior high school. Medium education is those who graduated from high school and higher education is those who graduated from bachelor and master studies. Based on the research results, the majority of respondents or 40.74% had moderate education, 34.57% had low education, and 24.69% had high education.

Table 8. Formal education and participation rates

Formal Education Level	Participation Rate			
	High	Medium	Low	No Participation
Low	29.03%	37.5%	66.67%	-
Medium	54	37.5%	-	30%
High	-	-	-	-
Total	100%	100%	100%	100%

Based on table 8, most of the respondents who participated highly (54.84%) were respondents with moderate formal education while respondents who participated moderately were each 37.5% with low and moderate formal education. Most of the respondents who participated low (66.67%) were respondents with low formal education but most of the respondents who did not participate (40%) were respondents with high formal education. Informal education level: most respondents or 35.8% had no formal education, 33.33% had low informal education, 13.58% had moderate informal education, and 9.88% had high formal education. Respondents with high education mean they have received counseling and 2 or 3 trainings. This is as quoted from the following interview:

"But there is no specific schedule for teaching the community about sorting. Sometimes the community asks to be visited, sometimes the government wants to visit the area." (K, Head of Cleanliness and Partnerships).

Based on Table 9, the majority, or 70% of respondents who did not participate, were those who did not have informal education related to waste sorting and processing in the household. Most of the respondents who participated low (66.67%) and those who participated high (35.48%) were respondents who also had a low level of informal education. Meanwhile, each (29.17%) of respondents who participated moderately were respondents who had no informal education, low informal education, and high informal education. Most respondents, or 51.85%, had a moderate level of understanding. Only 6.17% had a high level of understanding, and the remaining 41.98% had a low level of understanding.

Table 9. Informal education and participation rates

Informal Education Level	Participation Rate			
	High	Medium	Low	No Participation
Do not have	22.58%	-	16.67%	-
Low	35.48%	-	66.67%	-
Medium	22.58%	-	-	5%
High	-	-	0%	0%
Total	100%	100%	100%	100%

Based on table 10, most of the respondents who participated high, medium, low, or did not participate, they had a medium level of understanding (respectively with a percentage of 67.47%, 62.50%, 66.67%, and 55%). Income level: the research location consists of 3 areas with different characteristics. Overall, most of the respondents or 48.15% had low income, namely IDR <3,300,000, 37.04% had medium income or IDR 3,300,001–13,625,000, and 14.81% had high income or >IDR 13,625,000 per month. The distribution of respondents' income levels is explained in table 11.

Table 10. Understanding and level of participation

Understanding	Participation Rate			
	High	Medium	Low	No Participation
Low	0%	8.33%	-	-
Medium	67.74%	62.50%	66.67%	-
High	32.36%	29.17%	-	30%
Total	100%	100%	100%	100%

Based on Table 11, the majority of respondents who did not participate and those who participated lowly (53.85% each) were those with low income levels. Most respondents who participated moderately (45.83%) were those with medium income levels, and most respondents who participated highly (48.39%) were those with medium income levels. The level of the driving actor's role perceived by most respondents (48.15%) was in the medium category. A total of 22.22% of respondents felt the level of the driving actor's role was low, and the remaining 29.63% felt the level of the driving actor's role was moderate.

Table 11. Cross tabulation between income level and participation rate

Income Level	Participation Rate			
	High	Medium	Low	No Participation
Low	32.26%	41.67%	53.85	53.85
Medium	48.39%	45.83%	38.46%	30.77%
High	19.35%	12.50%	7.69%	15.38%
Total	100%	100%	100%	100%

Based on Table 12, the majority of respondents who did not participate (55%) and those who participated lowly (50%) were those who received a low level of driving actor role. Meanwhile, the majority of respondents who participated moderately (54.17%) and those who participated highly (54.84%) received a medium level of driving actor role. The majority of respondents, or 39.5%, felt direct benefits in the high category, 35.8% of respondents in the medium level, and 24.7% of respondents in the low level.

Table 12. Cross tabulation between the level of the driving actor's role and the level of participation

Level of Role of Driving Actor	Participation Rate			
	High	Medium	Low	No Participation
Low	-	25%	50%	-
Medium	54.84	-	-	-
High	32.26%	20.83%	33.33%	5%
Total	100%	100%	100%	100%

Based on the results of the questionnaire and in-depth interviews, the thing that respondents felt most was the form of incentives from the environmental side, namely that their environment was free from the unpleasant odors caused by garbage. This is as quoted in the following interview:

"What keeps me going is getting fertilizer from the neighborhood unit. It's quite good, so if we sort, we get free fertilizer." (M, resident of RW 06).

"I need it, ma'am. Before the trash was sorted, it smelled bad here. And then there was the occasional wind from Cipayung when we came here in the morning." (N, resident of RW 3).

"Before that, rats used to wander around, so they'd get run over by cars. Now, trash bins are no longer allowed outside, so there are no rats." (W, resident of RW 21).

Disincentives for people who don't sort their waste are still quite low, with only 9.8% of respondents receiving disincentives in their neighborhood for not sorting their waste. The sanctions imposed in RW 21 include the private sector not having to collect waste if it isn't sorted, forcing residents to use waste collection services from other parties. This is reflected in the following interview excerpt:

"Previously, my maid threw it into the garbage track and often stopped collecting it... the payment was double, the complex fee was for security and garbage, and I paid the person who collected the mixed garbage, the fee was fifty thousand a month, I usually paid six hundred thousand straight away for a year (M, resident of RW 21).

The sanction in RW 06 was a direct warning to respondents who were accidentally discovered by the RW head not sorting their waste. Meanwhile, in RW 03, the sanction was a warning from the RW head to respondents who were found not to have sorted their waste and were throwing their waste into the river. This was based on information obtained in the field, namely:

"At first it was difficult, some residents didn't understand, but we kept reminding them to be kind, if someone throws mixed rubbish, especially if it's in the organic bucket, then we will reprimand them." (MR, Actor Driving RW 06).

Table 13. Cross-tabulation between direct benefit levels and participation levels

Direct Benefits	Participation Rate			
	High	Medium	Low	No Participation
Low	3.23%	20.83%	-	-
Medium	-	45.83%	-	-
High	58.06%	33.33%	66.67%	-
Total	100%	100%	100%	100%

Based on table 13, it can be seen that most of the respondents who did not participate were respondents who received direct benefits in the low category. Meanwhile, most of the respondents who participated low (66.67%) were those who received direct benefits in the high category, but most of the respondents who participated moderately (45.83%) were those who received direct benefits in the medium category. Availability and accessibility of rides: overall, most of the respondents or 55.56% felt that the availability and accessibility of rides were in the high category, 39.51% in the medium category and 4.94% in the low category.

Table 14. Cross-tabulation between availability and accessibility of rides and participation rate

Availability and Accessibility of Rides	Participation Rate			
	High	Medium	Low	No Participation
Low	6.45%	0%	0%	-
Medium	-	37.50%	50%	-
High	77.42%	62.50%	50%	-
Total	100%	100%	100%	100%

Based on Table 14, the majority of respondents who did not participate (75%) were respondents who felt that the availability and accessibility of rides were in the moderate category. Fifty percent of respondents who participated lowly felt that the availability and accessibility were in the moderate and high categories, respectively. Meanwhile, the majority of respondents who participated moderately (62.5%) and participated highly (77%) were those who felt the availability and accessibility of rides were in the high category.

3.2.3 Social interventions that need to be carried out

In this study, internal factors that are significantly related but most respondents have a level of not having it, namely the level of informal education and sig.= 0.004 < α= 0.05) and in the medium category, namely at the level of understanding (r= 0.231 and sig.= 0.038 < α= 0.05). Meanwhile, external factors that are significantly related to the level of community participation in household waste sorting activities, but most respondents feel that these external factors are in the medium category, namely the level of the role of the driving actor (r=0.389 and sig.= 0.000 < α= 0.05). The level of informal education of most respondents who did not participate was included in the low category (70%), while those who participated were included in the medium category (66.67%). Social interventions that need to be carried out are through providing socialization and training related to waste sorting, follow-up after waste is sorted, and waste processing that is carried out more regularly in the frequency of implementation (Qu et al., 2009). The level of understanding of the majority of respondents who did not participate and those who did participate fell into the moderate category (55% and 66.67%, respectively).

This understanding primarily relates to hazardous waste, where the majority of the community does not understand what is meant by hazardous waste and does not separate it (Rousta et al., 2015). The level of involvement of the driving actors for the majority of respondents who did not participate and those who did participate fell into the low category (55% and 50%, respectively). This includes providing outreach on waste sorting and following up on sorted waste according to the system (time and collection method) applicable in the community, as well as providing training in sorting and processing organic and inorganic waste (as one of the prioritized waste management hierarchy, in addition to source reduction) (Sarwono, 2006; Sinurat & Salomo, 2013). According to Slamet (2014) & Soemarwoto (2004), social interventions will be effective if there is monitoring and evaluation. Based on this, efforts/activities to improve informal education, understanding, and the role of driving actors require setting goals and monitoring. Monitoring and evaluation are necessary throughout the project to identify ongoing issues and community needs. Through monitoring and evaluation, the success of efforts to improve informal education, understanding, and the roles of key actors can be measured against planned objectives (Suyoto, 2008; Tai et al., 2011). This also serves as a means of ensuring the sustainability of the project (UN-DESA, 2015; Uyarra & Gee, 2013).

3.3 Contribution to waste reduction

Waste reduction in this study is the weight of waste generated by the community that is not processed at the landfill because it has been collected for later processing or processing so that it has economic value (Vicente & Reis, 2008; Wahyudi, 2014). Organic

waste is managed by UPS to be used as fertilizer through collection at communal organic waste sites or direct transportation by collectors who pick up organic waste from homes, while inorganic waste is collected at the waste bank independently by the community (Xu et al., 2017). Based on the weighing that has been carried out, it is known that the community's waste generation is as follows:

Table 15. Daily waste generation

Types of Waste	Mixed	Organic	Inorganic	Residue	Total
Weight (Kg)	38.8	77.15	48.75	4.16	168.86
Total number of family members	331 people				
Average weight of the load per person	0.51 kg/person/day				

Table 15 shows that the total weight of waste generated is 168.86 kg/day. Through waste sorting activities, not all of the waste generated is transported and processed at the landfill because there is organic and inorganic waste that is managed (Yukalang et al., 2017). Adaptɪn the amount of organic and inorganic waste managed is explained in Table 16.

Table 16. Waste to be managed

Types of Waste	Organic	Inorganic	Total
Weight (kg/day)	67.82	24.56	92.38

Based on the data in tables 15 and 16, it can be seen that the total weight of waste generated per day at the research location in RW 03, 06, and 21 is 168.86 kg, the waste that is managed so that it is not transported and processed at the landfill is 92.38 kg. This means that the weight of waste transported and processed at the landfill from the research location in RW 03, 06, and 21 is 76.48 kg. This shows that the sorting at the research location in RW 03, 06, and 21 has contributed to the reduction of waste transported and processed at the landfill by 54.7% of the total waste generation in the three areas. Meanwhile, the contribution of the research locus to waste reduction in Depok Village which has a population of 44,686 people with an average waste generation of 0.51/kg/person/day or produces 22,790 kg of waste/day, which is 0.008%. When compared with the average waste generation of Depok City which has a population of 2,179,813 people with an average waste generation of 0.51/kg/person/day or produces 1,111,705 kg of waste/day, which is 0.008%.

3.3.1 Waste composition

The data on the composition of respondents' waste according to the material obtained in the field is that most of it consists of organic waste (51%). The organic waste consists of organic kitchen waste/food scraps and dry organic waste/yard waste such as leaves, twigs, and the like). Inorganic waste generally consists of plastic, textiles/cloth, paper, glass, rubber/leather, and metal/aluminum. A total of 9% consists of residual waste and B3 which consists of sanitary napkins, diapers, cigarette butts, aluminum foil, and etc.

Table 17. Recycling potential based on waste composition

No	Composition by Material	Amount
1	Organic (Food scraps and leaves/twigs)	51%
2	Plastic bags	9%
3	Plastic bottles/containers	5%
3	textiles	4%
4	Paper	11%
5	Glass	5%
6	Rubber/leather	2%
7	Metal/aluminum	4%
8	Residue, 133, and others	9%
9	Total	100%

Table 17 shows that based on the composition of household waste generated in RW 03, 06, and 21, a large portion of the waste can be processed. Fifty-one percent of organic waste can be composted, either at the household level or at the UPS, and 4,096 percent of inorganic waste can be recycled. This is as shown in the following excerpt.

"Organic waste is collected straight away, never used for fertilizer. In the past, my father used to separate it for fertilizer, but now that I have a bucket, I just collect it there." (S, Resident of RW 03).

"I never make crafts like that, I just sell it straight to the waste bank." (V, Resident of RW 06).

"I never recycle waste. I just collect it, and the lady takes it to the waste bank..." (I, Resident of RW 21).

Some respondents process hazardous waste (B3) to use as plant fertilizer. This is illustrated by the following quote:

"I like to dismantle battery stones, inside there are items, I like to take them and then use them as fertilizer so that my plants grow well." (I, Resident of RW 21).

The respondent's action of dismantling the components in the battery to be used as plant fertilizer can be said to be dangerous, this is because according to Zhang & Wen (2014), B3 waste (including battery stones) has toxic characteristics, so if plants are given components in the battery stones, this has the potential to harm the plants. Based on the results of the survey and interviews regarding the parties who handle waste in RW 03, 06, and 21 are depicted in Figure 3.

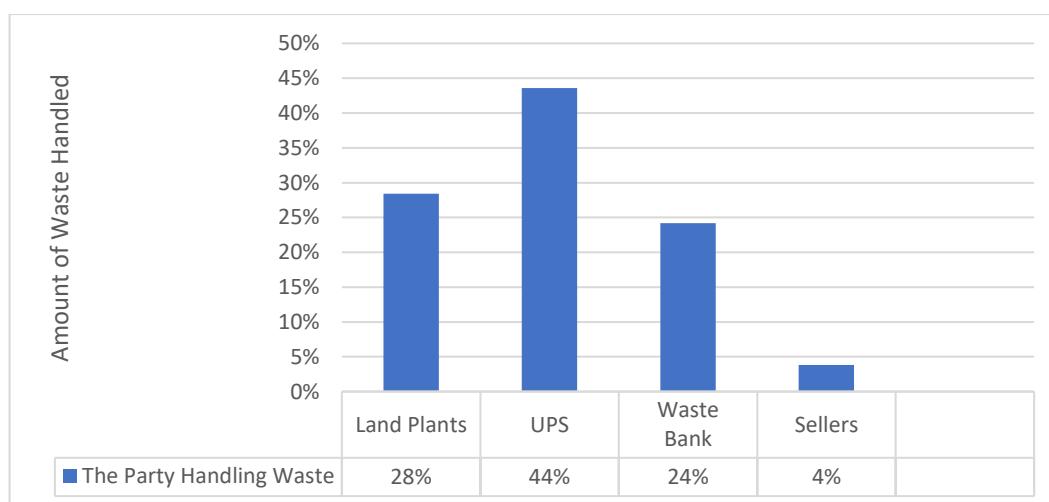|	Land Plants	UPS	Waste Bank	Sellers
■ The Party Handling Waste	28%	44%	24%	4%

Fig 3. Parties handling waste

Based on Figure 3, the majority of waste generated at the research location is handled and processed by UPS, amounting to 43.6%. This indicates that most of the organic waste generated by the community will be processed and processed into organic fertilizer and therefore not processed at the landfill. A total of 28.4% of the waste is processed at the landfill while 71.60% is handled, precisely 24.20% by the waste bank, and 3.8% by the seller. This indicates that 280% of the inorganic waste can be processed and then processed and used as a resource for the production of other inorganic goods. Both of these things support the achievement of sustainable waste management. The results of the field findings show that the composition of waste generated by communities with high and medium incomes is

dominated by inorganic waste (plastic bottles/containers), paper, textiles/cloth, metal/aluminum, and rubber/leather.

3.3.2 Analysis of community waste generation

The waste generation of the community in RW 03, 06, and 21 consists of organic, inorganic, residual, and mixed waste. The total waste reached 168.86 kg/day, consisting of 77.15 kg organic, 48.75 kg inorganic, 4.16 kg residual, and 38.8 kg mixed. Referring to this, the researcher analyzed the waste generation, especially the types of waste that were sorted (organic, inorganic, and residual) based on the community's income level, as shown in table 18.

Table 18. Cross tabulation between the amount of waste generated and income level

| Income level | Number of people | The amount of waste generated | | | | | | Total Average Per Person |
| | | Organic | | Inorganic | | Residue | | |
		Amount	Average	Amount	Average	Amount	Average	
Low	227	54.76	0.241	23.9	0.105	1.92	0.011	0.357
Medium	67	14.48	0.216	14.57	0.217	0.81	0.012	-
High	37	7.91	0.214	10.28	0.278	1.43	0.039	0.531
Total	331	77.15	-	48.75	-	4.16	-	-
				130.06				

Based on Table 18, in general, at high and medium income levels, the most waste generated by the community, in order, is inorganic, organic, and residual. Meanwhile, the higher the income level, the higher the average amount of inorganic and residual waste generated per person. Then, the highest amount of organic waste per person is generated by people from low-income families, while the highest amount of inorganic waste is generated by families with high incomes. This is consistent with the results of Kolekar's (2016) research, which found that the relative percentage of organic waste generally increases with decreasing socioeconomic status (income). The average number of family members at low income levels is 4 people, while for families at medium and high income levels it is 5 people. This is as stated in the following interview excerpt:

"We buy newspapers every day, we don't buy plastic bags but we usually get a lot when we go shopping, cardboard boxes too, used donuts, drink bottles, and other daily necessities. We usually stock them, sis, we have enough for a month's needs." (I, Resident of RW 21)

Likewise with people at the middle income level, this is as quoted in the following interview:

"It depends on my needs, but most often I use cardboard glass bottles, to keep in stock when I have guests or go out, so it's practical. Sometimes at night I also go to the minimarket to buy corned beef, powder, and other daily necessities." (V, resident of RW 06).

People with lower incomes consume more organic foods, such as vegetables. This is as stated in the following statement:

"Usually I cook by buying vegetables and spices. I cook in the morning, then the family eats it. I often buy vegetables because everyone likes them." (S, Resident of RW 03).

In general, each person at a high income level produces an average amount of organic, inorganic and residual waste (0.53 kg) more than people on a medium income (0.445 kg). Each person at a medium income level produces an average amount of waste more than

people at a low income level (0.35 kg). This is in accordance with the comparison of income levels and waste generation in a country, according to the World Bank (1999) in Opeyemi (2012), high-income countries generate more waste than middle- and low-income countries.

3.3.3 The relationship between participation level and waste reduction

Based on the results of the Pearson analysis test with SPSS statistic 20 (table 19), it is known that N (the number of research data is 81) with a correlation coefficient value of 0.778 and a Sig. (l-tailed) value of 0.000, it can be concluded that there is a significant relationship between the level of participation in household waste sorting activities and the amount of waste reduction. The correlation coefficient value is 0.778, so this value indicates a strong relationship between the level of community participation in household waste sorting activities and waste reduction in Depok Village. In addition, the sig value = <0.05, this indicates that Ho is rejected, which means there is a significant relationship between the level of community participation in household waste sorting activities and the amount of waste reduction.

Table 19. Relationship between the level of participation in household waste sorting activities and waste reduction

	Mark	Sig. (I-tailed)
Correlation Coefficient Value	0.778	0.000

Based on the results in Table 19, it is clear that the relationship between the level of participation in household waste sorting activities and the amount of waste reduction in Depok Village can be concluded. High levels of waste reduction are associated with high community participation in waste sorting activities, and vice versa. In general, when the level of participation is linked to the amount of waste reduction, the resulting correlation coefficient is 0.778. This value indicates a strong relationship between the level of participation and the amount of waste reduction. Waste generation in neighborhood units (RW) 03, 06, and 21, which reached 0.51 kg/person/day, is higher than the 0.3 kg/person/day recorded in the waste generation measurement study conducted in East Surabaya. The composition of the household waste generated in RW 03, 06, and 21 is similar to that in East Surabaya, dominated by organic/food waste. Socioeconomic characteristics have a smaller influence than supporting factors on sorting, recycling, and composting activities.

In accordance with Presidential Decree No. 97 of 2017 concerning National Waste Management Policy and Strategy, in order to achieve the national target in the aspect of waste handling and reduction 2017-2025, efforts are needed from various elements of society, including the government, private sector, and community, and starting from the local level in the household. Researchers see that waste management in Depok Village can be sustainable because it involves community participation in Depok Village, this reflects the active involvement of waste producers to be responsible for managing their waste through systematic, comprehensive, and sustainable activities that include waste reduction and handling in the household.

4. Conclusion

Based on the findings obtained in this study, it can be concluded that: The level of community participation in household waste sorting activities in Depok Village is mostly or 38% included in high participation. Some 30% participated low, 7% participated low, and 25% did not participate. This high participation is because although most respondents have internal factors of not having informal education related to waste sorting and processing and have low income levels, respondents have other internal factors (formal education level and level of understanding) at a moderate level. In addition, external factors (level of the

driving actor's role) are included in the moderate level, while the level of direct benefits and the availability and accessibility of facilities are included in the high category.

Internal and external factors show significant differences in their influence on community participation in household waste sorting activities in Depok Village when analyzed simultaneously and partially. Simultaneously, internal factors (level of formal education, level of informal education, level of income, level of understanding) and external factors (level of the driving actor's role, level of direct benefits, and availability and accessibility of facilities) have a significant effect on the level of community participation in household waste sorting activities. Partially: The level of formal education does not have a significant effect on the level of community participation in household waste sorting activities. The level of informal education does not have a significant effect on the level of community participation in household waste sorting activities. The level of understanding has a significant effect on the level of community participation in household waste sorting activities. The level of income does not have a significant effect on the level of community participation in household waste sorting activities. The level of the role of the driving actor has a significant effect on the level of community participation in household waste sorting activities. The level of direct benefits has a significant effect on the level of community participation in household waste sorting activities. The availability and accessibility of facilities have a significant effect on the level of community participation in household waste sorting activities.

The level of community participation in household waste sorting activities is significantly related to waste reduction with a correlation value of 0.778, this shows that there is a strong and unidirectional relationship, if the level of community participation in household waste sorting activities increases, waste reduction will also increase. Communities that sort waste and follow up on waste that has been sorted have contributed to a reduction in waste of 54.7% in RW 03, 06, and 21, 0.41% in Depok Village, and 0.008% in Depok City. Sustainable waste management occurs if there is handling through sorting carried out independently by the community, providing economic benefits, and goodness on the environmental side, this contributes to waste reduction.

Author Contribution
The author contributed equally to the conceptualization, methodology, analysis, and writing of this review. The author collaboratively reviewed and approved the final manuscript for submission.

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