SPATIUM
No. 50, December 2023, pp. 55-65

UDC 628.47(594)"21"
616.98:578.834(594)"21"
502.131.1(594)"21"
Original scientific paper
DOI: https://doi.org/10.2298/SPAT230615011L

THE DRIVING FACTOR FOR RAISING URBAN COMMUNITY AWARENESS IN WASTE MANAGEMENT, TO REDUCE WASTE DURING THE COVID-19 PANDEMIC

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Solid waste management is a complex issue, and this was especially true during the COVID-19 pandemic in Indonesia. Several challenges related to this issue emerged because of the pandemic, during which countries with limited resources heavily relied on community participation. This study investigates the factors that contribute to the collective action of urban communities in waste management as a solution to raising awareness. This study adopted a quantitative method that incorporated four independent variables and one dependent variable with a 4-point Likert scale questionnaire. The data were collected through a survey using a purposive sampling method. The data collected are proportional because there is no sampling frame in this study. An analysis of the 200 samples collected in Jakarta reveals that community participation, social norms, social influence, and socioeconomic status impact collective action. However, the result from an ordinal regression analysis only shows community participation and social influence as significant variables with corresponding odds ratios of .263/.379 and .053/.168 for every one-unit increase. This study concludes that higher community participation and social influence will likely affect people's collective action in waste management. Policies and programs incorporating community participation and social influence can be implemented based on the findings to tackle waste management awareness issues.

***Key words*: awareness, COVID-19, collective action, urban communities, waste management.**

INTRODUCTION

The current level of solid waste generation in Indonesia is alarming. In 2020, predictions for cities in Indonesia suggested an estimated 38.5 million tonnes of solid waste per year, with the national amount of waste generated reaching 73 million tonnes per year (The Ministry of Environment and Forestry Republic of Indonesia, 2020). The exact data in Indonesia revealed that 29 million, 28.6 million, and 35 million tons of solid waste were generated in 2020, 2021, and 2022, respectively (The Ministry of Environment and Forestry Republic of Indonesia, 2023). The data from 2020 to 2022, especially during the COVID-19 pandemic, prove that waste management is a severe problem that must be addressed because of the increment of waste generation each year. However, despite the importance of solid waste management, many problems, such as implementing efficient separation processes, remain unaddressed.

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Incineration, a potential solution to reduce landfill usage and a popular waste management method, has become controversial in recent years because it generates harmful emissions (Di Maria *et al*., 2021). Indonesia is no exception to the problem caused by waste management methods, as the country has now changed from the collect-transport-dump method to 3R (reduce, reuse, recycle) in its bid to achieve a circular economy. However, this new paradigm requires source-based support from the community to ensure efficient implementation (The Ministry of Environment and Forestry Republic of Indonesia, 2020; Mahartin, 2023). Currently, waste management processes in Indonesia still have room for improvement, especially in terms of sustainability. This is because the old method of using landfills without any measure to reduce waste from their sources is still being used, creating a burden and "waste mountains", while simultaneously contributing to the risk of diseases, pollution, and hazardous emissions (Fatimah *et al*., 2020).

Waste management in Indonesia is a complex issue because environmental problems caused by related inefficiencies, such as disease and greenhouse gases (GHGs) need new scenarios and innovation to improve (Puchongkawarin and Mattaraj, 2020). Studies have shown that during the COVID-19 pandemic, large amounts of infectious/medical waste were generated through the increased use of personal protective equipment (PPE; Chen *et al*., 2021; Mahmoudnia *et al*., 2022). This statement is further evidenced by other studies showing that the pandemic created more challenges in waste management. Furthermore, the use of PPE, along with food and plastic waste, increased during the pandemic (Hantoko *et al.*, 2021). Meanwhile, other studies have shown that COVID-19 correlated with reduced waste generation because of the changing behaviors by many people during the pandemic (Mahmud *et al.*, 2022; Sarmento *et al.*, 2022). However, the study by Mahmud *et al*. (2022) and Sarmento *et al*. (2022) was conducted in a developed country. In comparison, the study by Mahmoudnia *et al*. (2022) revealed that medical waste generation in Indonesia reached 433.98 US tons/day or around 394 tons/day at the height of the COVID-19 pandemic. Hence, there is a gap in behaviors observed between countries. Other studies have shown that the pandemic in developing countries such as Indonesia worsened waste management, thus requiring new and urgent solutions (Hantoko *et al*., 2021; Mahmoudnia *et al*., 2022).

Practice focused on behavioral aspects, such as individual participation and the public perspective toward waste management, can be encouraged to facilitate greater participation (Pandit *et al*., 2021). This study aims to fill the gaps in collective public participation by exploring which aspects must be incorporated behaviorally to achieve effective waste management. In particular, this study combined the variables into factors comprising the best solution for solving the waste management issue in urban communities during the COVID-19 pandemic.

Literature review

Community participation

Several studies have already highlighted the importance of community participation in solving waste management issues. For example, Kuang and Lin (2021) showed that the behavior, willingness, and convenience of supporting facilities affect participation in waste management. However, other studies have become a center of debate in community participation. For instance, Dhokhikah *et al*. (2015) argued that the knowledge and awareness of environmental issues affect behavior by influencing community participation. Community participation has also become a vital component in tackling waste issues during the COVID-19 pandemic. Al Huraimel *et al*. (2022) showed that community participation helped reduce COVID-19 infections resulting from infectious waste and affected recovery. Hence, community participation can be considered relevant to waste management both during and after the COVID-19 pandemic.

Indeed, community participation is essential to Indonesia's collective action and waste management issues. A study by Brotosusilo *et al*. (2020) highlights the involvement of various voluntary activities, which could be implemented in Indonesia and integrated into collective action. Even though participation has become an essential factor in collective action, social dilemmas could occur when participants become "free-riders" (Ostrom, 1998; 2000). In such cases, collective action is affected by community participation.

On the one hand, participation in waste management is driven by internal factors, such as environmental care, public education programs, and other critical external variables, which encourage responsible behaviors toward it (Lawrence *et al*., 2020). On the other hand, Swapan (2014) argued that participation is affected by internal factors from the institution and external factors related to the cultural context. Therefore, this study will use the internal and external dimensions of community participation.

Collective action

Previous studies have demonstrated the need for collective waste management efforts (Blomsma, 2018; Harring *et al.,* 2019; Olawade *et al.,* 2023). For Blomsma (2018), collective action can be a framework that focuses on societal change, resulting in sustainable waste and resource management. Therefore, collective action is required for analyzing household practices that require institutional intervention to increase the frequency of recycling. This is because trust is considered crucial in enhancing collective action. Ostrom (1998) emphasized the importance of trust as a dimension of collective action. Meanwhile, Harring *et al.* (2019) showed that although institutional trust has a positive relationship with recycling behavior, to achieve a curvilinear effect on recycling practice, people must have greater trust in public institutions.

Other studies have shown that the role of institutions, such as institutional structures and formal rules, lead to mutual vulnerability by some communities and inequality, highlighting a social gap between communities that affects collective action in tackling environmental issues (Bisung, 2021). Further, collective action on waste management is

considered a critical factor in other research, which finds that economic incentives and social influence negatively impact collective waste management actions (Xu *et al*., 2018). Studies on collective action on waste management in three countries, Brazil, Nigeria, and Indonesia, have produced positive outcomes, with awareness-raising campaigns playing a role in achieving increased local education. Culture and government efforts are other vital factors that facilitate the development of collective action. This is because government intervention can mitigate individualistic culture, which is a barrier to collective action. It can also accelerate collaboration between communities and the local government, as in the case of Padang City (Oh and Hettiarachchi, 2020).

Therefore, discussing collective action is crucial in tackling waste management issues, especially in light of the increment of waste generation during the COVID-19 pandemic. Olawade *et al*. (2023) strengthened the argument on the importance of collective action by demonstrating the successful implementation of waste management programs during the COVID-19 pandemic. However, the present study will be using the collective action variable with the dimensions introduced by Harring *et al*. (2019) and Bisung (2021), namely, Institutional Trust, Institution, Mutual Vulnerability, and Inequality, to measure collective action.

Social influence

Social influence also plays a part in waste management, as shown in a study that profiled recyclers and nonrecyclers in Malaysia (Zen *et al*., 2014). Their results revealed that social influence strongly correlates with recycling motivation factors (Zen *et al*., 2014). Social influence has a major contribution to recycling behavior, as opposed to having an incentive, which only contributes below 5% of recycling behaviors (Li *et al*., 2021). However, although it has been proven that social influence increases the overall participation in waste separation programs by 5.3%, role model strategies work better in areas with stronger group cohesion, a higher affluence level, or a young population (Xu *et al*., 2021). Furthermore, they have a minimal effect on people with a lower economic level or an older population; hence, it depends on the local contexts and personal idiosyncrasies (Xu *et al*., 2021). The type of neighborhood can also influence residents' behaviors with regard to waste management, such that poor neighborhood waste management practices have a negative influence on the level of solid waste collection.

Social influence has close ties with collective action. Social influence should be one of the factors in solving collective action issues, such as the social dilemma of free-riders (people who do not contribute to the program but claim to be participants), and the need to reduce their number (Xu *et al*., 2018). Aside from social dilemma issues, the importance of social influence and collective action could be leveraged to encourage people to participate in waste management, such as in community-based projects in Indonesia such as waste banks involving the community and volunteers. The need to solve social dilemma issues has been discussed by Oh and Hettiarachchi (2020), who found that the free-rider phenomenon caused by social dilemmas interrupted collective actions in the waste banks.

The influence of friends, family, and one's surroundings affected attitudes toward reducing waste during the COVID-19 pandemic (Deliberador *et al*., 2023; Zhou *et al*., 2022). Social influence also influenced sustainable consumption before, during, and after the COVID-19 pandemic (Cui *et al*., 2022). Social influence can affect collective action on waste management by changing citizens' behaviors. Thus, as one of the variables in this study, social influence will include Family, Neighbors, and Peers.

Social norms

Social norms influence waste management, as reported by Sorkun (2018), who confirmed that social norms affected household recycling behavior by triggering the internalization process; thus, rather than going through the internalization of perceived convenience, social norms mediate the influence of recycling behaviors. Social norms are divided into injunctive norms, related to what people approve of, and descriptive norms, such as what most people do (Farrow *et al*., 2017).

Social norms also positively influence altruistic waste-sorting behavior. For example, in a study about social norms between males and females in waste management, Luo *et al.* (2020) showed that social norms influenced males' waste-related behaviors, while social norms influence women in social networks to promote waste-sorting behaviors. Furthermore, social norms during the COVID-19 pandemic were essential because adopting them could change individual perceptions and behaviors through social pressure (Dwipayanti *et al*., 2021). Related to this, Luo *et al.* (2020) and Dwipayanti *et al*. (2021) reported that social norms could be one of the vital components in ensuring the success of waste management programs.

Referring to collective action theory, Ostrom (2000) argued that social norms could influence individuals involved in collective action to behave appropriately while pursuing the same objective. Thus, they are essential to waste management in Indonesia, as they could shape individuals' behaviors and sense of responsibility. With the problem of waste generation during the COVID-19 pandemic, changing people's behaviors through social norms must be initiated. Thus, the present study will incorporate both injunctive and descriptive norms.

Socioeconomic factors

Rosecký *et al*. (2021) reported that past studies have shown the significant influence of socioeconomic variables on waste management via the reduction in municipal waste generation. Such socioeconomic factors also impact the structure of the waste management system, indicating that changes in the society and economy may inevitably affect the cost of waste management services (Tomić and Schneider, 2020). Meanwhile, Villalba *et al.* (2020) argued that socioeconomic factors have a role in the categorization of waste generation and waste separation behavior in communities.

Padilla and Trujillo (2018) argued that socioeconomic factors also influenced attitudes toward recycling, while education increased awareness of the importance of environmental protection and recycling. Another study on waste

generation and recycling performance reported that the effectiveness of waste and recycling procedures depended on socioeconomic factors, including income, education, employment status, and demographic characteristics (Soukiazis and Proença, 2020). Meanwhile, Anantharaman (2014) argued that socioeconomic status affected collective action in waste management by describing how the middle class—as a privileged socioeconomic group—could engage in collective action by encouraging changing behaviors in waste management. However, Oh and Hettiarachchi (2020) compared the waste management systems in Indonesia, Brazil, and Nigeria and found that income—as a socioeconomic dimension—played a crucial role in policies that promoted recycling to reduce the main problem of collective action (i.e., free-riding). Socioeconomics has been shown to affect waste generation during the COVID-19 pandemic by differentiating between the behavior of each socioeconomic group (Deliberador *et al.*, 2023). Socioeconomic and geographical factors were also found to be essential during the pandemic because intervention depended on them (Fan et al., 2021). Socioeconomic factors were particularly relevant during the pandemic in Indonesia because of the closure of waste banks—institutions that involved community participation, mainly with customers from low socioeconomic groups, causing waste generation and reduced income (Warmadewanthi *et al.*, 2021). Therefore, the socioeconomic variables in the present study will incorporate Education, Employment, and Income.

MATERIALS AND METHODS

Descriptive research aims to describe a detailed picture of types of people or social activities using data-gathering techniques, such as surveys, field research, content analysis, and historical-comparative research (Neuman, 2014). This research has four (4) independent variables (IVs) and one (1) dependent variable (DV). The IVs consist of Community Participation (CP), Social Norms (SN), Social Influence (SI), and Socioeconomic status (SES), whereas the DV is Collective Action (CA). Data collection was carried out through online surveys using primary data as material for analysis. The survey questions used a 4-point Likert scale (1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree). The survey was conducted through *Google Forms* from September 2021 until January 2022.

Aside from using the questionnaire to collect data, this study also used purposive sampling by setting the criteria in relation to the respondents residing in Jakarta (Figure 1.) A 4-point Likert scale was used following the argument that respondents' midpoint on a Likert scale had the tendency to be a dumping ground (Chyung *et al.*, 2017). Another argument for this study in support of using a Likert scale is

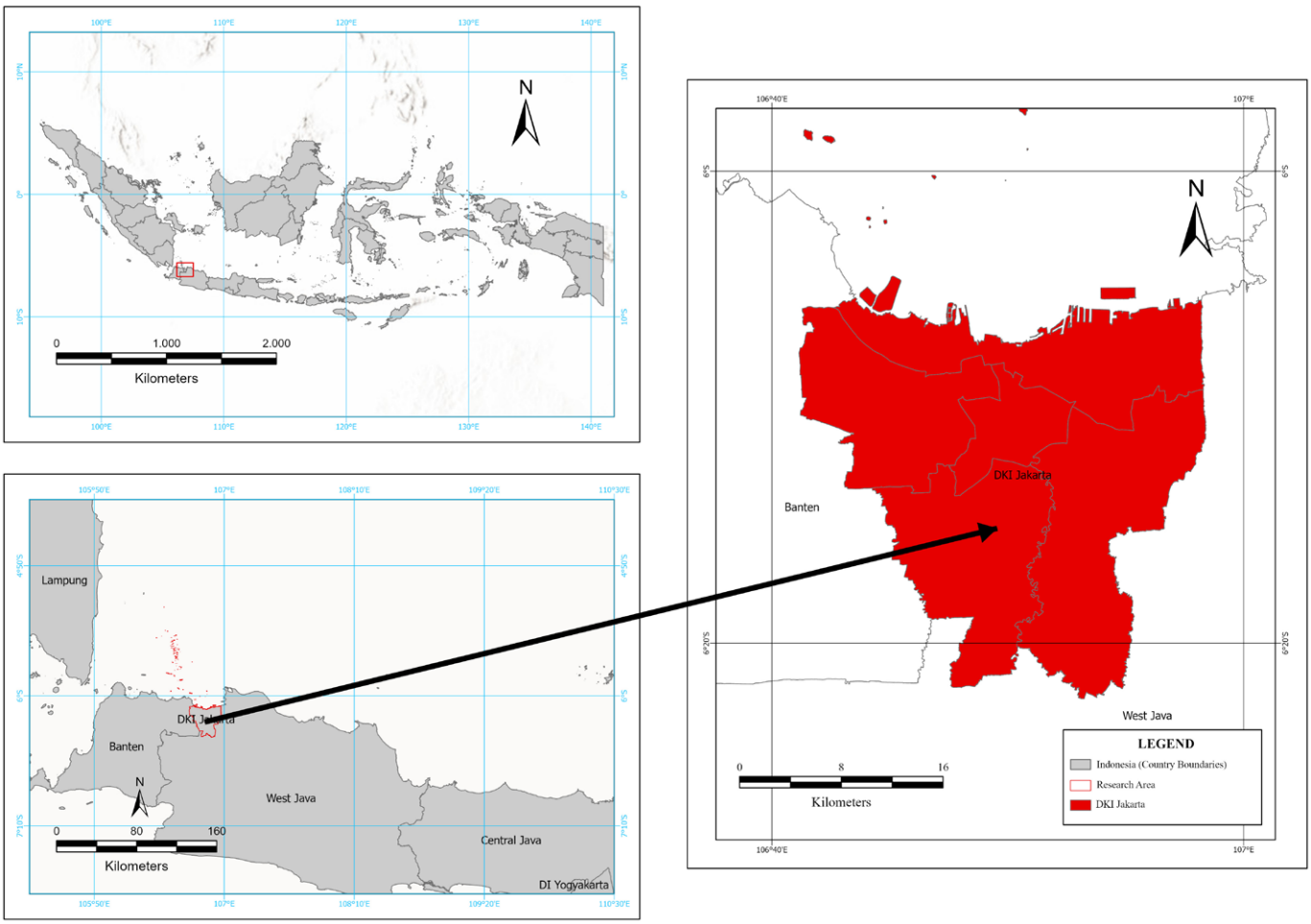

Figure 1. The map of Jakarta
(Source: Authors, 2023)

that this work examines the behavioral aspects of individual waste management, and the condition of the COVID-19 pandemic mainly relates to the social dilemma that caused free-riding behaviors (Harring *et al*., 2021; Oh and Hettiarachchi, 2020). The Likert response questionnaire data utilized ordinal scales data, which led to the use of nonparametric statistical analysis. The sample size was proportional because this study did not have a sampling frame. After collecting the data, they were summarized according to each variable and coded into three ordered categories (low, middle, and high). The categorization uses the 25th and 75th percentiles as high and low categories, respectively. The middle categories used the interquartile range. The interquartile range was obtained by using the range of both the 25th and 75th percentiles (Manikandan, 2011). Andrade (2021) argued that categorization can be done if the variable cannot be accurately measured, the data are not normally distributed, and if a nonlinear association exists between independent variables and dependent variable. Therefore, the present study uses three ordered categories (low, middle, and high) due to the nonlinear association from using ordinal scale data.

The data were also analyzed using a chi-square test to determine whether there was a relationship between the IVs and DV (Franke *et al*., 2012). Somers' D was used to measure any asymmetric association between the IVs and DV (Newson, 2006). Ordinal regression was employed to establish the significance of the relation between IVs and DV, after which the latter were measured by ranking them (Sun *et al*., 2022). This assumption also strengthened the nature of the Likert and placed individuals into ranked categories (Raudkivi, 2020). The following hypotheses were proposed in this study:

- **H1.** A relationship exists between Community participation and Collective action in waste management;
- **H2.** A relationship exists between Social norms and Collective action in waste management;
- **H3.** A relationship exists between Social influence and Collective action in waste management; and
- **H4.** A relationship exists between Socioeconomic status and Collective action in waste management.

RESULTS AND DISCUSSION

Of the 200 responses, 133 (66.5%) were females, and 67 (33.5%) were males. The Likert-type nature of the questionnaire placed the data in an ordered ranking scale. As mentioned previously, the collected data were coded into three ordered categories (low, middle, and high). In addition, a statistical analysis was conducted using nonparametric analysis.

Association between variables

The research used four IVs and one DV. The IVs were Community participation, Social norms, Social influence, and Socioeconomic status. The DV was Collective Action. The variables used in the research were asymmetric, and the variables were ordinal scales. The association between variables was determined using the chi-square test and Somers' D to identify the association between variables. In addition, this study used a 95% confidence level. Somers' D was used as a measure because the variables were ordinal, and the relationship between variables was asymmetric.

Community participation and Collective action

The crosstabulation between Community participation (IV) and Collective action (DV) is presented in Table 2.

As shown in Table 2, respondents with low, middle, and high collective action levels tend to have low (49.1%), middle (54.6%), and high (62%) community participation levels, respectively. The Chi-square test (Table 1) reveals a value of 60.408 and an asymptotic significance value that is statistically significant (.000). The result also shows that the test between two variables rejects the null hypothesis. Thus, the study concludes that a relationship exists between Community participation and Collective action on waste

Table 1. Summary of Chi-Square Test and Somers' D Results

Variable	Chi-square Value	Asymptotic Significance	Somers' D Value	Approximate Significance	Notes
Community participation and Collective action	60.408	.000	.464	.000	Significant
Social norms and Collective action	47.553	.000	.411	.000	Significant
Social influence and Collective action	91.797	.000	.551	.000	Significant
Socioeconomic status and Collective action	21.586	.000	.284	.000	Significant

Table 2. Cross-tabulation between Community Participation and Collective Action

		Community Participation			
		Low	**Middle**	**High**	**Total**
Collective action	**Low**	26 (49.1%)	25 (25.8%)	3 (6%)	54 (27%)
	Middle	26 (49.1%)	53 (54.6%)	16 (32%)	95 (47.5%)
	High	1 (1.9%)	19 (19.6%)	31 (62%)	51 (25.5%)
	Total	53 (100%)	97 (100%)	50 (100%)	200 (100%)

management. In addition, Somers' D has a value of .464, with the approximate significance at .000, which means that there is a moderate association between the two variables. The value of Somers' D also shows a moderate association between Community participation and Collective action. Furthermore, this value is positive, indicating a higher community participation level translating to higher collective action.

Association between Social norms and Collective action

The association between Social norms (IV) and Collective action (DV) is shown in the cross-tabulation in Table 3 below.

According to Table 3, respondents from low (45.1%), middle (52.1%), and high (56.4%) collective action levels also have low, middle, and high social norms levels, respectively. The chi-square test (Table 1) shows a value 47.553 and an asymptotic significance p-value lower than the alpha value (.000 < 0.05). Furthermore, the result of the test between two variables rejects the null hypothesis. Therefore, there exists a relationship between Social norms and Collective action. In addition, the Somers' D value is .411, with approximate significance value being statistically significant (.000), indicating that there are moderate and positive associations between the two variables. Based on the result, we can say that the higher social norms also lead to a higher degree of collective action.

Association between Social influence and Collective action variables

The association between Social influence (IV) and Collective action (DV) is reported in Table 4.

As shown in Table 4, respondents from low (59.3%), middle (63.5%), and high (68%) collective action levels tend to have low, middle, and high social influence levels, respectively. The chi-square test (Table 1) results also show a chi-square value of 91.797 and an asymptotic significance value lower than the alpha value (.000 < .050). The asymptotic significance value also shows that the null hypothesis is rejected, indicating an association between Social influence and Collective action. In addition, the Somers' D value is .551 (moderate association) with an approximate significance value lower than the alpha value (.000 < .050), indicating a positive relationship between the variables. From this result, it can be established that a higher social influence level translates to a higher collective action level.

Association between Socioeconomic status and Collective action level

The association between Socioeconomic status (IV) and Collective action (DV) is reported in Table 5.

Table 5 shows that respondents from low (34.5%), middle (53.6%), and high (44.1%) collective action levels have low, middle, and high socioeconomic status levels, respectively. The Chi-square test (Table 1) has a value of 21.586, with an asymptotic significance value lower than the alpha value (0.000 < 0.05), indicating an association between socioeconomic status and collective action. In addition, the Somers' D value is .284, and the approximate significance value is .000, indicating a low association between socioeconomic status and collective action variables. Thus, a higher socioeconomic status level means higher collective action levels.

Table 3. Cross-tabulation between Social norms and Collective action

		Social norms			
		Low	**Middle**	**High**	**Total**
Collective action	**Low**	23 (45.1%)	27 (28.7%)	2 (7.3%)	47 (27%)
	Middle	26 (51%)	49 (52.1%)	19 (36.4%)	106 (47.5%)
	High	2 (3.9%)	18 (19.1%)	28 (56.4%)	47 (25.5%)
	Total	51 (100%)	100 (100%)	40 (100%)	200 (100%)

Table 4. Cross-tabulation between Social influence and Collective action

		Social influence			
		Low	**Middle**	**High**	**Total**
Collective action	**Low**	32 (59.3%)	21 (21.9%)	1 (2%)	54 (27%)
	Middle	19 (35.2%)	89 (63.5%)	15 (30%)	95 (47.5%)
	High	3 (5.6%)	14 (14.6%)	34 (68%)	51 (25.5%)
	Total	54 (100%)	96 (100%)	50 (100%)	200 (100%)

Table 5. Cross-tabulation between Socioeconomic status and Collective action.

		Socioeconomic status			
		Low	**Middle**	**High**	**Total**
Collective action	**Low**	39 (34.5%)	4 (14.3%)	11 (18.6%)	47 (23.5%)
	Middle	58 (51.3%)	15 (53.6%)	22 (37.3%)	106 (53%)
	High	16 (14.2%)	9 (32.1%)	26 (44.1%)	47 (23.5%)
	Total	113 (100%)	28 (100%)	59 (100%)	200 (100%)

Multivariate analysis (Ordinal regression)

The research used ordinal regression because the questionnaires used a Likert-type scale, and because the DV was an ordinal scale, indicating that the data were ordered and ranked. To obtain the odds ratios on ordinal regression and the likelihood chi-square ratio, the research used a generalized linear model on SPSS.

As seen in Table 6, the omnibus test shows a statistically significant result (.000 < 0.05), indicating that the model significantly improved fit over the null hypothesis.

Table 6. Omnibus Test

Likelihood Ratio Chi-Square	df	Significance
98.970	8	.000

The parameter estimates (Table 7) show that the statistically significant variables (p-value < .050) are Community Participation (CP) and Social Influence (SI). The variables that are not statistically significant are Social Norms (SN) and Socioeconomic Status (SES). Only CP and SI can be analyzed from the significance value result. On the parameter estimates table (Table 7), the odds ratios can be explained by the fact that the >1 odds ratio means an increasing probability of a higher dependent variable from every one-unit increase of the IVs. In addition, a <1 odd ratio means a decreasing probability of higher values from every one-unit increase on the IV. Furthermore, the parameter estimates from Table 7 show that the estimate on low-level community participation (Community participation=1) is -1.336, which means that people with low community participation have lower collective action than those with higher community participation. Furthermore, for (Community participation=2), the middle level of community participation shows an estimate of -.969, indicating that people with middle community participation will likely have lower collective action than those with higher community participation. The odds ratios in Community participation, .263 and .379, are on the low and middle levels, respectively. Thus, given that both odds ratios <1, the odds of increasing collective action will decrease if people have low community participation levels.

Social influence, as a significant predictor, indicates a -2.937 estimate on the low-level category (Social influence=1), which means that people with lower social influence have lower collective action than those with higher social influence. In addition, the middle-level category (Social influence=2) in Table 7 shows an estimate of -1.782, meaning that people with middle social influence tend to have lower collective action than people with higher social influence. Table 7 shows that the odds ratios of both low and middle levels of social influence were <1 (.053 and .168), which means that the odds of increasing collective action will decrease if the social influence on the people tends to be low. Thus, the ordinal regression analysis reveals that that the CP and SI variables have a significant impact on collective action in waste management.

Regression analysis aims to predict an outcome based on the relationship between the DV and IVs (Ali and Younas, 2021). Ordinal regression was used in the current study because the dependent variable was an ordinal scale suitable for regression analysis. The ordinal regression is based on the likelihood ratio test, not the Wald test. It has been argued that the Wald test has weaker statistical power than the likelihood ratio (Gudicha *et al*., 2017). The statistical analysis shows that CP, SI, SN, and SES can all influence collective action. However, the statistical analysis on ordinal regression showing the translation from SN and SES to collective action cannot be estimated.

Table 7. Parameter estimates

Parameter		Estimates	Standard Error	Hypothesis Test			Odds Ratio
				Wald Chi-Square	df	Significance	
Threshold	[Collective action=1]	-5.160	.5153	69.170	1	.000	.014
	[Collective action =2]	-1.550	.4019	8.965	1	.003	.300
[Community participation =1]		-1.336	.5558	5.782	1	.016	.263
[Community participation=2]		-.969	.4334	5.000	1	.025	.379
[Community participation=3]		0[a]	.	.	.	.	1
[Social influence=1]		-2.937	.6433	20.842	1	.000	.053
[Social influence =2]		-1.782	.5215	11.677	1	.001	.168
[Social influence =3]		0[a]	.	.	.	.	1
[Socioeconomic status =1]		-.249	.3658	.464	1	.496	.779
[Socioeconomic status =2]		.257	.4912	.274	1	.600	1.293
[Socioeconomic status =3]		0[a]	.	.	.	.	1
[Social norms=1]		-.477	.5566	.733	1	.392	.621
[Social norms=2]		-.146	.4773	.094	1	.760	.864
[Social norms=3]		0[a]	.	.	.	.	1
(Scale)		1[b]					

CP is one of the significant variables based on the result of ordinal regression. Previous studies support this result, indicating that involvement from urban residents also influences individuals' willingness to participate in waste management because urban residents tend to have apathy toward waste management problems if the government does not involve them in such efforts (Cobbinah *et al*., 2017). However, the collaboration between private and public sectors in decision-making is essential for improving education, leading to increased waste management participation (Dhokhikah *et al*., 2015; Ma and Hipel, 2016). Improving community participation can also be achieved by improving waste facilities that could improve the convenience of the public. The government must create regulations because the behaviors of others, moral obligations, and facilities affect the intention to separate waste (Wang *et al*., 2018). In comparison, community involvement is affected by many factors, such as satisfaction, better information, improved convenience in waste facilities, and better knowledge, which could improve participation in waste management (Xiao *et al*., 2017).

To change prevailing behaviors related to sorting waste and to influence the involvement of citizens, consumers, volunteers, and community organizations in waste management, maintaining trust between citizens and the government also requires policy consistency and commitment to facilitating public participation and cultural adaptation in other regions (Lu and Sidortsov, 2019). Other studies support this statement by arguing that improving participation can be achieved by providing better information, creating community regulations, and building better waste facilities to improve the convenience of waste management for citizens (Lawrence *et al*., 2020; Xiao *et al*., 2017). The convenience of waste management could improve participation by motivating and shaping individual behaviors.

Furthermore, incentives can contribute to participation in waste management by raising the financial motivation of individuals, which in turn leads to the involvement of communities. Economic incentives have contributed to changing the behaviors that encourage community participation in waste management (Wang *et al*., 2021). However, economic incentives in waste management must be carefully considered before they can be effectively implemented, because such incentives could also affect the continuity of participation.

Meanwhile, the ordinal regression results show that social influence is a significant variable in this study. Agovino *et al*. (2019), however, argued that social influence is like a double-edged sword that could have good and bad effects. Other studies have shown that social influence in improving participation in waste management tends to be more effective than incentive systems (Li *et al*., 2021). However, Xu *et al*. (2018) argued that economic inducement effectively promotes waste management and that combining social influence and economic incentives is one of the best strategies for improving collective action in waste management. Hence, given its importance, social influence must be considered to strengthen collective action in waste management. The present study also agrees with Agovino *et al*. (2019) that social influence can be a critical factor. However, various implementation strategies incorporating community participation and social influence must be considered to increase collective action.

Solid waste management in Indonesia is a complex issue, and the recent COVID-19 pandemic impacted waste management by worsening healthcare, waste management, and infectious waste generation (Singh *et al*., 2022). Harring *et al*. (2021) emphasized that the pandemic was closely related to collective action because it was part of the collective action problem. Therefore, the present study showed that the combination of community participation and social influence affected collective action in waste management during the COVID-19 pandemic. In this regard, strengthening and solving the collective action problem was crucial.

CONCLUSION

This study investigated the factors that improve collective action in tackling waste management issues in urban communities by examining the situation during the COVID-19 pandemic and incorporating several important variables as factors. The results showed that some variables were associated with collective action in waste management. Therefore, incorporating collective action can be a solution to tackling waste management issues. However, the regression analysis results showed that the only significant variables were CP and SI with odds ratios of .263 and .379 for CP variable and .053 and .168 for SI. Therefore, incorporating community participation and social influence can affect collective action in waste management. In addition, community participation and social influence could be the supporting factors when solving the collective action dilemma in waste management, especially those caused by the COVID-19 pandemic, which increased waste generation.

In accordance with the regression analysis results, the implications of this study show that the best practice for involving collective action to tackle waste management issues is incorporating community participation and social influence aspects. The government of Indonesia has implemented Government Regulation (*Peraturan Pemerintah*) Number 27 in 2020, which tackled waste management by encouraging people to separate their waste. However, this has been insufficient in encouraging the public to participate in waste management. Therefore, collective action incorporated with community participation and social influence—as proposed in this study—could be the best practice for reducing waste generation increased by the COVID-19 pandemic.

Furthermore, incorporating community participation and social influence could reduce the probability of a collective action dilemma that leads to inefficiencies in waste management. For this purpose, the government must implement a detailed program that could encourage people to participate in waste management, such as the empowerment of waste banks or socialization in schools. Such a program could lead to behavioral changes (e.g., avoiding littering) that benefit sustainability. For it to be effective, this program should involve many stakeholders, such as the local government and nongovernmental

organizations. At the same time, transparency and effective government policies are crucial in ensuring collective action in solving waste management issues.

Acknowledgements

Funding: This work was supported by the Hibah Publikasi Terindeks Internasional (PUTI) Q1 Directorate of Research and Development, Universitas Indonesia [grant numbers NKB-525/UN2.RST/HKP.05.00/2022].

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Received June 2023; accepted in revised form October 2023.