Jurnal Kesehatan Lingkungan
Journal of Environmental Health
Vol. 17 No. 3
DOI: 10.20473/jkl.v17i3.2025.277-286
ISSN: 1829 - 7285 | E-ISSN: 2040 - 881X
Journal Home Page: https://e-journal.unair.ac.id/JKL
ORIGINAL RESEARCH Open Access

A CASE STUDY OF WASTE BANK IMPLEMENTATION IN AN ELEMENTARY SCHOOL IN BONANG SUB-DISTRICT, DEMAK REGENCY

Sutan Sahala Muda Marpaung[1*], Kartika Ariswara[2], Yulizar Ihrami Rahmila[3], Varenna Faubiany[3], Mira Yulianti[3], Marwan Setiawan[3], Wawan Halwany[3], Hendris Syah Putra[4], Edgar Octoyuda[5], Bunga Resa Hartati[6]

[1]Department of Forestry, Politeknik Pertanian Negeri Kupang, Jl. Prof. Herman Johanes, Lasiana, Kupang, East Nusa Tenggara, 85011, Indonesia
[2]Master of Environmental Science, Postgraduate School, Diponegoro University, Semarang, Central Java, 50275, Indonesia
[3]Ecology and Ethnobiology Research Center, National Research and Innovation Agency, Cibinong, Bogor Regency, West Java, 16911, Indonesia
[4]Agribusiness Study Program, Satya Terra Bhinneka University, Medan, North Sumatra, 20128, Indonesia
[5]Digital Business Study Program, Satya Terra Bhinneka University, Medan, North Sumatra, 20128, Indonesia
[6]Departement of Forestry, Faculty of Agricultur, Palangka Raya University, Jl. Yos Sudarso, Palangka Raya, 73111, Indonesia

Corresponding Author:
*) marpaungsutan@gmail.com

Article Info

Submitted	: 20 April 2025
In reviewed	: 12 June 2025
Accepted	: 8 July 2025
Available Online	: 31 July 2025

Keywords : *Attitude, Knowledge, Perception, Student Behavior, Waste Management*

Published by *Faculty of Public Health Universitas Airlangga*

Abstract

Introduction: *The community's behavior, perceptions, and willingness to pay (WTP) are vital in forming and implementing integrated waste management. Thus, zero waste theory advocates the need for research on perceptions, behavior, and WTP for school waste management. This study analyzes school residents' perceptions, behavior, and WTP regarding waste management.* ***Methods:*** *This study used a mixed-methods sequential explanatory design, combining quantitative and qualitative approaches. The study was conducted at Betahwalang Public Elementary School, selected purposively due to its active waste bank program. A total of 86 students and 75 school community members were surveyed. Quantitative data were analyzed using crosstabs and the Contingent Valuation Method (CVM), while qualitative data were obtained through in-depth interviews with key stakeholders. Results and* ***Discussion:*** *This study used a mixed-methods sequential explanatory design. The research was conducted at Betahwalang Betahwalang Public Elementary School, purposively selected for its active school waste bank program. The variables measured included students' socio-economic characteristics, perception, environmental behavior, and willingness to pay for waste bank development. A total of 86 students and 75 school community members were surveyed. Data were analyzed using crosstabs and the Contingent Valuation Method, supported by qualitative insights from in-depth interviews.* ***Conclusion:*** *This study concludes that integrating environmental education through both formal and non-formal approaches effectively improves students' knowledge, perception, and behavior toward waste management. Furthermore, the school community shows strong support for waste bank development, as indicated by their willingness to pay. These findings highlight the importance of institutional synergy and continuous environmental education in promoting sustainable waste practices in schools.*

INTRODUCTION

Humans play a major role in environmental issues through their activities, which inevitably produce waste. In Indonesia, high population density and consumption levels have made waste management challenging. In 2016, waste generation reached 65.2 million tons per year, with a sharp increase from 0.64 kg/person/day in 2002 to 1.2 kg/person/day in 2012 (1–3). In addition, in 2019, the amount of waste generated in Central Java Province was 4,874,479.43 m³/day. Waste problems are one of the challenges that every city/regency in Indonesia must face, making it the focus of many studies (4–6). This is due to several factors, such as the large volume of waste, which causes the capacity of final disposal sites

Cite this as :
Marpaung SSM, Ariswara K, Rahmila YI, Faubiany V, Yulianti M, Setiawan M, et al. Waste Management Model Through the Waste Bank Program in the Primary Schools of Bonang Sub-district, Demak Regerency. *Jurnal Kesehatan Lingkungan*. 2025;17(3):277-286. https://doi.org/10.20473/jkl.v17i3.2025.277-286

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or landfills insufficient. Waste management is considered to have no positive impact on the environment, and there is a lack of government policy support, especially in the utilization of waste by-products, resulting in the accumulation of these products in landfills (7-8).

Waste management has been widely studied, including in Demak Regency, where high population growth contributes to increasing waste. According to SIPSN (2018), 8 tons/day of waste were unmanaged, and 30 tons/day were sent to landfills. From January to July 2019, landfill waste reached 63 tons/day. Continuous accumulation highlights the need for integrated waste management in both urban and rural areas.

One of the main aspects of urban waste management is the source of funding to improve services such as collection, processing, and final disposal, and this funding can come from waste fees (9-10). Waste management fees depend on the community's willingness to pay (WTP) for environmental services. WTP reflects how much individuals are willing to spend to improve the environment. Besides infrastructure, public knowledge, behavior, and awareness are key to successful waste management (11–13).

One effort to increase awareness in waste management is the government's requirement for provinces and cities/regencies to adopt the concept of a waste bank, including Central Java Province. This is supported by the issuance of the Minister of Environment and Forestry Regulation No. 13 of 2012 concerning Guidelines for the Implementation of Reduce, Reuse, and Recycle through Waste Banks. In addition to the Adiwiyata program implemented in schools, the Waste Bank program can also be used to foster environmental awareness in schools. The waste bank can also help students economically, meaning that with a waste bank, students can save the proceeds from selling waste to help cover educational expenses.

The results of observations at Betahwalang Elementary School, Karangrejo 2 Elementary School, Jatirogo Elementary School, Jatimulyo Elementary School, and Gebang 1 Elementary School in Demak Regency show that environmental education integrated with subjects has been taught, but many students still litter. In addition, it can be seen that the rivers around the schools are covered with waste, and there is scattered waste in the school environment. However, these schools have also developed waste banks, which are expected to contribute to the perception and behavior of students in managing waste. Based on these findings, it can be seen that waste management in these five elementary schools still has problems, especially in waste bank activities.

Therefore, information regarding students' perceptions and behaviors towards waste management and better waste management approaches is necessary to improve the waste bank's services and create a clean environment. In addition, waste banks can make students care about the environment and appreciate the value of non-organic waste. However, the school waste bank program still faces challenges regarding customer participation in collecting and depositing waste.

Meanwhile, based on the research there are differences in students' knowledge, attitudes, and behaviors in waste management before and after receiving socialization. This socialization includes knowledge and awareness of environmental issues and environmental literacy, which is also one way to improve attitudes, awareness, decision-making skills in environmental issues, environmental ethics, and participation in environmental conservation. However, some students still lack discipline in maintaining environmental cleanliness because the socialization and training provided have no follow-up (14–16). Waste management through school waste banks is less effective without environmental education. This research also proves that the environmental education process contributes to the socialization of waste banks in schools.

Furthermore, a study on willingness to pay for waste management services in the Nsukka urban area showed that demographic factors such as age, household size, and education significantly influence households' desire to demand waste management services in the metropolitan area of Nsukka (17-18). Awareness significantly influences the demand for waste management services, while home ownership does not significantly influence households' preferences and willingness to pay for waste management services.

Based on these factors, there are several objectives of this research, namely: Analyzing students' perceptions and behaviors regarding waste savings in schools; Analyzing willingness to pay to determine the maximum potential price that households are still willing to pay for the development of waste savings in schools; Analyzing the relationship of priority factors in waste management in schools.

METHODS

This research used a mixed methods approach with a sequential explanatory strategy. In this research, the first stage involved collecting and analyzing quantitative data to answer the first and second research questions: students' perceptions and behaviors

regarding waste savings in schools and willingness to pay to determine the potential price for developing waste savings in schools. Then, in the second stage, qualitative data were collected and analyzed to answer the third research question: the relationship of priority factors in school waste management. This research focuses mainly on quantitative data, and qualitative data is used to strengthen the quantitative data. This research was conducted at Betahwalang Elementary School in Bonang District, Demak Regency, which was chosen as the location to obtain data related to the research. This location was chosen because the school is located in a conservation village that has a significant waste problem, especially in the river area where the school is located.

The target population of student respondents to assess students' perceptions and behaviors regarding waste savings in schools is students enrolled in elementary schools in Bonang District, where the elementary schools have implemented waste savings programs, totaling 1,194 students. In this study, students were considered a distinct population group and were included as key respondents to assess perception and behavior toward waste management. While the overall study employed different sampling strategies, student respondents were selected purposively from SDN Betahwalang due to its active waste-saving program, making them relevant for representing behavioral outcomes in a targeted school context.

The target population of school community respondents to assess willingness to pay (WTP) for the development of school waste savings consisted of 75 individuals, including teachers, educators, staff, and canteen workers from five elementary schools in five different villages. The distribution of respondents across the villages is presented in Table 1 below.

The detailed distribution of student respondents, school community members, and expert informants across the five villages is presented in Table 2.

Table 1. Proportion of School Community Respondents by Village

Village / School	Number of Respondents	Proportion (%)
Betahwalang	20	26.7%
Karangrejo	15	20.0%
Jatirogo	14	18.7%
Jatimulyo	13	17.3%
Gebang	13	17.3%
Total	75	100%

Table 2. Distribution of Respondents by Village

Village	Student Respondents	School Community	Expert Respondents	Total Respondents
Betahwalang	86	20	1	107
Karangrejo	–	15	–	15
Jatirogo	–	14	–	14
Jatimulyo	–	13	1	14
Gebang	–	13	1	14
Total	86	75	3	164

Purposive sampling was used to select student respondents from SDN Betahwalang, which was chosen due to its active waste savings program, unlike the other four schools. The sample consisted of 86 student customers of the program: 28 from grade 3, 26 from grade 4, and 32 from grade 5.

The determination of school community respondent samples used a total sampling technique, where the sample size is equal to the population size of the school community, which is 75 people, consisting of teachers, staff, school employees, and canteen employees from 5 schools (Karangrejo 2 Public Elementary School, Jatirogo Public Elementary School, Gebang 1 Public Elementary School, Jatimulyo Public Elementary School, Betahwalang Public Elementary School).

The informants in this study were selected using a purposive sampling technique. The informants consisted of three elements: Academician (A), Government (G), and Community (C). The key informants chosen to represent these three elements were individuals with experience in waste banks and the environment.

The data collection method in this study was conducted through interviews assisted by questionnaires, observations, and literature review. This study used a mixed-methods approach. Quantitative data were analyzed descriptively using SPSS, focusing on the socio-economic characteristics of school community respondents and students' perceptions and behaviors

toward school waste management and waste savings, interpreted through cross-tabulation.

The analysis of the school community's willingness to pay (WTP) for school waste management through waste savings used the Contingent Valuation Method (CVM). The stages of the CVM method are as follows (4):

Creating Market Hypothesis

The development of a hypothetical market in this study was carried out by formulating the reasons behind respondents' willingness to pay (WTP), designing a structured questionnaire, and identifying relevant payment attributes. Although this study employed purposive sampling, limiting the statistical generalization of findings, the construction of a hypothetical market remains methodologically acceptable for capturing WTP values within a specific community context. non-probability samples are appropriate in contingent valuation studies focused on case-specific or policy-relevant populations, provided that generalization limitations are acknowledged. Field observations were also conducted to ensure that respondents understood the context of waste management services offered by the school waste bank program (20-21).

Obtaining Auction Values (Bids)

These values are obtained using the bidding game format technique, which involves asking closed-ended questions where respondents are asked if they are willing to pay a certain amount of money proposed as a starting point, with dichotomous choice or dichotomous valuation options, yes or no, or agree or disagree.

Calculating Average WTP

After obtaining the auction values, the next step is to calculate each individual's average WTP value. The calculation of the estimated average WTP value of respondents is determined using the following formula:

$$EWTP = \frac{\sum_{i=1}^{n} Wi}{n}$$

Description:
EWTP: Average estimated value of WTP
Wi : Lower limit of class i
n : *Number of classes*
i : *Sample (1,2, ... n)*

Estimating the WTP Auction Curve (Bid Curve)

The WTP auction curve depicts the relationship between the WTP value and the number of respondents, obtained by regressing the WTP value as the dependent variable with several independent variables using Microsoft Excel 2010 software with the formula:

WTP = f (age, gender, education level, occupation, income level, marital status). The graph explains the individual WTP level and the number of respondents willing to pay at that WTP level.

Aggregating Data

The next step is to combine data from the average bids into the total population value. This stage is obtained by multiplying the sample mean by the population size to get the total WTP.

$$TWTP = \sum_{t=0}^{n} WTPi \; ni$$

Description:
TWTP : Total WTP
WTPi : Individual WTP of sample i
ni : Number of sample i willing to pay
Wi : Sample (1,2, ... n)

Cross-tabulation

Cross-tabulation is done to see or explain the public's responses to WTP based on respondent characteristics, satisfaction, and knowledge levels. Cross-tabulation is an analysis that presents data in the form of tables and is presented in nominal or categorical periodic data.

Qualitative analysis is done using the In-depth Interview method and criteria encoding. After qualitative data is collected through In-depth Interviews, the data is processed by checking the accuracy of the data, organizing the data, conducting encoding, classifying the data, and correcting unclear interview answers (17). Then, to analyze the qualitative data in this study, computer applications are used to assist in data processing for various encodings as explained above and to build relationships between concepts using networking processes. Various computer applications can be used, but Atlas Ti 8 is used in this study.

RESULTS

Students Perception

This study explores students' perceptions of waste savings programs, including school cleanliness, waste reduction, facility completeness, service quality, registration ease, socialization, and operational fees. Perceptions are measured on a 1–5 scale, from strongly disagree (1) to strongly agree (5). The distribution is presented in the following diagram:

For the statement "The school environment is already clean," 45 students strongly agreed, with none disagreeing. Relatedly, 55.8% agreed and 34.8% strongly

agreed that "The amount of waste has decreased since the implementation of waste savings." This suggests students perceive a cleaner environment due to the program. Additionally, over 50% agreed with statements on service quality, indicating high student satisfaction with waste savings services.

Regarding the need for socialization of school waste savings, 55.8% of students agreed and 43% strongly agreed. This highlights the importance of regular outreach to students and waste-saving participants. According to the central waste bank chairman, socialization should occur at least twice before starting the program and continue twice a month thereafter. This is based on the results of the (22–24), which states that socialization must be done more to improve perceptions of sustainable waste management.

Student Behavior

Student behavior toward waste savings is assessed through variables of knowledge and environmental attitudes. Environmental behavior is reflected in students' knowledge, awareness, and attitudes. The results on students' knowledge levels are shown in the following diagram:

The knowledge level of Betahwalang Public Elementary School students on waste management is considered good, with an average score of 56.1%. However, most students struggled with three questions on waste-related issues, such as causes of waste problems, non-degradable waste, and organic waste processing. This is likely due to limited socialization and guidance on waste management at school, home, or through the waste savings program. Environmental education at home can influence students' environmental knowledge. In addition, several factors also affect the level of students' environmental knowledge, such as gender (25–28). the level of environmental knowledge of female students is higher than that of male students (15,29).

Also, the higher the parents' income, the higher the students' environmental knowledge level (30-31). Environmental knowledge is also influenced by age. The older someone is, the more they know about the environment. It is further explained that the older someone is, the wiser they are compared to younger people regarding knowledge, attitudes, and environmental participation (32-33).

In addition to students' environmental knowledge, environmental attitudes are essential predictors of environmental behavior (34-35). In this study, students' environmental attitudes were measured using five indicators. Students were asked for their opinions, ranging from strongly agree to disagree strongly. The more they agree with the statement, the higher the students' intention to implement sustainable waste management behavior.

Overall, the environmental attitudes of Betahwalang Public Elementary School students are good, as can be seen from the number of students who answered strongly agree and agree. In addition to knowledge, attitudes are believed to influence behavior/ actions. Several factors, including gender, influence environmental attitudes. Female students have better attitudes towards their environment compared to male students (36-37). In addition, social interaction allows for mutual relationships that influence each other. Students have high attitudes because the social environment around them, especially the school environment, has a high environmental attitude, and students have positive personal experiences regarding environmental care (38).

Educational institutions also influence students' attitudes, where academic institutions, in terms of environmental care, must support and facilitate students to be environmentally friendly. As observed in the field, schools encourage students by providing waste bins according to their types, integrating environmental education into subjects, and involving students in environmentally friendly activities such as creating crafts from non-organic waste, so that students are accustomed to being environmentally friendly.

Based on the level of environmental knowledge and attitudes of students, it can be said that students also have good environmental behavior, where the more positive someone's attitude towards waste management, the better their behavior in managing waste (39). This statement is supported by the research findings of (40), Stating that attitude has a significant impact on recycling behavior. The same results were also reported by (41), That attitude is significantly related to the intention to purchase environmentally friendly products. These findings are in line with the assumptions of the theory of planned behavior (42) That attitude is a determinant factor of intention. In addition, communication and educational efforts to increase knowledge about issues related to environmental concern have been effective in encouraging good behavioral disposition towards the environment (26). This means that student behavior is formed not only through formal education at school but also by the family and the surrounding community in shaping student behavior in waste management.

Willingness to Pay Analysis

This study found that 90% of school residents,

including teachers, staff, and canteen workers, were willing to pay more to support school waste savings. The amount varied due to differences in age, income, education, and marital status.

Female respondents showed greater willingness to pay than males. Both tended to choose the highest offer due to the completeness of the proposed facilities. Gender-based differences in offer selection align with previous studies indicating that willingness to pay for waste management is influenced by gender.

The results obtained from respondents with an income category of more than IDR 5,500,000, where all respondents chose the highest offer value. This is in line with economic theory, which argues that high-income households are more willing to pay for waste management services (43). These results contradict where income shows a negative relationship with WTP, thus increasing income does not necessarily increase WTP for waste management (44).

Respondents with a bachelor's degree as their highest education level are more dominant in choosing the highest offer value, with 41 respondents (73.2%). Meanwhile, respondents with junior high school and high school education tend to select the lowest offer value, and no respondents prefer the highest offer value. Similar to the findings of (45) it shows that the higher the respondents' environmental knowledge, the higher the WTP for waste management, although statistically insignificant, the coefficient value can be explained. Education level is a key factor in determining willingness to pay for waste management services (12). This is consistent with other studies exploring the relationship between education level and WTP, where it is found that education level positively affects WTP. Respondents with higher education (92.3%) pay more than less educated respondents (46).

Most respondents chose the highest bid of IDR 31,200, which was selected by 48 respondents (64%). Based on the calculation of the average value of respondents, the average WTP value of respondents is IDR 24,523, which is then rounded to IDR 24,500. The average WTP value of respondents can be used to determine the amount of waste savings development costs in schools that are charged to school residents, such as teachers, educators, canteen employees, and school employees, to support waste savings development efforts in schools. The formation and development of waste banks cannot be done properly if only students do it, but it requires synergy and participation from the school community. This average WTP value is paid regularly.

The total WTP value obtained in waste savings development efforts is IDR 1,837,500. This total WTP value will be used to develop and maintain school waste savings.

Factor Priority Analysis (Atlas TI)

After analyzing the Willingness to Pay (WTP) value of students as well as waste savings account holders related to waste savings development efforts in schools, the next step is to analyze the conditions and problems of waste bank activities along with their solutions that can be considered in waste savings development efforts in schools through in-depth interviews with relevant stakeholders.

The relationship between the criteria factors obtained after conducting in-depth interviews with stakeholders shows that schools and students have independently sorted waste as an initial step in waste management, and the waste savings activities carried out are pretty effective in reducing waste. In addition, it can be seen that there are several problems in waste savings activities, namely the lack of complete waste savings facilities, the lack of guidance in managing organic waste, and the lack of socialization about waste savings activities, resulting in many students being unaware of the waste savings mechanism and the benefits of waste savings. The solutions to these problems obtained from interview data with informants and then reinforced by the relationships of the marked codes and quotations are as follows:

Adding Waste Savings Facilities in Schools

One of the solutions in waste savings development efforts is to add waste savings facilities to improve the comfort and enthusiasm of students in saving waste. School residents can collaborate with the leading waste bank to determine the development plans that will be carried out to improve waste management facilities in schools. With the improvement of waste savings facilities, customer satisfaction will also increase. In addition, with proper facilities, students will be more interested in saving waste, resulting in a reduction in waste generation, and students can also experience the economic value of the waste, where the money from selling the waste can be used for students' educational expenses.

Providing Guidance for Managing Organic Waste

In addition to inorganic waste, organic waste can also be utilized to generate economic value. Therefore, guidance in managing organic waste is considered necessary. Guidance can be provided by conducting composting activities together, and can be assisted by members of the central waste bank. In addition, the

Environmental Agency can provide counseling related to composting in schools. The compost produced by students can be used as fertilizer for school gardens or can be sold.

Providing Socialization to Customers and Students

Socialization to customers and students about waste savings activities also plays an essential role in implementing waste savings, where the socialization includes explanations of waste management-related materials such as the mechanism of saving waste, how to sort waste, how to weigh and record the collected waste, and the benefits of saving waste. The school can seek assistance from the central waste bank to provide socialization. Socialization is given at specific times and carried out continuously so that waste savings activities can run properly.

School Community Synergy in Waste Management.

Waste savings will not succeed if done by only one party, but it requires synergy with several other parties, such as educators, teachers, students, and parents. This synergy is essential for smoothly developing and implementing waste savings in schools. Therefore, the synergy of school residents needs to be improved so that school waste savings can be even better. With the support of parents, students will be more confident in collecting and saving waste.

DISCUSSION

Research on waste management through the waste bank program at Betahwalang Public Elementary School, Bonang District, shows that students' perceptions and behaviors towards waste management are good, supported by positive environmental knowledge and attitudes from formal and non-formal education. Most school residents (90%) are willing to pay (WTP) an additional average of IDR 24,500 to develop waste bank facilities. However, there are differences based on age, income, education, and marital status.

Notably, female respondents showed a greater willingness to pay compared to males, which may be influenced by higher environmental awareness or a stronger sense of care for school cleanliness. These findings contrast with the study, which reported that gender did not significantly influence willingness to pay for waste management services (41). This difference may be due to the context of the study area, the role of women in household or school environmental management, or local cultural dynamics.

Respondents with higher income levels also tended to choose the highest WTP bid, which is consistent with classical economic theory stating that households with greater financial capacity are more likely to contribute to environmental services (42). However, this result differs from the findings of Massoud et al. (43), who observed a negative correlation between income and WTP for waste services. The divergence may stem from differences in socio-economic context, perceived urgency of waste issues, or institutional trust in how contributions are managed.

In terms of education level, respondents with a bachelor's degree or higher were more likely to select the highest WTP value. This trend aligns with previous studies showing that education plays a significant role in shaping environmental awareness and pro-environmental behaviors. For instance, study found a positive, although statistically insignificant, correlation between environmental knowledge and WTP (44). Similarly, education level is a key determinant of WTP for waste services (12). Another study also reported that 92.3% of respondents with higher education levels were more likely to pay than those with lower educational backgrounds (45). These findings reinforce the importance of educational attainment in influencing environmental values and the willingness to financially support sustainable waste management initiatives.

Although the condition of waste management at this school is quite good, challenges still exist, such as lack of facilities, organic waste management, and socialization of the waste bank program. These challenges are addressed through the provision of additional infrastructure, training on organic waste processing, regular awareness campaigns, and strengthening the synergy among school community members.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the support of Riset dan Inovasi untuk Indonesia Maju (RIIM)-Prioritas Riset Nasional. Special thanks to Rumah Program Organisasi Hayati dan Lingkungan and Rumah Program Organisasi Penerbangan Antariksa under BRIN for their essential contributions, which greatly facilitated the completion of this research.

CONCLUSION

The perception and behavior of students at Betahwalang Public Elementary School are already quite good. Students have good environmental knowledge and attitudes obtained from formal and non-formal socialization and learning that indirectly influence students' behavior towards waste management. This means that students' behavior can be formed not only

through formal education at school but also through the family and the surrounding community in shaping students' behavior in waste management.Out of 75 respondents, only seven were unwilling to pay because the respondents felt that the existing waste management was already good enough, so there was no need for further development efforts. The chosen bid value by the respondents varied because each respondent had different backgrounds, such as age, income, level of education, and marital status, which can affect a person's willingness to pay. Most respondents chose a bid value of IDR 31,200, 48 respondents (64%).

The waste management conditions at Betahwalang Public Elementary School are already quite good because students are directly involved in sorting waste, and there is an effective waste bank in reducing waste generation at school. However, there are still some problems, such as incomplete waste savings facilities, a lack of organic waste management, and a lack of socialization related to waste savings. The conclusions from interviews with informants obtained several solutions, namely by adding waste savings facilities such as waste warehouses, digital scales, composters, and others, improving school residents' synergy, and conducting regular socialization and coaching.

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