Jurnal Presipitasi
Media Komunikasi dan Pengembangan Teknik Lingkungan
e-ISSN: 2550-0023

Vol 21, No 3, 2024, 793-801
Article available at homepage presipitasi

Regional Case Study

Effectiveness and Efficiency of Waste Banks in Ambarawa District Semarang Regency in 2023

Dony Ariyadi[1*], Arum Siwiendrayanti[1]
[1] Building A Postgraduate Campus, Universitas Negeri Semarang, Jalan Kelud Utara III, Gajahmungkur, Semarang, Central Java
*Corresponding Author, email: donyariyadi@students.unnes.ac.id

Abstract
Ambarawa District, which is one of the districts with the highest density in Semarang Regency, experiences waste problems. Based on the official website of the Semarang Regency Environmental Agency, there are 10 active waste banks spread throughout Ambarawa District, including Acil, Rengas Asri, Mawar Asri, Mukti Bareng, Tegal Asri, Projo, Sari Asri, Tanjung Asri, Bina Lingkungan, and Bina Mandiri. The type of research used in this study was a case study based on quantitative data with a descriptive approach. Data analysis in this study uses the calculation of the Overall Equipment Effectiveness (OEE) equation and elasticity index. Based on the results obtained, 10 waste banks are located in Ambarawa District. The overall waste bank at OEE is less than 60%, and the elasticity index value is less than 1, which indicates that the effectiveness and efficiency of waste banks in Ambarawa District are low. In addition, the performance of waste banks in Ambarawa District is relatively low.

Keywords: Effectiveness, efficiency, waste bank, waste bank performance, community, waste

1. Introduction

The growing population contributes to an increase in waste volume. Semarang Regency is one of the most populated districts, with a population in 2021 of 1,059,844. This is based on the 2020–2023 interim population projection by BPS. The population density of Semarang Regency is 10.40 people per km² (Rosiyanti, Yeni, 2022). Some of the districts that have the largest density are Ambarawa District, West Ungaran District, and Bergas District, with each population density reaching 2,147 people per km², 1,667 people per km2, and 1,666 people per km2. The population density indicates economic growth in the area. To support economic growth, an increase in population consumption is inevitable. An increase in population consumption eventually results in an increased volume of waste (Gunartin, 2019). Efforts to handle waste in densely populated areas are still underway by local governments (Husen et al., 2021). To overcome this problem, it is necessary to drive the construction of waste banks in each region. Waste banks have significant benefits for the community (Guntoro et al., 2021).

Directly, waste banks can help reduce the amount of waste dumped into the environment (Munandar et al., 2020). By collecting and sorting waste, waste banks can reduce the risk of environmental pollution and the spread of disease (Setyaningrum, 2018). Poorly managed litter can become a hotbed for bacteria, viruses, and other pathogenic organisms. With the existence of waste banks, waste can be managed properly, thereby reducing the possibility of disease spread. These diseases include intestinal worms, dermatitis, and diarrhea (Sibua et al., 2023).

In addition, waste banks can reduce the negative impact of waste-burning activities (Fitriansyah et al., 2023). Uncontrolled incineration of garbage can cause air pollution, which is harmful to human health. By collecting organic and non-organic waste separately, waste banks can encourage more

environmentally friendly waste management practices and reduce pollutant emissions (Darmawan et al., 2019).

In addition to direct benefits, waste banks also have an indirect impact on public health. By promoting awareness of the importance of good waste management, waste banks can help educate the public about the importance of maintaining environmental cleanliness and health (Saputro et al., 2015). This can encourage the adoption of healthy living behaviors, such as maintaining personal hygiene, implementing good sanitation practices, and reducing the risk of environment-related diseases (Rosmala et al., 2019). However, it is important to remember that these waste banks must operate properly and comply with established hygiene and safety standards. Garbage banks that are not managed properly or are too close to residential areas can result in health problems such as unpleasant odors, the spread of pests, and an increased risk of disease (Putri et al., 2018).

Registered with the Indonesian Ministry of Environment, there are 9,915 unit waste banks. Waste accounted for as much as 12 million tons, while managed waste accounted for only 120 thousand tons in 2022. In Central Java, 1.2 million tons of waste went into the waste bank, with 37 thousand tons of managed waste in the same year. For Semarang Regency alone, there are 15 tons of incoming waste and 14 tons of managed waste (Indonesian Ministry of Environment, 2022). This raises some questions: Why is the waste that enters the waste bank not properly managed? Are waste banks in Indonesia ineffective and efficient in waste management?

This study uses the same method as Meidiana (2019) regarding the effectiveness and efficiency of waste banks. However, the difference is the location of the study. Research from Meidiana (2019) is located in Surabaya, with the Main Waste Bank as a research topic. Meanwhile, this study is located in Ambarawa District, Semarang Regency, with a discussion of unit waste banks that will be known for their effectiveness and efficiency. In addition, this study uses nine waste banks that will be known for their effectiveness and efficiency. Meanwhile, in Meidiana's research (2019), there is only one waste bank, namely the main waste bank. To date, no research has been conducted on waste banks in the Ambarawa sub-district. So, this research is relatively new and based on research from other cities by adding several waste banks.This study uses the same method as Meidiana (2019) regarding the effectiveness and efficiency of waste banks. However, the difference is the location of the study. Research from Meidiana (2019) is located in Surabaya, with the Main Waste Bank as a research topic. Meanwhile, this study is located in Ambarawa District, Semarang Regency, with a discussion of unit waste banks that will be known for their effectiveness and efficiency. In addition, this study uses nine waste banks that will be known for their effectiveness and efficiency. Meanwhile, in Meidiana's research (2019), there is only one waste bank, namely the main waste bank. To date, no research has been conducted on waste banks in the Ambarawa sub-district. So, this research is relatively new and based on research from other cities by adding several waste banks.

The waste problem is still increasing, and Ambarawa District still has another problem, namely the low public view of waste (Yuliana et al., 2018). The low view of the community towards this waste results in people being indifferent to the garbage that accumulates around them (Rahman et al., 2020). Therefore, it needs principles built to change negative things in a more positive direction, like the 3 Rs (reuse, reduce, and recycle). Based on Environmental Regulation No. 13 of 2012, 3R activities can reduce waste, reuse waste, and process waste into new products (Ghandi et al., 2023). 3R activities in waste banks are intended to manage household waste into more economical goods (Adiatmika et al., 2022). In Ambarawa sub-district alone, there are 10 waste banks that are active in handling household waste.

Another problem that requires attention is the occurrence of the COVID-19 pandemic, which has resulted in almost all activities experiencing obstacles (Tripathi et al., 2020). Waste banks were also affected by this pandemic owing to the implementation of PPKM in Ambarawa District from 2020 to 2021. This resulted in no customers depositing their waste in April 2020–July 2020. The absence of customers who deposit waste affects the value of marginal products of customers and the average customer of the Waste Bank in Ambarawa District, which can be further analyzed by analyzing the elasticity of the waste

bank to determine the efficiency of the waste bank. After the efficiency of the waste bank is assessed, recommendations will be produced to solve the problem.

Meanwhile, for its special purpose, it is to determine the value of the effectiveness and efficiency of each waste bank in Ambarawa District in order to improve the quality of waste banks in Ambarawa District in order to maintain a better quality of the environment by reducing waste at the community level by depositing waste into the waste bank.

According to Meidiana (2022), the number of daily active customers will affect the effectiveness of the waste bank because, in one operation, only a few deposit their waste into the waste bank (Meidiana et al., 2022). Based on the effectiveness assessment in Meidiana's research (2022), there are three important components in assessing the effectiveness of waste banks, namely availability, performance, and quality. Meanwhile, to assess efficiency, there are two important components, namely the value of waste bank products and the average product of waste banks. Referring to the study, the waste bank in Ambarawa District has not undergone research to find out whether it is effective and efficient. Therefore, this research must be conducted to address this problem. The results of this study will provide recommendations so that the Waste Bank in Ambarawa District can use them in making decisions (Wahanani et al., 2020).

2. Methods

The type of research used in this study was a case study based on quantitative data with a descriptive approach. The quantitative descriptive approach is a research approach that involves collecting data sourced from interviews, field notes, video tapes, photos, notes, personal documentation, memos, and other data. Then, the data were calculated using equations related to the study.

This research was conducted in the Ambarawa District, Semarang Regency. This study was conducted between September and October, 2023. Based on the official website of the Semarang Regency Environmental Agency, there are 10 active waste banks spread throughout Ambarawa District, including Acil, Rengas Asri, Mawar Asri, Mukti Bareng, Tegal Asri, Projo, Sari Asri, Tanjung Asri, Bina Lingkungan, and Bina Mandiri.

This study uses a questionnaire to gather data from participants from 10 waste bank administrators in each waste bank in Ambarawa District. The questionnaire questions are in the form of active customer data, income per opening, waste bank operational time, planned waste bank program, waste bank opening time (opening/year), planned waste bank opening time (opening/year), ideal time to be allocated to the waste bank program (minutes), waste bank opening time (minutes), the number of overall waste bank programs, the number of programs that have been run, and according to the expectations of the management, the total number of programs over a certain period of time (1 year).

The data analysis techniques used in this study use content analysis, namely, by analyzing the data obtained. In this case, the data is in the form of waste bank operational time, active customers of the waste bank, and the amount of income per opening. The data were then calculated using the Overall Equipment Effectiveness (OEE) equation, as shown in equation (1):

$$OEE = Availability \times Performance \times Quality \quad (1)$$

Availability consists of the opening time of the waste bank (opening/year) and the planned opening time of the waste bank (opening/year). Performance is influenced by the ideal time to be allocated to the waste bank program (minutes), the opening time of the waste bank (minutes), and the number of overall waste bank programs. Quality consists of a waste bank program. Based on the results of OEE calculations, the percentage of OEE value shows the effectiveness of waste banks at the research location (Suwardiyanto et al., 2020). The results of the OEE calculation are interpreted into the range of waste bank effectiveness levels to determine the level of waste bank effectiveness, as shown in Table 1 below:

Table 1. Range of waste bank effectiveness value

OEE value	Effectiveness Rate	Information
100%	High	The system is considered perfect
85%≤ OEE<100%	High	Value is used as a goal in most waste banks
60%≤ OEE<85%	Medium	Normal system, upgradeable
40% ≤ OEE<60%	Low	Low, but upgradeable
OEE< 40%	Low	Hard to upgrade

Source: Meidana (2019)

Efficiency is calculated using the elasticity equation. The elasticity value is the comparison of the average marginal product (MPN) with the average customer product (APN), following the equation (2):

$$E = \frac{MPN}{APN} \quad (2)$$

Waste bank efficiency includes the value of the customer's marginal product (MPN) and the average customer product (APN). The customer's marginal product value is influenced by the income value of each opening. Meanwhile, the average customer product is influenced by the income value of each opening and the number of active customers per opening. After knowing the elasticity index value, it will then be classified into the efficiency level of the waste bank along with the interpretation of the efficiency level of the waste bank as in Table 2 below:

Table 2. Range of waste bank efficiency value

Elasticity Value	Efficiency Rate	Information
>1	High	Waste banks have a larger output, so the average productivity of customers increases
=1	Medium	Customer productivity is constant, so it needs to be maintained
<1	Low	Customers need to be empowered again, in order to increase productivity in the waste bank program

Source: Meidana (2019)

To determine whether the waste bank is running well, here is a matrix of the relationship between effectiveness and efficiency:

Table 3. Waste bank performance matrix

Effectiveness / Efficiency	High Efficiency	Medium Efficiency	Low Efficiency
High Effectiveness	High Performance	High Performance	Medium Performance
Medium Effectiveness	High Performance	Medium Performance	Low Performance
Low Effectiveness	Medium Performance	Low Performance	Low Performance

Source: Meidana (2019)

3. Result and Discussion

3.1. Research Site Overview

Ambarawa District itself, which is one of the districts with the highest density in Semarang Regency, certainly experiences waste problems (Rosa, 2021). In 2018, the household landfill reached 106,310.85 liters per day, with a population of 62,025 people (Saefudin, 2018). This assumption is that in

one week, the volume of waste in Ambarawa District reaches 744,175.95 liters per week, while the existing TPS capacity is only able to accommodate 130,000 liters of waste per week. Based on the official website of the Semarang Regency Environmental Agency, there are 11 active waste banks spread throughout Ambarawa District, including Acil, Rengas Asri, Mawar Asri, Mukti Bareng, Tegal Asri, Projo, Sari Asri, Tanjung Asri, Bina Lingkungan, and Bina Mandiri (Semarang Regency Environment Agency, 2023). The following is the status of the waste bank and the number of customers from the waste bank in Ambarawa District:

Table 4. Number of waste bank customers in Ambarawa District

Waste Bank	Number of Customers	Number of families	Status
Tegal Asri	20	667	Active
Rengas Asri	82	156	Active
Mawar Asri	55	1090	Semi-Active
Mukti Bareng	20	517	Semi-Active
Projo	20	669	Semi-Active
Sari Asri	20	153	Active
Tanjung Asri	20	27	Active
Bina Lingkungan	50	190	Semi-Active
Bina Mandiri	8	167	Active
Acil	52	226	Active

Source: BPS Semarang Regency (2023)

3.2. Effectiveness of Waste Banks

The effectiveness of this waste bank uses the overall OEE equipment effectiveness equation, which focuses on quantity, quality, and time. There are 3 parameters that affect the OEE value, namely availability, performance, and quality. Table 5 shows the results from the calculation of the OEE value from the waste bank of the Ambarawa sub-district.

Table 5. Results of OEE calculation of waste bank in Ambarawa District

Waste Bank	A	P	Q	OEE	Effectiveness
Tegal Asri	100%	20%	100%	20%	Low
Rengas Asri	100%	43%	100%	43%	Low
Mawar Asri	100%	34%	86%	29%	Low
Mukti Bareng	92%	10%	100%	9%	Low
Projo	100%	19%	71%	13%	Low
Sari Asri	100%	23%	100%	23%	Low
Tanjung Asri	96%	15%	86%	13%	Low
Bina Lingkungan	100%	49%	100%	49%	Low
Bina Mandiri	100%	15%	71%	11%	Low
Acil	100%	49%	100%	49%	Low

Source: Individual calculation results

Based on Table 5, in the waste banks of Tegal Asri (20%), Mawar Asri (29%), Mukti Bareng (9%), Projo (13%), Sari Asri (23%), Tanjung Asri (13%), and Bina Mandiri (11%), the effectiveness of waste banks in Ambarawa District is at a low value (OEE < 40%), which category is difficult to develop into more advanced waste banks. This is influenced by the performance (P) parameter, which is less than the value of 40%. If the performance (P) is higher than 40%, then it affects the result of the OEE. This value is influenced by the small number of customers who want to deposit their waste into the waste bank. In addition, the length of opening time in one opening also affects the performance value of the waste bank.

Most of the waste banks with variable availability (A) have reached 100%; this indicates that the availability of waste banks for serving customers is fully open. On average, waste banks in Ambarawa District are open every 5 working days, or as many as 260 openings. However, if there are customers who want to distribute their waste outside of the day, they must contact the waste bank management directly.

In the quality variable (Q), most of them have touched 100%. However, there are several waste banks that are still below 100%, namely Mawar Asri waste banks (86%), Projo (71%), Tanjung Asri (86%), and Bina Mandiri (71%). The waste bank in the variable quality (Q) is quite good; it has exceeded 50%. The factors affecting the value of quality (Q) are the programs run by the waste bank. Most waste banks in Ambarawa sub-district have implemented pre-planned programs. However, some programs are considered difficult to implement because of limited resources.

Based on Table 5, there are waste banks with low effectiveness that can be further improved, namely Rengas Asri, Bina Lingkungan, and Acil. This was because the OEE value was greater than 40%. The performance value of the three waste banks is also greater than 40%, which indicates that the opening time and active customers of each opening are more optimal than those of other waste banks in Ambarawa District. In addition, the availability and quality parameters cause the OEE value to be higher than the others, both of which are at 100%. In terms of availability, the three waste banks opened as planned. This resulted in an availability of 100%. The quality parameter is influenced by the presence or absence of programs implemented by the waste bank. The more programs implemented, the higher the quality value of a waste bank. The three waste banks ran the program as planned before. This resulted in a quality value of 100%.

3.3 Efficiency of Waste Bank in Ambarawa District

The efficiency of waste banks in Ambarawa District was measured by calculating the elasticity index. The measurement is used to determine the economic efficiency value generated from each waste bank. Waste bank efficiency data are obtained from secondary and primary data on waste bank financial statements and customer data that deposit waste at each opening.

Table 6. Efficiency of waste bank in Ambarawa District

Waste Bank	Elasticity Index	Efficiency
Tegal Asri	0.45	Low
Rengas Asri	0.67	Low
Mawar Asri	0.35	Low
Mukti Bareng	0.03	Low
Projo	0.01	Low
Sari Asri	0.03	Low
Tanjung Asri	0.02	Low
Bina Lingkungan	0.34	Low
Bina Mandiri	0.07	Low
Acil	0.56	Low

Source: Individual calculation results

Based on Table 6, all waste banks in Ambarawa District have low efficiency, with an elasticity index of less than 1. This can be due to two factors from the elasticity index equation, namely the financial statements of waste banks and the number of active waste banks for each waste deposit. Both factors are unstable, such as ups and downs every month; sometimes active customers decrease every month, or the amount of income decreases every month (Triana et al., 2019).

Based on the calculation results in Table 6, all waste banks have a value of <1, which indicates that customers need to improve their participation in the waste bank. However, there are several waste banks that are almost close to 1, namely the Tegal Asri, Rengas Asri, and Acil waste banks. Based on the elasticity

equation (2), the three waste banks have a higher MPN value than other waste banks, where MPN is the average of the total monthly income of waste banks per average of the number of customers who submit their waste to the waste bank. This means that the three waste banks are more active than other waste banks in Ambarawa District.

3.4 Performance of Waste Bank in Ambarawa District

The performance of waste banks can be seen by comparing their level of efficiency and effectiveness. In the three waste banks, the level of efficiency and effectiveness has been calculated so that an assessment of the level of performance of the waste bank can be carried out. The performance of the waste bank in Ambarawa District is as follows:

Table 7. Performance of waste banks in Ambarawa District

Waste Bank	Effectiveness	Efficiency	Performance
Tegal Asri	Low	Low	Low
Rengas Asri	Low	Low	Low
Mawar Asri	Low	Low	Low
Mukti Bareng	Low	Low	Low
Projo	Low	Low	Low
Sari Asri	Low	Low	Low
Tanjung Asri	Low	Low	Low
Bina Lingkungan	Low	Low	Low
Bina Mandiri	Low	Low	Low
Acil	Low	Low	Low

Source: Individual analysis results

Based on Table 3, which shows the performance of the waste bank, a cross was made between the values of effectiveness and efficiency, and then a new value was obtained, called the performance of the waste bank. Table 5 shows that the effectiveness of all waste banks in Ambarawa District is still in the low category. In Table 6, the efficiency of all waste banks in Ambarawa District is still in the low category. The two variables were then crossed, and the results are shown in Table 7. In Table 7, the performance of all waste banks is in the low category. This is because the effectiveness and efficiency of waste banks are also in the low category. Low effectiveness and efficiency are caused by several factors. Based on the above discussion, the factors that make effectiveness and efficiency low are low levels of community participation, unimplemented waste bank programs, and low levels of waste bank income.

Based on field observations, the performance of some waste banks in Ambarawa District is in the low category, as shown in Table 7. This is due to the lack of customers who distribute their waste to the nearest waste bank. Based on simple interviews with residents around the waste bank, residents tend to throw their garbage into the trash can without being processed first; the waste is then picked up by mobile garbage men and then thrown into the Blondo landfill. In addition, some communities prefer garbage collectors compared to waste banks because distributing waste to collectors tends to have a higher price compared to waste banks in Ambarawa District. However, there is a waste bank that is at medium performance, namely the Acil waste bank. Waste banks are always active in serving customers who want to distribute their waste. Each opening also has enough customers who want to distribute their waste, and the number of customers tends to remain at each opening. In addition, programs are conducted annually. Therefore, waste banks need to be improved in terms of management, accessibility, member recruitment, and socialization to reduce waste in Ambarawa District. In addition, there is a need for the government to improve the performance of waste banks in Ambarawa District (Masruroh 2021).

4. Conclusions

Based on the discussion above, there are 10 waste banks located in Ambarawa District. The overall waste bank at OEE is less than 60%, and the elasticity index value is less than 1, which indicates that the effectiveness and efficiency of waste banks in Ambarawa District are low. In addition, the performance of waste banks in Ambarawa District is relatively low. This can be influenced by operational time, operating time per opening, active customers, active waste bank programs, and the income value of each opening. Based on field observations, the performance of some waste banks in Ambarawa District is in the low category. However, there is a waste bank that is at medium performance, namely the Acil waste bank.

References

Adiatmika, I.W.W. and Nain, U., 2022. Community empowerment in waste management through waste bank program in Tabanan Regency. Journal of Asian Multicultural Research for Social Sciences Study, 3(4), pp.17–31.

Darmawan, B. and Tahyudin, D., 2019. Partisipasi masyarakat dalam pengelolaan sampah di bank sampah Sakura Kelurahan Talang Kelapa Palembang. Jurnal Empirika, 4(1), pp.33–48.

Dinas Lingkungan Hidup Kabupaten Semarang, 2023. Peta interaktif sebaran lokasi bank sampah.

Fitriansyah, H. and Maryono, M., 2021. The effect of household waste reduction on the lifespan of Parit Enam Landfill in Pangkalpinang City: Using dynamic system modeling. Jurnal Presipitasi: Media Komunikasi dan Pengembangan Teknik Lingkungan, 18(1), pp.161-170.

Ghandi, A., Susilowati, D. and Sutrisno, H., 2023. Solid waste management system in Tanjungpura University: 3Rs concept integrated with the waste bank. Jurnal Presipitasi: Media Komunikasi dan Pengembangan Teknik Lingkungan, 20(1), pp.104-113.

Gunartin, G., 2019. Analisa efektivitas bank sampah sebagai alternatif pengelolaan sampah dalam upaya menuju smart city di Kota Tangerang Selatan. Inovasi, 6(1), p.1.

Guntoro, G., Ariyanto, A., Setiawan, D. and Hamzah, H., 2021. Sosialisasi website portal bank sampah Universitas Lancang Kuning. International Journal of Community Service Learning, 5(3), p.259.

Husen, V.B., Halim, R. and Mawarti, S., 2021. Gambaran pengelolaan bank sampah Dream dalam mengurangi timbulan sampah anorganik di Perumahan BCL 5 Kota Jambi. Science Environmental Health and Disease, 1(2), pp.40–51.

Kementerian Lingkungan Hidup Indonesia, 2022. Bank sampah unit di seluruh Indonesia. SIPSN.

Meidiana, C., Widyati, S. and Eka, K.S., 2022. Efektivitas dan efisiensi bank sampah Induk Surabaya. Planning for Urban Region and Environment, 11(2), pp.41–48.

Masruroh, 2021. Bank sampah solusi mengurangi sampah rumah tangga. Masyarakat Madani: Jurnal Kajian Islam Dan Pengembangan Masyarakat, 6(2), pp.48–69.

Munandar, A., Maizida, K. and Jatmiko, R., 2020. Pendekatan interdisiplin dalam pengembangan kesadaran gaya hidup bijak dan ramah lingkungan. Bakti Budaya, 3(1), p.102. https://doi.org/10.22146/bb.55506.

Putri, M.A. and Wahyudi, M.S., 2018. Manfaat asuransi sampah bagi peningkatan kesejahteraan masyarakat. Jurnal Ilmu Ekonomi, 2(2), pp.320–331.

Rahman, R., Sididi, M. and Yusriani, Y., 2020. Pengaruh pengetahuan dan sikap terhadap partisipasi masyarakat dalam pengelolaan sampah di Kampung Nelayan Untia. Jurnal Surya Muda, 2(2), pp.119–131.

Rosa, A., 2021. Pengelolaan sampah di Kabupaten Semarang capai level kritis. Harian Semarang, 1.

Rosiyanti, Y. and Trianto, S.S.B., eds., 2022. Kabupaten Semarang dalam angka. Semarang: BPS Kabupaten Semarang.

Rosmala, F. and Rosidah, I., 2019. Hubungan faktor resiko kesehatan lingkungan dalam pengelolaan sampah padat dengan kejadian demam berdarah dengue di Kelurahan Hegarsari Kecamatan Pataruman Kota Banjar. Jurnal Kesehatan Komunitas Indonesia, 15(1), pp.23–34.

Saefudin, G.O., 2018. Daya layan tempat penampungan sampah sementara di Kecamatan Ambarawa

tahun 2018. Jurnal Teknik Lingkungan, 5(2), pp.114-122.

Saputro, Y.E., Kismartini, and Syafrudin, 2015. Pengelolaan sampah berbasis masyarakat melalui bank sampah. Indonesian Journal of Conservation, 4(1), pp.83–94.

Setyaningrum, I., 2018. Karakteristik peningkatan pengelolaan sampah oleh masyarakat melalui bank sampah. Jurnal Teknik PWK, 4(2), pp.2018.

Sibua, S.N. and Watung, G.I.V., 2023. Penyuluhan kesehatan tentang bahaya buang sampah sembarangan bagi kesehatan pada masyarakat. Jurnal Pengabdian kepada Masyarakat MAPALUS, 2(1), pp.28-35.

Suwardiyanto, P., Siregar, D. and Umar, D., 2020. Analisis perhitungan OEE dan menentukan Six Big Losses pada mesin spot welding tipe X. Journal of Industrial and Engineering Sistem, 1(1), pp.11–20.

Triana, A.P. and Sembiring, D.E., 2019. Evaluasi kinerja dan keberlanjutan program bank sampah sebagai salah satu pendekatan dalam pengelolaan sampah dengan konsep 3R. Jurnal Teknik Lingkungan, 25(1), pp.15–28.

Tripathi, A., Tyagi, V.K., Vivekanand, V., Bose, P. and Suthar, S., 2020. Challenges, opportunities and progress in solid waste management during COVID-19 pandemic. Case Studies in Chemical and Environmental Engineering, 2.

Wahanani, M. and Umh Rizky, F., 2020. Peranan aset komunitas dalam pengembangan masyarakat Islam pada bank sampah Songolikoer. INTELEKSIA - Jurnal Pengembangan Ilmu Dakwah, 2(1), pp.27–54. https://doi.org/10.55372/inteleksiajpid.v2i1.83.

Yuliana, I. and Wijayanti, Y., 2018. Partisipasi masyarakat pada program bank sampah. HIGEIA, 3(4), pp.545–555.