GEMA PUBLICA
JURNAL MANAJEMEN DAN KEBIJAKAN PUBLIK
ISSN Cetak 2460-9714
ISSN Online 2548-1363

INNOVATION OF WASTE MANAGEMENT WASTE TO ENERGY TECHNOLOGY BASED IN MALANG CITY (SUPITURANG FINAL DISPOSAL SITE STUDY)

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Abstract

City waste continues to increase resulting from every human activity. The research objective is related to waste management innovation using waste to energy technology in the use of waste at the Supit Urang TPA. Gas emissions released by piles of rubbish piled up in final disposal sites not only try to reduce and prevent humans, the environment and the earth from being damaged, but also use renewable energy. Descriptive qualitative research method. Data collection techniques through documentation, interviews and field study observations. Data analysis techniques involve collecting data from field studies (written and verbal), researching, reducing and then drawing conclusions. Using Roger's innovation theory. The results of the research show that the waste problem is not only borne by the government. Waste management must be completed from upstream to downstream, namely from community settlements to the final disposal site. The renewal of the management system for waste utilization has been in effect since the decentralization of the program from the Ministry of Public Works and Public Housing to the Environmental Service to build the latest technology-based waste disposal system. German assistance in infrastructure development is one of the successful factors in implementing the renewal of the Supit Urang landfill waste utilization system. The output of the waste to energy program is electrical energy and gas. Increasing energy production from landfills provides benefits to the community and also local governments as energy producers.

Keyword*: **Innovation, Waste Management, Waste into Energy***

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ISSN Online 2548-1363

INTRODUCTION

The city's waste problem is an endless polemic. Community participation has an important role in realizing every activity program in an area. This is one way to help the government reduce waste generation, because problems in waste management require complex handling. The complexity of handling waste involves five aspects, namely legal aspects, institutional aspects, funding aspects or economic aspects, socio-cultural aspects and technological aspects.

The municipal waste management process includes sorting waste based on type and substance, collecting waste from each house, storing waste from hotels and markets, transferring waste from waste depots in temporary disposal sites for hotels and markets, transporting waste from TPS to TPA, recycling, composting, biogas, incinerators, and landfill disposal systems from waste generation. Malang City in managing waste must be based on environmental insight in its disposal system so that it does not cause negative impacts.

Waste management innovation is explained in Regional Regulation No. 10 of 2010, located in articles 7b and 7f regarding research and technology development activities, which means that waste management in Malang City continues to develop using the latest technology and is well facilitated, then the community can use it so that it can handle waste problems. and reduce waste accumulation. The Malang City Regional Medium Term Development Plan in the 4th mission regarding increasing infrastructure development as outlined in the Environmental Service Strategic Plan set for 2013-2018 has a policy strategy in the form of increasing the development and application of waste reduction technology, which is included in second purpose. The policy strategy used is improving the performance of final processing management at the Supit Urang TPA (Final Processing Place) waste management program.

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RESEARCH METHOD

The research method used is a qualitative research method with descriptive explanation. Describe waste to energy technology-based waste management innovations in Malang City. Data collection techniques used through primary and secondary data sources in research are through observation, interviews and field study documentation. Then data analysis techniques are carried out from the collected data which is then reduced, sorted and concluded from the research results.

The research subjects or key informants during the research were government members and staff including section heads, field heads, and also staff members. Other key informants also came from technical implementers and local communities who live in the area around the Supit Urang landfill site.

This research was conducted by Malang City, specifically the Malang City Environmental Service Government office. The research location is at the Supit Urang Final Disposal Site in Mulyorejo Village, Sukun District.

DISCUSSION

1. **Innovation in waste management based on waste to energy technology in Malang City.**

a. **Planning for waste management innovation based on waste to energy technology in Malang City**

Planning for the implementation of waste management innovations in the city of Malang, especially the use of discarded waste that produces methane gas into a new, renewable energy source, was carried out simply in 2013. In accordance with Law Number 30 of 2007 concerning energy, which states that the central and regional governments are encouraged to use the new energy that appears. One of them comes from waste which is converted into electricity or other gas which is useful for daily needs, which is a priority that cannot be abandoned.

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ISSN Online 2548-1363

The government issued Minister of Energy and Mineral Resources Regulation No. 39 of 2017 concerning the implementation of physical activities for the use of new and renewable energy and energy conservation (EBTKE). The scope of focus is the development, procurement and installation of EBT. One of the synergistic planned activity programs appears in the strategic plan, especially the Malang City Environmental Service which wants control in reducing the risk of pollution and damage to the environment. Because EBTKE can be produced from municipal waste which is processed at final disposal sites, then for every city that produces waste from all kinds of community activities, one of the many obligations of the Environmental Service is to provide final disposal sites and manage these final disposal sites.

The Ministry of Public Works and Public Housing provides program grants to several regions in Indonesia. Several programs have been granted to TPAs in five cities, including Malang City TPA, Jambi City TPA, Jakarta City TPA, Pekalongan City TPA, Kendari City TPA. Of the five cities, Malang is one part of it. This program grant is in the form of construction of landfill expansion infrastructure and a sanitary landfill disposal system. In it there is cooperation between Indonesia and Germany. Indonesia has the opportunity for international cooperation, which is one of Germany's priorities. This is in the form of loan assistance from the German state through KfW (Kreditanstalt für Wiederaufbau) which is Germany's best bank.

One of the focuses offered by Germany is to help Indonesia continue to develop, moreover this is also in synergy with the vision and mission of the Environmental Service which wants third parties or private parties who can work together to have the same views on development. Such as developing renewable energy, as well as utilizing methane gas which arises from waste generation in landfills which is renewed using processes to produce new energy such as electricity and gas which can be used for daily needs.

The development of a model for utilizing city waste that produces gas emissions began with the government's efforts to capture methane gas in

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order to reduce greenhouse gas emissions, which are abundant and easily found today. This gas is one of the causes of global warming. The influence of the greenhouse effect caused by methane gas that emerges from landfills has a stronger impact compared to carbon dioxide ((CO2) vehicle exhaust, factory smoke). The compound methane gas is also called CH4 which also contains silphides and nitrogen.

The latest planning was planned by the Ministry of Housing in order to implement Law No. 18 of 2008 concerning waste management. The funding problem that had become a concern for the agency managing the TPA has been resolved. Indonesia, which has collaborated with Germany to help in environmental matters, is one of the problem solvers. The aid funds provided by Germany as one of the problem solutions provide quite large funds with a nominal value of around 300 billion for one activity site, especially a waste disposal site. In this case, Malaang City is included in one of the projects that is currently planning new infrastructure development activities in terms of building a disposal area with a sanitary landfill system.

The planning was carried out for 2 years starting from 2015 to 2017. Then the realization plan was carried out from 2017. In the planning carried out, a sanitary landfill disposal system will be built. Previously, disposal systems were divided into 3 types, first open dumping, controlled landfill, and sanitary landfill. In accordance with the sequence, the sanitary landill is the best, safer and more environmentally friendly disposal system in Malang City.

Once the planning described above is considered mature and appropriate to proceed to the next stage, the further process will continue to facilitate the realization of the program. The continued progress of planning is organizational programs such as the implementation of socialization. The outreach will be carried out by the program organizer, namely the environmental service, to the community of the sub-district concerned, namely Mulyorejo sub-district.

b. Socialization of waste to energy technology to local communities. Mulyorejo

The name of the program used for this activity is the final processing

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site waste management program. There are various program activities carried out, one of which is carried out to utilize new energy (methane) so that it can be used for things that can benefit the region and also the people in the area, especially the landfill area. The concept outlined in the planning is to utilize methane with a sanitary landfill disposal system that accommodates the gas followed by processes using today's advanced technology so that it can produce heat, electricity and household gas. During the socialization activities which were carried out four times in the Mulyorejo sub-district, residents of the Mulyorejo sub-district attended with high participation.

The government carried out socialization to the people of Mulyorejo sub-district in 2012, at that time the people who attended the socialization were representatives from each RT/RW who had free time to attend this activity. The community is enthusiastic about hearing new ideas that will be implemented by the City Government. The community is helped economically by gas which can be used for daily cooking without time and quantity limitations for the community around the Supit Urang TPA.

Environmental Conditions The people who live in Mulyorejo Village, Sukun District are right on the waste transportation route from the City to the TPA. The activity of heavy and large vehicles disturbs the community, this can arise in terms of environmental cleanliness. Other consequences include that the road becomes dirty due to leachate dripping on every road it passes, rubbish falling, passing transport trucks carrying a stinky smell.

The negative impact of this activity, even though the distance between the Final Processing Site is quite far from residents' homes, cannot be denied if the surrounding community experiences positive and negative influences from this activity. The impact obtained will not be far from health and environmental problems, such as in the case of health, namely the emergence of various kinds of diseases (skin and respiratory diseases) due to the presence of waste collection. It could also be that the liquid that emerges from organisms that live in piles of rubbish triggers leachate that flows, polluting groundwater, and methane vapor can cause air pollution

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and damage to ozone.

Regarding innovation in waste processing by utilizing this waste, the community as residents around the Final Processing Site like this idea because the community can feel the positive or reciprocal of the negative waste activities which to some extent mess up people's homes. This is assistance from the City government which provides assistance to the community because they have felt a little inconvenience from waste transportation activities. So none other than compensation in the form of appropriate gas distributed to the community from waste processing at the final disposal site for the landfill at the Supit Urang Landfill.

c. Application of waste to energy technology to reduce and handle waste

Innovations taken to fulfill the waste utilization innovation program require facilities and infrastructure to support the success of this innovation activity. To achieve the desired goals, the tools and materials needed as a means from those used for construction to the process of distributing energy are carried out simply. Using pipes as a means to each house using small paralon pipes and also a simple generator which is useful as a gas booster.

Infrastructure is the main support for the implementation of a process such as business, development and project implementation. In contrast to facilities, which are tools used during the process of activities until results emerge, infrastructure is the steps from planning, construction to implementation of the designed energy distribution program.

In the innovation process, trials are first carried out to determine the quality of heat and optimal results obtained from this activity. See the series of implementations carried out from the results of the plans that have been made and finally realized in the form of activities. Next, look at the flow of mechanisms in implementation and the obstacles that are likely to arise during the activity. Then it will be seen from the test results as well as the quantity of heat that is output in the use of methane gas.

The waste management mechanism at Supit Urang TPA, Malang City, until 2017 still uses a controlled landfill system. With this German aid

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project, the disposal system will be upgraded to a sanitary landfill system. This system is the best system that will be implemented. Because the controlled landfill system is a disposal system where the waste will be covered by soil after every 3-5 days which will cause odors and air pollution, when compared with what will be implemented at the upcoming Supit Urang TPA, namely the sabitary landfill which is the best system where the landfill is closed. Garbage is carried out every day so that the rubbish will not cause a smell that can be annoying. Then, with this latest system, it has also been formed in such a way that methane gas can be utilized more optimally, not only from the gas vapor in the waste pile but also the leachate water which has been given a special place for it to flow.

The gas that comes out every day is not always the same quantity. All are influenced by the high heat of waste which can produce methane gas. How long the waste is buried is also a factor. Just as waste that has been buried for less than one year will not produce methane gas, methane gas will be more optimal if it has entered the age of the pile starting from three years and above, because the decomposition of the waste has occurred within that time period. Waste that has not yet produced gas will not be able to be used until the estimated time. If waste decomposition is optimal in the waste pile at the Supit Urang TPA, it can be ensured that gas supply will reach up to 500 residents' homes. If the gas quantity is not optimal during the dry season, it will only reach 200 houses. In implementing waste to energy, it is very important to focus on the stability of the planning and implementation of the technicians.

Success will be easily achieved if implementation is in accordance with calculated planning. The better the implementation and the more appropriate the life planning of the project being undertaken, the longer it will last because suitability is always taken into account. The achievement of fulfilling household gas in implementing simple pipes at the Supit Urang TPA decreases every year. This is all caused by weather factors that influence the waste decomposition process during the controlled landfill disposal system.

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d. The role of the environmental service in achieving waste management based on waste to energy technology

Monitoring takes place in several jobs, such as supervising the jobdesk of field workers who are tasked with construction specifically for capturing methane gas during the installation of pipes at gas sources to installing pipe installations to residents' homes and supervising the work period. Apart from that, supervisors also give tasks to field workers by monitoring the results of the work that has been done.

The authority of the final processing technical implementation unit (UPT) which is part of the Environmental Service has the duties listed in each functional task in the form of carrying out activities related to processing waste and returning waste to its proper place, such as nature and the environment safely. Then it also concerns the implementation of activities to distribute methane gas as new, renewable energy to replace LPG gas to communities around the landfill.

Another role played in implementing this policy is Kfw who has a fairly high position. Because of the unusual relationship between Indonesia and Germany, this program also runs smoothly. Starting from a thorough planning process, implementation is currently at the construction stage. All this is proof of the good relations between Germany and Indonesia. Here Germany provided quite a lot of assistance for one case of building a landfill. 300 billion funds are earmarked for the construction of Supiturang TPA infrastructure. The clarity of this relationship has a good impact on Indonesia's development, as evidenced by the areas that need assistance continuing to grow. The success of program implementation will be visible in the next few years.

Controlling the use of simple methane gas after 1 to 2 years is still being monitored by the Environmental Service. However, after that it was handed over to the community self-help group to continue the monitoring, improvement and evaluation process. During the monitoring period of simple utilization, weaknesses and shortcomings emerged which could become a benchmark for improving innovation with sophisticated

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technology. This is proof of the importance of the program to continue to progress and be continuously innovated with previous improvements.

At the end of 2018, there was not as much gas coming out as at the start of construction due to the inability of methane gas to come out and be channeled due to the process of backfilling the waste pile in order to expand the landfill area. There are no further evaluation activities carried out between the department and the KSM. This activity was only carried out and completed by the KSM itself with the assistance of several communities who wanted to be involved.

Tabel 1. Data of Household Gas Subdistrict Mulyorejo

No	Year	Gas (volume/m^3)
1	2013	500
2	2015	300
3	2017	100

Source : Environmental Service, managed by researcher 2019

The decrease from year to year shown in the table of new renewable energy users is the impact of the decrease in the quantity of heat produced from landfills. The cause of the decline was due to insufficient monitoring intensity. Thus, the steps taken by the department by utilizing aid funds from Germany have become an advantage in changing the disposal system into a sanitary landfill to reduce the occurrence of unwanted accidents as in the past.

2. Barriers to waste management in the use of methane gas.

In the implementation of carefully planned activity programs there are always small errors or shortcomings that occur. Not far from that, obstacles caused by small deficiencies become an obstacle to the successful implementation of an activity program. There were several obstacles that occurred when the Supit Urang TPA was constructing a pipe installation to distribute methane gas. These can occur due to internal obstacles and also

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obstacles influenced from outside. The obstacles that occur can be caused by many factors, including technical and non-technical. Firstly, the planning for determining the gas capture point was carried out by a research team which carried out intensive laboratory tests to determine the well points of the areas that would be used as gas capture wells. At that time, it was recorded in the test results that the heat content that could be taken and used was only sufficient as a tool to help residents for cooking, not strong enough if used as an electricity generator (waste to energy).

After there are technical obstacles experienced during development, in other words there will be non-technical obstacles too. Lack of regular training related to implementation, repair of technical errors that occur from time to time for new workers. Many of them only learn autodidactically or only learn from the experience of seniors who have struggled with technical tools with their seniors. The training given to technical implementers was only at the beginning of this activity, as it were said, there was no longer any special attention to gas utilization activities that have been ongoing to date. then non-technical obstacles due to lack of attention from the government, the repair budget has not decreased in the last 2 years. Being out of touch with the department is also a factor in the program not running smoothly.

There are also several difficulties faced with this innovation. In general, the difficulties felt are during the months when the heat of the sun makes the rubbish in the landfill waste pile dry. Dry waste cannot produce a lot of gas because dry waste reduces the level of waste decomposition. This results in the use of gas being distributed to residents' homes sometimes not reaching or not even being able to be used by residents whose houses are located at the edge of the land which is quite far from the gas source. This is different from when the rainy season comes, because the rain that falls has the effect of speeding up the decay process in waste piles.

That's why it is very important that innovation continues to be developed so that it can avoid and reduce errors that occur. The government is managing this latest technological development by working together. processing with this sanitary system will be built in an organized installation

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so that methane always appears and continues to decompose by building up soil which accelerates the decomposition process without the presence of air. That is the importance of careful planning accompanied by regular monitoring of final disposal sites. So minimizing failure by fixing the obstacles that occur is one of the best solutions.

CONCLUSION

Everyone has the right to receive and enjoy a clean, good and healthy living environment. The obligation to prevent and overcome environmental damage and pollution is carried out by all levels of Malang City society. The role of society and government is very important in maintaining environmental sustainability and security. The aesthetics of the city can attract tourists to stop by in Malang City. In general, positive benefits are also felt due to the reduction of the greenhouse effect from the use of waste methane gas on global warming. Especially for the people of Mulyorejo Subdistrict with electricity and gas.

The system renewal has been in effect since a program grant was presented to DLH from the Ministry of Public Works and Public Housing to build a new waste disposal system. With financial assistance from Kfw Germany as a form of JERIN collaboration. The amount of funds contributed as infrastructure development loans is 300 billion. So that WtE planning and WtE implementation are carried out as well as possible considering the very large funds provided.

One way the Environmental Service provides services to the community is through WTE innovation as a form of service to the community. Meanwhile, compensation for official services to the community is by giving permission to the community to enjoy the results of methane gas for daily activities such as cooking, trading, and other things that can be done using methane gas without limits. Carrying out its duties in planning, the KPUPR shows with actions that it cares about environmentally sound development is a noble start as a form of public service. Germany, with the amount of aid funds, one of the innovations aimed at infrastructure development. DLH implements the activity program and the Community

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until it ends with implementation. Everyone performed their respective roles well even though there were shortcomings.

The influence of the greenhouse effect caused by methane gas emerging from landfills has a stronger impact. Compared to carbon dioxide ((CO2) vehicle fumes, factory fumes), the methane gas compound is also called CH4, which also contains silphide and nitrogen. If gas compounds continue to be inhaled by humans, it can cause diseases to emerge, one of which is acute respiratory infection in the community and also workers in offices and fields around the landfill.

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