KnE Social Sciences
ICHELSS
The 3rd International Conference on Humanities Education, Law and Social Sciences
Volume 2024

Conference Paper

Technology Development in Waste Management in Makassar City

Maya Kasmita*, Muh. Rizal Suyuti

Faculty of Social Science, UniversitasNegeri Makassar, Makassar, South Sulawesi, Indonesia

ORCID

Abstract.

In the process of handling garbage in the City of Makassar, the government is always looking for ways that can be more effective and efficient in its use. The development of technology in the management of garbage to produce energy is a waste management solution in the City of Indonesia. The land in the management of waste has become a priority as the amount of waste grows daily. Through this research, it was discussed how to develop technology by offering the Landfill Gass Collection system through the application of technology for the utilization of the technology that is appropriate for the waste and conditions present in the city of Makassar. This study discussed one of the waste management systems that have been implemented in Indonesia, namely in TPA Benowo-Surabaya. The results of this study concluded that the Landfill Gass Collection technology system is more effective and significant in the handling of garbage, while generating energy converted from garbage to be used by the community with the cooperation process of the government and relevant parties. This process can produce a policy for the management of garbage in the city of Makassar.

Keywords: development, utilization of technology, waste management

Corresponding Author: Maya Kasmita; email: mayakasmita@unm.ac.id

Published 3 January 2024

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the ICHELSS Conference Committee.

1. Introduction

The problem of accommodation management becomes very serious in the city due to the complexity of the problems faced and the high population density, so the management of the accommodation is often prioritized for its handling in the urban area [1]. Waste management often occurs among other things from the behavior and lifestyle of the community still tends to lead to an increase in the rate of waste that is heavily burdened by hygiene managers, the limitation of resources, budgets, personnel vehicles so that the hygiene manager has not been able to serve all the waste produced.

The garbage that is the remainder of human activity needs to be managed well so that tidk resolves the problem. The management of garbage in the cities in Indonesia so far has not achieved optimal results. Various obstacles are still faced in implementing

the management of such garbage both economic, social and cultural barriers and the application of technology [2].

The source of the problem of garbage is always present, either in the temporary storage (TPS), the final disposal (TPA), or when it is distributed. Here are some of the causes of garbage [3]:

1. The volume of garbage is very large and is not offset by TPA's tamping power so that it exceeds its capacity.
2. The distance between the TPA and the garbage center is relatively long to the time to transport the waste less efficiently.
3. The facilities are limited and cannot transport all the garbage. The remaining garbage in the TPS could potentially become a dump dump.
4. The technology of garbage management is not optimal so it is slow and the rubbish becomes rotten
5. Not all neighborhoods have garbage shelters. People often dump garbage as a shortcut.
6. Lack of socialization and governmental support for the waste management and its products
7. Minimum education and good self-management on proper waste disposal
8. The waste management is ineffective.

Here are the data related to the composition of garbage in Indonesia based on the National Waste Management Information Source 2020 from the Ministry of Environment [4]

1.1. The composition of garbage based on the type of waste

1.2. Composition of garbage based on the source of rubbish

Data on the composition of the garbage above shows that most of Indonesia's garbages consist of food and plastic waste composition that mostly comes from household waste and traditional markets and following business centers and public facilities. As for the achievement of the performance of the waste management of the City of Makassar, which is the reduction of household garbage and the same kind of waste that increases every day.

The composition of garbage based on the type of waste

Figure 1: Graphic comparison of types of garbage in Indonesia in 2020.

Composition of garbage based on the source of rubbish

Figure 2: Graphic comparison of waste sources in Inodnesia in 2020.

Based on the table 1 obtained the amount of garbage buildings in the city of Makassar reached 5.931,40 m3/day and the waste handled to 5.623,61 m3/days if concentrated reached 94,81% of the garbages handled in the field. Based on information from internet media (http://www.Makassarterkini.com) stated that the management of garbage in the City of Makassar is still very poor. With the production rate of 3.680 cubic meters (m3) per day, which is handled by the Environmental Agency live only about 3.270 m3. Based on the information and data above shows that housing management in the City of Makassar and the Environmental Agency still need attention to more effective waste management.

Most issues with waste management in the City of Makassar may be resolved without the help of the Environmental Assembly of the City of Makassar. When communication and information are supplied efficiently, monitoring may go smoothly. One of the abilities that is evolving today is technology. Mobile phones are one of the technologies used by society in communicating and providing information [5]. There are several examples

of technological development that can be used in waste management in the City of Makassar, for example; automated garbage milling and grinding machines, organic waste management and biogas technologies, modern waste composters, sensor-based waste monitoring and management systems, and online waste surveillance and reporting systems. Some examples of such technological outreach do not have the City of Makassar in the management of garbage.

Waste can be managed well through increased public concern for the environment as well as cooperation between various stakeholders to leverage opportunities in renewable energy sources through the development of technology for converting waste into energy[6]. The waste management process into energy can be optimized if it is carried out in collaboration with various schemes. This is supported by the rule of no. 18 year 2008 related to integrated, systematic and continuous waste management. There are various waste disposal techniques that can be applied to thermal conversion and biological mechanisms, which are still limited to Makassar City. Based on the issues listed above, the author is interested in conducting a study on the management of accommodation and harvesting it in the research entitled "Technological improvement in the waste management in the City of Makassar."

2. Literature Review

2.1. Management

Management is a set of activities carried out to direct, coordinate, and supervise resources and processes in achieving a set goal. Management involves planning, organization, guidance, control, and evaluation [7]. In the context of management or management, there are several relevant areas, among others:

Operational management involves planning, organization, and control of operational processes within an organization. These include inventory management, production management, quality management, and supply chain management.

1. Financial management involves planning, management, and control of the financial resources of an organization. These consist of financial analysis, investment management, cash management, and budget management.
2. Human resource management is the process of organizing, planning, and controlling a company's human resources. These include hiring, choosing, training, reviewing performances, advancing careers, managing salaries, managing working relationships, and enforcing employee policies.

NO	LOKASI / location	Timbulan Sampah Perhari (m^3)	Persentasi Terhadap Total Timbulan (%)	Sampah Terangkut (M^3)	Persentase Terhadap Total Timbulan (%)
1	2	3	4	5	6
1	Pemukiman :				
	a. Mewah	132,62	2,24	128,15	96,63%
	b. Menengah	314,52	5,30	298,23	94,82%
	c. Sederhana	1265,27	21,33	1200,24	94,86%
2.	Fasilitas Kota :				
	a. Pasar	936,68	15,79	906,89	96,82%
	b. Kawasan Perniagaan	218,74	3,69	209,29	95,68%
	c. Kawasan Perkantoran	226,38	3,82	215,67	95,27%
	d. Kawasan Pendidikan	119,78	2,02	117,23	97,87%
	e. Terminal	98,68	1,66	92,88	94,12%
	f. Stasiun Kereta Api	-	-	-	-
	g. Pelabuhan	217,47	3,67	208,47	95,86
	h. Bandara	-	-	-	-
	i. Hotel	218,65	3,69	206,32	95,86%
	j. Rumah Sakit	214,66	3,69	206,32	94,36%
	k. Sarana Ibadah	88,46	1,49	81,98	92,67%
3	Kawasan Industri	129,27	2,18	121,27	93,81%
4	Perairan terbuka	875,74	14,76	858,05	97,98%
5	Pantai Wisata	184,63	3,11	173,68	94,07%
6	Sungai	-	-	-	-
7	Anak Sungai	-	-	-	-
8	Sapuan jalan dan taman	162,54	2,74	152,64	93,91%
9	Lain – lain	527,31	8,89	450,16	85,37%
Total Timbunan Sampah Kota		5.931,40	100	5.623,61	94,81%

Source: The Environmental Body of Life in 2022

Figure 3: City of Makassar Garbage.

3. Planning, managing, and controlling marketing operations inside a company are all part of marketing management.. These include market analysis, pricing, promotion strategies, product distribution, and customer relationship management.

4. Strategic management involves the formulation of the vision, mission, goals, and long-term strategy of the organization. It involves the analysis of thesexternal environments, the identification of the internal strengths and weaknesses of the organization, as well as the making of strategic decisions to the organization's goals.

5. Planning, coordinating, and directing project operations within predetermined time, cost, and resource constraints are all part of project management. These include schedule management, project team management, risk management, and project progress monitoring.

6. Innovation management: involves the management of innovation processes within an organization. This includes the development of ideas, research and development of new products or services, management of intellectual assets, and commercialization of innovation.

Efficiency, effectiveness, and sustainability in the operations of the company are the objectives of management, along with achieving the predetermined objectives [8]

2.2. Increased technology

The process of creating and utilizing new technologies or enhancing old technologies is known as technological advancement. In many areas of life, technological improvements have a significant impact on efficiency, productivity, quality, and sustainability [9]

Here are some examples of areas where technological advancements can occur:

1. The development of information and communication technology (ICT) has changed how people interact, communicate, and work. Examples of ICT technology developments include software development, communication networks, cloud computing, artificial intelligence, the Internet of Things (IoT), big data, and information security. It provides benefits including straightforward information access, enhanced teamwork, and operational effectiveness..

2. Renewable Energy and Energy Efficiency: Advances in renewable energy technologies, such as fuel cells, solar panels, and wind turbines, have made it feasible to use cleaner, more ecologically friendly energy sources. Additionally, the development of energy-efficient technologies reduces energy consumption and adverse environmental impacts..

3. Manufacturing and Automation: The use of robots, digital manufacturing, and process automation have transformed the way that products are produced and raised productivity in the manufacturing and automation sectors of the economy. This can be done by implementing automated control systems, sensor technology and using intelligent machines to manage and perform the production process.

4. Smart transportation: developing smart vehicles without using a driver and conducting traffic with intelligent management is also an example of smart transportation technology. The advancement of smart technology can help reduce greenhouse gas emissions and even improve road safety.

5. Digital Health: Telemedicine, electronic medical records, wearable medical technology, and health data analysis are some examples of technological advancements in the field of digital health. Real-time monitoring of patient status, increased accessibility to healthcare services, and improved treatment and diagnosis are all facilitated by technology.
6. Food and Agriculture: Sensors, drones, food processing equipment, and intelligent irrigation systems are just a few of the technological innovations in agriculture. This might increase food security, pest control, sustainability, and agricultural output..
7. Environmental sustainability: The development of solutions to better protect and manage the environment is aided by the development of technology. This entails the creation of technology for efficient water management, recycling, reducing pollution, and exact environmental monitoring.

2.3. The garbage

Waste management is the act of taking responsibility for the environment, such as transporting, collecting, disposing of waste and even processing it. By doing this good waste management can help in protecting the environment, so that it can reduce the impact on health and be able to maximize resources in the content of waste[10] There are several elements that must be considered in processing waste:

1. Minimize the use of waste: This can be done so that there is not too much waste or waste. We can try to use items carefully so that they can last longer in use, get used to bringing food containers that can be used multiple times and always think wisely when you want to buy something.
2. Waste disposal: In order to be effectively processed, waste must be disposed of. Cleaning can be accomplished by separating organic waste from non-organic waste (such as food residue). (such as plastic, rubber, wood, and kaca). Good cooling makes recycling and subsequent processing easier.
3. Waste that has been deposited is then collected and delivered to a facility for processing or disposal. A trash truck may be used to collect rubbish, and it can be done regularly and in accordance with the set timetable.
4. Recycling and processing: It is necessary to transform recyclable trash, such as plastic, paper, metal, and glass, into useable raw materials. Separation, purification, and processing of waste into new goods are all parts of the recycling process.

Additionally, the process of composite-making may be used to treat biological waste.

5. Waste that cannot or is difficult to recycle has to be handled properly and safely. In order to minimize the amount of trash and provide usable energy or raw materials, this may use operations like destruction, combustion, or thermal processing.

6. Waste that cannot be recycled or processed further must be disposed of securely at the end. Such trash is handled so as not to contaminate the environment at end disposal sites as TPA (End Disposal Places) or other waste treatment facilities. Strict safety and environmental requirements must be met by the waste management procedure at the final disposal location.

7. Education and Public Awareness: It's important to raise awareness of the need of efficient waste management. Campaigns for trash reduction, appropriate disposal, and environmentally friendly waste management techniques may all promote education. The advantages of recycling and trash reduction methods at the home level must also be made known to the general population.

Good waste management involves cooperation between governments, garbage management agencies, the private sector, and society. With a comprehensive and integrated approach, effective waste management can be achieved, which in turn will help maintain environmental hygiene and create a more sustainable society [11]

3. Method

In order to understand how the manufacturing process of technology is used in its management, this research was conducted in the City of Makassar using qualitative descriptive analysis to explain the issues that are related to the implementation of waste management in the city. This study used a case study methodology, with research participants drawn from a specific community group who are decision-makers in the City of Makassar's rubbish management policy. The purpose of this study is to explore a particular character or social aspect. This method is used to study a phenomenon or subject of investigation.

The steps taken in the study are:

1. Doing library/literature studies through various sources on handling rubbish problems

2. Conduct a descriptive analysis of the opportunities of waste utilization in Indonesia for sustainable energy development.

generating findings and recommendations about the efficacy of waste management, enhancing the selection of the most appropriate waste reference technology in light of the kind and circumstances of waste in Indonesia, and promoting sustainable energy.

4. Result and Discussion

The analysis of this study related to the breakthrough of garbage processing in Indonesia used the theories of Thomas Halvorsen, Per Koch and Johan Hauknes [12]It contains four parameters.

1. of technology. This parameter indicates the use of technology in the processing of garbage where its degradation is the conversion of garbs into electricity. (PLTSa)
2. The development of technology. This aspect describes the existence of the optimization of the development of technology in the breakthrough of the conversion of garbage into electric energy, i.e. the evolution of any technology that is utilized in the breakout of such waste conversion.
3. Organizational and bureaucratic reform. This parameter explains the existence of management reform (bureaucracy and organization) in an effort to create a good and comprehensive governance. (pemerintah, stakeholder, struktur organisasi dan kondisi social masyarakat)
4. The new policy. This aspect shows that there is a new policy of breakthrough rubbish disposal.

With the presence of the City of Makassar Waste Bank management with a new paradigm, such as the acquisition of the Bank of Waste, is still something foreign to the community of the Town of Macassar, the characteristics of the problem of waste management that arises in the City of Makassar have a paradigm that is considered new and modern. The inhabitants of Makassar City still have no idea what a trash bank is. The cornerstone of the implementation of waste management regulations is the 3R (reduce, reuse, and recycle) movement, however things aren't going well. Other systems, like the notion of empowerment (empowerment), are nevertheless subject to community engagement.

In the issue of waste management there is no permanent institution that separates the functions of regulators and operators in the management of premises and green

open spaces. This is included in the 2020 LAKIP Life Environmental Service, which is the environmental problem of living in the city of Makassar. Plans for the development and utilization of environmentally friendly technologies in meeting the needs of recycling and final disposal of waste.

Indonesia is striving to increase means and pricing in the handling of garbage. Similarly, in the City of Makassar, integrated waste management includes environmental technology and social culture of the community. This can be done by converting waste into energy, through the development of thermal technologies (burning/insineration, gasification, pyrolysis) which can minimize the capacity of garbage as well as generate energy as an advanced benefit from waste.

1. (a) Consider the development of garbage technology, which is as follows:
2. Technical considerations: technology, operational, minerals, mass and energy balance, environment, energy production
3. Economic Considerations: Investment, Operating and Maintenance Costs.

The breakthrough of garbage disposal is needed to complete the waste disposal with the acquisition of technology as well as the development of technologies that can be optimized in the management of waste management in the City of Makassar. As an example of the waste volume of Surabaya City with Makassar City that has occurred and has been applied in the Benowoin TPA a large 1500 tons/day managed into electricity up to 2 technologies Landfill Gas Collection. The garbage in Benowo is collected and processed to produce methane gas. (CH4). The methane gas is the primary raw material for power plants. The landfill gas collection system located in Benowo TPA produces electricity of 2 MW/day [12]

Gasification systems in waste management and also convert to electric and environmentally safe. The process on the Landfill Gas Cillection system is that the garbage that has been accumulated is compressed and populated for about 3 (three) weeks up to 1 (one) month so that it produces methane gas (CH4) which can then be processed by flowing the so-called Methane gas through the pipe to the power plant engine and then connected to the PLN network. [12] This waste management is carried out as a form of development and improvement to significantly manage the problem of garbage so that it is beneficial for the benefit of the community and the environment.

Based on the outline above the discussion mainly on the sample management example on TPA Benowo Surabaya to be carried out on the management of garbage in the City of Makassar produced the analysis as follows:

1. Technology.

The Landfill Gas Collection technology system represents a breakthrough in the conversion of rubbish into power as a result of technological advancements.

1. The development of technology

With the development of technology efforts to make efficient waste treatment in the City of Makassar and eliminate electricity converted from garbage. The development of technology that generates larger and more useful electricity and can harm the environment and provide a short time in good waste management.

1. Reform of bureaucracy

A good and comprehensive management system (government, stakeholders, organizational structure and social conditions of the community) is demonstrated by the cooperation of various waste management parties, namely the Government with PT PLN to distribute the generated electricity.

1. The New Policy

Politics in the breakthrough of garbage is that with the presence of oppressive policy utilization in the management of sapah can also produce lsitrikes. (energi terbarukan).

5. Conclusion

Pengembangan teknologi konversi sampah dari system teknologi penghancur sampah menjadi system Landfill Gas Collection technology is a more effective and significant internal waste management especially in the City of Makassar. Managed garbage can waste electricity that can be directly utilized by society.

Acknowledgments

This research is supported by the Faculty of Social Sciences of the University of Negri Makassar as well as public support in the development of waste conversion technology into energy that should be supplemented with the 3R principle (Reduce, Reuse, Recycle) on the system of its application in the field. In order for the mindset to be well-established.

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