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Overview of Waste Final Processing Place (TPA), Kubu Raya: A Descriptive Study

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ABSTRACT

The Kubu Raya landfill uses an open dumping system in its operations. (This method is no longer recommended for use in Indonesia). In this research, we describe the conditions surrounding the Kubu Raya TPA using observational methods and interviews with a descriptive approach. We describe landfill operations, infrastructure and facilities, daily waste volume, Kubu Raya landfill resources, remaining land, and service life. We also discuss future landfill land needs. The Kubu Raya landfill uses an open dumping system and does not practice vector control. The leachate collection facilities don't function, and the landfill's existing facilities and infrastructure need improvement. We have 270 m3 of waste entering Kubu Raya landfill each day, with a workforce of 37. The landfill covers 270 ha, and its remaining service life is approximately 300.84 days. In Kubu Raya Regency, it is necessary to consider adding 14.6 ha of land or building a new landfill. We need vector control efforts, infrastructure improvements, and considerations for additional land to make Kubu Raya TPA's waste management more environmentally friendly and efficient.

Keywords: Landfill, Waste management, Open Dumping

ABSTRAK

TPA Kubu Raya menggunakan sistem pembuangan terbuka dalam operasinya. (Metode ini sudah tidak direkomendasikan lagi untuk digunakan di Indonesia). Dalam penelitian ini, kami menggambarkan kondisi di sekitar TPA Kubu Raya dengan menggunakan metode observasi dan wawancara dengan pendekatan deskriptif. Kami mendeskripsikan operasional TPA, infrastruktur dan fasilitas, volume sampah harian, sumber daya TPA Kubu Raya, lahan yang tersisa, dan masa pakai. Kami juga membahas kebutuhan lahan TPA di masa depan. TPA Kubu Raya menggunakan sistem pembuangan terbuka dan tidak melakukan pengendalian vektor. Fasilitas pengumpulan lindi tidak berfungsi, dan sarana dan prasarana TPA yang ada perlu ditingkatkan. Sampah yang masuk ke TPA Kubu Raya mencapai 270 m3 per hari, dengan jumlah tenaga kerja sebanyak 37 orang. Luas TPA adalah 270 ha, dan sisa masa pakai TPA sekitar 300,84 hari. Di Kabupaten Kubu Raya, perlu dipertimbangkan untuk menambah lahan seluas 14,6 ha atau membangun TPA baru. Diperlukan upaya pengendalian vektor, perbaikan infrastruktur, dan pertimbangan penambahan lahan agar pengelolaan sampah di TPA Kubu Raya menjadi lebih ramah lingkungan dan efisien.

Kata Kunci: Tempat Pembuangan Akhir (TPA), Pengelolaan Sampah, *Open Dumping*

INTRODUCTION

Waste is the result of human activities which can be in the form of solids and liquids that no longer needed or desired and have not been reused because the main element or function has been taken (Armus et al., 2022; Pemerintah RI, 2008; Purnomo, 2021). Even though they are considered useless and undesirable, these materials can sometimes still be reused and used as raw materials (Armus et al., 2022). Food waste has great potential to be a raw material for making energy, fuel, and chemicals given the diverse and high-value volume and chemical content (Lin et al., 2013; Rakhmah, Ramadhan, Zahrasiwi, & Kurniawati, 2023).

Along with population growth in Indonesia, waste production increases every year. Based on data from the Ministry of Environment and Forestry of the Republic of Indonesia, the waste produced by Indonesia in 2022 is 35,347,766 tons, and West Kalimantan itself contributes around 525,332 tons of waste. The waste produced is mostly sourced from households with predominantly organic waste from food waste (Anggraini, Alva, Kurniawan, & Yuliarty, 2018; KemenLHKRI, 2023). This can be influenced by poor knowledge, abilities, and household behavior regarding waste generation resulting from routine food waste behavior. The waste problem is an ongoing problem that includes increasing the quantity of waste, the type and diversity of waste, and waste management (Chaerul & Zatadini, 2020; Kahfi, 2017).

Waste can have an impact on the environment such as a breeding ground for vector-borne diseases and urban zoonoses such as mosquitoes, flies, and rats that can pose a risk to human health. Apart from being a breeding ground for seeds, garbage diseases can cause pollution in the environment such as pollution of the soil, air pollution due to unpleasant odors and also disturbing the scenery (Krystosik et al., 2020; Wijaya & Muchtar, 2019).

At this time, pollution is experiencing an increasing trend as a result of the increasing human population, so the production of waste produced is also increasing. The lack of landfill sites and low awareness of managing waste are the causes of increasing environmental pollution (Mulyati, 2020). From this, waste needs to be processed starting with sorting, transportation, and final processing. Waste management is a systematic, comprehensive, and sustainable activity that includes reducing and handling waste as regulated in Law Number 18 of 2008 (Pemerintah RI, 2008).

One of the government's efforts in handling the waste problem is by providing waste processing places in the form of Temporary Collection Places commonly known as TPS. Then Integrated Waste Processing Places or TPS-T where waste is processed before entering final processing, and final processing places or TPA which are the place where the waste ends up later. There are several criteria in building a waste TPS, namely based on the population, the volume of waste, soil conditions, road accessibility to the TPS, regional conditions, service coverage from the TPS (TPS service area), and at least 50 m from public places (Martinus Sihotang, Nobelia Vincent Tarus, & Widiastuti, 2019; Qasim, 2017).

There are three types of landfills: sanitary, controlled, and open dumping (KemenLHKRI, 2009). Sanitary landfills involve piling and compacting waste, covering it with soil every day (Abdillah & Rachamanto, 2021) to reduce health risks (Iravanian & Ravari, 2020). Controlled landfills are an improved version of open dumping that involves adding soil once every seven days (Isni, Sungkowo, & Widiarti, 2019; Jehosua, Arungpadang, & Mende, 2021). Open dumping is not recommended due to its environmental impact (Izharsyah, 2020; Priatna, Hariadi, & Purwendah, 2020). Municipal waste can be disposed of using controlled or sanitary landfilling, and waste storage methods for tidal areas (BSN, 2002).

Although the government recommends that sanitary landfills be implemented, yet, landfills harm air, soil, water, and natural life. Landfill risks causing serious pollution from leachate that can cause groundwater pollution in the vicinity or can even affect the food chain it has an impact on ecosystems and human health (Iravanian & Ravari, 2020). Existence of TPA according to Solikhah et. al. (2011), several impacts that will have on the environment around the landfill (Solikhah, Hidayat, & Ardian, 2011). The environmental impacts that are usually felt by people around the landfill are air pollution, strong odors, dust pollution, and noise from waste trucks passing by every day. In addition, the presence of landfills can also cause contamination of surrounding groundwater (Ozbay, Jones, Gadde, Isah, & Attarwala, 2021).

The Kubu Raya TPA which is managed by the Kubu Raya Regency PUPR Service is a TPA with the Open Dumping waste processing type, where the waste is only piled in a basin-

shaped area without any ground cover. This results in the mixing of organic and inorganic waste at waste accumulation locations (KemenPU, 2013). Therefore, researchers need to conduct an assessment of the Kubu Raya Waste Final Processing Site (TPA) based on Minister of Public Works Regulation Number 3 of 2013 (KemenPU, 2013). The purpose of this study is to identify the existing conditions related to landfill construction and provide suggestions for actions to be conducted.

RESEARCH METHODS

This research is an observational research and interview with a descriptive approach. Interviews were conducted with the manager of the Kubu Raya Landfill. The research used an interview form and a form of environmental observation results of the Kubu Raya Landfill. The data obtained is then analyzed descriptively, processed, and presented in the form of numbers and narrative stories that describe the situation in the field. This research is located at the Final Waste Processing Site (TPA) Rasau Jaya JL. Sultan Agung, Kuala Dua, Kec. Sungai Raya, Kubu Raya Regency, West Kalimantan. This research was conducted from June to August 2023.

According to Gusmar, quoted by Fadhlurrahman & Burhanuddin, (2021), in carrying out the existing remaining capacity analysis method to determine the remaining capacity and remaining useful life of the Kubu Raya TPA, use the following calculation formula (Fadhlurrahman & Burhanuddin, 2021) :

Remaining landfill capacity (m^3) = L landfill x t (plan)
Information:
L = Land area of the landfill available (ha).
T (plan) = Height of the dam planned (m).

V waste year n = a (m^3)/year = a (m^3)/month = a (m^3)/day
Difference DT = total waste for year n- VDT TPA
Remaining DT = total VS up to month n in year n–the difference in DT
Remaining days of use = remaining / volume of waste per day

Information :
A = waste volume (m^3)
VDT = Capacity volume
DT = Capacity

To determine the location of a new landfill, it is necessary to review the area of land required. The calculation of the landfill area is carried out using the following formula (Manurung & Santoso, 2019) :

$$LTPA = \frac{V+SC}{T}$$

LBuffer = 25% x LTPA

Information:
LTPA = Landfill area (m^2)
LBuffer = Buffer zone area and TPA supporting facilities (m^2)
V = Volume of waste (m^3)
SC = Soil cover/soil layer cover (m^3) = 15 % of waste vol
T = Height of waste accumulation and the cover layer (m)
Generally in Indonesia is around 10 - 15 meters.

RESULTS

Kubu Raya Landfill Operations

The Kubu Raya landfill is a landfill that still uses an open dumping processing system, where the waste is directly dumped in an open area without covering it with soil when compacting the waste entering the landfill (Sandyka Rukmana, Purwanto, & Paiman, 2021).

Based on the statement of the TPA management, vector control at the Kubu Raya TPA is not carried out. Then the leachate collection system, at the Kubu Raya TPA has these facilities but is currently not functioning and there are no methane gas collection facilities available at the TPA. To maintain aesthetics, the Kubu Raya TPA has a garden that grows various ornamental plants such as red shoot trees and bamboo trees which are useful for adding to the aesthetics of the TPA, and personnel are provided to sweep the TPA roads every day.

The Kubu Raya TPA operating system involves transporting waste using dump trucks or armrolls to the TPA location. The vehicle driver fills out a daily waste control card by matching the vehicle number plate with the operator, and then signs and records the time of entry to the landfill. After filling in the card, the waste is taken to a designated disposal location. After the trash is unloaded from the dump truck or armroll by the driver, the trash is tidied up using a dozer to ensure it does not block the entrance of other vehicles. Then, the waste is taken and stacked using an excavator, then compacted. Dump truck and arm roll drivers must report the exit time from Kubu Raya TPA before continuing their journey. This system still operates manually, and TPA managers use control cards to record and monitor waste delivery activities to the Kubu Raya TPA.

Facilities and Infrastructure at Kubu Raya Landfill

Regarding the facilities and infrastructure at the Kubu Raya TPA, the entrance roads available at the Kubu Raya TPA are 2 roads 3 meters wide but only 1 (one) road is active for access in and out of the TPA and the other road is piled with rubbish at the TPA. When the researcher made observations the road was under repair. There is sufficient electricity and water available for Kubu Raya landfill operations such as the landfill management office, guard post, and landfill lighting needs. There is drainage at the landfill but there is a lot of rubbish in the Kubu Raya landfill drainage channel. There is a fence surrounding the area in front of the landfill and there are 2 (two) offices, namely the Management office and the guard post.

Impermeable lining facilities, test or monitoring wells, and gas handling are still not available at the Kubu Raya landfill. Leachate collection channels and leachate processing facilities are available at the Kubu Raya TPA but these facilities are not currently in use due to blockage. The buffer zone at the Kubu Raya landfill is in the form of a garden planted with various trees, apart from the buffer zone needs of the garden, it also functions as an aesthetic enhancer.

There are heavy equipment operational facilities at the Kubu Raya TPA, namely: 2 excavators, 2 dozzers, and 1 loader. However, when observing in the field there were only 2 pieces of equipment that were being used and functioning, namely 1 excavator which was piling up rubbish, and 1 dozzer which was operating to push trash and all this heavy equipment was controlled by operators who work at the landfill. There are 24 waste transport vehicles registered with the TPA management, namely 7 dump trucks and 17 arm rolls with a total of 24 drivers.

The landfill must have the necessary facilities to ensure the comfort and well-being of the workers (Poluakan, Purwaningrum, & Indrawati, 2018). The study location had supporting facilities, such as facilities for washing heavy equipment and waste transport vehicles available in the form of vehicle washing water pumps. First aid equipment for accidents is available and the equipment is located in the TPA management office and the guard's office.

There are no workshops available for repairing heavy equipment and waste transport vehicles. When interviewed, the management stated that if the service life of waste transport vehicles is calculated using hours, if they have been operating for 500 hours then waste transport vehicles such as dump trucks and arm rolls are taken to the TATA Asia workshop located on Jalan Adi Sucipto, Pontianak, West Kalimantan. Meanwhile, heavy equipment has special mechanics who are brought directly to the TPA to repair and carry out maintenance on the heavy equipment. Meanwhile, the weighbridge, laboratory, and parking space are not yet available at the Kubu Raya TPA.

Table 1. Analysis of Waste Management of Kubu Raya Landfill

Waste Facilities (Permen PU No. 3 of 2013)	Waste Management				Information
	Availability		Use		
	Available	Not Available	Used	Not Used	
Entrance	v		v		There are 2. 1 Active, 1 covered garbage
Operational roads	v		v		
Electricity or generator set	v		v		
Drainage	v			v	Covered in garbage
Clean water	v		v		
Fence	v		v		
Office	v		v		Management offices and guard posts
Leachate collection duct	v			v	Clogged garbage
Leachate treatment plant	v			v	Clogged garbage
Buffer zone	v		v		In the form of a garden planted with trees
Test or monitor wells		v			
Gas handling		v			
Heavy Equipment	v		v		
Soil hauler truck	v		v		
Workshop		v			
Garage		v			
Machine wash	v		v		
First aid kits in accidents	v		v		
Weighbridge		v			
Laboratory		v			
Parking lot		v			

Daily Trash Volume at Kubu Raya Landfill

The volume of waste from the Kubu Raya TPA was obtained from the results of calculating the volume of incoming waste per day carried by waste transport vehicles using either dump trucks or arm rolls. The data was obtained from interviews with the TPA manager and also documentation with the TPA entry waste control card. proof of the entry and exit of waste transport vehicles, where on the sheet there are motor vehicle numbers from arm rolls and dump trucks along with the volume carried. From this data, it is known that the number of trucks entering and leaving the Kubu Raya landfill is 54 trucks, and the average volume of waste carried is 5 m^3 per vehicle, so it can be calculated that the daily volume of waste at the Kubu Raya landfill is 270 m^3/day.

Overview of Kubu Raya Landfill Human Resources

Kubu Raya TPA has a total number of workers of 37 people, of which 13 people work at the TPA and 24 people work as drivers of waste transport vehicles, with the structure of Kubu Raya TPA workers, Mr. Budi Kurniawan as Kubu Raya TPA coordinator, 3 TPA guards,

equipment operators. 3 people heavy, 3 street sweepers, 2 car washers, 1 TPA park attendant. Another 24 (twenty-four) officers were drivers of waste transport vehicles. When interviewed regarding the employment status of the drivers, they answered that they were honorary workers employed by the District PUPR Service Kubu Raya.

Remaining Land and Calculating the Kubu Raya Landfill Service Period

Based on the results of interviews with managers and combined with the results of measurements in the field, namely a length of 400 meters and a width of 90 meters, the area of the Kubu Raya landfill is 3.6 ha and the area used to pile up waste is 2.5 ha with a pile height of 12 meters, so the power volume Kubu Raya landfill waste capacity can be calculated using the following formula:

L x t (plan) = VDT TPA
25,849 m^2 x 12 m = 310,188 m^3

Then the remaining life of the landfill can be calculated as follows:
V waste in 2023 = 98,550 m^3/year = 8,370 m^3/month = 270 m^3/day

Difference in capacity = 162,000 m^3 – 310,188 m^3
Difference in capacity = 148,188 m^3

Remaining capacity = 148,188 m^3 - 66,960 m^3
Remaining capacity = 81,228 m^3

Remaining days of use = remaining / volume of waste per day
Remaining days of useful life = 81,228 m^3 / 270 m^3
Remaining days of useful life = 300.84 days.

Analysis of Kubu Raya Landfill Land Needs

The next analysis of landfill land requirements is with an operational age of 10 years and it is assumed that the volume of waste is still 270 m^3/day.

$$L_{TPA} = \frac{985,500 + 147,825}{10}$$

L_{TPA} = 113,332 m^2 atau 11.33 ha

LBuffer = 25% x LTPA
LBuffer = 25% x 113,332 m^2
LBuffer = 28,333 m^2 or 2.8 ha

Based on the results of research conducted by researchers, the Kubu Raya TPA must switch to a Sanitary Landfill system. The current annual waste volume is 98,550 m^3/year, and in 10 years it will be 985,500 m^3. Plus 15% for land cover, the total volume required is 1,133,000 m^3. With a planned height of 10 meters, the land area required is around 11.33 ha for the next landfill, with an estimated useful life of 10 years. In addition, for the landfill buffer zone, 25% of the landfill area is required, which is around 28,333 m^2. It is recommended to build a landfill in a hilly area so that the hilly land can be used as cover for waste in the landfill. This will help in more efficient and sustainable management.

DISCUSSION

The Kubu Raya Landfill (TPA) still uses the open dumping method. This is not in accordance with Law No. 18 of 2008 which states that since 2013 all regions must have landfill developed into controlled landfill and sanitary landfill methods. The open dumping method is no longer recommended because it can cause various problems such as air pollution of methane gas (CH4), leachate pollution that has not been well systemized which can pollute soil to groundwater, and massive disease spread because landfill is a source of growth that causes disease.

The landfill is similar to Kubu Raya, namely the Gohong Landfill located in Central Kalimantan which still uses an open dumping system which has an impact on environmental air pollution around the landfill. That there has been a change in the environmental air quality of the Gohong Landfill during 11 years of operating the landfill with an open dumping system which is characterized by an increase in the concentration of NO2, O3, SO2, dust and NH3 which are at risk of spreading respiratory diseases (Sukarmawati, Ayu Murti, & Abdus Salam Jawwad, 2023). Another landfill is the Terjun Landfill located in Medan City. The Terjun Landfill also still uses an open dumping system. Landfills with open dumping systems create an ideal environment for the breeding of malaria vectors, dengue fever, leptospirosis, and gastrointestinal infections (Hafizah, Pratiwi, Nuzlan, & Hasibuan, 2023).

To form a landfill using the controlled landfill method requires several facilities, including rainwater drainage channels, leachate collection channels and leachate water treatment plants, operational control posts, methane gas control facilities, and heavy equipment. Based on the results of observations, it was found that the Kubu Raya TPA already has several of these facilities, but the function of these facilities has not been used optimally (Khalid, 2023). The Kubu Raya landfill has rainwater and leachate drainage channels but is not operational because it is blocked by rubbish. Kubu Raya landfill does not yet have leachate water treatment equipment and methane gas control, but does have heavy equipment. There is no special workshop available to repair heavy equipment. The Jatibarang Landfill in Semarang City is one example of a landfill that has used a controlled landfill system in its management. The landfill already has facilities and infrastructure that are quite suitable for waste management, so that it can minimize negative risks due to improper waste management (Harjanti & Anggraini, 2020).

The development and management of the Kubu Raya TPA cannot be separated from the responsibility of the relevant waste institutions or agencies. This is because the waste management agency is the main motor driving all waste management activities from the source to the landfill and how the landfill method is applied in the area. The condition of the landfill is the responsibility of the district government based on the waste management law and the Regional Government Law (UU No. 23 of 2014 concerning Regional Government) (Qodriyatun, 2015).

CONCLUSION

Based on the research results, it can be concluded that the Kubu Raya TPA operating system still uses the open dumping method. Many facilities at the Kubu Raya TPA are available, but several facilities are not yet available, such as laboratories, weighbridges, gas handling facilities, waterproof layers, and parking lots. Human resources at Kubu Raya TPA are 37 people, 13 of whom are TPA workers and 24 other people are waste transport vehicle drivers. The volume of waste entering the Kubu Raya landfill every day is 270 m3/day. The remaining useful life of the Kubu Raya TPA if calculated is 81,228 m3 / 270 m3 = 300.84 days. The land required for the next landfill, which is assumed to have a lifespan of 10 years and the waste volume is still 270 m3/day, is 11.33 ha and the buffer zone is 2.8 ha, so the amount of land required is 14.16 ha.

Suggestions that can be given to the Kubu Raya Landfill manager to carry out vector control in a safe and controlled manner, improve leachate collection facilities, improve the operational roads of the landfill, control the cleanliness of drainage channels so that they are not buried in garbage, provide a weighbridge to measure the weight of waste entering the landfill, and add adequate parking spaces. In addition, it is also recommended to landfill managers to consider adding new land or coordinating related to 3R facilities at TPS so that waste entering the landfill can be reduced. Suggestions were also given to the relevant agencies so that they could consider and study to open a new landfill that meets the requirements of SNI 19-2454-2002. The Kubu Raya TPA must switch to a Sanitary Landfill system. It is recommended to build a landfill in a hilly area so that the hilly land can be used as cover for waste in the landfill. This will help in more efficient and sustainable management.

REFERENCES

Abdillah, M. C. M., & Rachamanto, T. A. (2021). Integrated Risk Based Approach (IRBA) dan Perencanaan Keberlanjutan Tempat Pemrosesan Akhir (TPA) Gedangkaret Kabupaten

Jombang. *Jurnal Teknik Lingkungan Universitas Pembangunan Nasional Veteran Jawa Timur*, *2*(1). https://doi.org/10.33005/envirous.v2i1.75

Anggraini, R., Alva, S., Kurniawan, T., & Yuliarty, P. (2018). Analisis Potensi Limbah Logam/Kaleng, Studi Kasus di Keluarahan Meruya Selatan, Jakarta Barat. *Jurnal Teknik Mesin*, *07*(2), 83–91.

Armus, R., Mukrim, M. I., Makbul, R., Bachtiar, E., Tangio, J. S., Sitorus, E., … Marzuki, I. (2022). *Pengelolaan Sampah Padat*. Yayasan Kita Menulis. Retrieved from https://www.researchgate.net/publication/373193080

BSN. (2002). *SNI 19-2454-2002 tentang Tata Cara Teknik Operasional Pengelolaan Sampah Perkotaan*. Retrieved from https://www.nawasis.org/portal/digilib/read/sni-19-2454-2002-tata-cara-teknik-operasional-pengelolaan-sampah-perkotaan/51435

Chaerul, M., & Zatadini, S. U. (2020). Perilaku Membuang Sampah Makanan dan Pengelolaan Sampah Makanan di Berbagai Negara: Review. *Jurnal Ilmu Lingkungan*, *18*(3), 455–466. https://doi.org/10.14710/jil.18.3.455-466

Fadhlurrahman, M. W., & Burhanuddin, H. (2021). Kajian Daya Tampung Tempat Pemrosesan Akhir (TPA) Jatiwaringin Di Kabupaten Tangerang. *Perencanaan Wilayah Dan Kota*, *7*(2), 377–385. https://doi.org/10.29313/pwk.v0i0.29155

Hafizah, A., Pratiwi, D. A., Nuzlan, D. N. R., & Hasibuan, A. (2023). Analisis Dampak Sistem Pengelolaan Sampah TPA Terjun di Kota Meda. *Zahra : Journal of Health and Medical Research*, *3*(3), 320–329.

Harjanti, I. M., & Anggraini, P. (2020). Pengelolaan Sampah Di Tempat Pembuangan Akhir (TPA) Jatibarang, Kota Semarang. *Jurnal Planologi*, *17*(2), 185. https://doi.org/10.30659/jpsa.v17i2.9943

Iravanian, A., & Ravari, S. O. (2020). Types of Contamination in Landfills and Effects on the Environment: A Review Study. *IOP Conference Series: Earth and Environmental Science*, *614*(1). https://doi.org/10.1088/1755-1315/614/1/012083

Isni, N. N., Sungkowo, A., & Widiarti, W. (2019). Upaya Teknis Rehabilitasi TPA Sampah Kopi Luhur dengan Sistem Lahan Urug Terkendali. *Jurnal Ilmiah Lingkungan Kebumian Pelestarian Fungsi Bumi Dan Atmosfer*, *2*(1), 24–33. https://doi.org/https://doi.org/10.31315/jilk.v2i1.3287.g2552

Izharsyah, J. R. (2020). Analisis Strategis Pemko Medan dalam Melakukan Sistem Pengelolaan Sampah Berbasis Open Dumping menjadi Sanitary Landfill. *Jurnal Ilmu Muqoddimah : Jurnal Ilmu Sosial, Politik, Dan Humaniora*, *4*(2), 109.

Jehosua, J. P. B. A., Arungpadang, T. A. R., & Mende, J. (2021). Analisis Tata Letak Fasilitas Tempat Pembuangan Akhir (TPA) Mobongo dengan Sistem Controlled Landfill di Minahasa Selatan. *Jurnal Tekno Mesin*, *7*(1). Retrieved from https://ejournal.unsrat.ac.id/v3/index.php/jtmu/article/view/36817/34223

Kahfi, A. (2017). Tinjauan terhadap Pengelolaan Sampah. *Jurisprudentie: Department of Law, Faculty of Sharia and Law*, *4*(1), 12.

KemenLHKRI. (2009). Tempat Pemrosesan Akhir Sampah yang Berwawasan Lingkungan.

KemenLHKRI. (2023). Sistem Informasi Pengolahan Sampah Nasional. Retrieved April 23, 2024, from Direktorat Pengolahan Sampah Direktorat Jendral Pengolahan Sampah, Limbah, Dan B3 Kementrian Lingkungan Hidup Dan Kehutanan. website: https://sipsn.menlhk.go.id/sipsn/

KemenPU. (2013). Peraturan Menteri Pekerjaan Umum Republik Indonesia nomor 3 tahun 2013 Tentang Penyelenggaraan Prasarana dan Sarana Persampahan dalam Penanganan Sampah Rumah Tangga dan Sampah Sejenis Sampah Rumah Tangga. In *In Kementerian Pekerjaan Umum Republik Indonesia (Permen PU Nomor 3/PRT/M/ 2013)*. Retrieved from https://peraturan.bpk.go.id/Home/Details/144707/permen-pupr-no-03prtm2013-tahun-2013

Khalid, H. (2023). Mengenal Macam-macam Fasilitas Pengelolaan Sampah di Indonesia. Retrieved May 30, 2024, from Indonesia Environment & Energy Center website: https://environment-indonesia.com/mengenal-macam-macam-fasilitas-pengelolaan-sampah-di-indonesia/

Krystosik, A., Njoroge, G., Odhiambo, L., Forsyth, J. E., Mutuku, F., & LaBeaud, A. D. (2020, January 17). Solid Wastes Provide Breeding Sites, Burrows, and Food for Biological

Disease Vectors, and Urban Zoonotic Reservoirs: A Call to Action for Solutions-Based Research. *Frontiers in Public Health*, Vol. 7, p. 405. Frontiers Media S.A. https://doi.org/10.3389/fpubh.2019.00405

Lin, C. S. K., Pfaltzgraff, L. A., Herrero-Davila, L., Mubofu, E. B., Abderrahim, S., Clark, J. H., … Luque, R. (2013, July 31). Food waste as a valuable resource for the production of chemicals, materials and fuels. Current situation and global perspective. *Energy and Environmental Science*, Vol. 6, pp. 426–464. Royal Society of Chemistry. https://doi.org/10.1039/c2ee23440h

Manurung, D. W., & Santoso, E. B. (2019). Penentuan Lokasi Tempat Pemrosesan Akhir (TPA) Sampah yang Ramah Lingkungan di Kabupaten Bekasi. *Jurnal Teknik ITS*, *8*(2), C123–C130. https://doi.org/10.12962/j23373539.v8i2.48801

Martinus Sihotang, D., Nobelia Vincent Tarus, K., & Widiastuti, T. (2019). Penentuan Lokasi Tempat Pembuangan Sementara Sampah Menggunakan Metode Brown Gibson Berbasis Sistem Informasi Geografis. *Jurnal Sistem Informasi Bisnis*, *2*, 2. https://doi.org/10.21456/vol9iss2pp177-184

Mulyati. (2020). Dampak Sampah terhadap Kesehatan Lingkungan dan Manusia. *Universitas Lambung Mangkurat*, 1.

Ozbay, G., Jones, M., Gadde, M., Isah, S., & Attarwala, T. (2021). Design and Operation of Effective Landfills with Minimal Effects on the Environment and Human Health. *Journal of Environmental and Public Health*. https://doi.org/10.1155/2021/6921607

Pemerintah RI. (2008). *Undang-Undang Republik Indonesia Nomor 18 Tahun 2008 Tentang Pegelolalan Sampah. Segneg*. Retrieved from https://peraturan.bpk.go.id/Home/Details/39067/uu-no-18-tahun-2008

Poluakan, L. C., Purwaningrum, P., & Indrawati, D. (2018). Environmental Risk Considerations in the Development of Solid Waste Facility: Case Study Rawa Kucing Solid Waste Facility, Tangerang City. *Indonesian Journal of Urban and Environmental Technology*, *1*(2), 124–136. https://doi.org/10.25105/urbanenvirotech.v1i2.2822

Priatna, L., Hariadi, W., & Purwendah, E. K. (2020). Pengelolaan Sampah di Tempat Pembuangan Akhir (TPA) Gunung Tugel, Desa Kedungrandu, Kecamatan Patikraja, Kabupaten Banyumas. *Cakrawala Hukum Majalah Ilmiah Fakultas Hukum Universitas Wijaya Kusuma*, *22*(1), 73–79. Retrieved from https://e-journal.unwiku.ac.id/hukum/index.php/CH/article/view/171

Purnomo, C. W. (2021). *Solusi Pengelolaan Sampah Kota*. Yogyakarta: Gajah Mada University Press. Retrieved from https://books.google.co.id/books?hl=id&lr=&id=he5IEAAAQBAJ&oi=fnd&pg=PP1&dq=sampah+adalah+pdf&ots=R9WRq5uhLl&sig=k9AhkogEg1IInGxeypQytrheIMw&redir_esc=y#v=onepage&q&f=false

Qasim, S. R. (2017). *Sanitary Landfill Leachate Generation, Control and Treatment*. New York: Routledge. https://doi.org/https://doi.org/10.1201/9780203740217

Qodriyatun, S. N. (2015). Bentuk Lembaga Yang Ideal Dalam Pengelolaan Sampah Di Daerah (Studi Di Kota Malang Dan Kabupaten Gianyar). *Aspirasi : Jurnal Masalah-Masalah Sosial*, *6*(1), 13–26.

Rakhmah, A. A., Ramadhan, D., Zahrasiwi, R. F., & Kurniawati, W. (2023). Pemanfaatan Potensi Sampah Sebagai Sumber Energi. *Jurnal Penelitian Teknologi Informasi Dan Sains*, *1*(4). https://doi.org/https://doi.org/10.54066/jptis.v1i4.1391 Pemanfaatan

Sandyka Rukmana, S., Purwanto, A., & Paiman. (2021). Analisis Sistem Pengelolaan Sampah di Tempat Pembuangan Akhir (TPA) Rasau Jaya Desa Kuala Dua Kecamatan Sungai Raya Kabupaten Kubu Raya Tahun 2021. *Geo Khatulistiwa: Jurnal Pendidikan Geografi Dan Pariwisata*, *1*(2), 7–17. Retrieved from https://jurnal.fipps.ikippgriptk.ac.id/index.php/GEOGRAFI/article/view/57

Solikhah, N. H., Hidayat, A. S., & Ardian, A. A. N. (2011). Dampak Keberadaan Tempat Pembuangan Akhir (Tpa)Terhadap Kondisi Sosial Masyarakat Dusun Ngablak,Desa Sitimulyo, Kecamatan Piyungan, Kabupaten Bantul. *Pelita - Jurnal Penelitian Mahasiswa UNY*, *6*(2). Retrieved from https://journal.uny.ac.id/index.php/pelita/article/view/4278

Sukarmawati, Y., Ayu Murti, R. H., & Abdus Salam Jawwad, M. (2023). Dampak Pembuangan Sampah Terbuka (Open Dumping) terhadap Kualitas Udara di Tempat Pemrosesan Akhir

Sampah (TPA) Gohong. *Jurnal Envirotek : Jurnal Ilmiah Teknik Lingkungan*, *15*(1), 34–48. https://doi.org/10.33005/envirotek.v15i1.218
Wijaya, Y. F., & Muchtar, H. (2019). Kesadaran Masyarakat Terhadap Kebersihan Lingkungan Sungai. *Journal of Civic Education*, *2*(5), 2622–237.