Poll Res. 40 (1) : 88-92 (2021)

ISSN 0257–8050

SUSTAINABLE SANITATION ASSESSMENT OF SETTLEMENTS CLOSE TO A LANDFILL: A CASE STUDY OF PIYUNGAN LANDFILL, YOGYAKARTA, INDONESIA

AULIA ULFAH FARAHDIBA[1], WIWIEN ADEFITRI[2], ANDIK YULIANTO[2], AGIL HARNOWO PUTRA[3], ANIS ZUSRIN QONITA[1] AND NUR INDRADEWI OKTAVITRI[4]*

[1]Department of Environmental Engineering, Faculty of Engineering, Universitas Pembangunan Nasional "Veteran" Jawa Timur, Indonesia
[2] Department of Environmental Engineering, Faculty of Civil Engineering and Planning, Universitas Islam Indonesia, Special Region of Yogyakarta, Indonesia
[3]Settlement Infrastructure Center of West Nusa Tenggara, Directorate General of Human Settlements, Ministry of Public Works and Housing, Mataram, Province of West Nusa Tenggara, Indonesia
[4]Environmental Engineering, Department of Biology, Universitas Airlangga, Surabaya, Indonesia

(Received 10 May, 2020; Accepted 20 July, 2020)

ABSTRACT

The presence of a landfill will affect the activities around it due to the leachate that is generated from the accumulation of waste. Piyungan landfill poses a problem to the populations living nearby, which will impact on the sanitary conditions of the settlements. This study analyzed the environmental sanitation and health in the settlements around the landfill site. The study was conducted by examining the conditions of sanitation, health, clean water, wastewater, and houses nearest to the landfill in a 500 m range in five villages. Likert scale was used to measure the sustainability level of sanitation in the population around the landfill in the category of clean water, wastewater, and public health. In some villages, diseases such as itching and Upper Respiratory Tract Infection (URI) arise. This is affected by the condition of the existing drinking water and wastewater facilities. Therefore, an integrated environmental management of the Piyungan Landfill, Yogyakarta and the provision of adequate sanitation for the surrounding population are necessary.

KEY WORD : Sustainable sanitation, Landfill, Public health

INTRODUCTION

Environmental sanitation plays an important role in the sustainability of human life. Some sources say that diarrhea and intestinal worms cause millions of people affected by fecal-borne diseases. The fecal-borne diseases are directly related to poor water supply, inadequate sanitation, and hygiene problems (Ministry of Health Indonesian, 2002). Therefore, Ministry of Health Indonesia stated Open Defacation Free (ODF) environment as target for cities at Indonesia. Purnama *et al*. (2019) investigate the distribution mapping of ODF at Surabaya. ODF represent sanitation condition at certain area which environmental sanitation refers to an environment's health status, comprising places of residence, supply of water, and sewerage (Farahdiba *et al.,* 2015; Soedjono *et al.* 2019). Sanitation also enable many human settlements prosper without jeopardizing the environmental condition.

Landfill is the place where waste is safely isolated so as not to cause damage or negative impact on the surrounding environment (Fitriana *et al*., 2014; Farahdiba *et al.,* 2014). Previous studies have shown that groundwater contamination due to the transport of landfill leachate can endanger the environment and human health (Chen *et al*., 2019; Przydatek, 2019). According to Dwicahyo (2017),

landfill can be cource of environmental pollutants and disease as well if the landfill management is not conducted properly. Prajnawita *et al*. (2020) explained that the high density of flies increase the risk of transmitting fly borne diseases, such as diarrhea, dysentery, typus, etc. Several approaches have been taken to identify the level of influence of landfill presence on the environmental condition and population (Rahimi *et al*., 2020; Kumar *et al*., 2013; ElSaidand Aghezzaf, 2018). It is mentioned on SNI 03-32141 (1994) that the minimum distance between a landfill and a settlement is 500 m. However, Piyungan landfill has a coverage area of less than 500 m, which is full of human settlements. Therefore, there needs to be a study on the assessment of the sanitary conditions of the community around Piyungan landfill.

MATERIALS AND METHODS

Research Location

Piyungan landfill is the final place to collect waste originating from community activities in three areas, namely Sleman Regency, Yogyakarta City, and Bantul Regency. The area of Piyungan landfill is 12.5 ha. Piyungan landfill research site with a range of 500 m from the center of the landfill. This study focuses on the 5 closest villages to the landfill, namely: Ndapan Village, Lengkong Village, Ngablak Village, Mbendo Village and Mojolegi Village.

Data Collection and Analysis

The data needed to support this report were divided into two, namely primary data (such as observation, questionnaire data, and interviews) and secondary data (such as references and regulation) (Adiani, 2012). The score of variable was compared with the criteria that the authors determined based on the lowest score and the highest score in the questionnaire results (ElSaid and Aghezzaf, 2018). The Likert scale is used to measure social phenomena, but in this case the use of the Likert scale was modified in order to calculate the sustainability level of sanitation in Piyungan landfill. From the Likert scale calculation, this research used 3 categories, namely poor, fair, and good.

Indicators for Sustainable Environmental Assessment

In assessing sustainability, sanitary conditions in settlements around a landfill are taken from 2 variables with 7 indicators of evaluation. The first variable is environmental variables, including settlement, clean water, wastewater, and solid waste. The other variable is health variables, which consist of diarrhea, and skin diseases. Indicators for sustainable environmental assessment were obtained from previous studies by providing modifications that are appropriate to the landfill conditions. Equation 1 is the calculation of sanitation sustainability. Table 1 shows the literature used as a basis for determining indicators:

$$\text{Value of sustainable sanitation} = \frac{\text{Total score}}{\text{Highest score}} \times 100\% \quad \ldots (1)$$

RESULTS AND DISCUSSION

The presence of a landfill is a highly influential factor for the health of a population. Poor air condition is also a cause of respiratory diseases. Not only that, diarrhea and skin diseases also frequently arise in the area. The lack of clean water and government attention is a problem in 5 villages around Piyungan landfill.

The sustainable analysis results of the study were divided into 2 (two) variables, namely environmental and health variables. A score divided in 3 categories, i.e., 3 was categorized as good, a score of 2 as fair, and a score of 1 as poor. The results example of the analysis can be seen in Table 1. After describing the categories of poor, fair, and good, an analysis of each village was carried out with seven indicators. The results from this research shows that there were two villages with poor sustainability scores. The two villages were Mojolegi Village and Lengkong Village. Both villages had low sustainability scores from several categories. Mbendo and Ngablak villages had a higher level of sustainability among the five although clean water facilities were still low. Each village had inadequate clean water facilities because it used drilled wells located around the landfill, which caused skin diseases, diarrhea, and odors.

Figure 1 shows the sustainability score of each indicator for the assessment of environmental indicators in the villages around Piyungan landfill. However, for the clean water indicator, all villages around Piyungan landfill had the same problem . This is because the residents in these villages still used clean water sourced from drilled wells. Therefore, special attention concerning water quality improvement for residents living in villages around

Table 1. Description and Scoring

No	Indicators	Category	Score (S)	Description	Source
1	Environment: Clean Water	Good	3	Water supply must meet the quality for the health requirements, and demand for clean water and/or drinking water. The water source is outside a landfill area.	(Kondoati *et al.*, 2014; Przydatek, 2019)
		Fair	2	Water quality meets the health requirements for clean water and the water is always cooked prior to use. the water source is <10 m from the landfill	(Kondoati *et al.*, 2014; Przydatek, 2019)
		Poor	1	Water quality does not meet the health. The water source is located in a landfill area and used in an open storage and water demands are not met.	(Kondoati *et al.*, 2014; Chen *et al.*, 2019)
2	Environment: Wastewater	Good	3	Household wastewater have a septic tank with well manage of drain.	(Sharada Prasad and Ray, 2019)
		Fair	2	If a septic tank is not available, settlements are equipped with a city sanitation and disposal system or other treatments and water channel in front of the house.	(Sharada Prasad and Ray, 2019)
		Poor	1	There are no facilities such as septic tanks and sewerage. Wastewater contaminates water supply, which results in poor environmental health.	(Prasad and Ray, 2019)
3	Environment: Solid Waste	Good	3	There is a waste collection at home before it is collected, moved, transported, and disposed of to landfill. Implement community-based waste management	(Fitidarini and Damanhuri, 2011; David *et al*., 2019)
		Fair	2	There is a waste collection at least in the environment or communal waste collection. Fellow residents around a landfill educate each other	(Fitidarini and Damanhuri, 2011; David *et al*., 2019)
		Poor	1	The residents have no awareness on the management of the waste they generate, so their waste is scattered in the environment.	(Fitidarini and Damanhuri, 2011; David *et al*., 2019)
4	Health: Diarrhea	Good	3	There are sanitation facilities in the house and sanitary conditions for disposal of waste meet the requirements and far from source of waste.	(Ahmed *et al.*, 2020)
		Fair	2	There is lack of awareness to pay attention to the factors that trigger diarrheal diseases Residents have experienced continuous bowel disease with feces.	(Ahmed *et al.*, 2020)
		Poor	1	Sanitation in the house that does not meet the requirements, poor waste treatment, and the short distance between the settlement and a landfill, defecation for more than 3 days.	(Schenck *et al.*, 2019)

Souce: Data Analysis, 2020

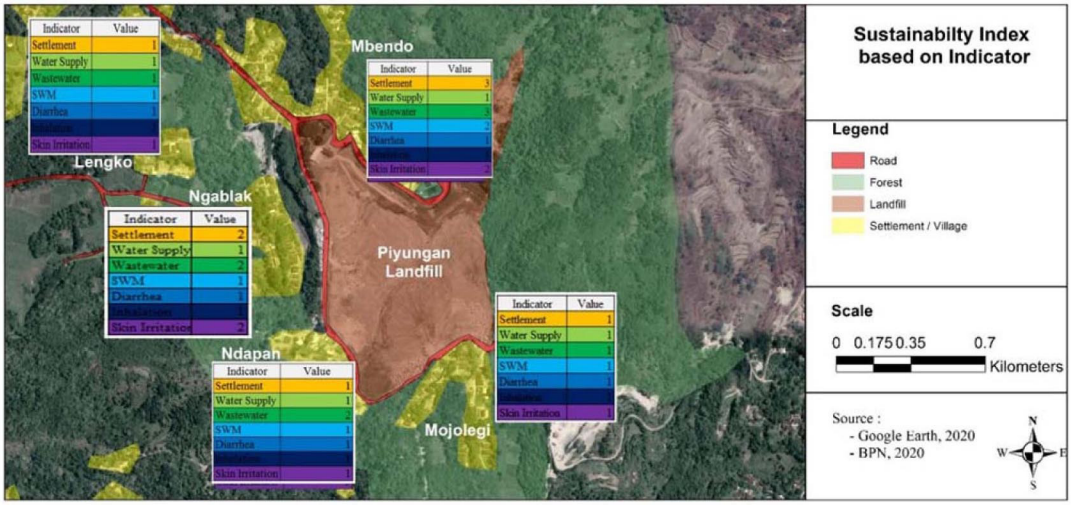

Fig. 1. Mapping of Sustainability Values of Villages around Piyungan Landfill Based on Each Indicator

Piyungan landfill is necessary (Adidarma *et al.*, 2014). The percentage of sustainable sanitation in Mbendo Village was 61.90%, which can be categorized as a fair sanitary condition compared to the other four villages. The percentage of sustainable sanitation in Ngablak and Ndapan Village was 47.62% and 38.10%, so it can be categorized as fair sanitary condition. The level of sustainable community sanitary conditions in the five villages shows that Lengkong and Mojolegi villages had the lowest value with a percentage of 33.33%.

CONCLUSION

The level of environmental sanitation sustainability illustrates the environmental conditions of each of the five villages. The condition of the landfill that is not equipped with good leachate management affects the sanitary conditions of the population with skin diseases, air pollution, and diarrhea. Inadequate sanitation facilities, especially clean water facilities, are one of the factors that increase the risk of disease transmission from the leachate produced by the landfill, which can cause diarrhea and skin diseases. Therefore, there needs to be a good landfill management to overcome the effects of waste/leachate and odor problems.

REFERENCES

Adidarma, K.P., Al-Rosyid, L.M., Putra, H.K. and Farahdiba, A.U. 2014. Gas emissions inventory of methane (CH4) with First Order Decay (FOD) method in TPA Piyungan, Bantul, DIY. *International Conference on Sustainable Built Environment.* 119-128.

Ahmed, A. S., Halabi, Z. and Antoun, J. 2020. The effect of the waste disposal crisis on the rates of hospitalization due to acute diarrheal illness in a middle-income country: Retrospective chart review. *International Journal of Infectious Diseases.* 90: 65-70.DOI://doi.org/10.1016/j.ijid.2019.10.026

Chen, G., Sun, Y., Xu, Z., Shan, X. and Chen, Z. 2019. Assessment of shallow groundwater contamination resulting from a municipal solid waste landfill- A case study in Lianyungang. China. *Water (Switzerland).* 11 (12) : 1-18.

David, A., Thangavel, Y. D. and Sankriti, R. 2019. Recover, recycle and reuse: An efficient way to reduce the waste. *International Journal of Mechanical and Production Engineering Research and Development.* 9 (3): 31-42.

Dwicahyo, H. B. 2017. Analysis of NH_3 Content, Individual Characteristics and Respiratory Scavenger Complaint in Landfills Benowo Rubbish and Not Scavenger Around Landfills Benowo Surabaya. *Jurnal Kesehatan Lingkungan.* 9 (2) : 135-144.

ElSaid, S. and Aghezzaf, E. H. 2018. A progress indicator-based assessment guide for integrated municipal solid-waste management systems. *Journal of Material Cycles and Waste Management.* 20 (2) : 850-863.

Farahdiba, A., Ramdhaniati, A. and Soedjono, E. S. 2014. Pengembangan Teknologi Air Bersih Masyarakat dalam Rangkaian Percepatan MDG's 2015 Di Kabupaten Malang. *Jurnal Sains dan Teknologi Lingkungan.* 6 (1) : 48-62.

Farahdiba, A., Ramdhaniati, A., Soedjono, E. S. and Rubi, R. 2015. Evaluasi Teknologi Sanitasi Masyarakat dalam Percepatan Pencapaian Sanitasi 100% Tahun 2019 Kabupaten Malang. *Jurnal Teknologi.*

8 (1) : 30-36.

Fitidarini, N. L. and Damanhuri, E. 2011. Timbulan Sampah Styrofoam di Kota Bandung. *Jurnal Teknik Lingkungan*. 17(2): 87-97.

Kondoatie, R. J., Darsono, S., Budi, G. S., and Krissetyatno, F. W. 2014. Pengendalian Banjir Kawasan Simpang Lima Semarang. *Jurnal Karya Teknik Sipil*. 3 (1) : 87-92.

Kumar, K. S., Nagendra, G. U., Veerendranath, L., Bhanu, S. B. and Sowjanya, N. L. C. 2013. Evaluation of Environmental Sustainability of Landfill Sites using Rapid Impact Assessment Matrix Method. *International Journal of Engineering and Advanced Technology*. 2 (6) : 369-376.

Ministry of Health Indonesia. 2002. Reducing Inequalities in Health. Reducing Inequalities in Health.

Permenkumham, RI. 2008. Nomor: 22/Permen/M/2008 Tentang Standar Pelayanan Minimal Bidang Perumahan Rakyat Daerah Provinsi Dan Daerah Kabupaten/Kota.

Prajnawita, D., Moelyaningrum, A.D. and Ningrum, P.T. 2020. Analysis flies density at final waste disposal Jember district area, Indonesia. *Jurnal Kesehatan Lingkungan*. 12 (2) : 136-143.

Przydatek, G. 2019. Multi-indicator analysis of the influence of old municipal landfill sites on the aquatic environment: case study. *Environmental Monitoring and Assessment*.

Purnama, M. Y., Soedarti, T., Oktavitri, N. I. and Fitriani, N. 2019. Distribution Mapping of Open Defacation (OD) Houses in East Surabaya basen on Geographic Information System (GIS). *IOP Conference Series: Earth and Environmental Science*. Volume 259.

Rahimi, S., Hafezalkotob, A., Monavari, S. M., Hafezalkotob, A. and Rahimi, R. 2020. Sustainable landfill site selection for municipal solid waste based on a hybrid decision-making approach: Fuzzy group BWM-MULTIMOORA-GIS. *Journal of Cleaner Production*. 248 : 119186. DOI://doi.org/10.1016/j.jclepro.2019.119186

Schenck, C. J., Blaauw, P. F., Viljoen, J. M. M. and Swart, E. C. 2019. Exploring the potential health risks faced by waste pickers on landfills in South Africa: A socio-ecological perspective. *International Journal of Environmental Research and Public Health*.16(11): 2059. DOI: 10.3390/ijerph16112059.

Sharada Prasad, C. S. and Ray, I. 2019. When the pits fill up: (in) visible flows of waste in urban India. *Journal of Water Sanitation and Hygiene for Development*. 9(2) : 338-347.

SNI 03-32141. 1994. Tata Cara Pemilihan Lokasi Tempat Pembuangan Akhir Sampah.

Soedjono, E., Fitriani, N., Santoso, F. R. E., Destio, R., Fahmi, I., Gemardi, A. and Ningsih, D. A. 2019. Achieving Open Defacation Free in Surabaya City by 2019. *IOP Conf. Series: Materials Science and Engineering* 669.