Community based solid waste management to reduce open burning incidents: A case study of waste treatment facility in Gajahmungkur District, Semarang City

B S Ramadan¹, H S Huboyo¹, E Sutrisno¹, A M Sari¹, B P Samadikun¹, N Hardyanti¹, A Karmilia¹

¹Department of Environmental Engineering, Diponegoro University, Semarang Indonesia 50275

Abstract. Ngudi Kamulyan is a domestic waste treatment facility which imply 3R (reduce, reuse, recycle) in Gajahmungkur District, Semarang City-Indonesia. This facility is already in status quo due to the lack of human resources and this Covid-19 pandemic. Therefore, this facility has chances to improve its services after the pandemic. The activation of this facility can reduce the number of mismanage waste and open burning incidents. Performance improvement planning is carried out based on the five aspects of waste management. This study was conducted using qualitative analysis and questionnaire survey to the neighbourhood leaders and facility officers. Community participation planning was done with activities focused on improving the 3R habit in the community. There is a need for continuous supervision from related parties, such as Gajahmungkur District Semarang City Government and the Environmental Agency of Semarang City. That supervision will be necessary to make the waste treatment facility and operational activities of 3R could run consistently.

1. Introduction
Solid waste management constituted one of the most environmental and human health problems facing the Semarang City government. Waste that cannot be processed and managed will be transported from the temporary storage area to the landfill and then disposed of safely to minimize the impact on the surrounding environmental footprint [1]. However, in reality, most of the waste that goes to landfills in Indonesia does not go through a sorting process first, so it ends up piling up openly in the landfill. Waste management treatment like this can shorten the life of landfills as the population increases, which is directly proportional to an increase in the volume of waste [2]. Therefore, waste treatment and management are needed that can help processing waste before it enters the landfill. Regional-scale solid waste treatment facility is already constituted in several areas in the Indonesian cities. This facility is hoped as a communal waste management which could promote 3R (reduce, reuse, and recycle) activities at district scale [3]. Community awareness is important to reduce the number of waste burning incidents.

The policy of managing urban waste or regional waste in Indonesia defines that waste management, outlined in 5 (five) subsystem components: operating engineering, institutional, regulatory, financing, and community participation aspects [2]. This paper focused on the planning of community participation for waste management in the waste treatment facility at regional-scale level and promote Ngudi Kamulyan waste treatment facility (WTF) as the case study area. Community participation is very
supportive of a waste management program region. Community participation in waste management is a process where people, as consumers at once, waste service producers, and citizens affect the quality and smooth infrastructure available for them. Community participation is essential because participation is a valuable tool to obtain information about the local community's condition, needs, and attitudes. Participation will make people trust more in the development of the projects/programs. One alternative for regional-scale waste management that can be built to reduce the generation of waste transported to landfills is to manage waste in the form of sorting waste that still has use-value to be further processed or recycled into valuable products. WTF in Ngudi Kamulyan is one of the pilot waste temporary storage area 3R in Semarang City, which serves 300 families in Sampangan Village, Gajahmungkur District, with the amount of waste entering before being disposed of to landfill of 92.74 tons/year in 2017 [4].

In addition to reducing waste generation at the landfill and mismanagement of waste (such as open burning and backyard disposal), it is necessary to implement further waste management to increase the economic value of waste, such as compaction, purification, drying, and waste counting [5]. It is necessary to redesign the Ngudi Kamulyan WTF to improve performance. The final result of this recommendation is expected to be used as an academic reference in the development and optimization of waste treatment facility at similar regional-scale in Indonesia.

2. Methodology
This study was conducted starting with a literature study related to the general description of the Ngudi Kamulyan WTF then continued with surveys and direct observations in the field. A data and information collection survey were carried out to understand three things: regional development policies in the field, realities on the field, and the development of ideas, ideals, and aspirations from all parties interested in implementation in the field. The stages of data collection include: Institutional survey, field survey, interviews, and questionnaires. The neighbourhood leaders (4 person) and WTF officers (5 person) were interviewed to gain their insights about waste management practice. This type of research is qualitative research. Methode used to examine the object's condition that natural where the researcher is as key instruments, data collection techniques triangulated (combined), data analysis is inductive and the results qualitative research emphasizes meaning rather than generalization. This paper focuses on community participation in the construction and management of Ngudi Kamulyan WTF.

3. Results and discussion

3.1. Overview of the Ngudi Kamulyan WTF, Gajahmungkur District
Ngudi Kamulyan is one of the active WTF in the city of Semarang in carrying out its function as a place for collecting, sorting, and recycling activities on a regional scale. This WTF is located on Akasia street, Sampangan Village, Gajahmungkur District. WTF was established in 2008 in a Self-help community (KSM) with the management chairman. WTF has also promoted the establishment of a waste bank that actively accepts waste from residents at any time. The service area of Ngudi Kamulyan WTF currently only covers the area around the WTF, especially Sampangan Village. The waste management process at the WTF did not work effectively. It was temporarily stopped due to the ongoing Covid-19 pandemic and the lack of human resources that did not allow the Ngudi Kamulyan WTF to run correctly. Ngudi Kamulyan WTF has a total area of about 60 m². Facilities and infrastructure were available at the facility to support 3R activities include signage, waste transport vehicles, office space, sorting room, and composting room. The physical condition of the Ngudi Kamulyan WTF is still very decent. However, due to the ineffective operation of the facility, the incoming waste is not adequately organized and is scattered around the WTF.
3.2. Community participation in Ngudi Kamulyan WTF

Community participation in 3R-based waste management on the individual scale is lacking. Because the community accommodates their waste without separating dry, wet, and hazardous waste [6]. People who care about the environment join a self-help group community whose management consists of from neighborhood and citizen association, community leader of Ngudi Kamulyan and WTF officers is voluntary without getting a reward or salary. Ngudi Kamulyan WTF already has workers from residents. These workers carry out activities such as waste sorting, composting and also run a waste bank program. Community participation is quite good, with participation provided in the form of personnel, facilities, and operational costs, all from residents and the results of the waste bank program. Therefore, community participation in waste management based on the 3R scale excellent group. The participation of the Ngudi Kamulyan WTF community in the development and still lacking during this pandemic due to restrictions on public activities because the government must always involve the community in village development so that development will be right on target and according to community needs. For this reason, it is necessary to optimize community participation to increase the movement of activities at the Ngudi Kamulyan WTF to achieve common goals for the health of the environment and the Ngudi Kamulyan community.

3.3. Planning improvement of community participation aspects of Ngudi Kamulyan WTF

Community participation plays a significant role in the urban waste management system because the community is a person or group directly affected by or interested in a decision with legal responsibility [7]. In this paper, Ngudi Kamulyan WTF is planned for a service period of 10 years, with the calculation of waste generation increasing every year. The plan can extend its service time to more than 10 years if there is awareness from the community or stakeholders to manage and process the waste generated [8]. In order to realize the excellent participation of the Gajahmungkur district community in waste management and processing, it is necessary to have various activities that are the responsibility of each relevant stakeholder.

The district government should counsel and disseminate information regarding constructing a sub-district WTF in the Gajahmungkur district. The district should also construct waste management regulations from the Semarang city government to neighborhood association stakeholders. This activity aims to make the WTF built, and the applicable waste management regulations are known [9] and understood by every representative of the Gajahmungkur District community. The district could promote the appeal and applicable waste management regulations by installing infographic billboards and bulletin boards at strategic places in every neighborhood association in Gajahmungkur District. Continuous monitoring should also conducted to evaluate the implementation of waste management regulations that apply to each village. The district government should also affirm the reduction of single-
use products such as plastic, and food packaging for all business actors in Gajahmungkur District. The district government Innovate a simple garbage vending machine in public facilities in Gajahmungkur District, which can record the value or points obtained by consumers from the waste deposit activities carried out. These points can be exchanged at the nearest waste bank in Gajahmungkur District. The points earned are well recapitulated with the QR code system. Internalization is also important to deliver of appeals and applicable waste management regulations into the school curriculum in the form of adiwiyata schools. This program is supervised by the Semarang City Education Office and the Semarang City Environment Service, and Ngudi Kamulyan KSM supports its implementation. Implementation of this program begins with determining a pilot school in each kelurahan, then continues to add the number of adiwiyata schools gradually until it reaches the 100% target.

Each sub-district level government is responsible for conducting education on waste management. The environmental care movement's primary focus is activities for managing organic, inorganic, and hazardous waste from sources with the 3R concept (Reduce, reuse, recycle) and application of sustainable lifestyle [10]. The sub-district level government should also support the establishment of a waste bank that can accept hazardous waste and composting facilities for organic waste [11]. In every village by empowering local communities as managers. Waste bank activities focus on producing recycled products that can become the characteristics of each village. The lowest level of the government should ensure that the appeal letter has been well understood and implemented in each neighborhood association in Gajahmungkur district and reports on the progress of the application appeal letter to Gajahmungkur district regularly every month. Implementation of reward and punishment system for each household should be conducted to the respective neighbourhood.

Local community can socialize the Ngudi Kamulyan WTF development plan to the people around WTF, such as Sampangan Village, and involving the opinions of the surrounding community in decision making. The community can empower the community around Ngudi Kamulyan WTF as operational employees of the facility. Formulation a community-based 3R waste management strategy is important, including hazardous waste management, with the Gajahmungkur District scale referring to the applicable regulations. The local community must ensure the implementation of the waste management strategy with the 3R concept in the community, especially the Sampangan Village community where the Ngudi Kamulyan WTF was established. Increasing the role is carried out in training and support for the local community, which is the responsibility of the Environmental Service and Gajahmungkur District Government. The community can enforce waste management regulations in the Neighborhood association, village, and a subdistrict that apply to the community of Gajahmungkur District. Scavengers and waste transporters should also be educated by the community who work in the Gajahmungkur District in terms of sorting waste by type.

4. Conclusion
Ngudi Kamulyan WTF in Gajahmungkur District could reduce the improper waste management in Semarang City. The role of the community in the management and construction of the Ngudi Kamulyan WTF was slightly hampered during this pandemic. Some activities have stopped due to limiting crowds and gatherings. Community participation in Ngudi Kamulyan is quite good by following the waste bank that has been formed, sorting waste, and composting. Nevertheless, it is still not optimal in developing the Ngudi Kamulyan WTF because there is still a lack of personnel working there. Planning for the aspect of community participation is carried out by maximizing the role of each relevant community representative in Gajahmungkur District, starting from the District, village, and neighborhood association, as well as KSM Ngudi Kamulyan itself. The activities carried out focused on increasing the 3R culture in the community and promoting the contents of circulars in the form of billboards in strategic places.

Acknowledgements
The authors would like to thanks to the Faculty of Engineering which support this research under strategic research grants number 195/UN7.5.3.2/HK/2021.
References
[1] Massreshaw A A 2017 *Int J Scient Eng Sci* 10(1) 1-6
[2] Maharani A, Dewilda Y, Darnas Y, and Dewata I, 2019 *IOP Earth Environ Sci* 314 012017
[3] Environmental Service Program, Medan, Bandung, Subang and Surabaya 2006
[4] Putra H P, Damanhuri E, and Sembiring E 2020 *J Mat Cycl Waste Manag* 22 396–404
[5] Rathore and Sarmah 2019 *J Clean Prod* 211 44-60
[6] Hou D, Al-Tavva A., Guthrie P, and Watanabe K 2012 *Environ Sci Tech* 46 2494-2495.
[7] Lin T. Guo X H, Zhao Y, et al, 2010 *J Sustain Dev Ecol* 17(4) 285-291
[8] Lishan X, Sha H, Zhilong Ye, Ouwen Z, Tao L 2020 *J Clean Prod* 278 123569
[9] Shekdar AV 2009 *Waste Manag* 29(14) 38-48
[10] Ağacsapan B, and Cabuk N S 2020 *Sustain Cities Society* 52 101829
[11] Wang S, Shen W, Tang W, Wang Y, Duffield C F, Hui F K P 2019 *Renew Energy* 132 326-334