Evaluation of Post-Construction Communal Wastewater Treatment Plants (WWTPs) in Sleman District, Special Region of Yogyakarta

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Abstract. The Special Region of Yogyakarta Government took one step to improve access to proper sanitation for the community through the Communal WWTP. There are four communal WWTP procurement programs in Sleman District: Community-based Sanitation, Urban Sanitation Rural Infrastructure (USRI), Special Allocation Fund and Community-based Environmental Sanitation. After the Communal WWTP was built and operated, various problems indicate the Communal WWTP has not run optimally after construction. Therefore, this study evaluated thirteen Communal WWTPs in Sleman District after construction was carried out. The aspects reviewed in this study were the administrator institutional and the management’s performance using the scoring method. The evaluation results based on the administrator institutional aspect and the management’s performance showed that Ambarketawang WWTP had less performance with a total score of 16. At the same time, other WWTPs got the optimal category with a total score more than equal to 25. These results indicate that the Community-Based Environmental Sanitation procurement program was considered less than optimal because the Ambarketawang WWTP did not keep Communal WWTP documentation and had no maintenance Standard Operational Procedure (SOP). The administrators did not also understand the main tasks and functions as administrators.

1. Introduction

Domestic wastewater is wastewater from domestic or household activities whose number increase along with the increase of population. Based on a 2017 survey of drinking water in Yogyakarta, about 89% of water source and 67% of domestic drinking water was contaminated by faecal bacteria [1]. It is necessary to do good management of domestic waste so that the whole community can access proper sanitation. Nowadays, access to proper sanitation in Indonesia is 67.89%, so there are still 32.11% of Indonesians who have not had access to proper sanitation [2]. To improve access to proper sanitation, the Indonesian Government has a 100-0-100 program, namely the target of 100% access to safe drinking water, reduction of slum areas to 0% and access to 100% proper sanitation following the 2030 Sustainable Development Goals (SDGs) [3]. To achieve 100% access to proper sanitation, the Government created a community-based sanitation development program through the Communal WWTP procurement program. Community involvement in this program aims to make the community contribute to proper sanitation in Indonesia. In addition, community involvement is also expected to support the sustainability of the Communal WWTP so that it can operate well after it is built. One of the districts in the Special Region of Yogyakarta that has this program is Sleman District. Based on data from the Environment Agency, currently, there are 130 Communal WWTPs built in Sleman District. There are four Communal WWTP procurement programs in Sleman District: Community-based Sanitation, USRI, Special Allocation Fund and Community-based Environmental Sanitation.

After the Communal WWTP is built, there are still various problems in the Communal WWTP, indicating that the Communal WWTP has not run optimally after construction. From 376 Communal WWTPs in all Special Region of Yogyakarta, 41 Communal WWTPs, 11 of which are in Sleman Regency, were monitored by the relevant institution at the beginning of the operation of the Communal WWTPs [4]. This raises the suspicion that the Communal WWTP, which is not directly monitored, the operation is not running optimally and become neglected due to construction, operation
and maintenance errors [5]. Support is needed through implementing organizations at the local level, funding, and support from the government so that the Communal WWTP program can run well after construction. In principle, all WWTP Communal procurement programs are the same in terms of concepts and principles. The difference between the Communal WWTP procurement program is in the mechanism and source of funding.

This research aimed to evaluate post-construction Communal WWTP based on different procurement programs in Sleman Regency. This post-construction evaluation aims to analyze whether the Communal WWTP is running well based on the institutional aspects of the administrator and the management performance.

2. Materials and Methods
In this study, the thirteen Communal WWTPs spread across Sleman Regency, which indicated as research locations. The Communal WWTP data was obtained from Environmental Agency, Sleman District. Based on the location, the Communal WWTP were divided into four procurement programs: Community-Based Sanitation, USRI, Special Allocation Funds and Community-Based Environmental Sanitation. The names of communal WWTPs based on the procurement program was shown Table 1.

| Table 1. Communal WWTPs and Procurement Program |
|------------------------------------------------|
| Program                          | WWTP Name          | Adress                                      |
|----------------------------------|--------------------|---------------------------------------------|
| Community-Based Sanitation       | Sukunan            | Sukunan, RW 19, Banyuraden, Gamping         |
|                                  | Agung Lestari      | Bontitan, Sendangagung,Minggir              |
|                                  | Mendiro            | Mendiro Sukoharjo Ngaglik Sleman           |
|                                  | Dukuh Berbakti     | Dukuh, Tridadi,Sleman                      |
|                                  | Tirto Mili         | Jongkang, Sariharjo, Ngaglik               |
| Urban Sanitation Rural Infrastructure | Nologaten         | Nologaten, Caturtunggal,Depok              |
|                                  | Ganjuran           | Bletuk, Ganjuran, Sidorejo, Godean          |
|                                  | Condong Catur      | Condongcatur, Depok                         |
|                                  | Ngaglik Sejahtera  | Ngaglik, RT 02/RW 06, Sinduadi, Mlati      |
| Special Allocation Funds         | Mino Sehat         | Plosokuning V, Minomartani, Ngaglik        |
|                                  | Kaliwaru           | Kaliwaru, Condongcatur                      |
| Community-Based Environmental Sanitation | Ambarketawang | Bodeh, Ambarketawang, Gamping |
|                                  | Blimbingsari       | Blimbingsari, RT 04/RW 16, Caturtunggal, Depok |

The data collection was done by interviewing the thirteen Communal WWTP administrators. One administrator was interviewed for each WWTP, so there were thirteen respondents in this study. The instrument used in the interview was the questions form with thirty questions that have been compiled based on the reference to the Technical Guidelines for the Implementation of Labor-Intensive Activities of the Directorate General of Human Settlements. The results of the interviews then entered into database and grouped based on the aspects reviewed to facilitate data analysis. In this study, the aspects reviewed were the institutional aspect of the administrator and the management's performance. Data analysis and evaluation used in this research was the scoring method.

The Scoring method aims to score each indicator that affects an aspect. The higher the score obtained, the greater influence of the indicator. In this scoring analysis, a score of 1 is given to an with small effect and score of 3 to an indicator that has a greater effect on aspects. Each indicator has its own parameters that are adjusted based on the results of interviews with informants. The aspects, indicators and scoring values used in this study was shown in Table 2.
Table 2. The Aspect, indicator, and value for scoring method

| Aspect / Criteria | Indicator | Parameter and value |
|-------------------|-----------|---------------------|
| **Management structure** | The number of administrators is sufficient and functioning actively | 3 |
| | The number of administrators is sufficient but less active | 2 |
| | The number of administrators is less and not active | 1 |
| **Reporting on communal WWTPs to the public** | There is a report and regular meetings | 3 |
| | There is a report but no regular meetings | 2 |
| | There is no report and no regular meetings | 1 |
| **Management documentation** | Documentation is kept in a good place and kept by the administrator | 3 |
| | Documentation is kept in a good place but not kept by the administrator | 2 |
| | Documentation is not kept | 1 |
| **Maintenance of Standard Operational Procedures (SOPs)** | There are SOPs | 3 |
| | There are not written SOPs but only training | 2 |
| | There are not SOPs | 1 |
| **Collect and manage the operational and maintenance costs** | Answer and understand the tasks | 3 |
| | Answer but not understand the tasks | 2 |
| | Not answer and not understand the tasks | 1 |
| **Efforts to improve service quality** | Answer and understand the tasks | 3 |
| | Answer but not understand the tasks | 2 |
| | Not answer and not understand the tasks | 1 |
| **Administrator understand how to operate communal WWTP** | Answer and understand the tasks | 3 |
| | Answer but not understand the tasks | 2 |
| | Not answer and not understand the tasks | 1 |
| **Responsible for the damage** | Answer and understand the tasks | 3 |
| | Answer but not understand the tasks | 2 |
| | Not answer and not understand the tasks | 1 |
| **Health Education** | Answer and understand the tasks | 3 |
| | Answer but not understand the tasks | 2 |
| | Not answer and not understand the tasks | 1 |
The analysis of the scoring results used a trend test to determine the category of the Communal WWTP based on the procurement program. The steps taken are to determine the ideal standard deviation score (Sbi) and the ideal average score (Mi), which are used as criteria according to equations 1 and 2 [6]. From Table 1, nine indicators have the highest score of 27 and the lowest score of 9. The value of Mi and Sbi are 18 and 3, respectively. The results of the score interval according to the equation was shown Table 3.

\[ Mi = \frac{1}{2} \times (\text{highest score} + \text{lowest score}) \]  
\[ Sbi = \frac{1}{6} \times (\text{highest score} - \text{lowest score}) \]  

Table 3. Category of communal WWTP based on interval

| Interval | Value               | Category of Communal WWTP |
|----------|---------------------|---------------------------|
| score ≥ (Mi + 1.5 Sbi) | Score ≥ 22.5 | Optimal                   |
| (Mi + 0.5 Sbi) < score ≤ (Mi + 1.5 Sbi) | 19.5 < score ≤ 22.5 | Good                      |
| (Mi − 0.5 Sbi) < score ≤ (Mi + 0.5 Sbi) | 16.5 < score ≤ 19.5 | Sufficient                |
| (Mi − 1.5 Sbi) < score ≤ (Mi − 0.5 Sbi) | 13.5 < score ≤ 16.5 | Less                      |

3. Results and Discussion

3.1 Common Problems of Communal WWTPs in the Study

The Problems in communal WWTPs could be known from the results of interviews with administrators. Based on the results of interviews, thirteen communal WWTPs are still operating and functioning. The most common problems experienced by almost all communal WWTPs were clogged piping and odours. These problems were still the same with the research conducted by Widodo et al in evaluating decentralized communal wastewater treatment in Yogyakarta 2009 [7].

3.2 Administrator Institutional Aspects

Many basic requirements that should be considered in communal WWTP. One of the fundamental requirement issues was the institutional aspect because the communal WWTP required more participation from local users [8]. Institutional has an essential rule because it will serve as decision-maker and responsible for the development and implementation of operational and maintenance [9] [10]. Based on Institutional Aspects of Administrator, the total score obtained by the thirteen Communal WWTPs was shown in Figure 1. According to the Directorate General of Human Settlements in 2016, the minimum number of personnel managing Communal WWTPs is five persons, and all Communal WWTPs in this study meet these requirements. From the thirteen Communal WWTPs, Nologaten WWTP and Ambarketawang WWTP scores were lower on the management structure indicator because the administrator did not have regular meetings. While other Communal WWTPs have high scores.

The Second indicator was reporting to the public that represents transparency because one of the principles of the Communal WWTPs procurement program is transparency. This showed that Communal WWTP activities were carried out openly and known to the whole community (Ministry of Public Works and Public Housing, 2014). In the indicators of reporting to the public, the lowest scores were obtained by WWTP Agung Lestari, WWTP Nologaten and WWTP Ambarketawang. This was because these three WWTPs report only if there were visits from the local Government and did not have regular meetings.

The third indicator, management documentation, Ambarketawang WWTP got the lowest score because the Ambarketawang WWTP administrator was not aware of Communal WWTP documentation. The function of documentation was as a report to the Government and as an
evaluation. The last indicator on the institutional aspect of administrator was the Standard Operation Procedure (SOP) for the operation and maintenance of the Communal WWTPs. The SOP was a guideline used as a reference by administrator in the operation and maintenance of Communal WWTPs and must be owned by the administrator (Directorate General of Human Settlements, 2016). From the score, Ngaglik Sejahtera WWTP, Tirto Mili WWTP and Mino Sehat WWTP got moderate scores because they have SOPs but are not written. Meanwhile, WWTP Ambarketawang got the lowest score because it did not have operational and maintenance SOPs.

![Figure 1](image.png)

**Figure 1.** The result of scoring for institutional aspects of administrator

### 3.3 Management Performance

Management performance is one of the essential aspects of the Communal WWTP. The communal WWTP are more flexible in the management aspect and simpler technology [11]. Based on the management performance aspect, the total score obtained by the thirteen Communal WWTPs was shown in Figure 2. There are five indicators which are the main tasks and functions of the administrator performance aspect according to the Ministry of Public Works and Public Housing Special Allocation Fund Implementation Guidelines (2016) [12]. The five indicators are collecting and managing finances include operational and maintenance costs, operation and maintenance WWTP, improving services quality, being responsible for damage and conducting health education. In the indicators of collecting and managing finances, the thirteen administrators in the Communal IPAL understood the main tasks and function as administrators. Still, the Ambarketawang IPAL gets the lowest score. There were five Communal WWTPs that did not understand service quality improvement. Those five WWTPs were Ngaglik Sejahtera, Ganjurun, Kaliwaru, Mino Sehat and Ambarketawang IPALs so that they got low scores. In the indicator of understanding the operation of communal WWTPs, all Communal WWTP administrators get a high score. In the indicator of responsibility for damage, Ambarketawang WWTP got a low score compared to other WWTPs. In addition, the Ambarketawang WWTP obtained the lowest score in the health education aspect because the administrator did not know and had not conducted health education.
Figure 2. The result of scoring for management performance aspect

3.4 Evaluation of post-construction communal WWTPs

In this study, thirteen Communal WWTPs from four procurement programs in Sleman district were evaluated at the post-construction stage. Based on the results of scoring on the institutional aspects of administrator and management’s performance with nine indicators, the post-construction Communal WWTP category was shown in Table 4. The analysis of the category was shown in Table 3. There are four categories of communal WWTP used, namely optimal, good, sufficient and less performance. From Table 4, based on institutional aspects and management performance, only Ambarketawang WWTP got the less performance category while the others got the optimal category. Ambarketawang WWTP, which is from Community-Based Environmental Sanitation procurement program, has the lowest total value compared to other WWTPs.

Table 4. Category of communal WWTPs based on institutional aspects of administrator and management’s performance

| Program                          | WWTP Name       | Total Score | Category |
|----------------------------------|-----------------|-------------|----------|
| Community-Based Sanitation       | Sukunan         | 26          | Optimal  |
|                                  | Agung Lestari   | 26          | Optimal  |
|                                  | Mendiro         | 27          | Optimal  |
|                                  | Dukuh Berbakti  | 25          | Optimal  |
|                                  | Tirto Mili      | 27          | Optimal  |
| Urban Sanitation Rural           | Nologaten       | 27          | Optimal  |
| Infrastructure                   | Ganjuran        | 25          | Optimal  |
|                                  | Condong Catur   | 26          | Optimal  |
|                                  | Ngaglik Sejahtera | 26      | Optimal  |
| Special Allocation Funds         | Mino Sehat      | 26          | Optimal  |
|                                  | Kaliwaru        | 25          | Optimal  |
| Community-Based Environmental    | Ambarketawang   | 16          | Less     |
| Sanitation                       | Blimbingsari    | 27          | Optimal  |
4. Conclusion
In this study, evaluation of thirteen communal WWTPs in Sleman district was conducted based on the procurement program. The most common problems experienced by almost all communal WWTPs were clogged piping and odours. The results of the scoring analysis for post-construction showed that the Ambarketawang WWTP got the less performance category, while the other twelve WWTPs got the optimal category on the institutional aspects of administrator and management performance. These results indicate that the Community-Based Environmental Sanitation procurement program was still considered less than optimal because the Ambarketawang WWTP did not keep Communal WWTP documentation and did not have a maintenance SOP and the administrators did not understand the main tasks and function as administrators.

References

[1] United Nations International Children's Emergency Fund (UNICEF) Water, sanitation, and hygiene: Providing children with a clean environment to live, play and learn. [online] https://www.unicef.org/indonesia/water-sanitation-and-hygiene

[2] Prinajatî P D 2020 Domestic Communal Wastewater Treatment Plant Evaluation In Sindangrasa, Bogor, Indonesia Journal of Community Based Environmental Engineering and Management, 4

[3] National Planning Agency 2019 Achievements and Targets for Sanitation Development in the RPJMN and SDGs 2030

[4] Wijayaningrat A T P 2018 Evaluasi Kinerja IPAL Komunal di Kecamatan Banguntapan dan Bantul, Kabupaten Bantul, D. I. Yogyakarta ditinjau dari Parameter Fisik Kimia Tugas Akhir Jurusan Teknik Lingkungan Universitas Islam Indonesia

[5] Bhakti A H and Herumurti W 2016 Evaluasi kinerja IPAL-IPAL program SPBM-USRI tahun pembangunan 2012-2014 di Surabaya Jurnal Teknik ITS 5 2337-3539.

[6] Ananda D and Fadhli M 2018 Statistik Pendidikan (Teori Dan Praktik Dalam Pendidikan) Medan: CV. Widya Puspita

[7] Widodo B, Andik Y, Silvia U and Ribut, L 2009 Evaluation Of Decentralized Communal Wastewater Treatment In Yogyakarta. 1st International Conf. on Rehabilitation and Maintenance in Civil Engineering (ICRMCE)

[8] Capodaglio S G 2017 Integrated, Decentralized Wastewater Management for Resource Recovery in Rural and Peri-Urban Areas Resources 6 1-20

[9] Balkema J A, Preisig H A and Otterpohl R F J D 2002 Indicator for Sustainability Assesment of Wastewater Treatment Systems Urban Water 4 153-161

[10] Bahar E, Sudarno and Zaman B 2017 Sustainability study of domestic communal wastewater treatment plant in Surabaya City IOP Conf. Series: Earth and Environmental Science, Proc. of the 3rd International Conf. of Planning in the Era of Uncertainty

[11] Hendrawan D, Widanarko S, Moersidik S S and Triweko R W 2013 Evaluation Of Centralized WWTP and The Need Of Communal Wwtp In Supporting Community-Based Sanitation In Indonesia European Scientific Journal 9 229-239

[12] Ministry of Public Works and Public Housing 2016 Special Allocation Fund Implementation Guidelines