Strategy For Fullfilling Sustainable Clean Water Infrastructure In The Commercial Area Of Sentul City

Edward Alfin, M. Yanuar J. Purwanto, Hadi Susilo Arifin, Satyanto Krido Saptomo

Abstract: Rapid economic growth followed by increased urbanization has resulted in an increase in water demand in an area. Like the independent city of Sentul City, Bogor Regency, the developer of the Sentul region that carries the concept of an independent city with its commercial area must meet its water needs independently. The purpose of this study is to look for strategies for meeting the right water infrastructure in the independent area. The method used in this research is the Analytical Hierarchy Process (AHP) method. The results showed that the priority strategy for fulfilling clean water infrastructure in the commercial area of Sentul is the urban specific water infrastructure development strategy. This study also indicates that the priority goal for fulfilling the strategy is to improve the infrastructure of water harvesting in accordance with the needs of clean water. It is also known that the factors that influence the fulfillment of clean water infrastructure are Economic and Ecological Factors. Next to the actor who played a role in the initial conditions is the Government.

Index Term: Analytical Hierarchy Process (AHP)

1. INTRODUCTION
Clean water is a basic human need. Clean water needed by humans as their daily needs must meet various requirements, especially quality, quantity, continuity and health aspects [1]. Recent years show that population growth is concentrated in urban areas with a population growth rate of more than 3.5% [2]. The phenomenon of regional autonomy which is sometimes not seen as a unity of work between the central, provincial and district/city results in a lack of coordination in the management of water resources which in essence accelerates the occurrence of water crises in many areas [3]. The challenges of providing clean water, urbanization and synchronizing decisions between the center and the regions provide a guide that requires a holistic strategy or optimization of water resources including management. Clean water management can be carried out properly and correctly required management with a professional management system both in terms of planning, production capacity, distribution system, financial management and supervision so that clean water needs can be met. By referring to this matter, the Regional Water Company (PDAM) is a solution to overcome it [1]. For the Sentul area, the PDAM has been able to distribute clean water to the area even though in the provision of water infrastructure in the Sentul area, a collaboration with the Sentul developer was held. This research is part of a series of studies with the big title Model of Fulfillment of Clean Water Infrastructure in Sentul Commercial Area. Specifically, this study aims to formulate priority strategies for fulfilling water infrastructure in urban areas. This study considers the need for clean water infrastructure in the Sentul region and the availability and demand for water in the Sentul region. This research uses Analytic Hierarchy Process (AHP) method.

2. RESEARCH METHODS
In determining the priority strategy for the fulfillment of sustainable water infrastructure in the Sentul Commercial Area, the Analytical Hierarchy Process (AHP) method is used. AHP is a measurement theory through pairwise comparison analysis based on expert judgment to obtain priority scale [4]. The results of a systematic literature review by [5] related to the criteria in the AHP show that the AHP technique is mainly used to weigh criteria and select and rank alternatives, while the origin of the source of the problem is rarely revealed, the type of knowledge sought is not determined, most are more technical. Therefore in this study, the criteria used in analysis are inseparable from the use of the previous method (waterbalance), as a result of the search for root causes.

Expert choice version 11 is software for analyzing the AHP method used in this study. In the use of the AHP method there are several steps that must be performed [4]. The steps are as follows:
1. Define the problem and determine the type of knowledge sought Structuring the decision hierarchy
2. The hierarchical structure that will be used consists of:
   a. Goal (G), which is a priority strategy for fulfilling sustainable water infrastructure in the Sentul commercial area
   b. Actor (A), is the party or institution involved, identified from the achievement of previous goals. The actors or institutions involved are determined to include the Government, developers, academics/experts, consumers and water operators.
   c. Factor (F), which is influencing the fulfillment of sustainable water infrastructure in the Sentul commercial area, is identified in the achievement of the previous objectives, namely ecology, socio-economic, infrastructure, legal and institutional
d. Objective (T), is what is to be achieved in the fulfillment of sustainable water infrastructure in the Sentul commercial area, which consists of improving water resources infrastructure, increasing the role of consumers, increasing the role of developers, harvesting water and improving clean water management.

e. Alternative Strategies (S), obtained in achieving the previous objectives. The alternative strategies determined are optimization of water use, strengthening water security and infrastructure development. Hierarchical Structure AHP analysis for the strategy of meeting the clean water infrastructure in the Sentul commercial area is presented in Figure 1.

3. Construct a set of pairwise comparison matrices
4. Uses priorities derived from comparisons to weigh priorities at levels below them directly. The scale / score of AHP assessment in determining the strategy to fulfill water infrastructure in Sentul commercial area is presented in Table 1.

5. Logical Consistency
In the AHP analysis, consistency calculations are performed to measure the level of inconsistency of respondents in filling out the questionnaire, which will affect the validity of the results. If more than 10%, then the assessment is still random and needs to be improved.

![Figure 1. Hierarchy of the fulfillment of clean water infrastructure](image-url)

The expert respondents involved in this study consisted of 9 (nine) selected expert respondents, who had been involved in the fulfillment of clean water infrastructure activities. Expert respondents were selected based on their educational background and / or suitable occupation, sufficient experience and or involvement in the issues discussed. The selected expert respondents represented, among others, the government, practitioners, and universities.
Water infrastructure development should not only prioritize physical or structural infrastructure development but also must pay attention to the development of non-structural water infrastructure such as laws, regulations, policies, zoning and economic incentives so that there will be good collaboration between the two and complement each other. Then, the achievement of a strategy to fulfill the clean water infrastructure in Sentul commercial area is inseparable from the role and contribution of elements at the top level of the AHP hierarchical structure produced. The priority weights for each element of Actors, Factors, and Objectives in achieving alternative strategies as a result of AHP analysis are contained in Table 2.

### RESULTS AND DISCUSSION

#### Table 1. AHP assessment / score for the strategy to fulfill the clean water infrastructure in the Sentul commercial area

<table>
<thead>
<tr>
<th>Score</th>
<th>Equally important / strong</th>
<th>Weak / important differences between one and the other.</th>
<th>The more important / important.</th>
<th>Shows the very important / strong nature.</th>
<th>Extreme important / strong</th>
<th>The middle value between the two assessments</th>
<th>If activity i, compared to j, gets a nonzero value, then j when compared to i, has the opposite value.</th>
<th>Agreemnt required (compromise)</th>
<th>If consistency needs to be forced by getting as many as n number values to complete the matrix.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Two activities make the same contribution to the goal</td>
<td>A little experience and tastes lead to being preferred over others</td>
<td>Experience and taste greatly cause one judgment more than another, one is preferred over another.</td>
<td>One activity is highly favored compared to another, its dominance apparent in reality.</td>
<td>Evidence that one is preferred over another shows the highest degree of certainty that can be achieved.</td>
<td>Agreement required (compromise)</td>
<td>Reasonable assumption</td>
<td>If consistency needs to be forced by getting as many as n number values to complete the matrix.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>2, 6, 8</td>
<td>Resiprokal</td>
<td>Racional</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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### Priority Actor

From the weighted hierarchical structure as shown in figure 2, the most priority actors in supporting the main strategy are Government Actors (0.369), then Developer Actors (0.254), Water Operator Actors (0.152), Consumer Actors (0.116), and the latter is the Expert Actor (A3) (0.109). The results of this analysis confirm the results of previous studies that in meeting the clean water infrastructure, the government is the most influential criteria or the fastest in providing planned policy interventions. The government is an element that has the full mandate and is responsible for all aspects of resources, plays a role in the availability of water resources, primarily to provide fair and equitable water infrastructure. It is known that the government plays an important role in fulfilling infrastructure, including fulfilling clean water infrastructure. This is in accordance with Article 33 (paragraph) 3 of the 1945 amendment IV which reads that the Earth and water and the natural resources contained therein are controlled by the state and used for the greatest prosperity of the people. At present the fulfillment of regional water infrastructure is the responsibility of the regional government with its regional business entity, the Dringking Water Company (PDAM). The PDAM distributes water to Sentul City with a Distribution Pipe through Kandang Roda water distribution channel. Then entering the Sentul City area, the developer who built the distribution pipeline includes distributing it to every customer in Sentul City including the Commercial Area. Sentul City itself is known to have a water treatment platform (WTP), which originally planned to independently procure water resources for its residents, but currently only distributes water to customers. Based on the Waterbalance analysis that has been done on the purpose of this study beforehand, it is known that Sentul City is an area that gets full supply from PDAM Tirta Kahuripan for the fulfillment of its clean water. As a developer who carries the concept of an independent city, which means that all needs can be met...
by themselves, the water problem should be prioritized. Water infrastructure should get more portions, especially structural water infrastructure for the fulfillment of clean water, such as improving the function of the PAPs from distributing water to processing and producing clean water sources. In addition to the Government, Developers and PDAMs which rank first, 2nd and 3rd for the actors. Then the next actor who should take the role is the Expert. It is known that experts are the sources of information development and scientific laboratories for the development of water infrastructure to be applied in the field. The role of consumers in this case is that water users can be optimized to facilitate or develop the same thinking so that they can provide input for other actors on water infrastructure, because consumers are a part that directly feels the presence of water in the Sentul City area.

**Priority Objectives**

AHP weighting structure for Weight Weights gives the results of the analysis of Infrastructure Improvement (0.375) is a priority goal for the fulfillment of clean water infrastructure. Followed respectively are the goals of increasing the role of the developer (0.201), the purpose of clean water management (0.189), the purpose of increasing the role of consumers (0.141) and the last priority goal is water harvesting (0.095). The physical impact of the decentralized water supply system on the current centralized water infrastructure is always there. Then the concept of a combination of a centralized and decentralized system was developed, which is called a hybrid water supply system. This system is hypothesized to produce a more sustainable and resilient urban water system. The basic concept is to use decentralized water supply options such as rainwater tanks, water harvesting and local wastewater treatment and reuse in combination with a centralized system. At present the impact of hybrid water supply technology on the operational performance of downstream infrastructure and existing treatment processes is unknown. The water industry needs a collective methodology to assess the reliability, resilience, water quality, cost and sustainability of infrastructure so that it can help determine when centralized, decentralized and / or hybrid solutions are used [9]. So we need a real role to work together between these five priority goals.

**Priority Strategy**

Human civilization will increasingly move forward, thus forcing us to be adaptive to existing changes, especially regarding strategies in the planning and fulfillment of water infrastructure. Adaptive attitudes can eliminate and enable us to adapt to these changes. One step that can be taken to be adaptive is to see the extent to which policies and strategies are still relevant to use [10]. The strategy update can be started by using a method that is considered appropriate. The water infrastructure fulfillment strategy in this study uses AHP. The results of pairwise comparison measurements are based on experts' assessment of elements in the hierarchical structure, AHP analysis is performed using Expert Choice 11 software. Weight of interest of the three alternative strategies to be determined as contained in Figure 2. The level of inconsistency of the model of the analysis results is 0.01 (less than 0.1), meaning that the model formed is considered good and does not require improvement.

<table>
<thead>
<tr>
<th>Priority Objectives</th>
<th>Weight Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improving water use</td>
<td>0.375</td>
</tr>
<tr>
<td>Increasing developer</td>
<td>0.201</td>
</tr>
<tr>
<td>Increasing consumer role</td>
<td>0.141</td>
</tr>
<tr>
<td>Water harvesting</td>
<td>0.095</td>
</tr>
</tbody>
</table>

AHP analysis results show that the main priority in the strategy of fulfilling clean water infrastructure in the Sentul commercial area is infrastructure development (Penngembangan Infrastruktur) with a gain of 0.470. The next priority is the optimization of water usage (Optimalisasi...
Pemakaian air) (weight 0.282). The last priority is strengthening water security (Penguatan ketahanan air) (weight 0.248). Water infrastructure development and strategies are advances from traditional approaches that use efficiency logic to centralize water flow as quickly as possible centrally, many cities implement rainwater infrastructure through a distributed or decentralized strategy that manages rainwater runoff closer to its source through low-impact development (low impact development) and green infrastructure (green technology) [8] [11] [12]. Sustainable urban water management, sustainable urban drainage system, integrated water resources management, water-sensitive urban drainage design is an engineering activity that change-oriented in urban water management, although each of the activities shares roles and objectives [13]. Clean water infrastructure development is actually a joint activity between the government, the private sector and the community, however the development of water infrastructure initiated by the government is still needed to influence the awareness of other parties. Water infrastructure development will give more roles to the community and the private sector to be more independent and empowered in water supply, so that they can play an active role in the management of clean water in their area. Optimizing the use of water in meeting the clean water infrastructure in the commercial area of Sentul is the second priority that needs attention. It is known that the use of non-domestic water basis is determined by the number of non-domestic consumers which include facilities and types of activities by each of the non-domestic units. Optimizing the use of water in addition to being determined by the facilities and activities of the facility unit is also determined by the loss of water. Water loss is the difference between the amount of water supplied and the water consumed [1]. Optimizing water use can be started from minimizing water loss in distribution and is water using water. Strengthening water security in meeting the clean water infrastructure in the Sentul commercial area is the third priority in this strategy. It is necessary to examine how future targets and threats from water security are. Potential water in Bogor is quite large because it has many rivers, especially in Sentul there are 2 rivers namely the citeureup river and the cikeas river. In addition, Bogor also earned the nickname the city of rain, which directly refers that Bogor is an area with large rainfall so there is a lot of water in Bogor. [10] said that several threats that need to be considered in developing water resources for water security include climate change which is increasingly making unclear water characteristics in the region. During the rainy season extreme natural disasters such as floods often occur, while in the dry season drought hit.

CONCLUSION
The conclusion in this study, namely that the most priority actors in supporting the main strategy are government actors, especially the PUPR Office and PDAM, then successive actors (0.254), water operator actors (0.152), consumer actors (0.116), and those who the last is expert actors (0.109). Then for priority factors namely Economic Factors (0.285), Ecological Factors (0.281), Infrastructure Factors (0.194), Legal and Institutional Factors (0.129) and finally Social Factors (0.111). Furthermore, for Priority Goals, namely Infrastructure Improvement (0.375), Enhancing the Role of Developers (0.201), Clean Water Management (0.189), Increasing the Role of Consumers (0.141) and the last priority goal is Water Harvesting (0.095). The priority strategy for fulfilling clean water infrastructure in the Sentul commercial area is an Urban Specific Infrastructure Development Strategy with a gain of 0.470. The next priority is the optimization of water use (weight 0.282). The last priority is strengthening water security (weight 0.248).

REFERENCES