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Selection of Alternative Locations for Rubber Weirs to Fulfill Clean Water needs in Rembang Regency

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ABSTRACT

Rembang Regency is one of the areas in Central Java that often faces the problem of lack of clean water, especially during the dry season. One of the innovations that can be applied to overcome the problems in Rembang Regency is to make a rubber weir. This study aims to consider and choose the location of the rubber weir which is planned to be built in the Kaliori District. There are 6 (six) criteria used in considering the selection of a rubber weir location and 3 (three) alternative location of weir. The data is then processed using the Analytical Hierarchy Process (AHP) method. The results showed that the most important criteria started from the ease of operational access (0.260), seawater intrusion (0.197), topographic considerations (0.161), social aspects (0.136), distance from water management installations (0.129), and the importance of fishing boats (0.117). As for Location 3, which is 300 m near the Dukuh Mbancang bridge, Tambakagung Village is the best alternative to be the location for the construction of a rubber weir. This is because the location has a straight river path and easy access and does not interfere with fishing activities.

Keywords: clean water; rubber weir; location; bridge; fishing activities.

INTRODUCTION

Water has an important role and its availability must always be maintained, so that it can support human life and fulfill other needs (Afriyanda et al., 2018). The important role of water is not only directed at humans, but also for all living creatures such as plants and animals. Water can be consumed provided that its quality meets water hygiene and is in accordance with the current legislation, then the water can be consumed if it is heated first. The increase in population and the development of structuring in an area can result in an increase in demand for clean water (Adi and Wahyudi 2020).

Rembang Regency is one of the regions in Central Java that often faces the problem of a lack of clean water, especially during the dry season. The drought problem currently hitting Rembang Regency has triggered the community to manipulate the availability of clean water by building wells and over-exploitation. This directly made conditions worse with the drought that occurred (Saputra 2020).

There are several ways to overcome drought and monitor water supplies. What is needed is a lot of supporting buildings that can accommodate rainwater, one example is a reservoir. A reservoir is one of the provision buildings that is made open to accommodate water using rainwater which is then collected or stored in a reservoir which is useful for supporting the clean water needs of the population (H. P. Adi, Wahyudi, and Ni'Am 2020). Currently, the Ministry of Public Works and Public Housing (PUPR) has also implemented rubber weir innovation to support water and food security in Indonesia. A rubber weir is a rubber bag that is installed across a river or water channel to raise the water level so that it can be used to irrigate irrigation channels, provide raw water or as a means of controlling floods.

In the case of the drought that hit Rembang Regency, Kaliori District is an area where it is possible to build a rubber weir. Regarding the construction of a rubber weir, an appropriate location is

required with various criteria that must be met. This research aims to obtain a priority order in determining the location of rubber weirs in Kaliori District, Rembang Regency.

Clean Water Supply System

The provision of clean water has several main requirements that must be met, namely quantitative requirements and continuity requirements (Tumanan et al., 2017), while according to the Regulation of the Minister of Health of the Republic of Indonesia No. 32 of 2017, clean water standards that meet the provisions are assessed from its physical, chemical and biological properties (Taufiq, Adi, and Wahyudi 2020). The main objective of the water supply system is to serve the needs of clean water for places that need clean water with sufficient flow and pressure. In reviewing the technical aspects, the provision of clean water can be divided into two systems, namely (Dawadi and Ahmad 2013) The individual water supply system (Individual Water Supply System), namely clean water that is used individually and has limited goods. The community clean water supply system (Community / Municipality Water Supply System) is a widespread clean water system that is used by the wider community for daily life. Water sources are an important component for providing clean water. The following are various sources of surface water, namely: (Poedjiastoeti et al. 2017).

A well-planned channel takes into account various aspects. The most important aspect is to first conduct a study of the water flow and plan to build a channel in accordance with the existing water flow. Measuring land contours also greatly influences channels with appropriate planning. So a water structure is needed that determines the direction and conditions according to the conditions in the field (Taqwa FML et.al, 2017; Dermawan A et.al, 2022. Taqwa FML et.al, 2017).

River water

The fast-flowing water source is centered on a spring upstream, which requires hydrological studies because the water source has a fluctuating nature, which is the definition of river water.

Water springs

Water that has the best quality that has not been contaminated with waste or other impurities and can be used directly without having to undergo processing is called water that comes from springs.

Dam/reservoir

A building that is built to act as a barrier to water or is used to store water is called a dam.

Well water

Water does not only come from high areas, but water can also come from deep ground, known as well water.

Rainwater

Apart from well water, there is also water that comes from precipitation, evaporation of water which becomes clouds and then falls to the earth, which is commonly known as rainwater.

Rubber weir

A rubber weir is a rubber bag that is installed across a river or water channel to raise the water level so that it can be used to irrigate irrigation channels, provide raw water or as a means of controlling floods. The Ministry of Public Works and Public Housing (PUPR) has implemented rubber weir innovation to support water and food security in Indonesia. A rubber weir is a rubber bag that is installed across a river or water channel to raise the water level so that it can be used to irrigate irrigation channels, provide raw water or as a means of controlling floods (Pranida 2022).

Innovation and technology support is needed in infrastructure development to make it better, faster and cheaper. The use of appropriate, effective and environmentally friendly technology

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is also encouraged to create added value and sustainable development so that the benefits of infrastructure can be felt by future generations (Gao et al. 2022).

Technically, the operation of this technology is carried out by pumping water/air into a rubber weir to block the flow of water. When the rubber swells, the flow of river water will be blocked to raise the water level. On the other hand, deflating manually or automatically can lower the water level according to needs. It can even be made completely flat with the river/canal bed (Artono, Andri; Mulyawati 2020).

Rubber weirs have several advantages, including relatively fast and simple construction times, gate panel spans can be longer (maximum 100 meters), no/few pillars, flexible weir bodies can follow the shape of the foundation, sub-structure (foundation) construction is relatively lighter so costs it is cheaper and more flexible against land subsidence, the operation and maintenance system does not require large amounts of power and costs and does not need maintenance by painting because it does not corrode (Wahyudi, Adi, and Wahyudi 2021).

RESEARCH METHODS

The data in this research was obtained through a questionnaire for selecting rubber weir locations. Questionnaires were distributed to respondents who were experts in the water sector. There are 6 criteria used to select the location of the rubber weir, namely topographic considerations, resistance to sea water intrusion, social aspects, distance from the water treatment plant (IPA), access to fishing boats, ease of operation. The alternative locations for the moving weir include: (a) Location 1 which is 200 m from the upstream of the Dukuh Mbancang bridge, Tambakagung Village, (b) Location 2 which is 100 m downstream from the Dukuh Mbancang bridge, Tambakagung Village, (c) Location 3 which is 300 meters away. m downstream from the Dukuh Mbancang bridge, Tambakagung Village.

The results of the questionnaire were then processed using the Analytical Hierarchy Process (AHP) method with the Expert Choice v.11 application to obtain priority criteria and alternative locations for rubber weirs to meet clean water needs. In general, the stages taken in this research are as follows:

Develop a research questionnaire and distribute it to experts in the water sector

Process the questionnaire results and calculate the geometric mean value for each compared criterion.

Carry out pairwise comparisons for each criterion at one level with the help of expert choice software.

If the inconsistency ratio is greater than 10% then data will be taken again,

Criteria and alternative weighting.

Ranking of criteria and alternatives from those with the largest weight to the smallest for each element.

RESULTS AND DISCUSSION

Hierarchical Structure of Criteria and Alternatives

Determining the location of the rubber weir to fulfill clean water needs in Rembang Regency will use 6 (six) criteria and 3 alternative locations, with a hierarchical structure as shown in the following figure:

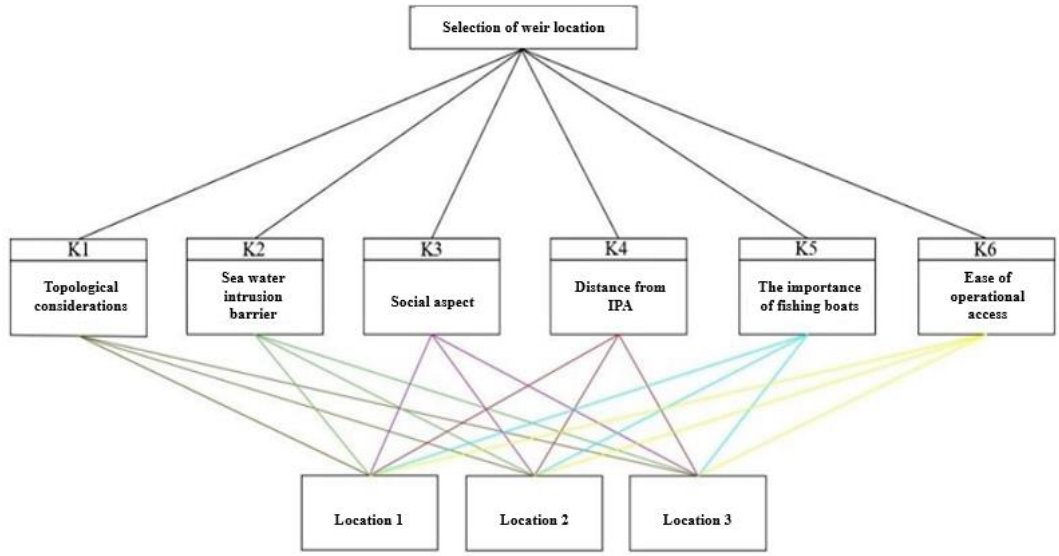

Figure 1. Hierarchical structure of rubber weir location selection

Alternative rubber weir locations, the three are planned to be in Tambakagung Village, Kaliori District, Rembang Regency. The location details are as follows:

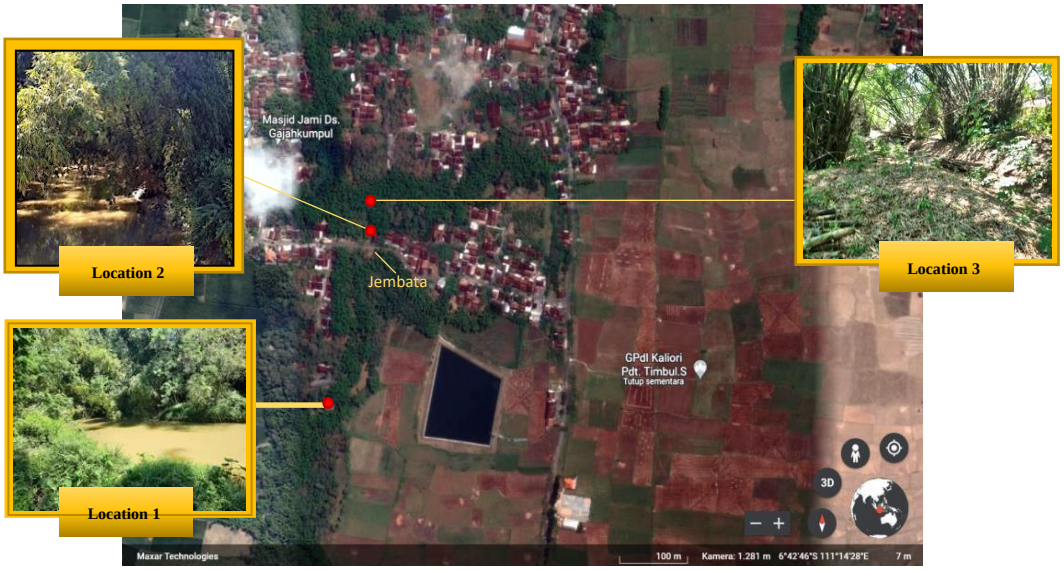

Figure 2. Map of the planned location of the Rubber Weir

Location 1 is 200 m from the upstream of the Dukuh Mbancang bridge in Tambakagung Village which has a curved river path, this location is in the rice fields of Tambakagung Village which is far from residential areas and to the east there is the Kaliori Reservoir which functions for irrigation of the Tambakagung Village rice fields and access to the location 1 can only be passed by pedestrians. Location 2 is 100 m downstream from the Dukuh Mbancang bridge, this location has a straight river route and easy access to operate, but the river bank is adjacent to residents' houses where there are concerns that river water will overflow which could have a negative impact on local residents. Location 3 is 300 m downstream from the Dukuh Mbancang bridge which has a straight river path and easy access for pedestrians and project work.

Criteria Weighting

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Criteria weight calculations are carried out by comparing each criterion. Respondents will fill out the questionnaire that has been provided by giving a score of importance on a scale of 1 to 9 for each comparison between the 2 criterion variables. The results of the questionnaire then calculated the geometric average. Then the importance level score of each component is processed using the Expert Choice v.11 application. Figure 3 below is the result of pairwise comparisons between criteria.

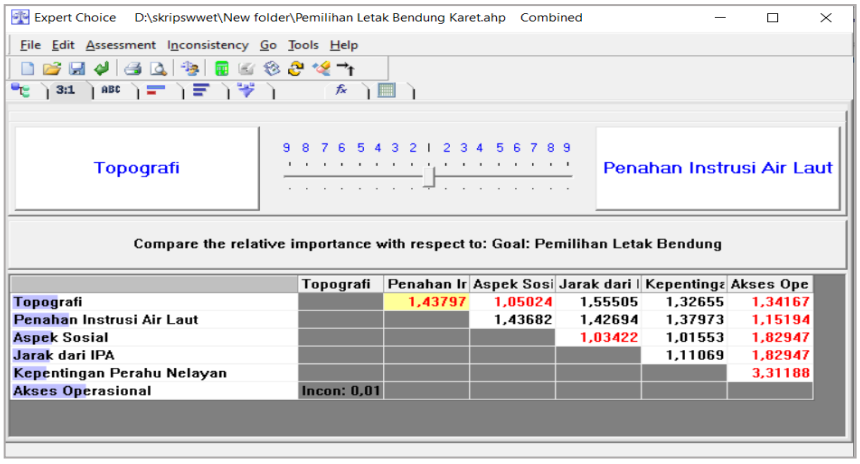

Figure 3. Pairwise Comparison Between Criteria

Based on the results of pairwise comparisons, a priority ranking of criteria can then be obtained. These results can be used to find out what criteria are most important to consider in choosing the type of rubber weir door. In Figure 4, it can be seen that the priority ranking of criteria that must be considered sequentially is containment of sea water intrusion (0.473), social aspects (0.245), topography (0.120), distance from water management installations (0.067), operational access (0.061), importance fishing boat (0.034).

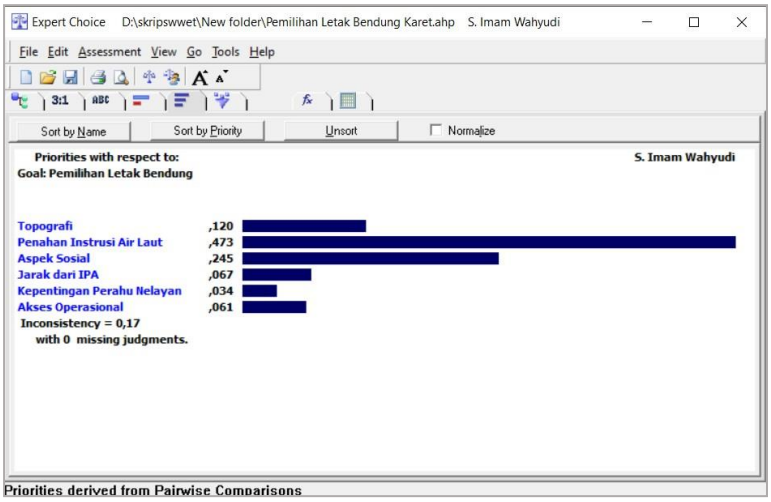

Figure 4. Criteria Priority Ranking

Priority Ranking of Alternative Rubber Weir Locations

All alternative locations in selecting the rubber weir location are then analyzed using all the criteria used. Next, a ranking of alternative rubber weir locations is generated based on a compilation of all criteria. Figure 5 shows the priority ranking of weir door types based on all

criteria, while Figure 6 shows the Relative Priority Graph resulting from a compilation of alternative rubber weir locations.

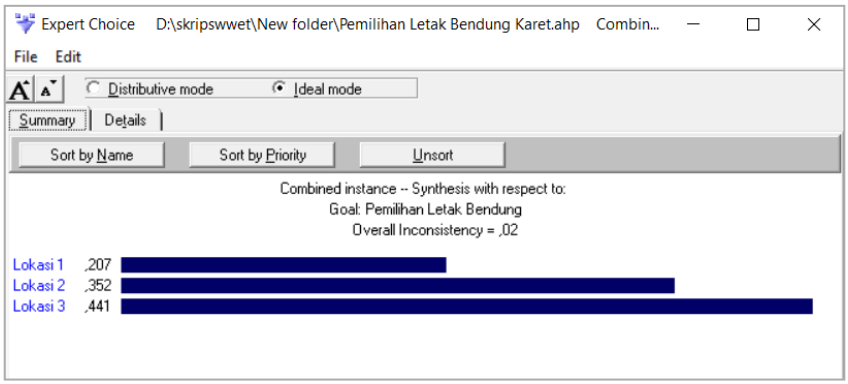

Figure 5. Comparison Results of Alternative Rubber Weir Locations against All Criteria

Comparison of alternative locations based on all criteria produces a consistency ratio value of 0.02. The comparison values between alternative locations are location 3 (0.441), location 2 (0.352) and location 1 (0.207). From these final results it can be concluded that according to the overall criteria, the most favored alternative type is location 3 with a weight of 0.441 or a percentage of 44%. In second place is location 2 which has a weight of 0.352 with a percentage of 35%. Meanwhile, in third place there is location 1 with a weight of 0.207 or a percentage of 21%.

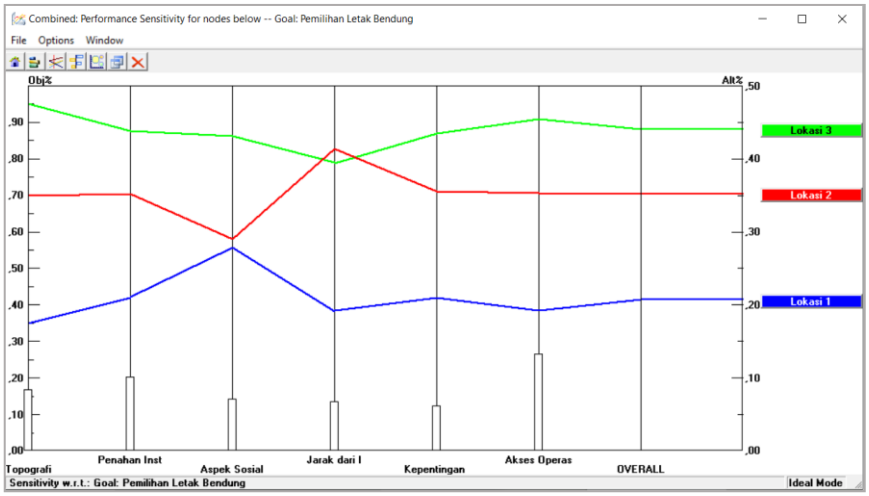

Figure 6. Relative Priority Graph

Based on the Relative Priority Graph in Figure 6, it can be seen that location 3 is the main priority most recommended by experts. Location 2 is the second priority that can be considered as a location for placing rubber weirs. Meanwhile, location 1 is the third priority considering that access to the location is quite difficult. Location 3 is the best alternative as a location to build a rubber weir, because this location has a straight river route, easy access and does not interfere with fishermen's activities.

CONCLUSION

Based on the research results, it was concluded that a). The selection of the location of the rubber weir is based on the results of analysis of criteria and alternatives using the Analytical Hierarchy Process method. The criteria used include considerations of topography, resistance to sea water intrusion, social aspects, distance from water management installations, importance of fishing boats, and ease of operational access. The most important criteria start from ease of operational

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access (0.260), resistance to sea water intrusion (0.197), topographic considerations (0.161), social aspects (0.136), distance from water management installations (0.129), and the last one is the importance of fishing boats (0.117). b). There are 3 alternative locations for placing rubber weirs. Location 3 is an alternative that is the first priority as a location for a rubber weir with a weight of (0.441), location 3 has a straight river route and easy access. The second priority is location 2 (0.352) which has easy access but the distance between residents' houses and the river bank is close, and the third priority is location 1 (0.207) which has a curved river route and access that can only be passed by pedestrians.

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