Technical Study Potential River Utilization for Improvement of Clean Water Services in Tabanan District

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Abstract: Tabanan Regency is one of the regencies located in the southern part of Bali Province which has limitations in terms of developing clean water services. This problem occurs because of the limited potential that is owned both in terms of springs, groundwater and from the potential of rivers that can be utilized. In 2021, the population in Tabanan Regency is 462,652 people and around 70% of the local drinking water companies (PDAM) have served them. In some remote areas that have not been handled by PDAMs, the supply of clean water for the population is fulfilled by non-PDAM clean water or rural PAM (PAM des) with the current service level reaching 23.87%. Population growth is one of the most important contributors to the increasing demand for clean water in the future. Based on observations that have been made, it shows that there are still several rivers in this area that can be used for the purpose of fulfilling clean water. However, until now there has been no definite study that can provide information related to the inventory of potential rivers that can be utilized. Therefore, it is very necessary to carry out an in-depth analysis of the potential of water that can be utilized for the development of clean water services in the future. Existing problems: how many rivers are there in Tabanan Regency, how many potential rivers can be developed in the future, how is the potential river development system in the development of clean water services. This research is a quantitative research using inventory method and direct flow measurement in the field to find out the actual condition of the river's potential. This potential is associated with the need for clean water based on the projected population growth. The results showed that there were 39 rivers in Tabanan Regency. Of the 38 rivers, there are 3 rivers that have the potential to be developed in the future for the use of clean water downstream, namely the Yeh Hoo, Yeh Empas and Balian rivers. If only 10% of the river's discharge can be utilized, it will be able to meet the water needs of Tabanan Regency for current needs.

1 INTRODUCTION

Population development and the expansion of urban areas that continue to increase in Tabanan Regency requires an increase in the amount of water that must be provided. The current provision of clean water is provided by the regional drinking water company (PDAM) Tabanan Regency with a capacity of 644.90 liters/second with a service coverage of 70%. Until now, the main source of PDAM Tabanan comes from groundwater through deep wells which are spread over four service units. On the other hand, the population that is not served by PDAM uses water through PAM des with the current coverage reaching 23.87%. Currently, the largest community drinking water company (PAM des in) Tabanan Regency is in the eastern part, namely in Marga District.

The limited springs and groundwater in the area is also followed by the limited number of rivers. River inventory data from the Bali Penida River Basin Council states that Tabanan Regency has 129 springs that have been used by PAMdes and 39 rivers, both in the Tabanan Regency area and those that cross with other regencies. Of course, the number of rivers is very small compared to the total number of rivers in Bali of 391. From this limited river, there are only a few rivers that still have discharge throughout the year. Taking groundwater as the main source of clean water in the long term has a negative impact on health and environmental sustainability.

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The population growth continues to increase while on the one hand the available water potential is very limited, so it is very necessary to conduct a study related to potential rivers that can be used as a source of clean water. It is necessary to conduct an in-depth study related to the position of the river and the possibility of its development in the future. The study from this research is expected to be able to answer: how many rivers are there in Tabanan Regency, how many rivers are potential that can be developed in the future and how is the development system the potential river in the development of clean water services.

2 METHOD

The research implementation is generally carried out in the form of instantaneous discharge measurements and calibration implementation. The instantaneous discharge measurement is carried out by using the one-point method into the water with several drains. The determination of the number and width of the drain is adjusted to the width of the existing channel in the field. The density of the inter-pias point determines the level of accuracy of the discharge measurement, but in this study the width is satisfied every 20 cm. Instantaneous discharge measurements were carried out 10 times with different discharge variations. While the calibration analysis is done by determining the average coefficient value of each measurement that is produced. From the 10 times the flow coefficient, the trendline analysis was analyzed to get the average flow coefficient value.

Surveys, Field Observations, Data Collection and Analysis

1. Conduct a field survey to determine the condition of the river as follows:

The survey was conducted on several rivers that currently have potential, especially in the estuary. The data to be searched includes:

a. River location
b. Condition of river morphological characteristics
c. The potential that exists today

2.1 Data Collection

Secondary data collection is carried out by collecting data from related agencies such as:

a. Bali Penida River Basin Center: the data sought is related to river administration, river length, river watershed area. Utilization of existing watersheds, Policies in river development in Bali
b. Tabanan Regency Public Works Agency: the data sought is related to the pattern of river water utilization for irrigation, clean water and flood control systems
c. Regional drinking water company in Tabanan Regency: searched data related to water production and capacity, water sources, development plans, community drinking pair data
d. Community drinking water companies in each sub-district: the data sought is the current production and water sources

2.2 Stages of Analysis

Stages of analysis carried out starting from the analysis of the potential to the analysis of the development plan. In more detail, the analysis carried out is as follows:

2.2.1 Theoretical Analysis of River Potential

The scarcity of water resources is increasingly becoming apparent along with the increase in population and the reduction in green open space as a catchment area. In the past, springs were the prima donna of clean water sources that became a reference for many residents to get water. Along with the passage of time and the enormous interest in water, at this time there are not a few remaining potential rivers in the downstream to become an alternative in developing raw water for clean water services (Lisa Guppy; Kelsey Anderson; Mehta; P.; Nagabhatla; N . and and M. 2017), (Marshall 2011), (National Research Council 2011). Rivers are places and containers as well as a network of water drainage from springs to estuaries, bordered on the right and left and along its flow by a border line. The potential of water in rivers is associated with the amount of water that is available and has the possibility to be utilized. Utilization can be used for various purposes both for irrigation, industry, clean water services and other purposes. (Eryani 2014), (Hasbiah and Kurniasih 2019), (Maulana 2017). After the development of infrastructure for water utilization through buildings such as reservoirs, dams, reservoirs and others, this potential turns into the availability of water or water that is ready to be utilized (Sanim 2011), (Law Number 17 of 2019 2019), (Zhao et al. .2020). River utilization is closely related to several factors, namely water discharge, elevation, flow and water quality (B. Setiawan et al. 2015). Judging from the continuity of its flow, rivers can be divided into three groups, namely those that flow throughout the

year (pharenial), those that flow during the rainy season (ephimeral) and those that flow when it rains (intermittent) (Savitri and Pramono 2017).

2.2.2 Water Demand Analysis

Increased development in all aspects has an impact on increasing water in terms of quantity and quality. In urban areas, where most of the area has been built, green open space is getting narrower and in general there is a decrease in infiltration. This decrease in infiltration has an impact on decreasing water reserves in the soil. In several countries, clean water services in urban areas are mostly met from services sourced from groundwater (Deo Volentino 2013), (Rejekiningrum 2009), (Susanto, Rusdianto, and Sawir 2014). With limited groundwater that can be utilized, the role of rivers becomes very large as a source of clean water. Water needs are generally divided into 2 groups, namely domestic water needs, namely water needs for daily needs and non-domestic water needs, namely outside water needs for daily needs such as education, trade, offices, health facilities, tourism facilities and others. other. (Yamamoto at al 2021), (Vairavamoorthy 2007), (Twort 2003), (Sukartini and Saleh 2016).

Domestic water demand is determined in liters/person/day which is strongly influenced by population, temperature and population welfare. An increasingly dense population, higher temperatures and better welfare have resulted in greater per capita water needs. Likewise, non-domestic water needs are influenced by the type of designation, such as for tourism, the use of water in star hotels is greater than the use of water for jasmine hotels. Likewise, the food and beverage industry requires more water than the clothing industry, for example (Cole 2012), (Lu 2007)

2.2.3 Analysis of Population Projection

Projection of population growth is needed to calculate the size of the population in the future. Population projections can be carried out using several calculation methods, namely arithmetic, geometric and exponential (BPS 2010).

a. Arithmetic Method

Population projections using the arithmetic method assume that the population in the future will increase by the same amount every year.

b. Geometric Method

Population projection using the geometric method uses the assumption that the population will increase geometrically using the compound interest calculation basis. The rate of population growth (rate of growth) is considered the same for each year. The following formula is used in the geometric method.

c. Exponential Method

This method takes into account the faster population growth which is growing exponentially.

2.2.4 Potential Analysis

Determination of river potential can be done by empirical analysis through the transfer of rain that falls on a watershed and through direct discharge measurements through instantaneous discharge measurements (Indra 2012), (Bawantu 2018), (Ri. Setiawan and Purwanto 2018).

3 RESULTS AND DISCUSSION

3.1 Drinking Water Fulfilment System in Tabanan Regency

In addition to providing drinking water from regional drinking water companies in Tabanan district, there is also a rural drinking water supply system in 9 (nine) sub-districts, including Kerambitan sub-district, Tabanan sub-district, Penebel sub-district, Selemadeg sub-district, West Selemadeg sub-district, East Selemadeg sub-district, Marga sub-district, Baturiti and Pupuan sub-districts. Total services from community drinking water companies are able to serve as many as 75,343 reaching 23.87%.

Services for regional drinking water companies in Tabanan Regency:

1) Tabanan Regency PDAM Production System

   The general description of the existing clean water supply system of PDAM Tabanan Regency is as follows:

2) Tabanan City Unit and Kediri District

   For city services in Tabanan District, the raw water sources used are Gembrong Springs, Gangsang Springs, and Beji Riang Gede Springs. The distribution system for the cities of Tabanan and Kediri is still largely one unit. The raw water sources for the service of the city of Kediri sub-district are from the Dedari Spring, Beji Nyambu Spring, Yeh Nu Drilling Well, and IPA Nyanyi. The production capacity of drinking water for services in the cities of Tabanan and Kediri is currently very limited and the development of the distribution network is highly dependent on the

utilization of available resource capacity. The available source capacity is 1,973.30 lt/sec, the installed capacity is 455.3 lt/sec. From the installed capacity, it is only able to produce a production capacity of 362.79 lt/sec. From that production capacity, it is only able to serve 28,988 house connections (SR).

3) Selemadeg Unit

The service areas of the Selemadeg Unit include Bajera Village, Wanagiri Village, Belimbing Village, Lalanglinggah Village, Pupuan Subdistrict City Installation (IKK), and Mundeh. The distribution system at the Selemadeg unit utilizes the nearest water source to the service area. The springs used by MA Kikihan, IPA Antap, MA Makori, MA Pangkung Kidang, MA Arca I and II, IPA Lalanglinggah, MA Beji Pujungan, MA Yeh Hae, and MA Beji Dukuh. The available source capacity is 315.51 lt/sec, installed capacity is 70.80 lt/sec. From the installed capacity, it is only able to produce a production capacity of 52.92 lt/sec. From that production capacity, it is only able to serve 5,454 House Connections (SR).

4) Ambition Unit

Service areas in the Kerambitan unit include Batuaji Village, Tanguntiti Village, Megati Village, Gadungan Village, Gunung Salak Village, IKK Kerambitan. The raw water sources used in this system are MA Beji Panes, IPA Telaga Tunjung, IPA Selemadeg, MA Kelepud Gadungan, MA Tista Gn Salak, MA Riang Gede plus Tibu Ranjang, and MA Kerotok. The available source capacity is 290.00 lt/sec, the installed capacity is 122.40 lt/sec. From the installed capacity, it is only able to produce a production capacity of 107.74 lt/sec. From that production capacity, it is only able to serve 10,750 House Connections (SR)

5) Defender Unit

The service areas included in the Penebel unit are IKK Penebel, IKK Marga, Penatahan Village, and Apuan Village. The raw water sources for IKK Penebel and Penatahan Village come from springs Gembrong, MA Katos, MA Gangsang, and MA Pangangian. As for IKK Marga services, they come from Gangsang Springs, Dedari, and Apuan Villages with Pangangian springs. The available source capacity is 185.00 lt/sec, installed capacity is 51.50 lt/sec. From the installed capacity, it is only able to produce a production capacity of 48.24 lt/sec. From that production capacity, it is only able to serve 4,661 house connections (SR).

6) Baturiti Unit

Service areas in this Baturiti unit include East Perean Village, Luwus Village, Candi Kuning Village, Baturiti Village, Perean Village and Mekar Sari Village. The springs used are Lake Beratan (Candi Kuning), Lake Baratan (Baturiti), MA Tasakan, MA Kacagan 1 and 2, MA Kerobokan, and MA Beji Temacun. The available source capacity is 118 lt/sec, the installed capacity is 100 lt/sec. From the installed capacity, it is only able to produce a production capacity of 73.21 lt/sec. From that production capacity, it is only able to serve 6,156 house connections (SR).

3.2 Potential Rivers in Tabanan Regency

Most of the rivers in Tabanan Regency come from Lake Beratan which is at the top. Overall, the number of rivers in the province of Bali is 392 watersheds as shown in Table 5.15. Based on this number, there are 39 rivers in Tabanaan Regency or part of its territory in other regencies.

The criteria for potential rivers are more emphasized on the water discharge that is still in the estuary during the dry season. The existing debit can at least be a source for the development of raw water services by PDAM Tabanan. Based on observations, observations and direct observations in the field, 3 rivers have the potential to be used for their water downstream, namely:

1. Yeh Empas River
2. Yeh Ho . River
3. Balian River

1. Yeh Empas River

Yeh Empas River has a river length of 107.53 Km2 and the length of the main river is 32.84 Km. This river empties into the Yeh Gangga beach. From the results of the measurement of the instantaneous discharge, it was obtained that it was 6.15 m3/sec.

2. Yeh Hoo River

Yeh Hoo River has a river length of 172.94 Km2 and the length of the main river is 45.15 Km. This river empties into the Kedungu beach. From the results of the measurement of the instantaneous discharge obtained at 0.95 m3/sec.

3. Balian River

The Balian River has a river length of 155.02 Km2 and the length of the main river is 30.12 Km. This river empties into the west coast of Tabanan City. From the results of the measurement of the instantaneous discharge obtained at 0.95 m3/sec. After measuring the instantaneous discharge, the river's discharge was 8.02 m3/sec.

3.3 Population Condition of Tabanan Regency

Tabanan Regency as a district with an agricultural area supported by water sources from Lake Buyan, Lake Tamblingan and Danu Beratan is an area in Bali Province with considerable agricultural potential, in addition to this area as a tourist attraction including Bedugul tourism objects, Tanah Lot etc. Tabanan Regency has a population of 445,700 people in 2019 and based on the projected population in 2031 the total population of Tabanan Regency is 478,919 people. The percentage of the total population in Bali Province in 2019 was 10.272%, in 2031 it was 9.657%, by only occupying an area of 14.891% (839.330 km2) of the total land in Bali Province (Central Statistics Agency, 2020). In terms of quantity, the current population growth rate of Tabanan Regency is 0.59%. Tabanan Regency with a population density in 2019 was 531 people/km2, and in 2031 it was 571 people/km2.

Table 1: Recapitulation of Tabanan Regency's Total Clean Water Needs in 2020, 2025, 2030, 2035, and 2040.

Year	2020	2025	2030	2035	2040
Population projection	448,000	461,692	475,985	490,913	506,511
Total Water Demand Capacity Average (litre/second)	825,27	980,28	1,059,04	1,102,53	1,138,90

Tabanan Regency has experienced a shortage of clean water since 2020, and the shortage is getting bigger with the assumption that the existing production capacity of clean water will remain until 2040. Clean water production in Tabanan Regency reaches 644.9 liters/second 2020. If the potential of the Yeh Empas river, Only 10% of the Balian and Yeh Hoo rivers can be utilized, so the amount is 1,524 m3/sec, which is bigger than the projected water demand in 2040.

4 CONCLUSION

Based on the results of the analysis that has been carried out, it can be concluded several things as follows:

1. Based on the results of data analysis in Tabanan Regency, there are 38 watersheds and there are only 3 potential watersheds to be developed, namely Yeh Empas river, Yeh Ho River and Balian river
2. Based on the measurement of the instantaneous discharge, the potential magnitude of each river is obtained as follows: Yeh Empas 6.15 liters/sec, Yeh Ho 0.95 liters/second and Balian 8.02 liters/second
3. The design of the potential river development emphasizes the addition of raw water for PDAMs to reduce dependence on raw water sources from groundwater.

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