Clean Water Supply Policy to Support Tourism Activities in Gianyar Regency

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Abstract: Gianyar is one of the districts with the most tourist visits in the Province of Bali. In this area there are several tourism objects that are well known throughout the world with the center of development in the Ubud area. Tourist visits based on the strategic study of the Gianyar Regency tourism office in 2018 amounted to 4.3 million people with an estimated water need of 71.94 liters/second. The development of tourism causes an increase in the need for water provided in the future. Water provided for various purposes such as hotels, villas, restaurants and other tourist facilities the tourism sector has a big influence on the regional income of Gianyar Regency so that the Gianyar Regency Government carries out various efforts to develop facilities continuously. One important issue that needs careful attention is a reliable clean water supply system in terms of quantity, quality and continuity. At this time the largest use of water in Gianyar Regency is used for agricultural activities, especially irrigation for rice plants. The problem in this research is the strategy of meeting the increasing demand for clean water in Gianyar Regency which is caused by the growing population and tourism sector by utilizing the potential of rivers and deep wells that can be developed.Furthermore, water users that are quite large are the use of domestic water for the community and non-domestic water, especially for tourism. Based on the analysis, in 2020 the shortage of clean water is 298.27 liters/second and it is estimated that in 2030 the shortage of clean water is 398.88 liters/second. This research was conducted using the method of inventorying water resources, analyzing water needs, fulfillment systems, infrastructure and policies from the Gianyar district government. Currently, the main source of water from the regional drinking water company in Gianyar Regency is ground water and from springs taken upstream in the Tampaksiring area. On the other hand, water sources in the form of river water are still widely available and have not been utilized optimally in the downstream. The purpose of this study is to determine a strategy for fulfilling water in Gianyar Regency by utilizing the current potential either through rivers or groundwater by making deep wells. The fulfillment of water in the future can be done by utilizing water downstream of the river with a very large potential, namely 25.55 m^3/second and with the construction of deep wells in the southern region.

1 INTRODUCTION

The tourism sector is one of the leading sectors of the Gianyar Regency Government to obtain regional income in addition to other sectors such as agriculture and trade (Gianyar Regency, 2018) (Sudarmini, Sri Widari and Sukartini, 2017). This sector has a great influence in absorbing labor and has an effect on other sectors. Gianyar with the Ubud tourism area has become an icon of world tourism that brings in both domestic and foreign tourists (Suhendra, Agung and Maba, 2019). In an effort to increase the competitiveness of the tourism sector in Gianyar Regency, various arrangements related to facilities and infrastructure have been carried out, one of which is through a sustainable clean water supply system in coordination with other agencies. The clean water supply system concerns water potential, water availability and its development system.

In general, non-domestic water needs are calculated based on domestic water needs which range from 20-25 percent, but in some cases this amount can be exceeded due to very high non-domestic needs. Under these conditions, careful mapping is needed regarding the potential that can be utilized and a tourism development system based on

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a balanced tourism development system by taking into account the existing carrying capacity.

The growing population and the development of the tourism sector require an increase in the amount of water in the future. Preliminary studies that have been carried out show that up to now there is a large water potential with a total discharge of 25.55 m^3/sec in five rivers in the southern part of Gianyar is very potential to be developed as raw water. In addition, the alternative of making deep wells can be one solution in increasing the amount of water needed. With this condition, it is very necessary to conduct an analysis of the clean water supply policy in Gianyar regency to support tourism activities as a leading sector.

2 METHOD

The research was conducted by collecting primary data in the form of instantaneous discharge measurements carried out on five rivers. Secondary data was obtained from the recognized institutions, namely the regional water supply company, the Bali Penida River Council and from the Central Statistics Agency. From the data collected, an analysis is carried out to determine the existing water potential, water needs for the community and water needs for tourism and water loss during distribution. Based on the calculation data, it is found that the availability of water and the demand for it are the basis for the water management policy in Gianyar Regency. The research workflow is more clearly shown in Figure 1 below

The proposed hypothesis is that the increase in the need for clean water due to the development of the population and the tourism sector can be met by utilizing the potential of five rivers in the southern part of Gianyar Regency and by developing deep wells.

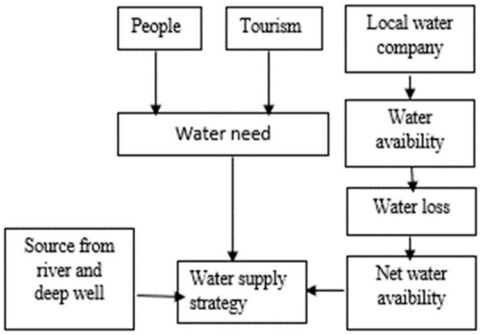

Figure 1: Research activity flow.

3 RESULTS AND DISCUSSION

3.1 Water Supply System

The clean water service system in Gianyar Regency is divided into two groups, namely those organized by the Regional Drinking Water Company and organized by the community or often called rural drinking water companies.

3.2 Water Resources

The sources of water used in the drinking water supply system of the regional drinking water company of Gianyar Regency are 55 water sources, with details of 10 springs that use pumps, 3 springs that use gravity, and 42 drilled wells. In general, it can be seen that the water source used by the regional drinking water company of Gianyar Regency is still concentrated in the central region, while in the southern part it is more dominant to use the drilled well system. Utilization of water sources whose distribution system uses the pump method is generally evenly distributed in the northern region. The use of this pump method tends to be caused by the undulating topography of the area so that the water distribution cannot use the gravity method. The condition of topographic factors also has an impact on the lack of use of the gravity method by regional drinking water companies in Gianyar Regency.

The regional drinking water company in Gianyar Regency utilizes two water treatment plants (WTP), namely Bali Bangun Tirta.Ltd (BBT WTP) and the Petanu Integrated Service Unit (PISU). The raw water treatment is in collaboration with the private sector and the Bali Provincial Government. Currently, the available capacity for BBT WTP is 200 liters/second, but that is utilized by regional drinking water companies of 162.62 liters/second. On the other hand, the PISU has an available capacity of 50 liters/second, but the utilization is 14.92 liters/second. The BBT WTP supplies water to the Gianyar Regency in eleven zones, while the Petanu WTP supplies water to the Gianyar, Badung and Denpasar areas.

Production efficiency is the real production volume in m^3 compared to the installed capacity in m3 owned by Gianyar regional water company. The current source capacity is 784.44 liters/second or 24,399,532 m^3 with an installed capacity of 866.25 liters/second or 26,463,965 m3. With an installed capacity of that size, it is only able to produce a real production capacity of 743.72 liters/second or 23,391,194 m3. Thus, the production efficiency of Gianyar Regional water is 88.39%. Source, installed

and production capacity of Gianyar Regional water company can be seen in Table 1.

Table 1: The water source of the regional company of the Ginayar district.

No	Sub Distric	Capacity (liters/second)		
		Source	Istalled	Produkction
1	Gianyar	193.84	223.60	178.96
2	Blahbatuh	99.21	116.26	106.22
3	Sukawati	149.56	156.78	136.75
4	Ubud	36.44	44.76	35.78
5	Payangan	188.78	189.08	181.98
6	Tegalalang	42.20	45.95	39.35
7	Tampaksiring	74.41	89.82	64.68

Source: Gianyar Regional Water Company, 2021

3.3 Water Quality Analysis

Sampling of water quality is carried out on several rivers that have sufficient discharge downstream. The rivers are Sangsang, Pakerisan, Melangit, Petanu and Oos rivers. Water quality must comply with physical, chemical and biological standards. In general, river water quality still meets the requirements to be used as raw water (WHO, 2017) (Murcott et al., 2015) (Gu *et al.*, 2014) . Several parameters seen in this water quality test are physical (DHL, TSS, turbidity), chemical (PH, $KMNO_4$, BOD_5, Zn) and bacteriology (E-Coli). Herschy, 2012), (Sandiford et al., 1989), The complete water quality test results are as follows:

1. Physical requirements (Physical Parameters)
In this case, it is obtained a further understanding of the elements contained in the physical requirements of raw water quality including Electrical Conductivity (Conductivity), Turbidity (Turbidity), Total Dissolved Solids (TSS: Total Suspended Solid)
a. DHL (Electrical Conductivity)
The result of the highest water quality test for DHL (Electrical Conductivity) in the Tukad Melangit River is 1,173 mg/ltr, exceeding the established Environmental Quality Standard.

b. Turbidity
Normal turbidity in river water ranges from 0.01 to 20 Newton Total Units (NTU) equal to milligrams per liter. The requirements in the Bali Governor Regulation Number 16 of 2016 Environmental Quality Standards stipulate the standard set for raw water is 5 milligrams per liter, while if we look at the Regulation of the Minister of Health of the Republic of Indonesia Number 32/Menkes/Per/VI/2017 Environmental Health Quality Standards and Requirements Water for Sanitation, set at 25 milligrams per liter. In the test results the Petanu and Oos rivers have turbidity qualities of 43.3 and 29.6 milligrams/liter, both rivers from 5 (five) rivers in Gianyar exceed the established Environmental Quality Standards.

c. TSS (Total Suspended Solid) Total Suspended Solids
The amount of dissolved solids can give an unpleasant taste to the tongue, nausea caused by sodium sulfate, magnesium sulfate and can cause cardia disease toxemia in pregnant women. The value indicated in the Environmental Quality Standard is 1000 milligrams per liter and all rivers in Gianyar Regency are still far below the Environmental Quality Standard.

2. Chemical Terms
Chemical substances dissolved in excessive drinking water, apart from being toxic, can also damage concrete materials, pipes, household appliances and others. Therefore, it is necessary to limit the content of chemical substances, including:

a. Degree of Acidity (pH) and Total Hardness (Total hardness)
pH is a term used to express the intensity of the acidic or basic state of a solution. In water supply, pH is one of the factors that must be considered because the degree of acidity of the water will greatly affect the processing activities to be carried out, for example in chemical coagulation, disinfection, softening of water and in preventing corrosion.

As an environmental factor, the degree of acidity is a very important factor because pH can affect the growth of microbes in water. Most microbes will grow well in a pH of 6.0 – 8.0, besides that pH will also cause chemical changes in water. If the pH is greater or less than that, it will cause corrosion in water pipes made of hardness in water, most of which comes from soil contact and rock formation. All pH for rivers in Gianyar Regency are still within the threshold of the established Environmental Quality Standards.

b. Organic Substance (as $KMnO_4$)
Organic substances contained in water include those from nature (eg vegetable oils, oil fibers, animal fats, cellulose alcohol, sugar, starch and so on), from synthesis (eg various compounds and fruits produced from processes in water). factory), from fermentation (eg alcohol acetone, glycerol, antibiotics, acids and

the like derived from the activity of microorganisms on organic materials).

Organic substances in water are caused by wastewater from households, agriculture, industry and mining as described above, their presence in water can be measured by the number of permanganate (KMnO4). The health effects that can be caused by deviations from this standard are the emergence of an unpleasant odor and can cause stomach pain. The content is under the Regulation of the Minister of Health of the Republic of Indonesia Number 32/Menkes/Per/VI/2017 Environmental Health Quality Standards and Water Requirements for Sanitation set KMnO4 is 10 milligrams per liter. The reading on the tool is still far below the Quality Standard, which is 1.75.

c. BOD (Biological Oxygen Demand)
The results of the overhaul of organic substances by certain bacteria will produce mineral substances, one of which is aggressive CO2. This substance is soluble in water so that it can cause corrosiveness to metal water pipes. This CO2 gas can be removed by aeration process and adding CaO or both. The five rivers in Gianyar exceeded the Quality Standards for the BOD5 value with results above 50 milligrams per liter, where the Regulation of the Minister of Health of the Republic of Indonesia Number 32/Menkes/Per/VI/2017 Environmental Health Quality Standards and Water Requirements for Sanitation states the threshold value is 12 milligrams per liter . Both the Jinah and Unda rivers exceed the Environmental Quality Standards.

d. Zinc (Zn)
The element of iron in water in a certain amount is needed by the human body for the formation of red blood cells, but excess of this element will cause an odor and a reddish color change so that the water is not pleasant to drink, but it can also form deposits in pipes. metal and laundry. The test results for Zinc are still far below the Environmental Quality Standards.

3. Microbiological requirements (E-Coli)
Environmental pollution by biological contaminants must be prevented because it can pose a hazard to public health. So that drinking water must be free from parasitic germs and pathogenic bacteria at all as well as coli group bacteria to exceed the predetermined limits, namely 1 coli. Rivers in Gianyar Regency detected more than 100 E-Coli bacteria. These results were read from samples taken per 100 milliliters of water sample and allowed to stand for 5 days. This result is still below the Environmental Quality Standard for river water treatment as raw material.

3.4 Projected Population and Water Demand

3.4.1 Population Projection

Population projection is one way to estimate the amount of water needed in the future. From the population data range from 2010 to 2019 it is known that the population growth rate in Gianyar Regency is 0.89% which includes Sukawati District 1.37%, Blahbatuh District 0.95%, Gianyar District 0.89%, Tampaksiring District 0.64%, Ubud District 0.72%, Tegalalang District 0.682%, Payangan District 0.50%. The population of Gianyar Regency in 2019 was 512,200 people which included Sukawati District 125,470 people, Blahbatuh District 72,140 people, Gianyar District 94,580 people, Tampaksiring District 48,740 people, Ubud District 74,320 people, Tegalalang District 53,760 people, Payangan District 43,190 people.

3.4.2 Water Demand Analysis

Domestic Water Needs
The need for water for households/domestic is the use of water for activities in the household environment. Provision of raw water for household purposes is calculated based on the population, the percentage of the population to be served, the method of water service, the consumption of water usage (L/person/day) (Lu, 2007) (Pender, 1998) (Asian Development Bank, 2016)

Non-Domestic Water Needs
What is meant by water needs for non-domestic purposes is the use of water other than household use. Included in the group of water needs for non-domestic purposes include commercial, health, social, office, education and worship. Non-domestic water needs are calculated at 20% of domestic water needs.

3.4.3 Water Loss

In the provision of clean water, it is very difficult to avoid possible water loss from the system. Water loss is caused by technical and non-technical factors. Technical factors, including pipe leaks and water meter damage. Meanwhile, non-technical factors include meter reading/recording errors and addition/subtraction errors. In planning a clean water supply system, a volume of water is always taken into

account to avoid the possibility of water loss. This is intended so that the supply of water for consumers will not be disrupted in the event of water loss either caused by technical factors or by non-technical factors. Pipeline water losses in Indonesia are assumed to be 20%-30% of the average population's clean water needs. This amount of water loss is estimated to be constant from the beginning until the design year. The complete population and water demand projection table can be seen in Table 2

Table 2: Population projection table and water demand.

No.	Description	Unit	Year	
			2020	2030
1	Population	People	516,300	563,646
2	Percentage Service	%	85	95
3	Serviced Residents	People	438,885	479,099
4	Consumption Rate	liter/people/day	150	150
5	Domestic Water Needs	liter/second	762,00	832,000
6	Non Domesctic Water Needs	liter/second	152,00	166,00
7	Non Doestic Percentage	%	20	20
8	Total Water Needs	liter/second	914	998
9	Water Loss	liter/second	183	200
10	Water Loss	%	20	20

Source: Analysis,2021

3.4.4 Water Balance Analysis

The availability of water that has been sought in Gianyar Regency is currently 743.72 lt/s from the regional drinking water company in Gianyar Regency and 55.15 lt/s from the community. Based on the projected water demand and water availability in Gianyar Regency, the Water Balance can be calculated as shown in the Table. 3

Table 3: Water Balance.

No	Description	Unit	Year	
			2020	2030
1	Production Of Local water company	liter/second	743.72	743.72
2	Production Of Non Local water company	liter/second	55.15	55.15
3	Water Needs	liter/second	1097.14	1197.75
4	Balance	liter/second	298.27	398.88

Source: analysis, 2021

3.4.5 River Water Potential

The potential of water in several rivers downstream of Gianyar Regency is still possible to be developed into raw water reserves. Potential measurements were carried out using the instantaneous discharge measurement method (Dastorani et al., 2013), (Clasing and Muñoz, 2018). Based on the results of instantaneous discharge measurements in the field, the average discharge in five rivers in Gianyar Regency is 5.11 m3/sec with the largest discharge in the Sangsang river at 7.97 m^3/second and the smallest discharge in the Melangit river at 2, 23 m^3/second. Complete data regarding the potential for the downstream of the river as shown in Figure 2 below:

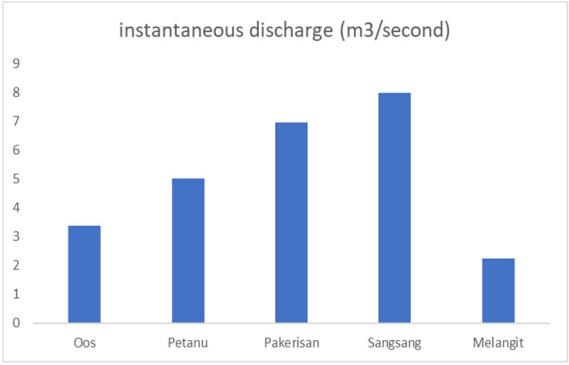

Figure 2: Instantaneous discharge measurement results.

3.4.6 Tourism Water Needs in Gianyar Regency

Gianyar Regency is one of the main tourist destinations in Bali Province with an estimated tourist arrivals visiting this area in 2018 of 4.3 million people consisting of 2.5 million foreign tourists and 1.8 million domestic tourists. The center of tourism activities in Gianyar Regency is the Ubud area with Ubud Palace as the center of its activities. Outside the Ubud area, there are many tourist attractions such as the Tirta Empul Temple Complex, Goa Gajah, Gung Kawi Temple Complex, Tegenungan Waterfall, Bali Safari And Marine Park, Bali Zoo and tourist villages scattered in almost all areas. Likewise, this area has been supported by an art market that sells various souvenirs for tourists.

Based on data from the Tourism Office of Gianyar Regency in 2015, there were 22 star hotels and 367 non-star hotels with a total of 11099 rooms. From the analysis carried out with the assumption that the water requirement for rooms is 400 liters/room/day, the amount of water needed based on the number of rooms is 51.38 liters/second. The water requirement for villas is 10.28 liters/second, the need for restaurants and bars is 5.14 liters/second and the water needs for tourism purposes is 5.14 liters/second, so the total water demand for tourism in Gianyar Regency is 71.94 liters/second. This value is smaller than the allocation of non-domestic water needs in Gianyar Regional water company which is 152.78 liters/second in 2020.

3.4.7 Plan to Improve Water Supply in Gianyar Regency

Based on the analysis of the water balance for the time period 2020 to 2030, the results show that there is still a shortage of drinking water for the community. As previously mentioned, water supply in Gianyar Regency is carried out through regional companies and the community, both by pipelines and non-pipeline networks. Meanwhile, regional companies are further divided into 7 service units for each sub-district. The plan for the development and improvement of drinking water services will be based on the area of the service unit as follows:

1. Gianyar region
The current production capacity of raw water sources is 157.59 liters/second. It can still serve until 2020 with a service level of 85%, while the projected water demand in 2030 is 264.53 liters/second, requiring additional water supply of 106.94 liters/second. second. This additional water supply is carried out by optimizing existing water sources owned by regional companies and by utilizing the Geroh spring and water from the Unda river.

By optimizing existing water sources, it is expected that water production can be increased to 160.27 liters/second. The Geroh Spring is located in the upstream of Pakerisan river with a water discharge ranging from 35 to 40 liters/second with small springs around it which when combined, the spring discharge becomes 75 liters/second. The discharge to be taken is based on the projected water demand in 2030, which is 60 liters/second. Water will be accommodated in the Madangan distribution reservoir with an increase in reservoir capacity from 500 m3 to 1000 m3 which is flowed by gravity. In addition, the WTP development plan on the Unda River is expected to provide an additional discharge of 50 liters/second. Water from the Unda river will be accommodated in the Bukit Jati Distribution Reservoir with an additional capacity from 500 m3 to 1000 m3 and flowed through gravity.

2. Blahbatuh region
The current capacity of raw water produced is 61.63 liters/second. To increase the production capacity to meet the demand in 2030 with a service level of 95%, an additional discharge of 132.81 liters/second is required. Efforts to meet these water needs can be done by utilizing water from the Petanu River WTP and building a reservoir in Wanayu with a capacity of 250 m3 and optimizing existing water sources. By optimizing existing water sources, water production can be increased to 66.20 liters/second. WTP in Petanu river provides additional water supply of 50 liters/second. Construction of a reservoir in Wanayu with a capacity of 250 m3 with a Wanayu discharge of 24.18 liters/second.

3. Tegalalang region
The current production capacity of raw water is 69.8 l/s serving Kedisan Village, Kenderan Village, Keliki Village, Tegalalang Village. In 2030, according to the projected results, the water required is 87.42 liters/second so that an additional water supply of 17.62 liters/second is needed. For Taro Village, Sebatu Village and Pupuan Village, drinking water services are optimized by using services from the community. Additional fulfillment of drinking water supply can be obtained by utilizing the Bayad spring located in Kedisan Village. The water discharge at the Bayad spring is 75 – 90 liters/second. The Kedisan Distribution Reservoir is used for water storage by increasing the capacity from 50 m3 to 100 m3 which will then be distributed by gravity.

4. Sukawati region
The current drinking water production capacity is 136.76 liters/second. Based on the projected drinking water needs, with service coverage 85% of water needs will be fulfilled until 2021. In 2030 water demand will increase to 285.54 liters/second so that additional supply is needed. water is 148.78 liters/second. Additional water supply is planned to utilize water from the Tukad Petanu WTP, increase the capacity of the Abianseka reservoir and optimize existing water sources. By optimizing existing water sources, water production can be increased to 141.49 liters/second. Utilization of water from WTP in Petanu river will provide additional water supply for Gianyar Regency by 50 liters/second. In Sukawati District, the water supply from the Petanu River WTP is used at 25 liters/second. To maximize the flow of water by gravity, it is necessary to build a distribution reservoir in Batubulan Kangin Village with a capacity of 250 m3. Increased Abianseka Reservoir Capacity with an existing capacity of 200 m3 to 1000 m3 which will accommodate water from the Lodtunduh well at 9 liters/second, Abianseka well 17.91 liters/second seconds, and the Cangi well of 14.27 liters/second will be able to improve the service of the Gianyar regional water company at the Sukawati Branch.

5. Tampaksiring region
The existing raw water capacity is 67.19 liters/second and is currently experiencing a water shortage. In 2030 the amount of water needed is 164.86

liters/second so that an additional water supply of 97.67 liters/second is needed. It is planned to utilize the Bayad spring and the relocation of the Tirta Empul spring to provide additional water supply. By optimizing existing water sources, water production can be increased to 78.48 liters/second. Take advantage of the Bayad spring with a flow rate of 75 – 90 liters/second. The point of taking the Tirta Empul spring is moved, at the new point of collection it is planned to take 35 liters/second

4 CONCLUSION

Based on the results of the analysis, it can be concluded that several things related to the provision of clean water to support the tourism sector in Gianyar Regency are as follows:

a. The need for clean water for the tourism sector in Ginyar Regency in 2020 is 71.94 liters/second or 47.09% of the estimated total non-domestic water needs of 152.78 liters/second.
b. In general, the quality of water produced by regional clean water companies is clean water that has not been drunk directly. In some rivers, the quality of the water is of inadequate quality
c. The strategy of increasing water supply in Gianyar Regency due to the growing population and tourism can be carried out by utilizing water in five rivers downstream, namely the Oos, Petanu, Sangsang, Pakerisan and Melangit rivers with a total capacity of 25.55 m^3/second. In addition to the use of river water in the downstream, additional water sources can be done by making deep wells.

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