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Analysis of Non Domestic Water Needs in the Clean Water Supply in Badung Regency

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Abstract

The need for clean water is generally divided into two groups, namely domestic water needs, and non-domestic water needs. Non-domestic water needs are water needs other than for household purposes such as for education, industry, tourism, social, and others. In general, the determination of non-domestic water demand is estimated to be around 20-25% of the total domestic water demand. Badung Regency has characteristics as the main tourist area in Bali as evidenced by the existence of 33 tourist destinations, both cultural tourism, natural tourism, artificial tourism, and youth tourism. With these characteristics, this study emphasizes the analysis of non-domestic water needs in the tourism sector. The research was conducted by analyzing various factors related to the need for clean water in the tourism sector such as hotel accommodation, tourism support facilities, and the number of tourism objects available. The results of this analysis are compared with domestic water needs according to the existing population. The analysis shows that non-domestic water demand for tourism accommodations (hotels, villas, and condominium hotels) is 186.76 liters / second, for tourism objects is 7.64 liters / second, restaurants and bars is 24.21 liters/second. Analysis of domestic water needs in Badung Regency in 2018 with a population of 630.00 people of 925 liters/second. This shows that the non-domestic water demand in Badung Regency for the tourism sector is 23.54%.

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1 Introduction

Bali Province is one of the provinces in Indonesia that is heavily reliant on regional tourism revenue. Several places in Bali, including Badung Regency, Gianyar Regency, Denpasar City, and other districts, have become well-known national and worldwide tourism destinations. Tourist visits, which continue to rise year after year, demonstrate that the tourism industry has firmly established itself as one of Bali's main economic drivers. Badung Regency, which contains 217-star hotels, 323 non-star hotels, 11 condotels, 84 villas, 2,009 tourist huts, 144 rental houses, 346 restaurants, 7 bars, 185 restaurants, 159 spas, 6 karaoke, and 15 live music, is one of the regencies in Bali with the greatest level of tourist visits in 2016. The number of tourism amenities is undoubtedly growing in tandem with the number of existing tourists.

Based on population projections from the 2016 census, there were 630,000 residents in 2016, with 321,300 males and 308,700 females, a rise from the 2015 population prediction of only 616,000. In Badung Regency, the population is unequally distributed throughout the sub-districts. South Kuta District has the greatest population, with 152,600 people, or around 24.22 percent of Badung Regency's total population. Meanwhile, Petang District has the smallest population, with only 25,910 residents, or 4.11 percent of Badung Regency's total population. Because this area is home to both higher education and a big population, the distribution of the population in the District of South Kuta cannot be divided.

Tirta Mangutama, a regional drinking water corporation, provides clean water services in Badung Regency, with a total service coverage of 64.20 percent. The Evening Zone, Mengwi Zone, Badung City Zone, and South Badung Zone are the four fulfillment schemes that provide water to Badung Regency, notably for the rise in water from the tourism sector. Given that the tourism sector is a cornerstone in Badung Regency, it is critical to perform a study of the water supply system so that the tourism sector can continue to be supported by a reliable, clean water supply system.

2 Materials and Methods

The research approach was carried out in stages, beginning with secondary data collecting and progressing to primary data collection and analysis. Secondary data collection includes data collected from the Badung Regency Public Works Office, the Bali Provincial Public Works Office, the Bali Penida River Council, and the Bali Regional Development and Infrastructure Center, all of which are involved in providing clean water services. Meanwhile, the major data collected comprises information on the irrigation structure's size and current discharge measurements.

3 Results and Discussions

Overview of Badung Regency

Badung Regency is one of the most popular tourist destinations in Bali Province, extending from south to north and comprising six sub-districts. This regency covers 418.52 km2, or 7.44 percent of Bali Province, and has an elevation range of 0-2075 meters above sea level. Regency of Badung The following boundaries are located between 08o14'20 "-08o50'48" South Latitude and 115o05'00 "- 115o26'16" East Longitude: Ocean Indonesia, west of Tabanan Regency, north of Buleleng Regency, east of Bangli Regency, Gianyar, and Denpasar City, in the south: Ocean Indonesia, north of Buleleng Regency, east of Bangli Regency, Gianyar, and Denpasar City. The location of the Badung Regency area can be seen in Figure 1 below

Fig 1. Map of Badung Regency

According to data from Badung Regency's Central Bureau of Statistics, the population of Badung Regency in 2018 was 630,000, with 321,300 male inhabitants and 308,700 female residents, a rise from the predicted population of only 616,000 people in 2015. In Badung Regency's six sub-districts, the greatest population is unequally distributed throughout the subdistricts. South Kuta District has the greatest population, with 152,200 people, or around 24.22 percent of Badung Regency's total population. Meanwhile, Petang District has a population of at least 25,910 individuals, accounting for 4.11 percent of Badung Regency's total population. The average population density of Badung Regency is quite high, reaching 2,378.53 people per km2, with the maximum population density being in Kuta District, at 5,866 people per km2. Meanwhile, Petang District has the lowest population density, with 225 persons per square kilometer. The social conditions of each location are substantially influenced by population density. Complete population data can be seen in Table 1 and Figure 2 below.

Table 1
Distribution population of Badung Regency

No,	Sub District	Area (km^2)	Population (people)	Density (people/km^2)
1	Kuta Selatan	101.13	152,600	1,509
2	Kuta	17.52	102,770	5,866
3	Kuta Utara	33.86	127,400	3,763
4	Mengwi	82.00	130,040	1,586
5	Abiansemal	69.01	91,280	1,323
6	Petang	115.00	25,910	225
	Total	615.52	630,000	

Source: Central Bureau of Statistics of The Province of Bali.2021

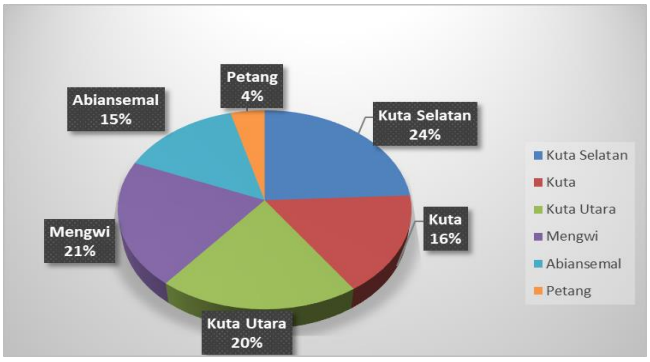

Fig 2. Population distribution of Badung Regency

Badung Regency water supply system

The Tirta Mangutama Regional Drinking Water Company, Badung Regency, is in charge of providing piped drinking water in Badung Regency. At the District level, each management unit already exists. The Tirta Mangutama Regional Drinking Water Company in Badung Regency obtains its drinking water from springs, groundwater, and rivers. As a result of recent changes and community activities, it is now more important than ever to upgrade drinking water infrastructure (Villarreal & Dixon, 2005; Archana et al., 2016). The provision of drinking water as a whole network system must be assessed, both in terms of the need for raw water and the network system's improvement at both the transmission and distribution levels. Tirta Mangutama Regional Drinking Water Company, Badung Regency now has 7,097 connections in Abiansemal District, 10,280 connections in Kuta District, 19,757 connections in South Kuta District, 16,384 connections in North Kuta District, 10,222 connections in Mengwi District, and 2,901 connections in Petang District. Tirta Mangutama Regional Drinking Water Company, Badung Regency, has a total installed capacity of 1,173.29 liters/second based on the water source capacity utilized.

Tourism sector water needs

The need for water for tourism is determined by the number of existing tourism facilities such as hotels, villas, and so on, and other supporting facilities such as restaurants, bars, and others (Wuysang et al., 2018; Warren, 2000; Kooy et al., 2018). The tourism sector in Badung Regency is the most favored and contributes the largest to the revenue of Badung Regency each year. This is due to the large number of tourist attraction objects in Badung Regency, most of which are scattered in the Districts of South Kuta and Kuta. The development of the tourism sector in Badung Regency is also influenced by the existence of Ngurah Rai Airport in Tuban, Kuta District. Preservation efforts for tourism areas in Badung Regency need to be considered carefully because Badung Regency has a large degree of dependence on the tourism sector. Based on the Bali Provincial Regulation No. 16 of 2009, regarding the Spatial Plan for the Province of Bali, it is stipulated that areas that are used as tourism areas include Badung Regency which includes 3 areas, namely Nusa Dua, Kuta, and Tuban. Based on the Badung Regent Regulation No. 7 of 2005 dated 7 February 2005 regarding tourist objects and tourist attractions in Badung Regency, 33 tourist objects in Badung Regency are scattered in all districts and generally in the form of natural tourism objects in the South Badung area, mostly in the form of beach tourism, mangrove parks, and turtle conservation. cultural tourism in the form of temples, and youth tourism in the form of the GWK monument and recreation area Water Boom Park & Spa. The growth of tourism in Badung Regency has sparked growth in a variety of other sectors, all of which have an impact on the region's economic development (Chambers & Clarke, 1966; Macedonio et al., 2012). Economic activity and trade are rapidly expanding, as are tourism demands. Various tourism activities are being developed that will require a large amount of community participation. The tourism industry employs a substantial number of people in southern Badung. Because it simply takes a little time to go to the South Bali area, the location of Ngurah Rai airport has an impact on the development of the tourism sector in southern Badung. Furthermore, this neighborhood has excellent roads, power, and clean water services (Bouchekima, 2003; Koop et al., 2019). Tourist destinations in Badung Regency can be seen in table 2.

Table 2
Tourist destinations in Badung Regency

No	Tourist attraction	Attraction type	Location	
			Village	Sub Distric
1	Uluwatu Temple	culture tourism	Pecatu	Kuta Selatan
2	Nyang Nyang Beach	Natural Tourism	Pecatu	Kuta Selatan
3	Padang Padang Beach	Natural Tourism	Pecatu	Kuta Selatan
4	Labuan Sait Beach	Natural Tourism	Pecatu	Kuta Selatan
5	Batu Pageh Beah	Natural Tourism	Ungasan	Kuta Selatan
6	Melasti Beash	Natural Tourism	Ungasan	Kuta Selatan
7	Samuh Beach	Natural Tourism	Benoa	Kuta Selatan
8	Geger Sawangan Beach	Natural Tourism	Benoa	Kuta Selatan
9	Nusa Dua Beach	Natural Tourism	Benoa	Kuta Selatan
10	Tanjung Benoa Beach	Natural Tourism	Tanjung Beno	Kuta Selatan
11	Turtle Island	Natural Tourism	Tanjung Beno	Kuta Selatan
12	Mangrove Park	Natural Tourism	Tanjung Beno	Kuta Selatan
13	Jimbaran Beach	Natural Tourism	Jimbaran	Kuta Selatan
14	Garuda Wisnu Kencana	culture tourism	Jimbaran	Kuta Selatan
15	Kedonganan Beach	Natural Tourism	Tuban	Kuta
16	Kuta Beach	Natural Tourism	Kuta	Kuta
17	Water Boom	Natural Tourism	Kuta	Kuta
18	Legian Beach	Natural Tourism	Legian	Kuta
19	Bom Bali Monument	Natural Tourism	Kuta	Kuta
20	Petitenget Beah	Natural Tourism	Kerobokan	Kuta Utara
21	Berawa Beach	Natural Tourism	Tibubeneng	Kuta Utara
22	Canggu Beach	Natural Tourism	Canggu	Mengwi
23	Seseh Beach	Natural Tourism	Munggu	Mengwi
24	Sada Temple	culture tourism	Kapal	Mengwi
25	Taman Ayun temple	culture tourism	Mengwi	Mengwi
26	Keraban Langit Temple	culture tourism	Sading	Mengwi
27	Baha Eco Tourism	Natural Tourism	Baha	Mengwi
28	Blahkiuh Village	Youth torism	Blahkiuh	Abiansemal
29	Monkey Forest sangeh	Natural Tourism	Sangeh	Abiansemal
30	Tanah Wuk	Natural Tourism	Sangeh	Abiansemal
31	Nungnung Waterfall	Natural Tourism	Pelaga	Petang
32	Pelaga Agro	Natural Tourism	Pelaga	Petang
33	Pucak Tedung Temple		Pelaga	Petang

Tourist accommodation

As evidenced by the increasing increase of tourism facilities and infrastructure from year to year, tourism activities are a backbone of promise in supporting development in Badung Regency. Kuta and Nusa Dua are the most popular tourist destinations in Badung Regency. Hundreds of star and non-star hotels, as well as various types of lodging, are located in this neighborhood. 170-star hotels with 26,543 rooms, 551 non-star hotels with 37,314 rooms, 885 jasmine hotels with 3,146 rooms, and 59 condotels with 8,992 rooms make up Badung Regency's tourism accommodations. The number of hotels and rooms can be seen in Table 3

Table 3
The number of hotels and rooms

No.	Year	Star Hotel		Non Star hotel		Room total	
		Total	Room total	Total	Room total	Total	Room total
1	2014	98	16,350	355	34,815	999	3,937
2	2015	155	24,683	458	28,282	685	2,405
3	2016	155	24,683	521	33,075	775	2,750
4	2017	155	24,543	539	35,698	839	2,983
5	2018	170	26,543	551	37,314	885	3,146

Source: Badung Regency Tourism Office, 2020

Water requirements

Domestic water requirements are estimated by multiplying the population by the water requirements per liter/per person per day. In this instance, the water requirements of each location change depending on the local conditions. The more the use water in a developed area, the more it is used (Robles-Durazno et al., 2019; Zhang et al., 2019). The following is a list of how each region's water is used: Water needs are 221 liters per second in South Kuta Subdistrict, 358 liters per second in Kuta and North Kuta Subdistricts, 188 liters per second in Mengwi District, and 116 liters per second in Abainsemal District. The Petang District's water needs are 30 liters per second, whereas the Petanu water treatment plant's service area is 12 liters per second. Water demand in Badung Regency is shown in Table 4

Table 4
Water needs for domestic water use in Badung Regency

No,	Service Area	Area (km^2)	Population (people)	Water Requitements (liter/second)
1	Kuta Selatan	101.13	152,600	221
2	Kuta & Kuta Utara	51.38	230,170	358
3	Mengwi	82.00	127,400	188
4	Abiansemal	69.01	130,040	116
5	Petang	115.00	91,280	30
6	WTP Petanu		25,910	12
	Total	615.52	630,000	925

Source: analysis, 2020

The number of tourism lodgings, tourist attractions, and other tourism support facilities in Badung Regency is used to assess the need for non-domestic water. According to the data, star hotels have a water demand of 92 liters per second, non-star hotels have a requirement of 78 liters per second, and jasmine hotels have a demand of 78 liters per second. condotel 12 liters per second, and 4 liters per second. The water demand for 33 tourism items is computed using the water requirement for toilets of 7.64 liters per perdtik and the water demands for supporting facilities such as restaurants (16.03 liters/second), bars (5.41 liters/second), and depots (2.16 liters/second). and the need for water for catering (0.61 liters/second). If proxied, non-domestic water needs in the tourism sector with domestic water needs in Badung Regency in 2019 amounted to 23.54%. The analysis results are shown in Tabel 5

Table 5
Water demand for the tourism sector

No.	Description	Water requirements (liter/second)	Total (liter/second)
1	Hotel		
	Star hotel	92	
	Non star hotel	78	
	Budget jotel	4	
	Condotel	12	
	Sub total	186	186
2	Tourist atraction	7.64	
	Sub total	7.64	7.64
3	Restoran		
	Restoran	16.03	
	Bar	5.41	
	Food stall	2.16	
	Catering	0.61	
	Sub total	24.21	24.21
	Total		217.85

Source: Analysis 2020

Strategy for fulfilling clean water

Several rivers in the Badung Regency area, including the Badung River, Mati River, and Penet River, have the potential to be developed based on available data. Until now, the effluent that has been discarded in the estuary has a good chance of being reused in the future. (Hickner, 2010; Thyagaraju, 2016; Jan et al., 2010). Tables 6 and 7 illustrate the findings of measuring the potential of rivers that can be exploited for clean water development.

Table 6
Results of measurement of the current discharge potential of Badung River

No	Wide		Water level		Velocity		Discharge
	Notation	(m)	Notation	(m)	Notation	(m/second)	(m^3/second)
1	L1	1.5	H1	0.24	V1	0.75	
2	L2	2	H2	0.23	V2	0.73	
3	L3	2	H3	0.24	V3	0.74	
4	L4	2	H4	0.24	V4	0.75	
5	L5	2	H5	0.24	V5	0.73	
6	L6	2	H6	0.23	V6	0.74	
7	L7	2	H7	0.24	V7	0.74	
8	L8	2	H8	0.25	V8	0.74	
9	L9	2	H9	0.24	V9	0.74	
10	L10	1.5	H10	0.24	V10	0.75	
11	L11	1.5	H11	0.23	V11	0.75	
12	L12	1.5	H12	0.24	V12	0.75	
	Total	22	Average	0,24	Average	3,89	3.89

Source: measurement results, 2020

Table 7
Results of measurement of the current discharge potential of Mati River

No	Wide		Water level		Velocity		Discharge
	Notation	(m)	Notation	(m)	Notation	(m/second)	(m^3/second)
1	L1	2	H1	0.5	V1	0.52	
2	L2	2	H2	0,35	V2	0.57	
3	L3	2	H3	0.45	V3	0.52	
4	L4	2	H4	0.51	V4	0.60	
5	L5	3	H5	0.45	V5	0.47	
6	L6	3	H6	0.33	V6	0.29	
7	L7	2	H7	0.25	V7	0.28	
	Total	16	Average	0.41	Average	0.46	3.02

Source: Measurement results, 2020

4 Conclusion

Several inferences can be drawn from the results of the previous section's explanation, such as:

a) For its own regional income, Badung Regency is heavily on tourism.
b) This Regency has an uneven population pulse, with the biggest population concentration in the South Kuta sub-district, based on the number of inhabitants.
c) Water requirements for residential use are estimated based on a population of 630.00 people in 2018 and water demands of 925 liters per second.
d) Meanwhile, non-domestic water consumption is 217.85 liters per second, primarily in the tourism industry.
e) When comparing non-domestic and domestic water needs, it can be concluded that non-domestic water needs for the tourism sector in Badung regency are 23.54 %
f) For future water fulfillment, Badung Regency can utilize water from the Badung river through the Nusa Dua estuary reservoir with an increased capacity and by taking water from the Mati river. This can be done after seeing the results of the instantaneous discharge measurement which is ideal for use in the downstream

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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