Eduvest – Journal of Universal Studies
Volume 5 Number 1, January, 2025
p- ISSN 2775-3735- e-ISSN 2775-3727

ECONOMIC RESOURCE ANALYSIS OF WATER IN THE LONG-TERM ECONOMIC DEVELOPMENT PLAN BADUNG DISTRICT 2025—2045

I Nyoman Tingkes, Ida Ayu Putu Sri Widnyani, I Made Sumartana
Assistant Professor in Management of Universitas Dhyana Pura Bali, Indonesia
Prodi Manajemen, Fakultas Ekonomi dan Bisnis Universitas Ngurah Rai
Email: nyomantingkes@undhirabali.ac.id, dayusriwid@unr.ac.id, sumartana63@gmail.com

ABSTRACT

The purpose of this research is to determine the carrying capacity of land for population settlements in the 2025-2045 Badung Regency Regional Long Term Development Planning. This research is a documentary research using quantitative data sourced from the 2023 Badung Regency Strategic Environmental Assessment Results Document. The quantitative data was analyzed using runoff coefficient analysis techniques to calculate water availability. In addition, conversion techniques were also used to calculate the population's need for water to live properly. The results of the documentary research found that for the years 2025--2045 Badung Regency has a water surplus status of 97,378.00 m3. However, when viewed based on the population's need for water per village/per kelurahan, it can be seen that there are fifteen water deficit villages. In addition, it can also be seen that the massive construction of hotels, housing, and other physical developments, which are accompanied by the use of underground water as much as 4,846 m3/month, can cause land subsidence and encourage tidal flooding.

KEYWORDS *runoff coefficient, population, area, and water carrying capacity*

INTRODUCTION

Development paradigms and indicators continue to evolve along with new challenges and problems facing the world (Jamadar, 2021). World leaders have agreed on eight specific and measurable global development goals called the Millennium Development Goals in 2000 and developed into the Sustainable Development Goals in 2015.

To ensure this commitment, Indonesia has issued Presidential Regulation No. 59, 2017 and Presidential Regulation No. 111, 2022 as the basis for the 2015--2019 and 2020--2024 medium--term development plans. The core development policies include: (a) sustainable improvement of people's economic welfare, (b) sustainable

How to cite: Tingkes I.Y et all. (2025). Economic Resource Analysis of Water in The Long-Term Economic Development Plan Badung District 2025—2045. Journal Eduvest. *Vol 5*(1): 240-252
E-ISSN: 2775-3727

social life, (c) environmental quality and inclusive development, and (d) guaranteed governance to maintain and improve the quality of life from one generation to the next. The core of the policy is the basis for provincial and district / city governments throughout Indonesia in preparing their respective regional long-term development plans (Esti, 2021; Haqi, 2023; Murni et al., 2024).

In this regard, Badung Regency has also issued Regional Regulation No. 8, 2007 concerning the Regional Long Term Plan or RPJPD 2005-2025. Because the RPJPD will end in 2025, as a logical consequence the Badung Regency Regional Government starting at the beginning of 2024 is obliged to prepare a long-term regional development plan for 2025-2045.

The initial step in the preparation of the RPJPD 2025--2045 begins with a strategic environmental assessment or SEA to ensure that the principles and objectives of development have become the basis and are integrated in the RPJPD 2025-2045. Aspects of the SEA include: (a) geographical conditions, (b) hydrology, (c) demographics, (d) land carrying capacity, (e) water carrying capacity, (f) food carrying capacity, (g) regional finance, (h) community welfare, (i) human development, and (j) several other important aspects.

One of the ten important aspects of SEA that is interesting to study is the economic resource of water (Pásková et al., 2024). Water is a basic human need, both for survival, domestic, industry and agriculture (Sharma et al., 2024). Water is all water contained in and derived from water sources, both above and below ground level, but what is not included in this definition is that found in the sea (BSN, 2022).

Various studies on water have been conducted in Badung Regency, including (Pasir, 2017), in his research entitled "Analysis of Debit Addition in the Luwus Irrigation Area, Carangsari Village, Petang District, Badung Regency". The study found that the availability and demand for water for irrigation experienced a surplus of 10,458 liters per second. The surplus is caused by the addition of water discharge through the improvement of irrigation networks to increase the availability of water in the dry season (Lu et al., 2021).

(Diana & Sudiarsa, 2017) in their research titled "Study of the Potential Debit of Pangsut Sari Dam on New Rice Field Development in Belok Sidan Village, Petang District, Badung Regency". They found that the efficient use of water economic resources can be done by regulating cropping patterns and utilizing water seepage from the terraces above, so that the balance of water availability is maintained.

(Aryastana et al., 2019) in their research titled "The Potential Occurrence of Rob Floods Due to Land Subsidence and Sea Level Rise in Badung Regency, Bali". They found that continuous hotel development in Badung Regency over a certain period of time will be able to lower the land surface caused by groundwater use by

4,846 m3/month. This, in turn, would raise the sea level, potentially leading to tidal flooding in the future (Khojasteh et al., 2022). Rapid subsidence rates occurred in Tuban Village, Kedonganan Village, Legian Village, and Tanjung Benoa Village from 2014 to 2020 and the most significant tidal flooding is predicted in 2030 to 2040 in Tuban Village.

Based on the description of the background of the research problem and the results of previous research, it can be explained that the purpose of this research is to determine the status of water carrying capacity availability in Badung Regency in the context of preparing the Regional Long Term Economic Development Plan of Badung Regency 2025--2045. Because the research objectives have a broad scope, this research is designed as documentative research, which is a research conducted by studying existing strategic environmental studies, especially those related to water carrying capacity for a decent life.

RESEARCH METHOD

Determination of water carrying capacity status can be done in three stages, namely the calculation of water availability, the calculation of water demand, and the determination of water carrying capacity status. The three stages are determined by comparing water availability and water demand. Each of these stages can be described as follows.

Water Availability Calculation Stage

$$C = \frac{\sum(C_i \times A_i)}{\sum A_i}$$

Description:
C = weighted runoff coefficient
C_1 = land use runoff coefficient
A_1 = land use area in hectares

$$R = \frac{\sum R_i}{m}$$

Description:
R = algebraic mean annual rainfall of the region (mm/year) from BPS or BMG data, or Dinas Related.
R_i = annual rainfall at station i
m = number of observation stations

$$S_A = 10 \times C \times R \times A$$

Description:
$S_{A.}$ = water availability (m^3/year)
C = weighted runoff coefficient
R = algebraic mean of rainfall
m = number of rainfall observation stations
10 = conversion factor from mm.ha to m^3
A = area in hectares

Water Requirement Calculation Stage

The formula for calculating water demand can be written as follows.

$D_A = N \times KHL_A$

Description:

D_A = water demand in m^3 per year

N = total

MOE_A = the water requirement for a decent life is 1,600 m3 of water/capita/year. However, according to WHO, the total requirement for each person is 1,000 to 2,000 m^3/year. This requirement includes domestic needs and the need to produce a unit of product, such as rice, eggs, fruit, meat, salad, soybeans, drinking water and household.

Stage of Determining Water Support Status

Water carrying capacity status is obtained by comparing water availability and water demand. If the water availability is greater than the water demand, the water carrying capacity is declared a surplus. Conversely, if water availability is less than water demand, the water carrying capacity is declared a deficit.

RESULT AND DISCUSSION

Regional Description of Badung Regency

Badung Regency is one of the nine regencies/cities in Bali Province. Badung Regency is located in the central part of the island of Bali, stretching from center to south at 8014'20"--8050'48 south latitude and 115026'16" east longitude, with an area of 418.52 km2 or 7.43 percent of the island of Bali. Administratively, the regency consists of six sub-districts and sixty-two villages. Abiansemal sub-district consists of eighteen villages, Kuta sub-district consists of five villages, South Kuta sub-district consists of three villages and three villages, North Kuta sub-district consists of three villages and three villages, Mengwi sub-district consists of fifteen villages and five villages, and Petang sub-district consists of seven villages.

Topographically and slope-wise, Badung Regency is located at an altitude of 0--2,075 meters above sea level with three topographies, namely lowlands, highlands, and hills. South Kuta sub-district is at an altitude of 0-215 meters above sea level and there are more hilly areas, Kuta sub-district is at an altitude of 0-27 meters above sea level, North Kuta is at an altitude of 0-65 meters above sea level, Mengwi sub-district is at 0-350 meters above sea level, Abiansemal sub-district is at an altitude of 75-350 meters above sea level, and specifically for Petang sub-district is at an altitude of 275-2,075 meters above sea level with a slope of 15-40 percent which is a steep area. The topographic conditions and rivers in each sub-district can be seen on the Badung Regency Map.

Hydrologically, water availability in Badung Regency is sourced from rivers, springs, groundwater, and groundwater basins. In Badung Regency there are two cross-district rivers, namely the Yeh Penet and Yeh Ayung Rivers. In addition, there are also parennial rivers that empty into Mengwi, North Kuta, and Kuta sub-districts. There are eleven parennial rivers, namely Yeh Penet, Yeh Ayung, Surungan, Pangkung Tebin, Baosan, Pangi, Canggu, Yeh Poh, Mati, Badung, and Buluh Rivers. In contrast, intermittent rivers are found in South Kuta Subdistrict. There are twenty-one springs in Badung Regency, namely Penataran I and II, Sulangai, Belong, Dungus, Mumbul, Sangeh, Blahkiuh, Uma Poh, Apuan, Taman I, Taman II, Pacung, Sudamala, Gangga, Dukun, Sagu, Bukti, Guming, and Panggul.

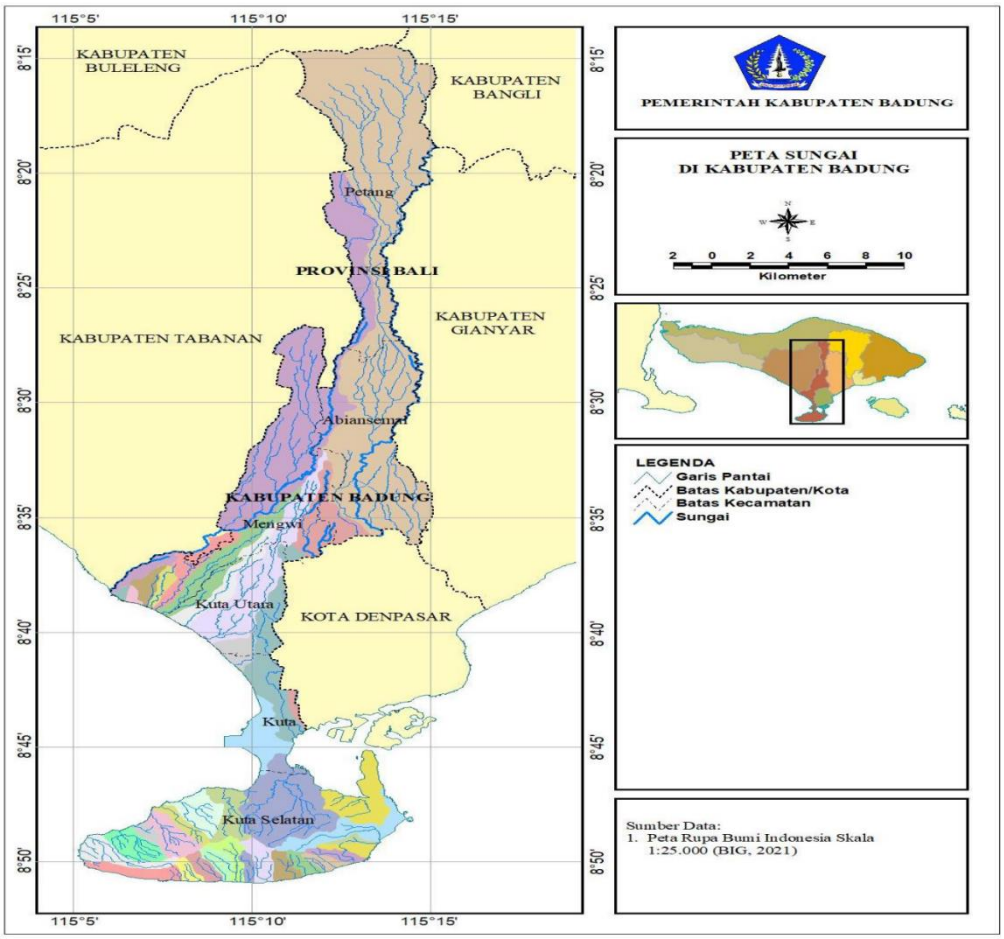

Figure 1. Map of Badung Regency

Source: Indonesia Earth Map Scale 1:25,000 (BIG, 2021).

Groundwater and water basins. Groundwater is found in layers of soil or rock below the ground surface. Groundwater flow starts from groundwater recharge areas or groundwater recharge areas that often pass through an aquifer layer that

has an impermeable layer above it. This results in a change in pressure between the water below the impermeable layer and the groundwater above it. This pressure difference is what distinguishes between free groundwater and pressurized water. Free groundwater is often utilized as dug wells. Conversely, depressed groundwater or water that penetrates the overburden is utilized as boreholes. An overview of the potential of water sources as the carrying capacity of a decent life can be seen on the Indonesia Earth Map Scale 1:25,000 (BIG, 2021).

Analysis and Discussion

Based on the results of data analysis of runoff coefficient, area, and rainfall, it can be seen that the availability of water in Badung Regency is 13,147,319 m3/year. Based on the projected population in 2023 of 503,592 people and in 2045 of 839,482 people, it can be seen that the population's need for water in 2023 was 22,057,329 m3/year and in 2043 was 36,769,318 m3/year. This shows that the water carrying capacity from 2023 to 2045 is surplus.

However, when broken down by sub-district, it can be seen that the water carrying capacity in all sub-districts until 2043 is surplus. However, when broken down by village/sub-district, there are two villages that have a water carrying capacity deficit in 2023, namely Blahkiuh Village and Mekar Bhuwana Village in Abiansemal Sub-district. Meanwhile, in 2045 there are fifteen villages that have a deficit in water carrying capacity. These villages are scattered in Abiansemal Sub-district with eight villages, North Kuta with two villages, and Mengwi Sub-district with five villages.

Water Support Capacity of Abiansemal Sub-district

Abiansemal sub-district consists of eighteen villages, a population of 97,710 people, and a water demand of 4,279,698 m3 in 2023. Meanwhile, in 2045, the population is estimated at 162,881 people and the population's demand for water is 7,134,208 m3. Table 1. shows that overall Abiansemal Sub-district has a water surplus. However, when viewed based on the population's need for water per village, it can be seen that as many as nine villages or fifty percent of villages experience a water deficit.

Table 1. Water Support Status of Sub-district

No.	Village/Kelurahan	Keterse-Water	Resident (Soul)		Need Water		Status Water Support Capacity	
			2023	2045	2023	2045	2023	2045
1.	Abiansemal	389.876	8.018	13.366	351.188	585.427	Surplus	Deficit
2.	Angantaka	313.519	4.140	6.901	181.332	462.033	Surplus	Deficit

3.	Swing	317..879	2.516	4.194	110.201	302.278	Surplus	Surplus
4.	Blahkiuh	241.975	6.320	10.535	276.816	183.703	Deficit	Deficit
5.	Bongkasa	611.006	6.276	10.462	274.889	461.449	Surplus	Surplus
6.	Bongkasa Pertiwi	394.063	2.633	4.389	115.325	458.237	Surplus	Deficit
7.	Darmasaba	492.594	10.675	17.795	467.565	192.246	Surplus	Surplus
8.	Dauh Yeh Cani	611.970	6.328	10.549	277.426	779.426	Surplus	Deficit
9.	Jagapati	233.296	4.029	6.716	176.470	294.174	Surplus	Deficit
10.	Mambal	327.719	5.353	8.923	234.461	390.844	Surplus	Deficit
11.	Mekar Bhuwana	213.390	5.193	8.657	227.453	379.162	Deficit	Deficit
12.	Stump	265.152	3.305	5.509	144.759	241.312	Surplus	Surplus
13.	Sangeh	633.667	4.776	7.962	209.189	348.715	Surplus	Surplus
14.	Medium	509.151	4.404	7.341	192.895	321.554	Surplus	Surplus
15.	Strait	177.891	2.458	4.097	107.660	179.469	Surplus	Deficit
16.	Sibang Gede	755.122	7.441	12.404	325.916	543.298	Surplus	Surplus
17.	Sibang Kaja	951.609	6.836	11.396	299.417	499.124	Surplus	Surplus
18.	Garden	720.997	7.009	11.684	306.994	511.756	Surplus	Surplus
	Total	8.160.877	97.710	162.881	4.279.68	7.134.28	Surplus	Surplus

Source: SEA in Badung Regency RPJPD 2025--2045.

Water Support Capacity of Kuta Sub-district

Overall, Kuta sub-district consists of five villages with a population of 50,678 people, and a population demand for water of 2,219,696 m3 in 2023. In contrast, in 2045 the population is estimated at 84,480 people and the population demand for water is 3,700,209 m3. Table 2 shows that overall Kuta Sub-district has a water surplus status. However, when viewed based on the population demand for water per neighborhood, it can be seen that there are no neighborhoods that experience a water deficit.

Table 2. Water Support Status of Kuta Sub-district

No.	Village/Kelurahan	Keterse-Water	Resident (Soul)		Need Water		Status Water Support Capacity	
			2023	2045	2023	2045	2023	2045
1.	Kedongan	1.083.108	7.364	12.276	322.543	537.676	Surplus	Surplus
2.	Kuta	4.661.543	17./643	29.42112	722.763	1.288.188	Surplus	Surplus
3.	Legian	1.277.999	5.372	8.955	235.294	392.232	Surplus	Surplus
4.	Seminyak	2.457.446	3.870	6.451	169.506	282.565	Surplus	Surplus
5.	Tuban	3.264.401	16.429	27.387	719.590	1.199.549	Surplus	Surplus
	Total	12.744.497	50.678	84.480	2.219.696	3.700.209	Surplus	Surplus

Source: SEA in Badung Regency RPJPD 2025--2045

Water Support Capacity of Kuta Selatan Sub-district

South Kuta sub-district consists of three villages (Jimbaran, Kutuh, and Pecatu), and three sub-villages (Benoa, Tanjung Benoa, and Ungasan), with a population of 115,020 people, and a water demand of 5,037,876 m3 in 2023. In contrast, in 2045, the population is estimated at 191,737 people and the population's demand for water is 8,398,082 m3. Table 3 shows that overall South Kuta Sub-district has a water surplus status. However, when viewed based on the population's need for water both per village and per sub-district, it can be seen that there are no villages or sub-districts experiencing a water deficit.

Table 3. Water Support Status of South Kuta Sub-district

No.	Village/Kelurahan	Keterse-Water	Resident (Soul)		Need Water		Status Water Support Capacity	
			2023	2045	2023	2045	2023	2045
1.	Benoa	15.527.104	32.759	54.609	1.434.844	2.391.869	Surplus	Surplus
2.	Jimbaran	16.891.201	49.119	81.881	2.151.412	3.586.380	Surplus	Surplus
3.	Kutuh	4.033.830	5.257	8.763	230./257	383.835	Surplus	Surplus
4.	Pecatu	16.234.832	8.235	13.728	360./693	601.271	Surplus	Surplus

5.	Tanjung Benoa	431.866	5.815	9.694	254.697	424.577	Surplus	Surplus
6.	Ungasan	7.172.531	13.835	23.063	605.973	1.010.150	Surplus	Surplus
	Total	60.291.364	115.020	191.737	5.037.876	8.398.082	Surplus	Surplus

Source: SEA in Badung Regency RPJPD 2025--2045

Water Support Capacity of Kuta Utara Sub-district

North Kuta sub-district consists of three villages (Canggu, Dalung, and Tibu Beneng) and three kelurahan (Kerobokan, Kerobokan Kaja, and Kerobokan Kelod), with a population of 80,174 people, and a water demand of 3,511,621 m(3) in 2023. In contrast, in 2045, the population is estimated at 133,649 people and the population demand for water is 75,853,833 m3. Table 4 shows that overall North Kuta Sub-district has a water surplus status. However, when viewed based on the population's need for water, both per village and per kelurahan, it can be seen that there are no villages or kelurahan that experience a water deficit.

Table 4. Water Support Status of Kuta Utara Sub-district

No.	Village/Kelurahan	Keterse-Water	Resident (Soul)		Need Water		Status Water Support Capacity	
			2023	2045	2023	2045	2023	2045
1.	Canggu	2.480.497	6.976	11.629	305.549	509.346	Surplus	Surplus
2.	Dalung	2.556.257	23.109	38.522	1.012.174	1.687.283	Surplus	Surplus
3.	Kerobokan	478.603	10.062	16.773	440.716	734.668	Surplus	Deficit
4.	Kerobokan Kaja	1.064.012	17.408	29.019	762.470	1.271.029	Surplus	Deficit
5.	Kerobokan Kelod	4.306.691	10.768	17.950	471.638	786.216	Surplus	Surplus
6.	Tibu Beneng	2.697.178	11.851	19.755	519.074	865.290	Surplus	Surplus
	Total	13.583.238	80.174	133.649	3.511.621	5.853.833	Surplus	Surplus

Source: SEA in Badung Regency RPJPD 2025--2045

Water Support Capacity of Mengwi Sub-district

Mengwi Sub-district as a whole consists of fifteen villages and five sub-districts (Abianbase, Kapal, Lukluk, Sading, and Sempidi), with a population of 127,389 people, and a water demand of 5,579,638 m3 in 2023. In contrast, in 2045, the population is estimated at 212,356 people and the population demand for water is 9,301,193 m3. Table 5 shows that overall Mengwi Sub-district has a water

surplus status. However, when viewed based on the population's need for water, both per village and per kelurahan, it can be seen that there are one kelurahan and three villages that experience a water deficit.

Table 5. Water Support Status of Mengwi Sub-district

No.	Village/Kelurahan	Keterse-Water	Resident (Soul)		Need Water		Status Water Support Capacity	
			2023	2045	2023	2045	2023	2045
1.	Abianbase	798.989	7.022	11.706	307.564	512.705	Surplus	Surplus
2.	Baha	746.146	3.950	6.585	173.010	288.406	Surplus	Surplus
3.	Buduk	385.797	8.553	14.258	374.621	624.490	Surplus	Deficit
4.	Cemagi	1.800.364	5.271	8.787	230.870	384.857	Surplus	Surplus
5.	Guliang	1.085.323	8.450	14.086	370.110	616.969	Surplus	Surplus
6.	Ship	672.255	11.639	19.402	509.788	849.811	Surplus	Surplus
7.	Kekeran	549.033	3.837	6.396	168.061	280.155	Surplus	Surplus
8.	Kuwum	446.135	3.134	5.224	137.269	228.826	Surplus	Surplus
9.	Lukluk	546.796	8.025	13.378	351.495	585.938	Surplus	Deficit
10.	Mengwi	785.228	8.087	13.481	354.211	509.465	Surplus	Surplus
11.	Mengwitani	1.259.859	7.941	13.238	347.816	579.805	Surplus	Surplus
12.	Munggu	1.217.707	7.255	12.094	317.769	529.717	Surplus	Surplus
13.	Fighting	570.848	7.126	11.879	312.119	520.298	Surplus	Surplus
14.	Pererenan	703.023	3.268	5.448	143.138	238.610	Surplus	Surplus
15.	Sading	310.310	8.293	13.824	363.233	605.506	Surplus	Deficit
16.	Sembung	1.051.044	5.895	9.827	258.201	430.418	Surplus	Surplus
17.	Sempidi	654.874	6.916	11.529	302.921	504.966	Surplus	Surplus
18.	Sobangan	1.045.097	3.942	6.571	172.660	287.822	Surplus	Surplus

19.	Tumbakbayuh	231.968	3.423	5.706	149.927	249.927	Surplus	Deficit
20.	Werdi Bhuwana	555.294	5.362	8.938	234.856	391.502	Surplus	Surplus
	Total	15.416.091	127.389	212.356	5.579.638	9.301.193	Surplus	Surplus

Source: SEA in Badung Regency RPJPD 2025--2045

Water Support Capacity of Petang Sub-district

Petang sub-district consists of seven villages, with a population of 32,621 people, and a population demand for water of 1,428,800 m3 in 2023. Whereas in 2045, with an estimated population of 54,379 people and a population demand for water of 2,381,793 m3. Table 6 shows that overall Petang Sub-district has a water surplus status. However, when viewed based on the population's need for water per village, it can be seen that no village has a water deficit.

Table 6. Water Support Status of Petang Sub-district

No.	Village/Kelurahan	Keterse-Water	Resident (Soul)		Need Water		Status Water Support Capacity	
			2023	2045	2023	2045	2023	2045
1.	Turn/Sideways	8.059.373	5.587	9.313	244.711	407.930	Surplus	Surplus
2.	Carang Sari	1.580.932	6.011	10.020	263.282	438.888	Surplus	Surplus
3.	Getasan	597.943	2.180	3.634	95.484	159.171	Surplus	Surplus
4.	Pangsan	1.042.382	2.920	4.868	127.896	213.201	Surplus	Surplus
5.	Pelaga	10.390.425	6.649	11.084	291.226	485.471	Surplus	Surplus
6.	Evening	1.033.596	4.435	7.393	194.253	323.813	Surplus	Surplus
7.	Sulangai	1.246.601	4.839	8.067	211.948	353.316	Surplus	Surplus
	Total	23.951.251	32.621	54.379	1.428.800	2.381.793	Surplus	Surplus

Source: SEA in Badung Regency RPJPD 2025-2045

CONCLUSION

Based on the research problem, objectives, literature review, and findings from the RPJPD 2023 strategic environmental assessment, it is concluded that the water economic resources for the long-term economic development of Badung Regency (2024-2045) indicate a surplus of 97,378,000 m³, but several areas,

including villages in Abiansemal, North Kuta, and Mengwi Sub-districts, are experiencing water deficits. Furthermore, uncontrolled underground water usage driven by extensive hotel, housing, and infrastructure development can lead to land subsidence and increase the risk of tidal flooding.

REFERENCES

Aryastana, P., Rahadiani, A. A. S. D., & Adnyana, W. S. (2019). Analisis pemenuhan kebutuhan air bersih masyarakat dusun kiadan, desa pelaga, kabupaten badung.

Diana, I. W., & Sudiarsa, I. M. (2017). Studi Potensi Debit Bendung Pangsut Sari terhadap Pengembangan Sawah Baru di Desa Belok Sidan Kecamatan Petang Kabupaten Badung. Jurnal Teknik Gradien, 9(1), 181–198.

Esti, D. R. S. (2021). Effectiveness of Evaluation Practices in Supporting Regional Development Planning in Indonesia: The Cases of DI Yogyakarta and West Sumatra Provinces. Flinders University, College of Business, Government and Law.

Haqi, F. I. (2023). From policies to actions: Mayoral leadership and local government's impact on urban resilience in Indonesia. Journal of Resilient Economies, 3(2), 62–76.

JAMADAR, N. (2021). Paradigm Shift of International Development and New Trends. 金沢星稜大学論集, 54(2).

Khojasteh, D., Lewis, M., Tavakoli, S., Farzadkhoo, M., Felder, S., Iglesias, G., & Glamore, W. (2022). Sea level rise will change estuarine tidal energy: A review. Renewable and Sustainable Energy Reviews, 156, 111855.

Lu, Y., Wang, E., Zhao, Z., Liu, X., Tian, A., & Zhang, X. (2021). Optimizing irrigation to reduce N leaching and maintain high crop productivity through the manipulation of soil water storage under summer monsoon climate. Field Crops Research, 265, 108110.

Murni, M., Noor, M., & Irawan, B. (2024). Enhancing basic education quality through the implementation of the regional medium-term development plan in oil-rich areas. Journal of Contemporary Governance and Public Policy, 5(2), 171–192.

Pasir, I. W. (2017). Analisa Penambahan Debit pada Daerah Irigasi Luwus Desa Carangsari Kecamatan Petang Kabupaten Badung. Jurnal Teknik Gradien, 9(1), 81–106.

Pásková, M., Štekerová, K., Zanker, M., Lasisi, T. T., & Zelenka, J. (2024). Water pollution generated by tourism: Review of system dynamics models. Heliyon, 10(1).

Sharma, K., Rajan, S., & Nayak, S. K. (2024). Water pollution: Primary sources and associated human health hazards with special emphasis on rural areas. In Water Resources Management for Rural Development (pp. 3–14). Elsevier.

National Standards Agency, 2022. Guidelines for Preparation of Resource Balance-Part 1 Water Resources. SNI 19-6728.1-2022.

Badung Regency Environment and Hygiene Office. 2023. Strategic Environmental Assessment (SEA). Regional Long-Term Development Plan of Badung Regency 2025-2045.

Sand, I Wayan. 2017. Analysis of Additional Discharge in Luwus Irrigation Area, Carangsari Village, Petang District, Badung Regency. Journal of Civil Engineering. Gradient Engineering Department. Vol. 9, No.1, April 2017.

Regulation of the Minister of Environment Number 17, Year 2009 on Guidelines for Determining Environmental Support Capacity in Regional Spatial Planning. Copy in accordance with the original, by the Deputy Minister of Environment for Environmental Management.

Ranperda, 2024. Draft Regional Regulation on the Regional Long-Term Development Plan of Badung Regency 2025-2045.

Walton, W.C., 1970. Groundwater Resource Evaluation. New York: McGraw Hill Book Co., p. 664.