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Technical Feasibility Assessment of Seaplane Operations at Tinabo Besar Island, Taka Bonerate National Park, Indonesia

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Abstract

Taka Bonerate National Park (TBNP) is one of the largest marine conservation areas in Indonesia, renowned for its unique atoll ecosystem and high marine tourism potential. However, limited accessibility remains a major constraint for tourism development. This study aims to assess the technical feasibility of seaplane operations at Tinabo Besar Island as a potential waterbase. The research employed hydro-oceanographic analysis (wind, currents, waves, and bathymetry), measurement of aerial distance and travel time between Makassar and Tinabo, as well as a technical review of four seaplane types (Kodiak 100, Cessna 208 Caravan, Dornier Seastar, and DHC-6 Twin Otter). The results indicate that the hydro-oceanographic conditions around Tinabo Besar are predominantly safe for seaplane operations, with 90.34% of days in a year classified as suitable for flights, 7.31% as marginal, and 2.34% as critical. The lagoon bathymetry, ranging from –2 to > –40 m, supports safe water landings. The Makassar–Tinabo route, approximately 245 km, can be covered in 1.5–2 hours by seaplane, which is significantly more efficient compared to sea travel (12–15 hours). From a technical perspective, the Kodiak 100 and Cessna Caravan are considered the most efficient for regular operations, while the Twin Otter is more suitable for higher passenger demand. Thus, Tinabo Besar Island is deemed feasible as a seaplane operational site, although risk mitigation during the west monsoon and coral reef conservation efforts remain essential, given that the reef ecosystem is the main tourism attraction of Taka Bonerate National Park.

Keywords: seaplane, technical feasibility, waterbase, Taka Bonerate, Tinabo Besar

1. INTRODUCTION

Remote islands and marine protected areas play an essential role in supporting marine biodiversity conservation, ecotourism, and regional economic development. However, many island destinations continue to experience limited accessibility due to inadequate transportation infrastructure and long travel times. Improving connectivity to remote islands has therefore become a major concern for sustainable tourism development while maintaining environmental protection. Among the available transportation alternatives, seaplanes have attracted increasing attention because they require minimal land infrastructure, can operate directly on water surfaces, and provide significantly shorter travel times than conventional marine transportation [1], [2].

Several countries with extensive archipelagic regions, including Canada, the Maldives, Australia, and Alaska (United States), have successfully integrated seaplane transportation into their regional transportation systems. Besides supporting tourism activities, seaplanes also facilitate emergency medical evacuation, logistics distribution, disaster response, and environmental monitoring in areas where conventional airports are unavailable. Previous studies have demonstrated that hydro-oceanographic conditions, water runway characteristics, aircraft performance, and operational safety are the primary considerations in determining the feasibility of seaplane operations [3]–[5].

Indonesia, as the world's largest archipelagic country with more than 17,000 islands, possesses enormous potential for the development of seaplane transportation. Nevertheless, the implementation of seaplane operations remains very limited, particularly within marine conservation areas where environmental protection and aviation safety must be carefully balanced. Most accessibility improvements to remote islands continue to rely on conventional ports and marine transportation, resulting in long travel durations and limited operational flexibility [6].

Taka Bonerate National Park, located in South Sulawesi, represents one of Indonesia's most important marine conservation areas and contains the third-largest coral atoll system in the world [7]. The park covers approximately 530,765 hectares and is internationally recognized for its exceptional coral reef ecosystem and marine biodiversity. Tinabo Besar Island serves as one of the primary tourism centers within the national park, offering world-class diving, snorkeling, and ecotourism attractions [8]. Despite its tourism potential, accessibility remains one of the principal constraints to sustainable tourism development. Visitors generally require approximately 12–15 hours of sea travel from Makassar under favorable weather conditions, while adverse sea conditions frequently reduce transportation reliability [9].

Seaplane transportation has the potential to substantially improve accessibility by reducing travel time to approximately 1.5–2 hours while minimizing the need for extensive land-based airport infrastructure. However, establishing a seaplane waterbase within a marine protected area requires comprehensive technical evaluation. Besides hydro-oceanographic suitability, operational planning must also consider water runway geometry, bathymetric conditions, aircraft operational requirements, obstacle clearance, infrastructure readiness, seasonal weather variability, and compliance with aviation regulations such as the Civil Aviation Safety Regulations (CASR) Part 139 and the International Civil Aviation Organization (ICAO) standards [2], [10].

Previous studies concerning seaplane implementation have primarily focused on hydro-oceanographic descriptions, airport planning, or transportation accessibility independently [4], [5], [11]. Very limited research has proposed an integrated engineering framework that simultaneously evaluates environmental conditions, operational safety requirements, aircraft compatibility, and regulatory compliance for seaplane waterbase planning, particularly within marine protected areas. Consequently, decision-making for waterbase development often remains descriptive and lacks a transparent quantitative assessment methodology.

To address this research gap, this study develops an Integrated Technical Feasibility Assessment Framework for evaluating the suitability of seaplane operations at Tinabo Besar Island. The proposed framework combines hydro-oceanographic analysis, operational water runway assessment, aircraft performance evaluation, infrastructure readiness, and regulatory compliance using a structured multi-criteria assessment approach. Unlike previous studies that rely primarily on descriptive observations, this framework provides a systematic and reproducible methodology for supporting engineering decision-making in seaplane waterbase planning.

The scientific contribution of this research lies in the development of an integrated technical assessment framework that can be applied not only to Tinabo Besar Island but also to other remote islands and marine protected areas throughout Indonesia. The findings are expected to support government agencies, transportation planners, and infrastructure developers in designing safe, efficient, and environmentally sustainable seaplane transportation systems that improve regional connectivity while preserving sensitive marine ecosystems.

2. METHODS

This study was conducted at Tinabo Besar Island, Taka Bonerate National Park, Selayar Islands Regency, South Sulawesi, Indonesia. The island was selected because it serves as one of the main marine tourism destinations within the national park and possesses considerable potential for seaplane waterbase development due to its lagoon morphology, sheltered waters, and strategic location. This research employed a quantitative engineering approach to evaluate the technical feasibility of seaplane operations by integrating hydro-oceanographic conditions, aircraft operational requirements, waterbase infrastructure readiness, and aviation regulatory compliance into a systematic assessment framework.

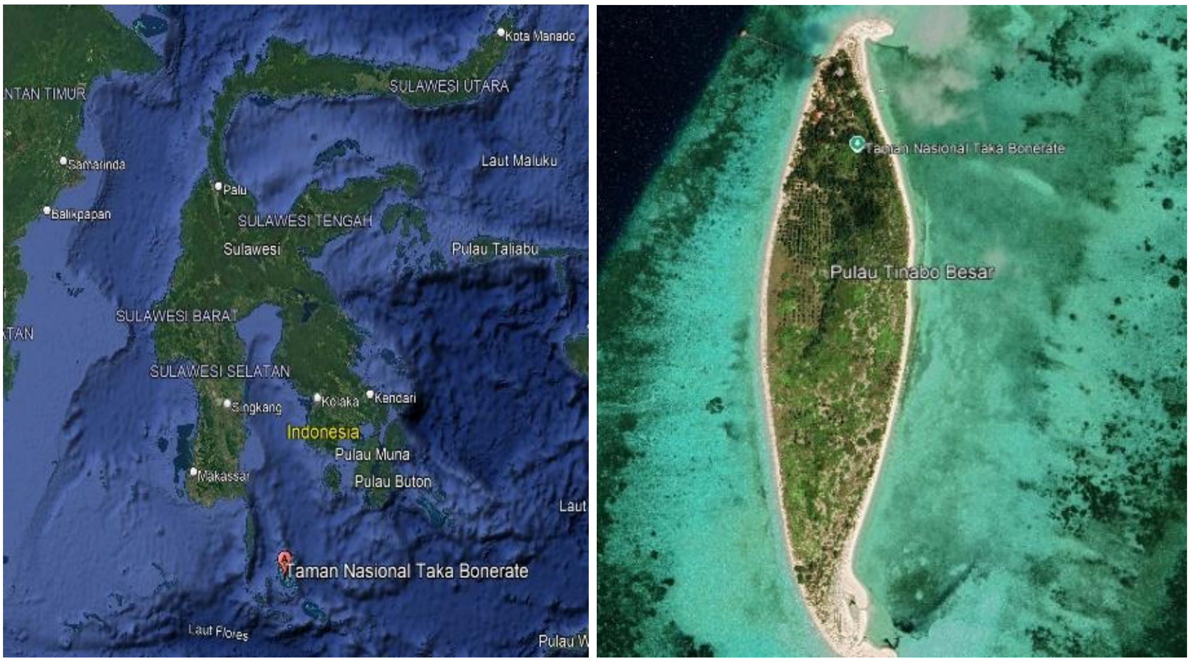

Figure 1. Research Location

The research utilized both primary and secondary data. Primary data were obtained through field observations to identify lagoon characteristics, coastal morphology, existing infrastructure, and potential operational obstacles surrounding the proposed waterbase location. Secondary data included wind, wave, current, bathymetry, tidal, and meteorological information collected from the Indonesian Agency for Meteorology, Climatology, and Geophysics (BMKG), the Taka Bonerate National Park Authority, the Ministry of Transportation of the Republic of Indonesia, Google Earth imagery, and previous scientific publications. Aircraft technical specifications were compiled from manufacturer manuals and aviation references for the Kodiak 100 Amphibian, Cessna 208 Caravan Amphibian, Dornier Seastar, and DHC-6 Twin Otter. The operational requirements and engineering criteria were adopted from the Civil Aviation Safety Regulation (CASR) Part 139 Volume III, ICAO Annex 14, and the ICAO APAC Water Aerodrome Working Group guidelines.

The technical feasibility assessment was performed through six sequential stages. Initially, hydro-oceanographic parameters, including wind characteristics, wave height, current velocity, bathymetry, and tidal conditions, were analyzed to determine the operational suitability of the proposed water area. Subsequently, the available water surface was evaluated to verify its compliance with operational water runway requirements, including minimum water depth, runway length, runway width, and maneuvering area. The third stage consisted of aircraft compatibility analysis by comparing the operational characteristics of each aircraft type with the physical conditions of the study area. The fourth stage evaluated supporting infrastructure, including docking facilities, passenger access, navigation aids, and emergency support facilities. The fifth stage examined compliance with national and international aviation regulations governing seaplane operations. Finally, all engineering parameters were synthesized to determine the overall technical feasibility of Tinabo Besar Island as a prospective seaplane waterbase. The overall research procedure is illustrated in Figure 2.

To improve the transparency and reproducibility of the assessment, this study introduces a Technical Feasibility Index (TFI) as a quantitative indicator of operational suitability. Unlike conventional descriptive assessments, the proposed index integrates all engineering parameters into a single numerical value representing the overall feasibility of the study area. The TFI is calculated using Equation (1).

$$TFI = \frac{\sum_{i=1}^{n} Si}{n} \quad (1)$$

Where (Si) represents the suitability score assigned to each engineering parameter, while (N) denotes the total number of evaluated parameters. Each parameter was assessed according to its level of compliance with the operational standards established by ICAO and CASR Part 139. A score of 3 indicates that the parameter fully satisfies the operational requirement (Suitable), 2 indicates that the parameter marginally satisfies the requirement but may require operational limitations (Marginally Suitable), and 1 indicates that the parameter does not satisfy the operational requirement (Unsuitable). The evaluated engineering parameters include wind speed, significant wave height, current velocity, bathymetric depth, water runway availability, aircraft operational compatibility, supporting infrastructure readiness, and regulatory compliance.

The final Technical Feasibility Index was classified into three operational categories. A TFI value between 2.50 and 3.00 indicates Highly Feasible, suggesting that the study area fully satisfies the technical requirements for routine seaplane operations. Values ranging from 1.75 to 2.49 are categorized as Moderately Feasible, indicating that operations may be conducted with certain engineering improvements or operational restrictions. Meanwhile, a TFI below 1.75 is classified as Not Feasible, implying that the existing conditions do not adequately support safe and sustainable seaplane operations.

The assessment results obtained from the Technical Feasibility Index were subsequently compared with the engineering requirements specified in ICAO Annex 14, ICAO APAC Water Aerodrome Guidelines, and CASR Part 139 Volume III to determine the overall operational suitability of Tinabo Besar Island. Furthermore, the findings were interpreted by considering seasonal hydro-oceanographic variability, aircraft performance limitations, environmental constraints, and infrastructure readiness to provide a comprehensive engineering evaluation for future seaplane waterbase development in marine protected areas.

3. RESULTS AND DISCUSSION

3.1 Hydro-oceanographic Assessment

Hydro-oceanographic conditions constitute the primary engineering consideration for determining the operational feasibility of a seaplane waterbase because they directly influence aircraft safety during take-off, landing, taxiing, and mooring operations. In this study, the assessment was conducted by evaluating wind characteristics, wave conditions, current velocity, bathymetry, and tidal conditions against the operational requirements specified in ICAO Annex 14 and CASR Part 139 Volume III.

The wind analysis indicates that the dominant wind directions at Tinabo Besar Island originate from the east (44.74%) and west (28.15%). Most recorded wind speeds range between 2–6 m/s, while wind speeds exceeding 8 m/s account for only a small proportion of annual observations. Based on BMKG records, approximately 90.34% of the annual wind conditions fall within the operational limits recommended for routine seaplane operations, whereas only 2.34% represent conditions that may significantly restrict aircraft movements. These results indicate that the prevailing wind environment is generally favorable for seaplane operations throughout most of the year.

Wave conditions also demonstrate favorable operational characteristics. The observed significant wave height within the lagoon generally ranges from 0.5 to 1.25 m, which satisfies the operational recommendations for sheltered seaplane water operating areas. Elevated wave conditions primarily occur during the west monsoon; however, the surrounding coral reef system functions as a natural breakwater that considerably reduces wave energy inside the lagoon. Consequently, the proposed operating area remains substantially calmer than the adjacent open sea, thereby providing safer conditions for take-off and landing operations.

Current velocity measurements further indicate suitable operational conditions. Approximately 31% of observations recorded current velocities below 0.1 m/s, while the remaining observations were between 0.1 and 0.2 m/s. No current velocity exceeded 0.2 m/s during the observation period. These values are well below the operational threshold commonly considered acceptable for safe seaplane maneuvering, indicating minimal hydrodynamic interference during taxiing and docking activities.

Bathymetric analysis shows that the lagoon depth varies from approximately –2 m to more than –40 m. Extensive shallow-water areas with depths ranging between 1.8 and 5 m satisfy the minimum water depth requirement specified for seaplane operations. Furthermore, deeper sections provide sufficient clearance for aircraft maneuvering without increasing the risk of underwater impact during landing or take-off.

The tidal analysis indicates a tidal range of approximately 2.89 m with a mixed predominantly semidiurnal tidal pattern (Formzahl Number = 1.28). Although tidal fluctuations influence the available operating depth, the observed bathymetric conditions remain within acceptable operational limits throughout the tidal cycle.

Overall, the hydro-oceanographic assessment demonstrates that Tinabo Besar Island satisfies the principal environmental requirements for seaplane operations. The combination of relatively low wind speeds sheltered wave conditions, weak currents, adequate bathymetric depth, and favorable tidal characteristics indicates that the proposed waterbase location is compliant with the engineering criteria adopted in this study. Nevertheless, operational restrictions should be considered during the west monsoon when stronger winds and higher waves may temporarily reduce operational safety.

Table 1. Tidal Data of Tinabo Besar Island

Tidal Range	Tinabo Besar
LAT (m)	-0.23
MLLWS (m)	0.58
MLLWN (m)	0.85
MSL = Zo (m)	1.21
MHHWN (m)	1.57
MHHWS (m)	1.85
HAT (m)	2.66
Tidal Range (m)	2.89
Formzal Number	1.28
Tipe Pasut	Daily double slant

Table 2. Current velocity of Tinabo Besar Island

Current Velocity (m/s)	Persentase
	Tinabo Besar Island
0.0-0.1	31%
0.1-0.2	69%
0.2-0.3	0%
0.3-0.4	0%
0.4-0.5	0%
>0.5	0%

Table 3. Wind Speed of Tinabo Besar Island

Percentage of Wind Occurrence (%)							
Directions	Wind Speed (m/s)						Quantity
	0.0 - 2.0	2.0 - 4.0	4.0 - 6.0	6.0 - 8.0	8.0 - 10.0	> 10.00	
North	0.54	0.46	0.05	0.00	0.00	0.00	1.05
Northeast	0.86	1.33	0.70	0.08	0.00	0.00	2.98
East	1.72	8.81	19.63	13.42	1.15	0.01	44.74
Southeast	1.99	4.63	4.13	1.19	0.01	0.00	11.95
South	1.49	0.81	0.05	0.00	0.00	0.00	2.35
Southwest	1.22	2.02	0.98	0.20	0.01	0.00	4.43
West	0.99	4.04	7.30	7.94	5.69	2.20	28.15
Northwest	0.57	1.27	1.15	0.77	0.45	0.13	4.34
Number of Wind Events							100.00
Number of No Wind Events							0.00
Quantity							100.00

Table 4. Wave Height of Tinabo Besar Island

Wave Incidence Percentage (%)							
Directions	Wave Height (m)						Quantity
	0.0 - 0.5	0.5 - 1.0	1.0 - 1.5	1.5 - 2.0	2.0 - 2.5	> 2.5	
North	0.53	0.00	0.00	0.00	0.00	0.00	0.58
Northeast	0.75	0.03	0.00	0.00	0.00	0.00	0.74
East	20.09	31.09	3.89	0.07	0.00	0.00	54.96
Southeast	3.20	0.58	0.00	0.00	0.00	0.00	4.01
South	1.42	0.00	0.00	0.00	0.00	0.00	1.52
Southwest	2.61	0.20	0.00	0.00	0.00	0.00	3.08
West	11.70	12.81	7.07	2.18	0.34	0.03	33.62
Northwest	1.29	0.09	0.00	0.00	0.01	0.00	1.49
Number of Waves							100.00
Number of No Waves							0.00
Quantity							100.00

From the wave aspect, the average wave height in the Tinabo lagoon area is below 1.25 m, in accordance with the minimum seaplane operational requirements. In the western season, waves can increase up to 2 m, but the lagoon area is relatively more protected by coral reef clusters so that it remains calmer than open water. The sea currents around the research area are also relatively safe, with an average speed of less than 0.5 m/s so that they do not interfere with seaplane maneuvers during takeoff or landing.

The bathymetry of the Tinabo lagoon shows a variation in depth between –2 m to more than –40 m. Areas with a depth of 1.8–5 m are quite wide and meet the standards of the water operating area according to the provisions of the Civil Aviation Safety Regulation (CASR) Part 139. With these conditions, the hydro-oceanographic aspect can be concluded to be feasible to support seaplane operations.

Table 5. Summary of Hydro-oceanographic Conditions of Tinabo Besar Island

Parameter	Measurement Results	Seaplane Operational Standards	Visibility
Wind	90,34% Safe; 2,34% Emergency	< 25 knot Safe	Fit
Wave	0,5 – 1,25 m (laguna)	< 1,25 m Safe	Fit
Current	< 0,5 m/s	< 1 m/s Safe	Fit
Batimetry	–2 up to > –40 m	Min. 1,8 m	Fit

3.2 Accessibility Assessment

The selection of an appropriate seaplane is a critical engineering consideration because aircraft performance must be compatible with the hydro-oceanographic conditions, operational water area, passenger demand, and supporting infrastructure available at the proposed waterbase. Therefore, this study evaluated four amphibious aircraft commonly used for regional and island transportation, namely the Kodiak 100 Amphibian, Cessna 208 Caravan Amphibian, Dornier Seastar, and DHC-6 Twin Otter.

The operational characteristics of the evaluated aircraft are summarized in Table 7. All four aircraft possess sufficient flight range to operate the Makassar–Tinabo Besar route, which is approximately 245 km in length. Since each aircraft has an operational range exceeding 1,500 km, fuel capacity does not represent a limiting factor for routine operations. Consequently, the selection of the most appropriate aircraft depends primarily on operational efficiency, passenger capacity, water operating characteristics, and infrastructure requirements rather than flight endurance.

The Kodiak 100 Amphibian demonstrates favorable characteristics for regular operations at Tinabo Besar Island due to its relatively low operating cost, high fuel efficiency, and capability to operate in remote areas with minimal infrastructure. Its passenger capacity of 8–10 persons is considered appropriate for small tourism groups, charter operations, environmental monitoring, and emergency missions. These characteristics make the Kodiak 100 particularly suitable during the initial stage of waterbase development when passenger demand is expected to remain relatively limited.

Similarly, the Cessna 208 Caravan Amphibian offers an effective balance between operational efficiency and passenger capacity. With accommodation for approximately 9–12 passengers and a cruise speed of around 340 km/h, the aircraft is capable of providing regular scheduled services while maintaining relatively low operating costs. The Caravan has also been widely utilized for island transportation in various archipelagic regions, demonstrating its operational reliability under conditions comparable to those of Tinabo Besar Island.

The Dornier Seastar possesses a higher passenger capacity and enhanced hydrodynamic stability owing to its twin-engine configuration. These characteristics improve operational safety under moderately rough sea conditions; however, the aircraft generally requires higher acquisition and operational costs than the Kodiak 100 and Cessna Caravan. Considering the relatively modest tourism demand currently observed at Tinabo Besar Island, the economic advantages of operating a larger aircraft may not fully offset the additional operational expenditure during the early phases of service implementation.

Among the evaluated aircraft, the DHC-6 Twin Otter offers the largest passenger capacity, accommodating approximately 15–19 passengers while maintaining excellent Short Take-Off and Landing (STOL) performance. This capability allows the aircraft to operate efficiently within relatively confined water operating areas and makes it particularly suitable for periods of high tourism demand. Nevertheless, its larger capacity may result in lower operational efficiency if passenger occupancy remains below the economic threshold required for sustainable commercial operation.

Overall, the aircraft compatibility assessment indicates that all evaluated aircraft satisfy the operational requirements for the Makassar–Tinabo route. However, considering the existing environmental conditions, anticipated passenger demand, and infrastructure availability, the Kodiak 100 Amphibian and Cessna 208 Caravan Amphibian are considered the most appropriate alternatives for routine operations. The DHC-6 Twin

Otter represents a suitable option for future service expansion when tourism demand increases, whereas the Dornier Seastar may be considered for specialized operations requiring enhanced operational stability under more challenging sea conditions.

Table 6. Comparisonof Makassar–Tinabo Travel Time

Modes of Transportation	Range (km)	Durations	Notes
Ship (via Bira)	±280	12–15 jam	Depends on weather situation
Seaplane	±245	1,5–2 jam	Direct, efficient

3.3 Aircraft Compatibility Assessment

Four types of seaplanes were considered for the Makassar-Tinabo route, namely the Kodiak 100 Amphibian, Cessna 208 Caravan Amphibian, Dornier Seastar, and DHC-6 Twin Otter. The Kodiak 100 has a capacity of 8–10 passengers with a range of 1,630 km, efficient for premium charters and small group trips. The Cessna 208 Caravan has a capacity of 9–12 passengers with a range of ±1,700 km and is popular for island touring routes. The Dornier Seastar is capable of carrying 12–14 passengers with the advantage of greater stability in the waves, despite its higher operating costs. The DHC-6 Twin Otter has a capacity of 15–19 passengers with *Short Take-Off and Landing (STOL) capability,* making it ideal for serving large numbers of tourists in remote island areas.

Table 7. Spesifikasi Seaplane untuk Rute Makassar–Tinabo

Pesawat	Kapasitas (penumpang)	Kecepatan Jelajah (km/jam)	Jangkauan (km)	Catatan
Kodiak 100 Amphibian	8–10	314	1.630	Efficient, suitable for small charters
Cessna 208 Caravan	9–12	340	1.700	Popular for sightseeing routes
Dornier Seastar	12–14	350–360	1.500	Stable in waves, high cost
DHC-6 Twin Otter	15–19	320	1.500	Large capacity, STOL

3.4 Technical Feasibility

The technical feasibility of Tinabo Besar Island as a prospective seaplane waterbase was evaluated through an integrated assessment of hydro-oceanographic conditions, transportation accessibility, aircraft operational compatibility, infrastructure readiness, and compliance with applicable aviation regulations. This approach provides a comprehensive engineering evaluation by considering the interaction among environmental conditions, operational requirements, and supporting facilities rather than relying solely on individual hydro-oceanographic parameters.

The hydro-oceanographic assessment indicates that the environmental conditions of Tinabo Besar Island are generally favourable for seaplane operations. Wind conditions remain within acceptable operational limits during most of the year, while the lagoon is characterized by relatively low wave heights, weak current velocities, and sufficient bathymetric depth to support safe take-off, landing, taxiing, and mooring activities. These findings demonstrate that the physical characteristics of the study area satisfy the principal environmental requirements for amphibious aircraft operations.

Accessibility analysis further strengthens the feasibility of the proposed waterbase. The Makassar–Tinabo route can be completed within approximately 1.5–2 hours by seaplane, representing a significant reduction compared with the existing sea transportation time of approximately 12–15 hours. Improved accessibility would not only enhance tourism mobility but also facilitate emergency evacuation, logistics distribution, conservation management, and government services within Taka Bonerate National Park.

Aircraft compatibility analysis demonstrates that all evaluated aircraft are technically capable of operating on the proposed route. However, considering passenger demand, operational efficiency, and existing infrastructure, the Kodiak 100 Amphibian and Cessna 208 Caravan Amphibian are considered the most suitable aircraft for regular operations. The DHC-6 Twin Otter is recommended for future operations with higher passenger demand due to its larger capacity and Short Take-Off and Landing (STOL) capability.

From an engineering perspective, several supporting facilities remain necessary before commercial seaplane operations can be implemented. These include floating docks, passenger waiting areas, mooring facilities, navigation aids, windsocks, communication equipment, and emergency response facilities. In addition, detailed engineering investigations regarding operational water runway dimensions, obstacle limitation surfaces, and environmental impact assessments should be undertaken during the detailed design stage to ensure full compliance with aviation regulations.

Seasonal hydro-oceanographic variability should also be considered in operational planning. Although the annual environmental conditions are generally favourable, stronger winds and higher waves during the west monsoon may temporarily limit flight operations. Therefore, weather-based operational scheduling and continuous meteorological monitoring are recommended to maintain operational safety throughout the year.

Overall, the integrated assessment indicates that Tinabo Besar Island possesses favourable environmental and operational characteristics for the development of a seaplane waterbase. The primary challenges are associated with infrastructure provision and operational management rather than environmental limitations. Accordingly, Tinabo Besar Island can be considered technically feasible for future seaplane operations, provided that the required supporting infrastructure is developed and all operational activities comply with applicable national and international aviation standards.

4. CONCLUSION

This study evaluated the technical feasibility of developing a seaplane waterbase at Tinabo Besar Island, Taka Bonerate National Park, through an integrated assessment of hydro-oceanographic conditions, transportation accessibility, aircraft operational compatibility, infrastructure readiness, and compliance with applicable aviation standards. The results indicate that the environmental characteristics of the study area, including wind conditions, wave height, current velocity, bathymetric depth, and tidal characteristics, generally satisfy the operational requirements for amphibious aircraft. In addition, the Makassar–Tinabo route can be served efficiently by the evaluated aircraft, providing a substantial reduction in travel time compared with conventional sea transportation and thereby improving regional accessibility.

Among the evaluated aircraft, the Kodiak 100 Amphibian and Cessna 208 Caravan Amphibian were identified as the most suitable alternatives for regular operations due to their operational efficiency, compatibility with the environmental conditions, and suitability for the anticipated passenger demand. Although the environmental conditions are generally favourable, the implementation of commercial seaplane services will require the development of essential supporting infrastructure, including floating docks, passenger facilities, navigation aids, communication systems, and emergency response equipment. Operational planning should also consider seasonal hydro-oceanographic variability and ensure compliance with the requirements of ICAO Annex 14 and CASR Part 139.

The principal contribution of this study is the application of an integrated engineering assessment framework that combines environmental characteristics, aircraft operational requirements, accessibility analysis, infrastructure readiness, and regulatory compliance to evaluate the technical feasibility of a prospective seaplane waterbase. This approach provides a more comprehensive basis for engineering decision-making than evaluations based solely on hydro-oceanographic observations and may serve as a reference for preliminary seaplane waterbase planning in other remote island regions of Indonesia.

This study is limited to a preliminary technical feasibility assessment based on available hydro-oceanographic data and operational requirements. Therefore, further investigations should include detailed operational water runway design, obstacle limitation surface (OLS) analysis, economic feasibility assessment, environmental impact assessment, and long-term operational performance evaluation before the implementation of commercial seaplane services.

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