Riwayat: Educational Journal of History and Humanities, 6 (3), 2023, pp. 914-926
P-ISSN: 2614-3917, E-ISSN: 2775-5037
DOI: https://doi.org/10.24815/jr.v6i3.33648

Study of API Banyuwangi Seaplane Operations with Connectivity Analysis and Flight Optimization Methods for Outermost, Remote and Underdeveloped Regions in Indonesia

Hadi Prayitno[1]✉, Achmad Setiyo Prabowo[2], Dhian Supardam[3] , Demmy Setyo Wiyono[4]
[1]Akademi Penerbang Indonesia Banyuwangi
[2]Politeknik Penerbangan Surabaya
[3]Politeknik Penerbangan Indonesia Curug
[4]Akademi Penerbang Indonesia Banyuwangi
Correspondence Author: hadi.stpi@gmail.com✉

Article history
Received : 2023-03-13
Accepted : 2023-05-22
Published : 2023-08-25

Keywords:
seaplane;
connectivity;
aviation optimalization;
accessibility;
travel time;

Available online at
http://jurnal.unsyiah.ac.id/riwayat/

Abstract:
This research examines API Banyuwangi seaplane operations in optimizing flights in Indonesia's outermost, remote, and underdeveloped regions. The connectivity analysis method measures regional connectivity with seaplane flights and identifies areas that require better accessibility. In addition, this research also involves optimizing flights by considering factors that affect seaplane operations, such as weather, topography, and distance. The results of this research can provide input for developing seaplane flight services in Indonesia, particularly in outermost, remote, and underdeveloped regions.

Abstrak:
Penelitian ini mengkaji operasi hidroaviasi API di Banyuwangi dalam mengoptimalkan penerbangan di wilayah terluar, terpencil, dan kurang berkembang di Indonesia. Metode analisis konektivitas mengukur konektivitas regional melalui penerbangan hidroaviasi dan mengidentifikasi daerah-daerah yang memerlukan aksesibilitas yang lebih baik. Selain itu, penelitian ini juga melibatkan optimisasi penerbangan dengan mempertimbangkan faktor-faktor yang memengaruhi operasi hidroaviasi, seperti cuaca, topografi, dan jarak. Hasil dari penelitian ini dapat memberikan masukan untuk pengembangan layanan penerbangan hidroaviasi di Indonesia, khususnya di wilayah terluar, terpencil, dan kurang berkembang.

INTRODUCTION

Air transportation is a crucial means of transportation in facilitating the movement of people and goods from one place to another (Rajendran & Srinivas, 2020). Air transportation is needed in Indonesia to connect islands separated by vast seas. However, many areas in Indonesia are challenging to reach by regular air transportation, especially the outermost, remote, and underdeveloped regions (Neni et al., 2020).

One alternative air transportation that can overcome this problem is a seaplane (Hammoudi, 2021). A seaplane or floatplane is a plane that can land and take off on water and land. Seaplanes can access areas inaccessible by conventional aircraft, such as lakes, rivers, and coastal areas.

API Banyuwangi is the only Aviation Education Institute that operates seaplanes in Indonesia. Although seaplanes have the potential to connect the outermost, remote, and underdeveloped regions in Indonesia, it still needs to study the operation and optimization of seaplane flights in Indonesia, especially in outermost, remote, and underdeveloped regions. Therefore, this study aims to examine API Banyuwangi seaplane operations using connectivity analysis methods and flight optimization in outermost, remote, and underdeveloped regions in Indonesia. The results of this research can provide input for developing seaplane flight services in Indonesia and improving regional connectivity in Indonesia.

Several issues need to be solved to enhance connectivity and accessibility in Indonesia's outermost, remote, and underdeveloped regions (Wijaya, 2021). Limited air transport accessibility in Indonesia's outermost, remote, and underdeveloped regions can hinder economic and social growth. It also has limited regular air transportation to connect areas that are difficult to reach by conventional aircraft. The potential for seaplanes as an alternative to air transportation to overcome the limited accessibility of the outermost, remote, and underdeveloped regions in Indonesia, but there is still a lack of research and studies related to the operation and optimization of seaplane flights in Indonesia. It is necessary to study regional connectivity with seaplane flights and identify areas that require better accessibility and optimization of seaplane flights in the outermost, remote, and underdeveloped regions in Indonesia.

METHODS

The research method should be included in the Introduction. The method contains an explanation of the research approach, subjects of the study, the conduct of the research procedure, the use of materials and instruments, data collection, and analysis techniques.

The method used in writing this research is utilizing a literature review and combining it with existing data and facts owned by API Banyuwangi or data and facts that have been disclosed in public. The data used is secondary data obtained from API Banyuwangi and other related parties such as the Ministry of Transportation, the Ministry of Public Works and Public Housing, the National Planning Agency, the National Search and Rescue Agency, and the District/City Transportation Services in the outermost, remote, and underdeveloped regions in Indonesia which have been verified and tested for validity. Existing data is combined and used to evaluate API Banyuwangi seaplane operations, as well as connectivity analysis and flight optimization in the outermost, remote, and underdeveloped regions in Indonesia.

2.

RESULTS AND DISCUSSION

Identifying areas that need better accessibility

The prospective study has selected several locations, obtained by considering the 3T regions categories and from the results of reference searches and interviews with several relevant parties (academicians, the Ministry of Transportation, and the community). The development model is determined based on route considerations for the potential use of the seaplane transportation mode to several provinces, such as the Riau Islands, North Sulawesi, East Nusa Tenggara, Aceh, Southwest Papua, Papua, and Central Papua.

Optimizing seaplane flights in the outermost, remote, and underdeveloped regions of Indonesia

1. Access to the outermost, remote, and underdeveloped islands in the Province of Riau Islands.

Figure 1. Access to the outermost, remote, and underdeveloped islands in the Province of Riau Islands.

Figure 2. Seaplane route scenario in the Province of Riau Islands.

Table 1. Seaplane route mileage measurement in the Province of Riau Islands.

No	Route between harbor/port	Estimated distance (km)	NM	Seaplane travel time (mins)	Boat travel time (mins)
1	Tanjung pinang → Siantan	286,57	154,73	77,37	714,14
2	Siantan → Selat lampa	217,57	117,47	58,74	542,17
3	Selat lampa → Subi	108,67	58,67	29,34	270,78
4	Subi → Serasan	59,67	32,21	16,11	148,66

3. Access to the outermost, remote, and underdeveloped islands in the Province of North Sulawesi.

Figure 3. Access to the outermost, remote, and underdeveloped islands in the Province of North Sulawesi.

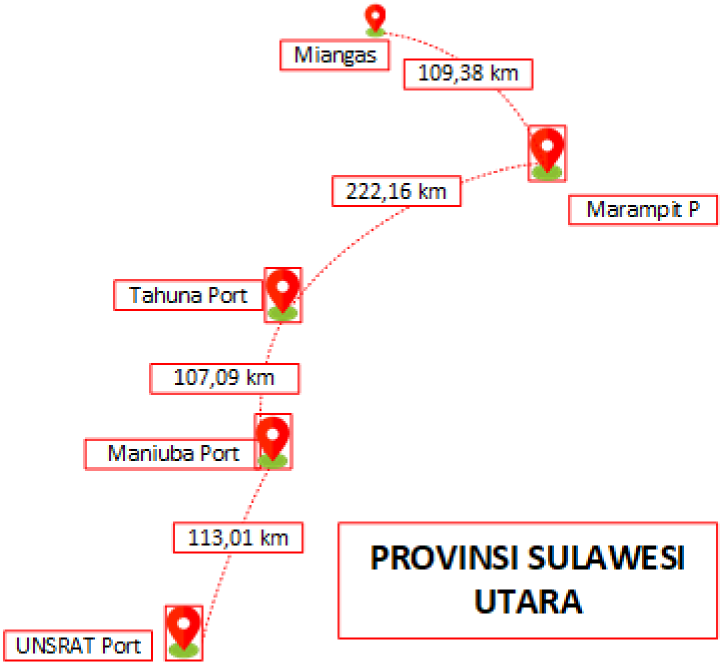

Figure 4. Seaplane route scenario in the Province of North Sulawesi.

Table 2. Seaplane route mileage measurement in the Province of North Sulawesi.

No	Route between harbor/port	Estimated distance (km)	NM	Seaplane travel time (mins)	Boat travel time (mins)
1	UNSRAT → Maniuba	113,01	61,02	30,51	281,63
2	Maniuba → Tahuna	107,09	107,09	53,55	494,26
3	Tahuna → Marampit	222,16	119,95	59,98	553,62
4	Marampit → Miangas	109,38	59,06	29,53	272,58

4. Access to the outermost, remote, and underdeveloped islands in the Province of East Nusa Tenggara.

Figure 5. Access to the outermost, remote, and underdeveloped islands in the Province of East Nusa Tenggara.

Figure 6. Seaplane route scenario in the Province of East Nusa Tenggara.

Table 3. Seaplane route mileage measurement in the Province of East Nusa Tenggara.

No	Route between harbor/port	Estimated distance (km)	NM	Seaplane travel time (mins)	Boat travel time (mins)
1	IPPI Ende → Seba-sabu	182,78	98,69	49,35	455,49
2	Seba-sabu → Salura	181,70	98,11	49,06	452,82
3	Seba-sabu → Papela	168,89	91,19	45,60	420,88
4	Papela → Kolbano	141,67	76,49	38,25	353,03

5. Access to the outermost, remote, and underdeveloped islands in the Province of Aceh.

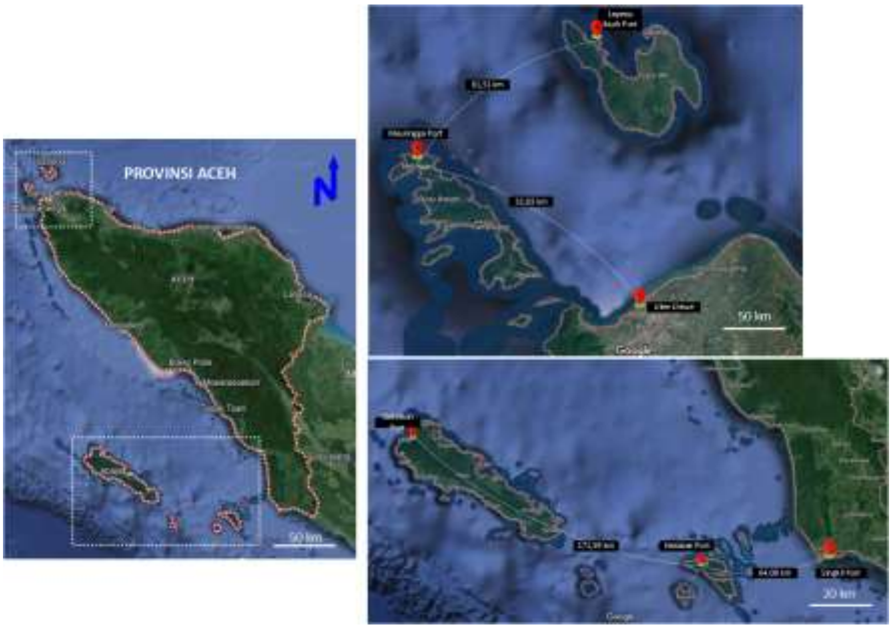

Figure 7. Access to the outermost, remote, and underdeveloped islands in the Province of Aceh.

Figure 8. Seaplane route scenario in the Province of Aceh.

Table 4. Seaplane route mileage measurement in the Province of Aceh.

No	Route between harbor/port	Estimated distance (km)	NM	Seaplane travel time (mins)	Boat travel time (mins)
Pulau Weh					
1	Ule lheue → Meulingge	32,03	17,29	8,65	79,80
2	Meulingge → Layeou Iboh	61,51	33,21	16,61	153,28
Pulau Tuangku					
1	Singkil → Haloban	64,08	34,6	17,30	159,69
2	Haloban → Detimon	171,59	92,65	46,33	427,62

6. Access to the outermost, remote, and underdeveloped islands in the Province of Southwest Papua, Papua, and Central Papua.

Figure 9. Access to the outermost, remote, and underdeveloped islands in the Province of Southwest Papua, Papua, and Central Papua.

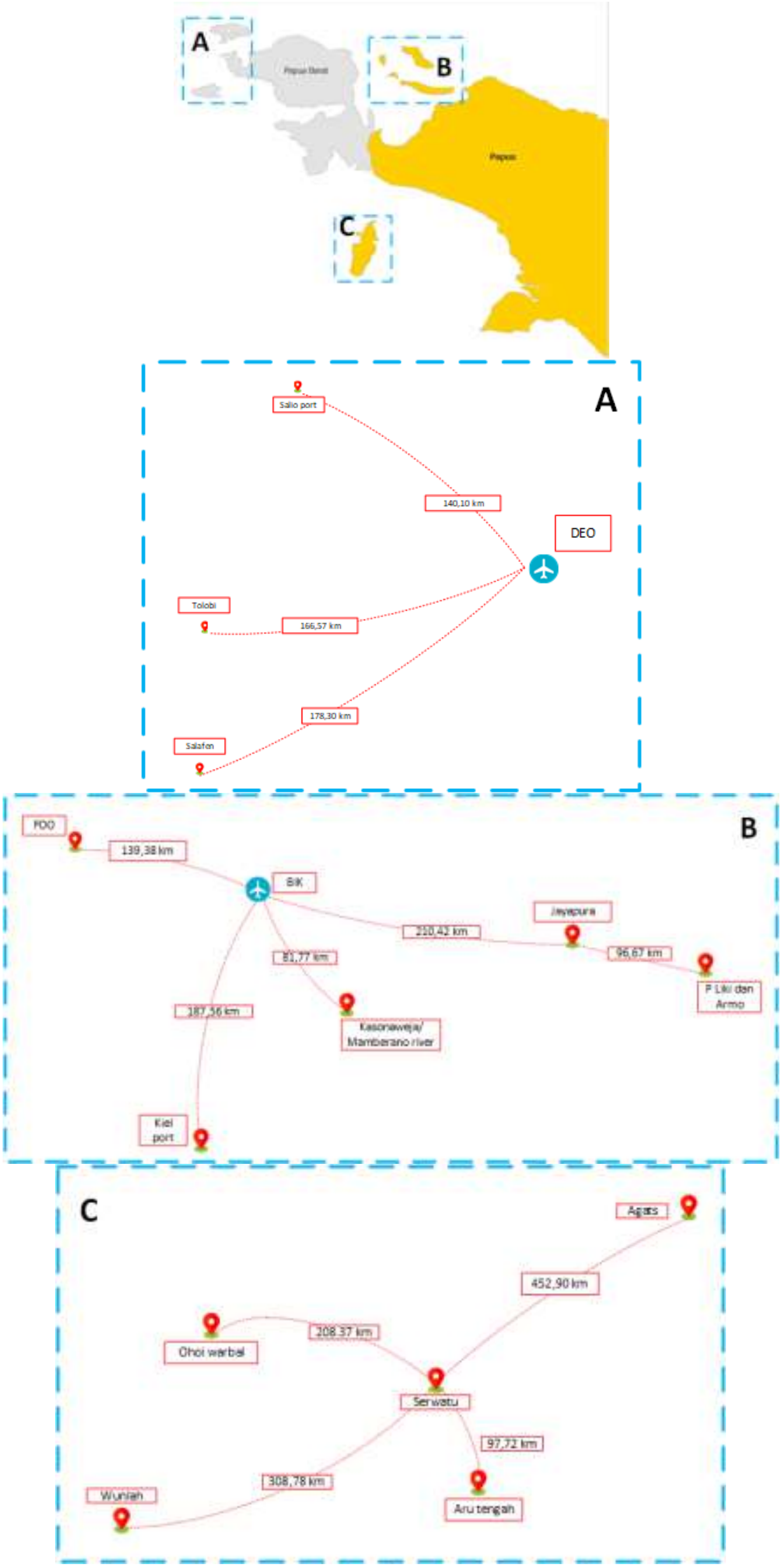

Figure 10. Seaplane route scenario in the Province of Southwest Papua, Papua, and Central Papua.

Table 5. Seaplane route mileage measurement in the Province of Southwest Papua, Papua, and Central Papua.

No	Route between harbor/port	Estimated distance (km)	NM	Seaplane travel time (mins)	Boat travel time (mins)
A					
1	DEO Airport → Salafen	178,30	96,27	48,14	444,32
2	DEO Airport → Tolobi	166,57	89,94	44,97	415,11
3	DEO Airport → Salio	140,10	75,64	37,82	349,11
B					
1	BIK → FOO	139,38	75,25	37,63	347,31
2	BIK → Kiel	187,56	101,27	50,64	467,40
3	BIK → Kasonaweja	81,77	44,15	22,08	203,77
4	BIK → Jayapura	210,42	113,61	56,81	524,35
5	Jayapura → Liki	96,67	52,19	26,10	240,88
C					
1	Agats → Serwatu	452,90	244,54	122,27	1128,65
2	Serwatu → Ohoi warbal	208,37	112,51	56,26	519,28
3	Serwatu → Wunlah	308,78	166,72	83,36	769,48
4	Wunlah → Aru tengah	97,72	52,76	26,38	243,51

In choosing the seaplane flight route, determining the longest route must consider the minimum operational cruising range of aircraft such as the Viking Twin Otter Series 400 with a minimum operational distance of ± 299.5 km. Therefore, for the performance database for each seaplane destination, the cruise altitude will be lowered, which was initially at an altitude of 26,000 ft to an altitude of 12,000-15,000 ft so that a potential route for seaplane transportation modes is formed which will be used to improve connectivity between 3T islands. A map of the potential seaplane routes can be seen in Figure 41-4.10. The flight route based on the data obtained illustrates the seaplane connectivity network model of inter-island flight routes in Riau Province. Anomaly of a waterbased as a vertex/vertex (v) and movement between one waterbased to another as a link/edge (e).

Results of connectivity analysis and flight optimization

Seaplane versus boat time travel analysis

Based on the previous considerations, a case study has been developed to apply to the 3T area. This analysis aims to prove the feasibility of scheduled flight services using seaplanes to increase accessibility to each province's outermost, remote, and underdeveloped regions.

The first step of this study is to identify the demand that will reach the most important tourist sites in the outermost, remote, and underdeveloped regions by using air transportation, which is faster but more expensive than land or sea transportation. Specifically, only visitors willing to pay more for time savings are considered to gauge potential seaplane demand. Therefore, statistics on tourist arrivals to four- and five-star hotels are used to predict the two components of demand for those traveling from (to) regional airports to (from) the main tourist areas of destination islands and those traveling between tourist areas to visit the island on a one-day tour.

So that planning routes for the potential use of seaplane transportation modes to several areas with the potential for marine tourism or other tourism that are not easy to reach that apply travel time analysis using seaplane transportation.

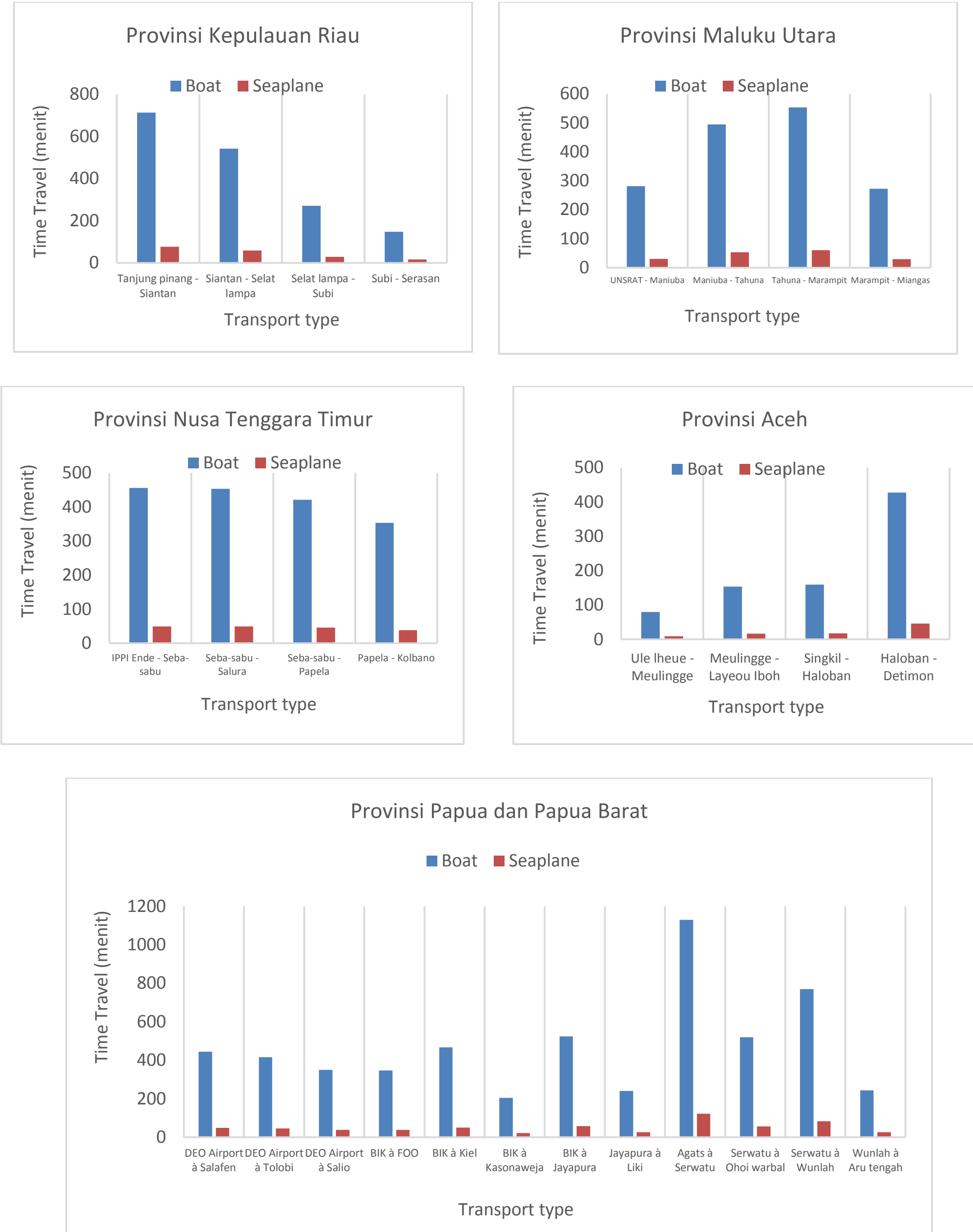

Figure 1. Gap travel time between seaplanes and for island conditions in all provinces.

To estimate the first component, we need to calculate the accessibility from each tourist location to the nearest airport, and tourists arriving at each airport are divided as a percentage of the nearest tourist location. It is assumed that these passengers can use regional flight services during the day. The second component (i.e., one-day tour) is measured taking into account the 50 percent share of total monthly tourist arrivals to each province, among other provinces, using the relative attractiveness indicator. Then, all origin-destination pairs that exceed a demand threshold that can justify scheduled air service are selected. In modeling the modal choices of tourists moving from the main island to the smaller islands, the authors assume heterogeneity of preferences related to travel time and examine differences in income as a source of heterogeneity along with other unobserved factors (Amoroso et al., 2012b).

In particular, the random parameter logit model with the travel time coefficient consists of two elements: a random part and a component that depends on the per capita income of each province. In addition, for inter-island travel within the province, the correlation between car rental and buses and between buses and the two air transport alternatives is suspect, as they are different forms of public transport. Therefore, the related model specification error components are added to represent the correlations among the alternatives.

Consideration of the water conditions and ports/piers in each district/island is needed to support mobilizing people/goods. Number and description of ports in each district/island. However, this study only examined the ports/piers whose routes were recorded from each region's Regional Regulations concerning RTRW (Regional Spatial Planning) in 2012-2032. Each port has port route characteristics that describe the movement of passengers/goods and ships operating at a port. In this stage, reviewing airport characteristics considers factors, including the number of districts/islands served by a port/pier and the frequency of ports between districts/islands served by each port.

The connectivity matrix of the representation graph involves several rows and columns equivalent to the number of ports reviewed. Then the ports reviewed totaled 29 ports, so the connectivity matrix is a 29 × 29 grid. Each connected port is given a value of 1 in its cell (for example, Labuha – Bajo). Meanwhile, each port that is not connected is given a value of 0 (for example, Labuha –Labuha). Then do it for all existing data.

The connectivity matrix table can provide a fundamental measurement of connectivity by adding existing connections where the sum of the values in the connectivity matrix cells can indicate the level of indirect connectivity per port.

The implication of research results

From the results of the analysis and calculations that have been done, several implications can be given. The results of the data analysis obtained the distance traveled and travel time between islands, both using the ship transportation mode and a new type of transportation mode, namely the seaplane. From the schematic figure 4.1-4.10, the connectivity matrix that has been made, it can be shown that the modes of transportation are ships, ports, and islands that have direct connections with the main island, such as Semelur Pier for access to Natuna Island, Marampit Island, Rote Island, Miangas Island, Weh Island, Liki Island, and several other islands.

In analyzing seaplane transportation modes, potential routes for seaplane flights in 5 provinces with the outermost, remote, and underdeveloped regions. In selecting the potential routes, the islands with a high level of tourism, long distances, and relatively long sailing times are selected using the ship mode of transportation.

From the results of an analysis of connectivity, travel time, travel costs, and capacity, it can be concluded that inter-island connectivity in South Halmahera Regency with the existence of a new mode of transportation, namely the seaplane, can make it easier for tourists or local people to go to tourist attractions or to islands that require a long travel time. Using the seaplane mode of transportation, tourists or the local community can save travel time. However, it can only carry a few passengers and incur travel costs far more expensive than a ship.

Recommendation for the development of seaplane flight services in Indonesia

In order to improve connectivity and accessibility in Indonesia, the development of seaplane flight services can be an attractive alternative. In order to meet the needs of transportation infrastructure development, including seaplane flight services, non-APBN creative financing is necessary. Government and Business Entity Cooperation Schemes (KPBU), Utilization Cooperation (KSP), and increasing the role of State-Owned Enterprises (BUMN) can be explored as sources of financing. In addition, the use of State Sharia Securities (SBSN) and private investment can also be an option to support the development of seaplane flight services.

The successful development of seaplane flight services is also highly dependent on the active role of stakeholders (Sendjaja et al., 2022). It requires a strong commitment from the government, transportation authorities, flight operators, local communities, and the general public to support and contribute to the development of seaplane flight infrastructure and services. Good coordination between stakeholders will ensure that the project goes according to plan and avoids obstacles that could hinder its development.

In addition, it is necessary to pay attention to adequate access for the community to reach this transportation. (Trihandayani et al., 2022) Good accessibility will ensure that people can easily reach seaplane stopping points and minimize obstacles and encourage the use of seaplane flight services as an efficient and effective transportation alternative which includes the selection of environmentally friendly technologies, protection of the coastal environment, and active participation of local communities in the management and utilization of seaplane services. This effort will ensure that the development of transportation infrastructure is carried out by considering environmental, social, and economic aspects in a balanced manner (Taghulihi, 2022).

CONCLUSION

Access to the outermost, remote, and underdeveloped islands in Indonesia is mainly based on seaside locations and small islands with tourist attractions in history, architecture, and nature. However, the accessibility is often poor. This research demonstrates the feasibility of scheduled transportation services using seaplanes to connect Indonesia's most popular tourist locations with scheduled infrastructure and service networks. However, seaplane service can improve access for tourists with high time values (Amoroso et al., 2012b). In addition, this alternative mode of transport, traveling at low altitudes under the Visual Flight Rules (VFR), can be considered part of the tourist experience with the possibility of taking scenic flights.

The analysis results show that seaplane transportation can capture a market share of between 1 and 14 percent of the demand for tourist trips. The seaplane-shuttle service can benefit travel couples involving the two main islands and famous locations such as Nias and Rote in NTT. However, the development of these alternative forms of air transport is linked to the planning of the aviation infrastructure network in the region. It is also essential to pay attention to the environmental compatibility of this type of low-altitude flight.

It should be underlined that some attempts to use seaplanes for passenger transportation. Many failure attempts were likely due to the wrong seaplane selection and lack of take-off/landing infrastructure. A comparison between the two types of transportation shows that seaplanes require less power to fly compared to ships. However, seaplane performance is highly dependent on weather conditions (especially sea conditions) when using the runway (water-based) for aircraft operations is impossible.

Due to their low maintenance costs, seaplanes are the most widely used alternative means of transportation for this type of service worldwide. It has achieved significant improvements in ship maintenance by reducing the associated costs. However, carriers need to consider the costs associated with aviation infrastructure and the actual presence of that infrastructure in the region.

From the results of an analysis of connectivity, travel time, travel costs, and capacity, it can be concluded that inter-island connectivity in Indonesia with the existence of a new mode of transportation, namely the seaplane, can make it easier for tourists or local people to go to tourist attractions or to islands that require a long travel time. Using the seaplane mode of transportation, tourists or the local community can save travel time. However, it can only carry a few passengers and incur travel costs far more expensive than using a ship.

REFERENCES

Amika, A. W. N., & Riorini, S. V. (2023). Pengaruh Transparansi Green Attributes Terhadap Perilaku Kewarganegaraan Hijau. *JIM: Jurnal Ilmiah Mahasiswa Pendidikan Sejarah*, *8*(3), 2268–2281.

https://doi.org/10.24815/jimps.v8i3.25699
Hammoudi, H. (2021). A Novel Approach To The Weight and Balance Calculation for The De Haviland Canada DHC-6 Seaplane Operators. *International Journal of Computer Science and Security (IJCSS)*, *15*(4), 123–133.
Ismail, I., Putri, R. S., Zulfadhli, Z., Mustofa, A., Musfiana, M., & Hadiyani, R. (2022). Student Motivation to Follow the Student Creativity Program. *Riwayat: Educational Journal of History and Humanities*, *5*(2), 351–360. https://doi.org/10.24815/jr.v5i2.27641
Neni, F., Rahmawati, Y., Agushinta, L., & Rizaldy, W. (2020). The Role Of Airfast As A Pioneer Flight In Supplying Logistics In Indonesia Remote Areas During Cofid 19 Pandemic. *Advances in Transportation and Logistics Research*, *3*, 64–71.
Nurlela, N. (2023). Assitulungeng: Studi Tentang Nilai Solidaritas Masyarakat Nelayan Danau Tempe. *JIM: Jurnal Ilmiah Mahasiswa Pendidikan Sejarah*, *8*(2), 792–798. https://doi.org/10.24815/jimps.v8i2.24844
Rajendran, S., & Srinivas, S. (2020). Air taxi service for urban mobility: A critical review of recent developments, future challenges, and opportunities. *Transportation Research Part E: Logistics and Transportation Review*, *143*, 102090.
Rizal, A., & Susilahati, S. (2023). Implementation of the Jakarta Elderly Card Program in Meeting the Basic Needs of the Elderly. *Riwayat: Educational Journal of History and Humanities*, *6*(2), 596–605. https://doi.org/10.24815/jr.v6i2.31545
Sendjaja, T., Zainal, V. R., Imaningsih, E. S., Nawangsari, L. C., & Lo, S. J. (2022). Digital Bank Transformation: Sustainable Innovation in Financial Institutions. *Journal of World Science*, *1*(12), 1118–1131.
Sulthani, D. A., & Thoifah, I. (2022). Urgency of Stakeholders in Improving the Quality of Education. *Riwayat: Educational Journal of History and Humanities*, *5*(2), 443–451. https://doi.org/10.24815/jr.v5i2.27600
Taghulihi, B. (2022). Strategi Pengembangan Daya Tarik Wisata Bahari Kelurahan Togolobe Pulau Hiri. *Jurnal Impresi Indonesia*, *1*(6), 604–611.
Trihandayani, E., Limakrisna, N., & Muharram, H. (2022). The Effect of Promotion Servicescape, Destination Image Visiting The Thousand Island of DKI Jakarta. *Journal Of World Science*, *1*(10), 936–943. https://doi.org/10.58344/jws.v1i10.107
Wijaya, F. P. (2021). The potential implementation of telemedicine in frontier, outmost, and underdeveloped region of Indonesia. *2021 2nd International Conference on ICT for Rural Development (IC-ICTRuDev)*, 1–6.
Prayitno, H., Supardam, D., & Idyaningsih, N. (2023). *Metodologi Penelitian Penerbangan.* Samudra Biru.
Yunianto, I. T., Nur, H. I., Ardhi, E. W., & Adhitya, B. P. (2019). Optimalisasi Model Jaringan Rute Multiport Tol Laut di Negara Kepulauan: Studi Kasus Evaluasi Rute di Maluku dan Papua Bagian Selatan. *Jurnal Penelitian Transportasi Laut*, 21(2), 83-95.
Aditiya, R. R., Triadmojo, B., & Suparma, L. B. (2022). Analisis Variabel Pengembangan Pelabuhan Laut (Pelabuhan Penumpang) sebagai Bandar Udara Perairan untuk Operasional Pesawat Apung (Seaplane) di Indonesia. *Pondasi*, 27(2), 205-215.
Xiao, Q., Luo, F., & Li, Y. (2020). Risk assessment of seaplane operation safety using Bayesian network. Symmetry, 12(6), 888.
Allen, J. G., MacNaughton, P., Cedeno-Laurent, J. G., Cao, X., Flanigan, S., Vallarino, J., ... & Spengler, J. D. (2019). Airplane pilot flight performance on 21 maneuvers in a flight simulator under varying carbon dioxide concentrations. *Journal of exposure*

science & environmental epidemiology, 29(4), 457-468.

Zheng, Y., Lu, Y., Jie, Y., & Fu, S. (2019). Predicting workload experienced in a flight test by measuring workload in a flight simulator. *Aerospace medicine and human performance*, 90(7), 618-623.

Masi, G., Amprimo, G., Ferraris, C., & Priano, L. (2023). Stress and Workload Assessment in Aviation—A Narrative Review. *Sensors*, 23(7), 3556.

Hidayat, R. W., Triadmojo, B., & Utomo, S. H. T. (2022). Penilaian Risiko (Risk Assessment) Pengoperasian Pesawat Udara Apung (Seaplane) di Bandar Udara Perairan (Studi Kasus: Waterbase Benete–Nusa Tenggara Barat). *Pondasi*, 27(2), 174-186.

Guo, Y., Ma, D., Yang, M., & Liu, X. A. (2021). Numerical Analysis of the Take-Off Performance of a Seaplane in Calm Water. *Applied Sciences*, 11(14), 6442.

N Shabrina. D Arianto, K.S Wardani, Z Qonita, A.R Ispandiari, Hariyanto, N I Gutami (2022). Session Assessment of Seaplane Operations : The Case of Marine Tourism Devepment on Gili Iyang island, Indonesia. *The 7th International Conference on Marine Technology* (SENTA 2022)

Khoirunnisa, H., Wibowo, M., & Hendriyono, W. (2021). Hydrodynamic And Boussinesq Wave Modeling for The N219 Amphibious Aircraft Seaplane Dock Development Plan in Panjang Island. *Majalah Ilmiah Pengkajian Industri*, 15(2).

MacDonald, C., Brooks, C., & McGowan, R. (2021). Survival from Canadian seaplane water accidents: 1995 to 2019. *Aerospace medicine and human performance*, 92(10), 798-805.

Ghifari, R. A., & Ahyudanari, E. (2021). Analisis Transportasi Seaplane terhadap Konektivitas Antar Pulau di Kabupaten Halmahera Selatan. *Jurnal Teknik ITS*, 10(2), E229-E236.

Gao, X., Li, C., Liu, T., Wu, B., & Wang, M. (2021, July). Research on wave motion response characteristics of a seaplane. *In Journal of Physics: Conference Series* (Vol. 1985, No. 1, p. 012031). IOP Publishing.