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Optimization And Application Of The Port Hub System In The Sea Toll Program To The Total Backload From North Papua

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Abstract: Sea Toll, a government program in the field of Transportation and Logistics created by Mr. Ir. H. Joko Widodo in 2015 as a stimulus program for the 3T regions (Underdeveloped, Frontier, Outermost). Northern Papua, with its abundant natural wealth potential, is part of this program, operating under route code T-9 as a connection to the island of Java. However, the program still faces a classical issue, which is the issue of return cargo. This problem is critical for the 3T regions in northern Papua. Therefore, the research aims to address this issue by optimizing the travel routes for return cargo. In this study, scientific methods such as Location Quotient (LQ), Analytical Hierarchy Process (AHP), and Dijkstra's Algorithm will play a crucial role in determining the most optimal routes and implementing the Hub and Spoke system.

Keywords: *Hub and Spoke, Location Quotient, Sea Port, Sea Toll*

1. Introduction

As a maritime nation with 17,508 islands and economic growth centers scattered throughout the archipelago, the interaction between regions and economic connectivity among the islands is heavily dependent on the role and organization of national transportation. The importance of transportation is articulated in the National Long-Term Development Plan (RPJP Nasional) 2005-2025, where the transportation system is directed towards supporting economic, social, cultural, and environmental activities. It is developed through regional development approaches to achieve balance and even development among regions, aiming to strengthen national unity for national defense and security and to establish spatial arrangements in pursuit of national development goals.

In the development of the national transportation system, it is essential to have a well-structured logistics system on both a large and small scale, encompassing local and national levels. This is because Indonesia is highly diverse in the use of transportation modes. Similarly, the implementation of sea toll programs through the National Transportation System must adhere to the logistics system designed for the use of sea transportation, namely ships used in the distribution of goods and cargo from west to east and vice versa, while still utilizing other transportation modes. This is because the logistics system consists of facilities connected with

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transportation mode services. This logistics system plays a strategic role in integrating and harmonizing progress among economic sectors and regions, aiming to achieve inclusive and sustainable economic growth, as well as serving as a safeguard for national economic sovereignty and resilience (Malisan et al., 2021).

In Indonesia, in the implementation of the National Logistics System development, numerous breakthroughs and innovations have been realized, setting examples for the world and drawing attention (Fitharti et al., 2019). One such example is the Sea Toll program proposed by President Jokowi through the Ministry of Transportation in 2015. The primary objective of the Sea Toll program is to "reach and distribute logistics to the outermost, remote, and border regions." There are three aspects the Sea Toll program aims to achieve: availability, ease of shipping connectivity (Accessibility), and making essential goods more affordable for the general population (Affordability) (Yunianto et al., 2019).

The eastern region of Indonesia, particularly Papua, has been a focus of special attention from the government due to the challenges of distributing goods to this area, resulting in high prices for essential commodities. Papua is a strategically located archipelagic region that is rich in various natural resources. It has potential in sectors such as sea fisheries (tuna and skipjack), agriculture (cocoa, nutmeg, sweet potatoes, sago), but the lack of transportation access has hindered optimal distribution. The Sea Toll program is one way to connect major ports across the archipelago to facilitate the distribution of goods to remote areas (Sholihah et al., 2018). With the Sea Toll program, it is hoped that goods from their source can be transported to the cities and regions that need them. Currently, there are sea routes transporting goods from other areas to Papua, but a significant portion of the distribution in Papua still relies on air transportation. The high cost of aviation fuel is one of the reasons for the high prices of goods in Papua. There is currently no established shipping route for the distribution of goods by sea in Papua.

The Sea Toll program is seen as a solution to reduce price disparities between Java and the 3T regions (Frontier, Outermost, and Remote) in eastern Indonesia, specifically the Eastern part. The Sea Toll program is implemented by providing affordable, regular, and scheduled shipping services, which can stimulate economic growth in Eastern Indonesia (Saragi et al., 2018). Consequently, the government intervenes in the market by making technical and non-technical decisions for the operation of the sea toll. In 2018, there were 15 routes in the Sea Toll program, and by 2021, this had increased to 28 routes. Sea Toll operations are based in various ports, including Teluk Bayur, Jakarta, Surabaya, Tahuna, Tobelo, and Biak. The hope is that the Sea Toll program can help reduce price disparities in Eastern Indonesia (R. Gultom, 2017), ultimately supporting economic development and greater equity across the nation.

As an archipelagic country, Indonesia has a wide-ranging potential that spans from the hinterland, connected by road transportation networks to ports, and the maritime transportation

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http://proceedings.itltrisakti.ac.id/index.php/altr

system (ports, shipping, and maritime movement potential) plays a vital role.

2. Literature review

2.1 Transportation

This section provides a critical overview of existing literature, helps situate the research within the broader academic discourse, and lays the foundation for the research objectives, methodology, and contributions presented in the journal article.

"Transportasi" originates from the Latin word "transportare," where "trans" means to cross or across, and "portare" means to carry or convey. According to Lasse (2016), transportation is an organized activity aimed at moving goods (cargo) or people (passengers) from the point of origin to their destination following a set of rules and regulations, including being (a) safe and secure, (b) fast and on schedule, and (c) in accordance with a plan.

According to Gunawan (2015), transportation is defined as the movement of goods and people from their point of origin to their destination. The transportation process involves the transfer from the point of origin, where the transportation activity begins, to the destination, where the transportation activity concludes. Based on this definition, transportation can be understood as the effort and activity of conveying goods and/or passengers from one place to another.

2.2 Transportation Planning

The goal of transportation planning is to find the most appropriate solution to transportation problems using available resources (Warpani, 1990). Transportation planning is conducted to estimate the quantity and location of transportation needs in the planning year, which can be used for various transportation planning and investment policies. Planning is also useful for making various changes within the system to work effectively and produce maximum benefits (Setiawati, 2015). According to Tamin (1995), a concept used in transportation planning is the Four-Step Transportation Planning Model, which includes:

a. Trip Generation Model
b. Trip Distribution Model
c. Mode Choice Model
d. Route Assignment Model

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Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

2.3 Network Design

The challenges faced in maritime transportation include optimizing the existing network. Even established networks must be optimized to generate optimal routes. Yang and Chen (cited in Danandjojo et al., 2019) state that there are three types of shipping routes, including: circle shipping line, pendulum shipping line, and hub and spoke shipping line.

3. Research method

According to Sugiyono (2013), "Data collection techniques are the most strategic step in research, as the primary goal of any research is to obtain data." Referring to previous research, various data management techniques have been used in studies related to sea toll, such as MatLab, Non-Linear Programming optimization, Analytical Hierarchy Process (AHP), (1-0) Insertion Intra Route method, Ant Colony Optimization, Tabu method, and Genetic Algorithms (Fachrurrazi, 2015). In this research, data processing involves using Location Quotient (LQ) as the basis for determining routes from each region, Analytical Hierarchy Process (AHP) for determining HUB ports, and the Dijkstra algorithm for route determination.

In this research, AHP is used to determine the ideal location based on several supporting factors for identifying the hub port. The data generated consists of responses from respondents when filling out questionnaires. Respondent selection is done using purposive sampling techniques, taking into consideration the characteristics or specific parties directly related to the field of study. The obtained data is then processed using Expert Choice 11 software through AHP analysis calculations.

This research explains how to implement the Dijkstra algorithm to solve the shortest path problem in the case of determining sea toll ship routes in northern Papua.

The secondary data for this research is obtained from documents maintained by both the city's Central Statistics Agency and the Provincial Central Statistics Agency. The analytical method employed in this study entails identifying the dominant sectors and subsectors within urban areas through LQ (Location Quotient) analysis. The input data used in the calculations consist of the production values for each sector and subsector within the city and the province, which are determined based on the total income values associated with these sectors and subsectors.

4. Results and discussion

The LQ calculations for each economic sector in Biak, Jayapura, Nabire, Oksibil, Sarmi,

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Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Serui, Sorong, and Waren are as follows:

Pertanian, Kehutanan, dan Perikanan

Table 1
Results of Sector 1

	BIAK	JAYAPURA	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBARI
Pertanian, Kehutanan, dan Perikana	1.941078121	1.769908598	1.434500266	2.599992451	2.076307784	2.278128137	0.928468716	3.456793607	6.090775188

The Agriculture, Forestry, and Fisheries sector are the base sectors for all 8 regions except Sorong, as the LQ calculations for the year 2020 indicate values greater than 1.

Manufacturing Industry

Table 2
Results of Sector 3

	BIAK	JAYAPURA	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBARI
Industri Pengolahan	1.912491341	2.296225885	0.735413798	1.024358284	2.074246577	0.547060081	0.1873587	0.080939086	0.037936201

The Manufacturing Industry sector is the base sector for 4 regions, except for Nabire, Waren, Sorong, Waisor, and Oransbari, as the LQ calculations for the year 2020 indicate values greater than 1.

Water Supply, Waste Management, Waste, and Recycling

Table 3

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Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Results of Sector 5

	BIAK	JAYAPURA	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBARI
Pengelolaan Pengadaan Air, Sampah, Limbah dan	2.807932103	2.91247134	0.68794433	1.127950646	2.596777682	0.239841951	2.611053228	0.416321837	0.322017158

Konstruksi

Hasil Sektor 6

	BIAK	JAYAPUR	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBA
Konstruksi	0.462432046	1.168342298	0.91486226	1.40869689	0.048416669	2.238145413	1.476912117	1.310735793	0.292104009

Sektor Konstruksi merupakan sektor basis bagi 5 wilayah kecuali Biak, Nabire, Serui, dan Oransbari karena hasil perhitungan LQ tahun 2020 menunjukkan nilai lebih dari 1.

Perdagangan, Reparasi Kendaraan

Hasil Sektor 7

	BIAK	JAYAPUR	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBA
Perdagangan, Reparasi Kendaraan	1.684399426	1.432220584	1.927752425	1.035774296	2.047384831	0.707630619	2.996282612	1.151990294	0.178778869

Sektor Perdagangan, Reparasi Kendaraan merupakan sektor basis bagi 7 wilayah kecuali Waren, dan Oransbari karena hasil perhitungan LQ tahun 2020 menunjukkan nilai lebih dari 1.

Transportasi dan Pergudangan

Hasil Sektor 8

	BIAK	JAYAPUR	NABIRE	SARMI	SERUI
Transportasi dan Pergudangan	1.846647266	3.108329061	1.187392773	1.477583848	2.101631358

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Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Sektor Transportasi dan Pergudangan merupakan sektor basis bagi 7 wilayah kecuali Waren, dan Waisor karena hasil perhitungan LQ tahun 2020 menunjukkan nilai lebih dari 1.

Penyediaan Akomodasi dan Makan Minum

Hasil Sektor 9

	BIAK	JAYAPUR	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBA
Penyediaan Akomodasi dan Makan	1.102856298	1.717945493	0.695932716	0.990384525	1.259747935	0.340263872	2.553035192	0.695216272	0.783592754

Sektor Penyediaan Akomodasi dan Makan Minum merupakan sektor basis bagi 4 wilayah kecuali Nabire, Sarmi, Waren, Waisor, dan Oransbari karena hasil perhitungan LQ tahun 2020 menunjukkan nilai lebih dari 1.

Jasa Perusahaan

Hasil Sektor 13

	BIAK	JAYAPUR	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBA
Jasa Perusahaan	2.014162494	1.8444593	0.839117724	0.478572408	1.194338175	0.211793469	2.969854125	0.565734821	0.750938125

Sektor Jasa Perusahaan merupakan sektor basis bagi 4 wilayah kecuali Nabire, Sarmi, Waren, Oransbari dan Waisor karena hasil perhitungan LQ tahun 2020 menunjukkan nilai lebih dari 1.

Jasa Kesehatan dan Kegiatan Sosial

Hasil Sektor 16

	BIAK	JAYAPUR	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBA
Jasa Kesehatan dan Kegiatan Sosial	1.23141144	0.990394423	1.057074086	1.323421535	1.527003205	0.772133743	2.275686707	0.915650159	1.754772909

Jasa lainnya

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Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Hasil Sektor 17

	BIAK	JAYAPUR	NABIRE	SARMI	SERUI	WAREN	SORONG	WAISOR	ORANSBA
Jasa lainnya	0.895967815	1.42690112	1.129185652	1.338138729	2.413791545	1.500367295	3.090088989	0.677786453	4.184638102

This section provides an in-depth presentation, interpretation, and analysis of the research findings.

5. Conclusion

The reason for the uneven balance between return cargo and outbound cargo on route T-9 is that the route only passes through one base region. As a result, cargo from non-base regions cannot sufficiently meet the demand for return cargo.

Based on the AHP data analysis, making Sorong Port a hub port for northern Papua has several significant impacts. Having a hub port means that return cargo from the planned regions will be collected at Sorong Port and then sent together to the main port located at Tanjung Perak. This arrangement allows for more efficient and optimal transportation of return cargo.

After analyzing the data using LQ, AHP, and Dijkstra algorithms, it was found that route T-9 from Java to northern Papua and vice versa did not cover many base sector areas. This resulted in return cargo from non-base sector areas being unable to meet the ship's return cargo demand. With the introduction of a new route that includes more base sector areas, the implementation of the Hub and Spoke port system, and optimized travel distances, the return cargo for the route can increase, making the new route more efficient.

This section offers a concise and final overview of the study, summarizing the main findings, emphasizing their significance, and providing a sense of completion to the research. Statistical calculations and other numerical figures are not presented here.

6. Suggestion

Based on the conclusions that have been drawn, the researcher offers recommendations that can be considered to make the sea toll program an integral part of the communities in the 3T regions.

In the development of the sea toll program, increasing return cargo from the 3T regions can be enhanced not only from the perspective of routes and the areas it serves but also by focusing on the development of human resources (HR) and natural resources (NR) in the 3T regions.

In realizing the aspirations of the sea toll program, the infrastructure of ports located in the 3T regions must be enhanced. This aspect is crucial because these ports in those areas serve as

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Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

a primary access point for trade.

Creating competent entrepreneurs in the 3T regions can help boost the local economy and increase return cargo for the sea toll program. Moreover, the sea toll program can serve as a reference for entrepreneurs in the transportation sector to become self-reliant and contribute to the development of their regions. To achieve this, the government should collaborate with the private sector to expand their operations into remote areas. Entrepreneurs working in collaboration with the government can be assigned and stationed in these regions for a specified period, acting as a stimulus for the local population to follow their entrepreneurial initiatives.

A suggestion for future research is to incorporate additional factors in the route planning process, such as weather conditions, wave heights, fleet utilization calculations, travel costs, and other factors that play a crucial role in determining the route. This approach will contribute to making research on sea toll routes to northern Papua more efficient, effective, and optimal.

References

Abubakar, I. (2013). Transportasi Penyeberangan - Suatu Pengantar. RajaGrafindo Persada.

Algoritma Dijkstra. (2011). http://www.arsitektur- routing.blogspot.com/ 2011/ 05/algoritmadijkstra.html

Anam, S. (2016). Pencarian rute terbaik menggunakan logika fuzzydan algoritma semut. Knpmp I, 873–881.

Arsyad, L. (1999). Pengantar Perencanaan dan Pembangunan Ekonomi Daerah. BPFE.

Danandjojo, I., Kombaitan, B., Santoso, I., & Syabri, I. (2019).

Pengembangan Varian Model Vehicle Route Problem (VRP) Untuk Penentuan Rute Angkutan Laut Penumpang Studi Kasus Pt. Pelni (Persero). Warta Penelitian Perhubungan, 26(3), 125. https://doi.org/10.25104/warlit.v26i3.874

Gunawan, H. (2015). Pengantar Transportasi dan Logistik (Edisi 1, C). Rajawali Pers

Jaya, A. (2013). Macam-macam Kapal Laut di Dunia. https://abadijaya.com/blog/macam-macam-kapal-laut- di-dunia/

Kabupaten Kepulauan Yapen.https://penghubung.Papua.go.id/5-wilayah-adat/saereri/kabupaten-kepulauan-

ISSN: 2622-5778 (online)
Advances in Transportation and Logistics Research
http://proceedings.itltrisakti.ac.id/index.php/altr

Peraturan Presiden Nomor 106 Tahun 2015 tentang Penyelenggaraan Kewajiban Pelayanan Publik untuk Angkutan Barang Di Laut, (2015).

R Gultom, E. (2017). Merefungsi Pengangkutan Laut Indonesia Melalui Tol Laut Untuk Pembangunan Ekonomi Indonesia Timur. Develop, 1(2). https://doi.org/10.25139/dev.v1i2.381

Undang-Undang Republik Indonesia Nomor 17 Tahun 2008 Tentang Pelayaran, 1 (2008).

Fitharti, S. D., Megawati, A. A., Sholihah, S. A., Triyasa, D. H., & Nugroho5, A. (2019). The Impact of Downtime Against Service Performance System Indonesia National Single Window (INSW). *Advance in Transportation and Logistics Research*, 37–45. https://proceedings.itltrisakti.ac.id/index.php/ATLR/article/view/142

Malisan, J., Sujarwanto, Arief, B., Fadhil, D. N., & Rahardjo, S. (2021). Kajian Pengembangan Pelabuhan Dalam Mendukung Ibu Kota Baru Berdasarkan Konsep Smart City, Smart Mobility.

Jurnal Itltrisakti, *2018*, 6–13. https://journal.itltrisakti.ac.id/index.php/jstl/article/view/628

Sholihah, S. A., Samadhi, T. M. A. A., Cakravastia, A., & Nur Bahagia, S. (2018). Coordination model in hinterland chain of hub-and-spoke export trade logistics. *Journal of Industrial Engineering and Management*, *11*(4), 776–793. https://doi.org/10.3926/jiem.2538