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Analysis of Traffic Volume and Frequency of Vannamei Shrimp (*Litopenaeus vannamei*) Shipments Based on a Certification Approach

Octovianus[1*], Mahendri Rohman Ghanim[1], Artanti Tri Lestari[1], R Adharyan Islamy[2]

[1] Fish Quarantine Center, Quality Control and Safety of Class I Fisheries Products Denpasar, Badung, Bali Indonesia.
[2] Aquaculture study program, Department of Aquatic Resources Management, Faculty of Fisheries and Marine Sciences, Brawijaya University, Malang, Indonesia.

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Corresponding Author:
Octovianus
octoviianus@gmail.com

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Abstract: Volume and frequency of shipping are crucial factors that impact the profitability and sustainability of the vannamei shrimp industry. This study aims to determine the volume of vannamei shrimp shipping traffic in Padangbai, Karangasem, Bali during the period 2019-2021 and the relationship between the volume of vannamei shrimp shipping traffic and shipping times during that period in the region. Data were obtained from fish quarantine stations, quality control and fishery product safety in Padangbai, Karangasem, Bali. The analytical method is carried out in a comparative descriptive manner which is presented through graphs that have been processed in the MS program. Excel while to find out the relationship between volume and frequency of shipping was analyzed using regression. The volume of traffic for shipping vannamei shrimp out of the Padangbai area, Karangasem, Bali was highest in 2021 (652,745,431 Juvenils) and lowest in 2019 (435,740,234 Juvenils). Data on the frequency of traffic was highest in 2020 (383 times) and lowest in 2019 (268 times). Based on the data provided, it can be seen that the average total vannamei shrimp shipment during the 2019-2021 period was around 4,702 x 10^4 juveniles per month. There were fluctuations in shipment volume from month to month, where in February, March, August, September and December the highest shipments were recorded of more than 5,000 x 10^4 juveniles, while in other months the lowest shipments were recorded of 2,929 x 10^4 juveniles in June. Based on these data, it can be concluded that the volume of vannamei shrimp shipments from Padangbai, Karangasem, Bali is quite stable with relatively small fluctuations. Even though there are fluctuations in shipping volume from month to month, overall, the volume of vannamei shrimp shipments from Padangbai, Karangasem, Bali is quite high.

Keywords: Bali; Fish quarantine center; Fish transportation; Shipping; Shrimp; Vannamei

Introduction

Vannamei shrimp (*Litopenaeus vannamei*) is a one of the leading fishery commodities in aquaculture that has high economic value (Hidayat et al., 2019). Vannamei shrimp is a type of shrimp originating from South America and Central America, but has now spread to various countries including Indonesia. Vannamei shrimp cultivation in Indonesia continues to experience an increase in production. The volume of vannamei shrimp production in 2016 was 698,138 tons and experienced a significant decrease of 20% in 2017 to 555,138 tons (Suriawan et al., 2019). Vannamei shrimp has great economic potential due to high market demand, both domestically and abroad. Even in this condition of the COVID-19 pandemic, the need for vannamei shrimp exports to the U.S (Leach et al., 2021). market remained stable. In addition, vannamei shrimp also have advantages in terms of productivity and resistance to various diseases compared to other types of

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shrimp (Mauladani et al., 2020; Suwoyo & Hendrajat, 2021; Tseng et al., 2009). Therefore, vannamei shrimp farming is one of the promising business sectors in Indonesia.

The trade and shipment of Vannamei shrimp (*Litopenaeus vannamei*) play a crucial role in the global seafood industry (Naser et al., 2022). To ensure the safety, sustainability, and quality of these shipments, various certification approaches have been implemented (Akkerman et al., 2010; Fonseca & Carvalho, 2019; Lee, 2018). One important aspect to consider in this context is the analysis of traffic volume and frequency, as it provides valuable insights into the patterns and dynamics of Vannamei shrimp shipments. Understanding these patterns is essential for optimizing logistics, identifying market trends, and ensuring compliance with certification standards. Therefore, this research aims to delve into the analysis of traffic volume and frequency of Vannamei shrimp shipments based on a certification approach. By examining the volume and frequency of shipments and evaluating their compliance with certification standards, this study seeks to contribute to the overall understanding of the dynamics within the Vannamei shrimp trade and shed light on the effectiveness of certification measures. The findings and insights generated from this research will not only benefit the stakeholders in the Vannamei shrimp industry but also contribute to the broader discussions on seafood trade, certification practices, and sustainable supply chain management.

Vannamei shrimp farming (*Litopenaeus vannamei*) is a rapidly growing industry in Indonesia (Bosman et al., 2021), including in the Padangbai region, Karangasem, Bali. The vannamei shrimp farming industry in Bali has experienced a significant increase in recent years, with an increase in vannamei shrimp production by 13.5% in 2020. Padangbai, as one of the vannamei shrimp farming industry centers in Bali, is important to study in order to obtain accurate information regarding the volume and time of delivery of vannamei shrimp.

This study aims to determine the volume of vannamei shrimp shipping traffic in Padangbai, Karangasem, Bali during the period 2019-2021 and the relationship between the volume of vannamei shrimp shipping traffic and shipping times during that period in the region. It is hoped that the results of this study can provide useful information in optimizing the delivery, monitoring and marketing of vannamei shrimp from the Padangbai region, Karangasem, Bali.

Method

This study uses time series data for vannamei shrimp which have been trafficked for 3 (three) years (2019-2021). Data were obtained from fish quarantine stations, quality control and fishery product safety in Padangbai, Karangasem, Bali. The analytical method is carried out in a comparative descriptive manner which is presented through graphs that have been processed in the MS program. Excel while to find out the relationship between vannamei shrimp shipping traffic volume and delivery time was analyzed using regression.

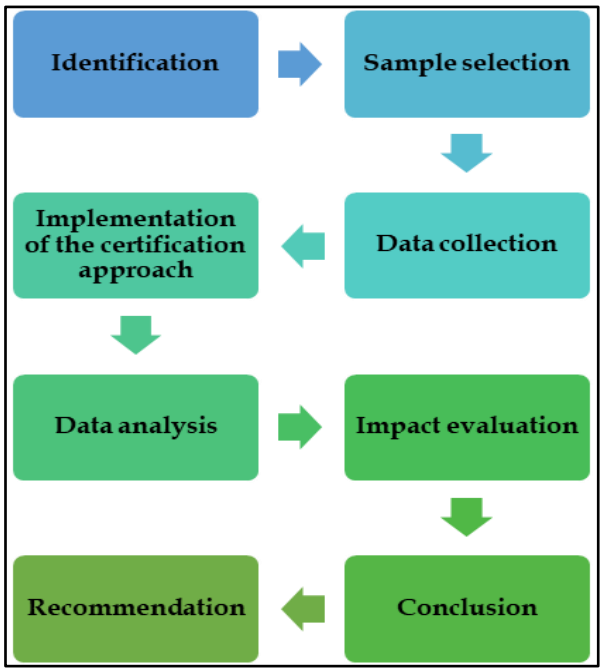

Figure 1. Flowchart of the research

The research titled "Analysis of Traffic Volume and Frequency of Vannamei Shrimp (Litopenaeus vannamei) Shipments Based on a Certification Approach" follows a specific flow (figure 1). Firstly, the research aims to analyze the volume and frequency of shipments of Vannamei shrimp, focusing on a certification approach. The next step involves selecting a representative sample from the population of Vannamei shrimp shipments for the study. Data is then collected from various relevant sources, including producers, traders, and suppliers, regarding the volume and frequency of Vannamei shrimp shipments. Subsequently, a certification approach is implemented to identify shipments that meet specific standards, such as food safety, sustainability, or product quality. The collected data is analyzed to identify trends in the volume and frequency of certified Vannamei shrimp shipments and to determine the factors influencing the variability in traffic. Furthermore, the impact of the certification approach is evaluated, including its benefits in enhancing the sustainability of the shrimp industry.

Result and Discussion

After simplifying the data for 3 years, the volume and frequency of vannamei shrimp traffic every month during 2019-2021 are obtained as shown in table 1.

The volume of traffic for shipping vannamei shrimp out of the Padangbai area, Karangasem, Bali was highest in 2021 (652,745,431 Juvenils) and lowest in 2019 (435,740,234 Juvenils). Data on the frequency of traffic for shipping vannamei shrimp out of the Padangbai, Karangasem, Bali area was highest in 2020 (383 times) and lowest in 2019 (268 times). Based on NOOA Fisheries (2020), it was recorded that the total export of Indonesia vannamei shrimp to the U.S. market in April 2019 was 9,544 MT (metric tons) and in April 2020 to 13,804 MT, which increases of up to 45%, which places Indonesia as the second largest of exporting country to the U.S. market.

Table 1. Total Shipment (TS) (Junevils) and Shipping Frequency (SF) (Times) of Vannamei Shrimp Shipping Traffic Every Month during the 2019-2021 Period

Month	2019		2020		2021	
	TS	SF	TS	SF	TS	SF
Jan	5,854,780	5	48,205,168	29	49,077,389	24
Feb	41,930,173	26	43,638,778	26	93,022,392	56
Mar	41,353,497	20	67,690,590	36	68,957,888	43
Apr	38,743,304	19	45,003,551	30	57,535,124	29
May	31,425,958	21	32,958,310	23	80,724,512	43
Jun	22,103,264	14	40,046,712	20	25,725,608	17
Jul	16,955,138	11	74,900,655	38	41,436,592	24
Aug	63,212,096	36	58,025,089	36	39,642,104	28
Sept	64,522,882	40	49,878,988	33	46,637,659	23
Oct	34,724,118	22	38,814,596	25	45,204,278	25
Nov	27,500,702	18	62,583,637	42	64,386,331	40
Dec	47,414,322	36	80,343,332	45	40,395,554	27
Total	435,740,234	268	642,089,406	383	652,745,431	379

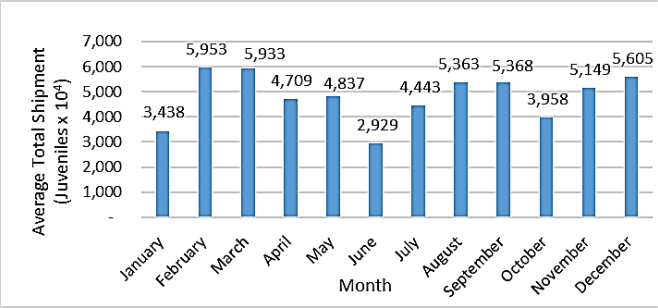

Figure 2. The average volume of vannamei shrimp shipping traffic every month during the 2019-2021

Based on the data provided, it can be seen that the average total vannamei shrimp shipment from Padangbai, Karangasem, Bali during the 2019-2021 period was around 4.702 x 10^4 juveniles per month. There were fluctuations in shipment volume from month to month, where in February, March, August, September and December the highest shipments were recorded of more than 5.000 x 10^4 juveniles, while in other months the lowest shipments were recorded of 2,929 x 10^4 juveniles in June.

Based on these data, it can be concluded that the volume of vannamei shrimp shipments from Padangbai, Karangasem, Bali is quite stable with relatively small fluctuations. Even though there are fluctuations in shipping volume from month to month, overall, the volume of vannamei shrimp shipments from Padangbai, Karangasem, Bali is quite high. This may occur due to seasonal factors, where in December there is an increase in demand for vannamei shrimp in the domestic or export market. In addition, other factors that affect delivery such as availability and price can also affect delivery in certain months. Vannamei shrimp (*Litopenaeus vannamei*) is one of the leading fishery commodities that have high economic value and the production with a super intensive system becomes a profitable future of the aquaculture orientation (Pratiwi et al., 2021).

The analysis results between the volume of shipments of vannamei shrimp and the shipping frequency during eight years (period 2009-2016) showed a significant relationship ($p < 0.05$) (Figure 3) in the form of regression with a coefficient of determination (R^2 = 0.09339) and the equation: Y = 0.0064x-2.2772. Y is the Average Total Shipment of vannamei shrimp and X is the Average Shipping Frequency. These analysis results indicate that the volume of shipments of vannamei shrimp from the Gorontalo Province area experienced fluctuations.

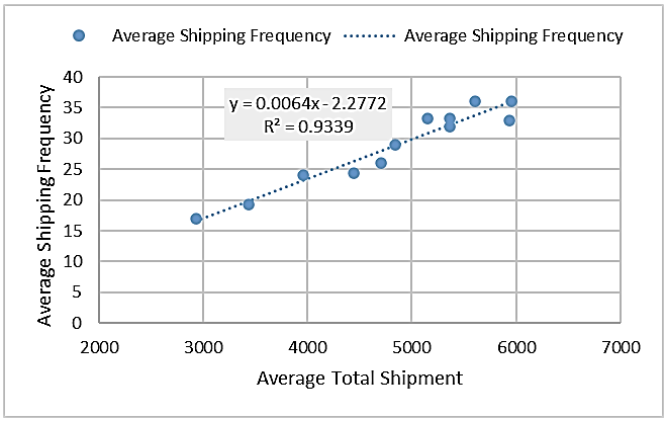

Figure 3. Relationship between average total shipment and average shipping frequency of vannamei shrimp every month during the 2019-2021

The coefficient of determination (R^2 = 0.09339) indicates that approximately 9.34% of the variability in the volume of shipments of vannamei shrimp can be explained by the shipping frequency. This means that other factors, such as market demand, availability of shrimp, and price fluctuations, may also contribute to the variability in the volume of shipments. The equation (Y = 0.0064x-2.2772) provides a way to estimate the volume of shipments of vannamei shrimp based on the shipping frequency. For example, if the average shipping frequency is 10 per month, the estimated average total shipment of vannamei shrimp would be approximately 0.0868 tons (0.0064*10-2.2772). Overall, these analysis results provide insights into the relationship between the volume of shipments of vannamei shrimp and the shipping frequency in Gorontalo Province. Understanding this relationship can help shrimp producers and distributors to optimize their shipping strategies and manage their supply chain more effectively.

Shipping or transportation is an important aspect of the shrimp industry (Pazir et al., 2022; Padliansyah & Sulistianingsih, 2023), including vannamei shrimp. Shipping plays a crucial role in ensuring that the shrimp products reach their intended destination in a timely and efficient manner, while maintaining the quality and freshness of the product (Saputra et al., 2022). There are various factors that need to be considered when shipping vannamei shrimp. One of the most important factors is the temperature control during shipping (Hussain et al., 2023). Vannamei shrimp is a perishable product that requires specific temperature conditions to maintain its quality and freshness (Kpoclou et al., 2023). Therefore, it is important to use proper temperature control equipment, such as refrigerated containers, to maintain the required temperature during transportation. Another factor that needs to be considered is the packaging of the shrimp (Hannan et al., 2022). Vannamei shrimp is usually shipped in either fresh or frozen form (Guan et al., 2021), depending on the market demand and the distance of the shipment (Saputra et al., 2022). Proper packaging is important to ensure that the shrimp is protected during transportation and that it reaches its destination in good condition.

The shipping frequency is also an important factor to consider (Asche et al., 2021; Mosallanezhad et al., 2021). The analysis results indicate that the shipping frequency plays a role in determining the volume of shipments of vannamei shrimp. A higher shipping frequency can result in a higher volume of shipments, but it also requires more resources and costs. Therefore, the shipping frequency needs to be optimized to balance the cost and benefits. In addition, it is also important to consider the shipping routes and the transportation mode. The shipping routes need to be optimized to minimize the shipping time and the cost, while ensuring the safety and security of the shipment. The transportation mode, such as air, sea, or land transportation, also needs to be considered based on the distance of the shipment, the volume of the shipment, and the market demand.

Besides, the transportation of live aquatic animals, such as Vannamei shrimp, requires diligent oversight due to its potential environmental impact. Certification is an appropriate approach for monitoring and regulating the handling of these animals during transportation. By implementing certification measures, it becomes possible to ensure that live aquatic animals are treated appropriately and prevent their introduction into new habitats, which can result in biological pollution. This is of utmost importance considering the potential negative consequences of biological pollution, as seen in cases such as the spread of invasive species like certain cichlid fish and alien predator fish in Indonesia (Fadjar et al., 2019; Hasan et al., 2020; Insani et al., 2020; Serdiati et al., 2022; Widodo et al., 2022). Therefore, certification serves as a crucial tool for safeguarding the transportation of live aquatic animals, including Vannamei shrimp, and preventing the ecological disruptions that can arise from the introduction of these animals into new environments. By examining the significance of certification in preventing biological pollution and protecting native ecosystems, this research aims to contribute to the broader understanding of sustainable practices in the transportation of live aquatic animals.

Conclusion

Shipping is a critical aspect of the vannamei shrimp industry that requires careful consideration of various

factors, such as temperature control, packaging, shipping frequency, shipping routes, and transportation mode. Understanding these factors and optimizing the shipping strategies can help shrimp producers and distributors to manage their supply chain more effectively and ensure that their products reach their intended destination in good condition.

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Author Contributions
O and MRG collects data and provide research facilities, ATL processes and analyzes data, RAI Compiles and prepares articles.

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Conflicts of Interest
The authors declare no conflict of interest.

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