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Financial Fundamental Analysis Of Vanamei Shrimp Farms With Various Concentrations

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Abstract:

The market needs for vanamei shrimp become less optimal due to constraints on expenditure costs during cultivation, one of which is the minimal cost of buying or renting pond land and the need for vanamei shrimp probiotics. Vanamei shrimp farming business using round ponds is one alternative in cost efficiency. The provision of probiotic composition is expected to be able to provide optimal income for this cultivation business. The purpose of this study was to determine how much influence the provision of probiotic composition calculated into expenditure costs on the income of vanamei shrimp ponds in round ponds. The research method used was quantitative in 10 round ponds of vanamei shrimp farming ponds with 5 different probiotic concentration treatments. The data analysis used was variance analysis, variation coefficient, and 5% LSD test. The results showed, that F Count > F Table 5% or 15.94 > 6.39. This shows that the administration of different probiotics can have a real effect on cultivation income at a significant level of 0.05. Then the value of the variation coefficient is included in the medium category with a value of 14%. In the 5% LSD test, the pool with a mixture of Trichoderma and Nitrosomonas probiotic treatment was the best treatment than the other four treatments by comparing the difference in production costs (variable) used and income obtained.

Keywords: *Effect; Probiotics; Production Cost; Income; Vanamei Shrimp*

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1. Introduction

Shrimp is one of the fisheries sectors that has the potential to contribute to improving the economy of fish farmers in Indonesia, both for domestic consumers and as a mainstay export commodity (Usura et al., 2023; Yunus et al., 2022). In addition, according to (Mauladani et al., 2020) in the January-September 2018 period, shrimp has become the main export commodity of Indonesian fishery products. By only contributing 18.35% of the total volume of commodities exported, shrimp can provide foreign exchange of USD 1.3 billion or 36.96% of the total export value. One type of shrimp is vanamei shrimp. Vanamei shrimp is one of the mainstay commodities because shrimp farming has great opportunities and high economic value (Gusni et al., 2023). Gunarto et al., (2012) (in (Rakhmanda et al., 2021) stated that the entire vanamei shrimp farming industry has been supported by vanamei shrimp production in Indonesia.

Sidoarjo Regency is one of the areas that is also the largest fisheries subsector reaching more than 40%, with an area for vaname shrimp cultivation of 15,531.4 ha, this was stated by BPS Sidoarjo Regency (2013) (in Husada et al., 2021). One of the areas of Sidoarjo Regency that have the potential to develop the vaname shrimp pond business is Jabon District, precisely in Tlocor Village. According to Haliman and Adijaya (2005) (in Yunus et al., 2022), traditional vaname shrimp farming is more widely used by local farmers. In addition, vaname shrimp was chosen because it has several advantages, including growing faster, saving feed, being more disease resistant, resistant to the environment, and having a shorter maintenance time, an average of 30-120 days per cycle.

In terms of increasing the vanamei shrimp farming business, many innovations have been developed. One of them is the provision of probiotics which are bacteria that can provide health (George Kerry et al., 2018). Naturally, probiotics will protect against disease by boosting the immune system and helping host development (Guo et al., 2022) or in aquaculture (R. Wang et al., 2020). In vanamei shrimp, probiotics not only increase growth (Larasati et al., 2021; Mirbakhsh et al., 2023), and survival but also improve water quality and immune response and disease resistance (Y. Cai et al., 2019) can even replace antibiotics (Won et al., 2020). This is also in line with research conducted by Husaeni and & I Ketut Agus Sudarmayasa (2018) that, the application of probiotics is considered effective for the growth of vanamei shrimp and can suppress disease.

In order for the development strategy of vaname shrimp farming to run well, a special study is needed (Sumiarsih et al., 2019). Biantara et al., (2016) (in Makalingga et al., 2019) explained that in maximizing welfare potential, breakthroughs are needed. Although vanamei shrimp has high economic value, this does not make vaname shrimp farming free from several problems (Purnamasari et al., 2022). The inability to maximize the area of cultivation is a problem that is often found in traditional vaname shrimp farming (Husada et al., 2021). The same problem also occurs in Tlocor Village farmers or even other Sidoarjo communities, they tend to have to use large areas of land or land for cultivation. Meanwhile, to rent or buy large land requires a lot of money. Due to limited costs, the number of farmers in Sidoarjo is less than optimal in meeting the needs of the vanamei shrimp market.

Seeing the high cost of land investment for vanamei shrimp farming, ponds with conventional systems can be an alternative investment (Rego et al., 2017). This study used round ponds as a medium for vanamei shrimp cultivation commonly referred to as millennial shrimp farming ponds in Indonesia (Pramudia et al., 2022), with different concentrations of probiotics in several ponds.

The purpose of this study is to determine the best treatment pool by considering in terms of production costs (variable) and income obtained.

2. Methodology

This research was carried out in the pond area around Tlocor Marine Tourism, Tlocor Village, Sidoarjo at the end of September – December 2022. This study is a quantitative study using sample data from the results of experimental research on 10 round ponds of vanamei shrimp farming ponds that have a stocking density of 5000 heads/pond or 5000 heads/12.56 m^2 with 5 different probiotic concentration treatments, where the data was taken by interviewing sources from experimental actors.

According to Sugiyono (2011), experimental research is a tightly controlled study to look for the influence of variables on one another. Then Purwanto (2010) also explained that experimental research is research where the dependent variables or usually the variables to be studied are raised deliberately by manipulating with treatment. So variables will exist after being treated in a research process—the independent variable is commonly called the causal variable (Almumtazah et al., 2021).

Quantitative research is scientific research that uses numerical or numerical data analysis (Suryani &; Hendryadi, 2018; Darmawan, 2019). In addition, quantitative research also aims to examine the problem of a phenomenon and see the relationship or relationship between variables in the problem set (Indrawan &; Yaniawati, R, 2016). Variable data in this study was obtained from interviews with resource persons who had conducted experimental research.

The experiment was conducted with five kinds of treatments arranged in a Group Randomized Design and replicated twice. Then the average value of income obtained from each production cost of the five kinds of treatment. Furthermore, variance analysis or ANOVA was carried out on all observational data followed by the Variation Coefficient and 5% LSD test.

Analysis of Variance or ANOVA

Analysis of variance commonly called ANAVA or ANOVA (Analysis of Variance) is a statistical method used to compare simultaneously from several populations or analyze differences between groups (Nuhasanah, 2019). Analysis of variance is not only to determine the impact between one variable (independent) on one variable (dependent) another but also between several independent variables on one dependent variable (Reksoatmodjo, 2007). The Anova used in this study is the Two-Line Anova which is to test the comparison of several samples where each sample consists of two or more types together (Irianto, 2004; Riduwan, 2009). Generally, Anova is presented in the Anova table to make it easier to see the results that have been studied. To find out the Anova table in the study, there are several calculations carried out. Here's the equation used to calculate the sum of squares in the anova table:

$$\text{FK} = \frac{(\sum Y)^2}{n} \quad (1)$$

Information:

FK = Correction Factor

$\sum Y$ = Total of all revenue

n = Number of observations

$$\text{JK Total} = (\text{The sum of squares of each observation}) - \text{FK} \quad (2)$$

$$\text{JK Group} = \frac{(The\ sum\ of\ squares\ of\ each\ group)}{number\ of\ treatment} - \text{FK} \quad (3)$$

$$\text{JK Behaviour} = \frac{The\ sum\ of\ squares\ of\ each\ treatment}{number\ of\ group} - \text{FK} \quad (4)$$

$$\text{JK Error} = \text{JK Total} - \text{JK Group} - \text{JK Treatment} \quad (5)$$

Information:
JK = Sum of Squares

Furthermore, the data is compiled into the analysis of variance table (ANOVA), the details of the analysis of variance table (ANOVA) can be seen in Table 1. the following:

Table 1. Analysis of Variance or ANOVA Table

Sources of Diversity	db	JK	KT	F Count	F Table	
					5%	1%
Group	I – 1	JK K	$\frac{JK\ K}{db\ K}$	$\frac{KT\ K}{KT\ G}$	db K, db G	db K, dbg
Treatment	j – 1	JK P	$\frac{JK\ P}{db\ P}$	$\frac{KT\ P}{KT\ G}$	db P, db G	db P, db G
Error	ij – (i+j) + 1	JK G	$\frac{JK\ G}{db\ G}$			
Total	IJ - 1	JKT				

Coefficient of Variation

The Variation Coefficient is the ratio of standard deviation to the calculated average (Jalilibal et al., 2021), where the magnitude is expressed as a percentage (Yunita et al., 2022). To calculate the coefficient of variation can use the following formula:

$$KK = \frac{\sqrt{KT\ G}}{\bar{Y}} \times 100\% \quad (6)$$

Information:
KK = Coefficient of Variation
$\bar{Y}$ = General average

5% Least Significance Different (LSD) Test

The LSD test is a comparison test of the average treatment with the smallest real difference to measure the source of variation at 5% (Noor Shah et al., 2021). This 5% LSD test can be calculated by the following formula:

$$LSD\ 5\% = t\ (0{,}05;\ db\ g) \times \sqrt{\frac{2\ (KT\ G)}{r}} \quad (9)$$

Information:
r = number of groups

3. Empirical Findings/Results

Probiotic Treatment in Vanamei Shrimp Farming

Probiotics are live microorganisms that can provide benefits to their hosts if given in sufficient quantities (Reid et al., 2019). Giving probiotics to vanamei shrimp can help improve the quality of life (Liao et al., 2022; Amiin et al., 2023), water quality (Khademzade et al., 2020; Truong et al., 2021; Hassan et al., 2022), immunity (Hamsah et al., 2019; Amoah et al., 2020; Butt et al., 2021), disease resistance (X. Cai et al., 2022; Sumon et al., 2022; Monier et al., 2023), also the growth of vanamei shrimp (Kesselring et al., 2019).

Similarly, what is expected in vanamei shrimp farming with various kinds of probiotic concentration treatments in this study? The use of probiotics such as Lactobacillus can usually help in the weight gain of vanamei shrimp (Peña Rodríguez, 2021), where if the shrimp weight increases it will certainly increase the selling value of shrimp and increase aquaculture income. Probiotic treatment was given to 10 pools with 2 pools each. Each treatment is Lactobacillus, Trichoderma, Nitrosomonas, a mixture of probiotics Trichoderma and Nitrosomonas, and a mixture of probiotics Trichoderma and Lactobacillus.

The use of Trichoderma probiotics can improve the immune system in vanamei shrimp (Muahiddah et al., 2022), so that shrimp are more disease-resistant. Meanwhile, Nitrosomonas probiotics can improve water quality (Wei et al., 2021), so that the growth rate of vanamei shrimp increases (Liu et al., 2023). The use of mixed probiotics between Trichoderma and Nitrosomonas and mixed probiotics Trichoderma and Lactobacillus is expected to provide double benefits to vanamei shrimp so that aquaculture income can reach the maximum.
Observations made approximately 3 months get the result data as can be seen in Table 2. the following:

Table 2. Observation Data

Cost in IDR	Conduct (j)	Income in IDR Group (i) 1	2	Total (Yi) in IDR	Average ($\bar{Y}$) in IDR
1,520,600	*Lactobacillus*	94,500	189,000	283,500	141,750
1,570,600	Trichoderma	225,000	337,500	562,500	281,250
1,549,000	Nitrosomonas	148,500	229,500	378,000	189,000
1,615,600	Trichoderma and Nitrosomonas	405,000	432,000	837,000	418,500
1,587,300	Trichoderma and Lactobacillus	351,000	327,000	678,000	339,000
	Total	1,224,000	1,515,000	2,739,000	273,900

Source: Data Analytics, 2023

This study used 5 treatments with 2 pond groups in each treatment, where the observed result data was production costs (variable) with the income of round pond cultivation of vanamei shrimp. The total number of pools observed is 10 pools where the results of the data can be seen in Table 2. In the first treatment pool, using Lactobacillus probiotics, production costs (variable) amounted to IDR 1,520,600.00 with pool 1 income of IDR 94,500.00 and pool 2 of IDR 189,000.00 so the total overall income in the treatment was IDR 283,500.00 with an average income of IDR 141,750.00. In the second treatment pool, using Trichoderma probiotics, production costs (variable) amounted to IDR 1,570,600.00 with pool 1 income of IDR 225,000.00 and pool 2 of IDR 337,500.00 so the total overall income in the treatment was IDR 562,500.00 with an average income of IDR 281,250.00. In the third treatment pool, using Nitrosomas probiotics, production costs (variable) amounted to IDR 1,549,000.00 with pool 1 income of IDR 148,500.00 and pool 2 of IDR 229,500.00 so that the total income in the treatment was IDR 378,000.00 with an average income of IDR 189,000.00. In the fourth treatment pool, using a mixture of probiotics between Trichoderma and Nitrosomonas, production costs (variable) amounted to IDR 1,615,600.00 with pool 1 income of IDR 405,000.00 and pool 2 of IDR 432,000.00 so that the total total income in the treatment was IDR 837,000.00 with an average income of IDR 418,500.00. In the fifth treatment pool, using a mixture of probiotics between Trichoderma and Lactobacillus, production costs (variable) amounted to IDR 1,587,300.00 with pool 1 income of IDR 351,000.00 and pool

2 of IDR 327,000.00 so that the total overall income in the treatment was IDR 678,000.00 with an average income of IDR 339,000.00. All observational data results can be seen in Table 2.

Analysis of Variance or ANOVA

Analysis of variance commonly called ANAVA or ANOVA (Analysis of Variance) is a method used to measure the average difference between experimental groups (Sawyer, 2009; Mishra et al., 2019; Acal &; Aguilera, 2023). After knowing the data from the observations in Table 2. the next is to process the data using variance analysis according to the details in Table 1. Which, the results of variance analysis (Anova) can be seen in Table 3. the following:

Table 3. Table of Results of Analysis of Variance (ANOVA)

Sources of Diversity	DB	JK	KT	F Count	F Table	
					5%	1%
Group	1	8,468,100,000	8,468,100,000	5.41	7.71	21.20
Treatment	4	99,745,650,000	24,936,412,500	15.94	6.39	15.98
Error	4	6,258,150,000	1,564,537,500			
Total	9	114,471,900,000				

Source: Data processing, 2023

The results of testing the income groups of each of as many as 2 experimental pools show that F Calculate < F Table 5% and F Calculate < F Table 1% or 5.41 < 7.71 and 5.41 < 21.20 can be seen in Table 3. This means that Ho is accepted so that the grouping carried out at either 0.05 and 0.01 significance was unsuccessful in controlling for data diversity due to non-treatment in the experimental environment.

The test results of 5 treatments show that F Count > F Table 5% or 15.94 > 6.39 can be seen in Table 3. This means that Ho is rejected so that the treatment of different types of probiotics can have a noticeable effect on the income of vanamei shrimp farming at a significance level of 0.05. However, it means the opposite or Ho is accepted because F Calculate < F Table 1% or 15.94 < 15.98 which can be seen in Table 3, which means that at 0.01 significant treatment of different types of probiotics does not have a real effect on the income of vanamei shrimp farming.

Coefficient of Variation

The variation coefficient is used to measure a series of treatment data independently by dividing the standard deviation by the calculated mean (Stępniak, 2011) in percentage form (Alvarado et al., 2020). Using the variation coefficient formula based on the data in Table 3. to find out the standard deviation then divided by the average calculated in Table 2. A result of 0.14 was obtained. Furthermore, the result if expressed in percentage form, amounted to 14%.

According to Hanafiah in 1991 (Basuki et al., 2020), the criteria for coefficient of variation can be divided into 3 (Supriyanto & Sari, 2020):

1. Coefficient of Variation with large categories has a minimum value of 10% in homogeneous conditions or at least 20% in heterogeneous conditions.
2. Coefficient of Variation with medium category has values between 5% to 10% in homogeneous conditions or 10% to 20% in heterogeneous conditions.
3. Coefficient of Variation with the smallest category has a maximum value of 5% in homogeneous conditions or 10% in heterogeneous conditions.

Based on this, the variation coefficient of 14% in this study is included in the medium variation coefficient.

5% Least Significance Different (LSD) Test

Furthermore, to calculate the smallest significant difference between treatment averages, the LSD test is used (Al-Fahham, 2018; Adnan et al., 2020) with a significance of 5% (Shafi et al., 2020; C. Wang et al., 2021). This can be seen in Table 4. the following.

Table 4. 5% LSD Test Results Table

Treatment	Average Revenue in IDR
Lactobacillus	141,750 to
Trichoderma	281,250 bc
Nitrosomonas	189,000 ab
Trichoderma & Nitrosomonas	418,500 d
Trichoderma & Lactobacillus	339,000 cd
BNT 5%	109,802.6

Source: Data processing, 2023

See the 5% LSD test results in Table 4. It can be seen that each treatment can have a real effect on each income obtained by each pool, giving a letter notation at the end of the data indicates the magnitude of the influence of each treatment. In the mixed probiotic treatment between Trichoderma and Nitrosomonas with mixed probiotic treatment between Trichoderma and Lactobacillus, both are known in Table 4. has a not-so-noticeable difference influence. This is because both treatments are followed by the letter "d".

Next, to find out which treatment is best. Then it can be seen in Table 4. that the treatment followed by the letter "d" has the greatest average. There are two treatments followed by the letter "d", namely the mixed probiotic treatment between Trichoderma and Nitrosomonas with a mixed probiotic treatment between Trichoderma and Lactobacillus. However, it is necessary to know how much production costs (variable) are incurred in both treatments. Generally, fewer (variable) production costs can be a reference to choose which treatment is the best that can generate the same income or influence according to the letters obtained.

But if you look again at Table 2. The production cost (variable) of a mixed probiotic treatment pool between Trichoderma and Nitrosomonas with a mixed probiotic treatment pool between Trichoderma and Lactobacillus is IDR 1,615,600.00 and IDR 1,587,300.00 respectively where both costs have a ratio of 1.02: 1. Then for the amount of income in Table 2. respectively it is IDR 837,000.00 and IDR 678,000.00 which has a ratio of 1.24:1. Production costs (variable) of mixed probiotic treatment pools between Trichoderma and Nitrosomonas are 0.02 more expensive figures or 2% of mixed probiotic treatment pools between Trichoderma and Lactobacillus. While the income obtained was 0.24 figures or 24% superior to the mixed probiotic treatment pool between Trichoderma and Lactobacillus.

By looking at expenses or production costs (variable) with a difference of 2% more expensive but can provide 24% superior income. So the mixed probiotic treatment pool between Trichoderma and Nitrosomonas can be the best treatment than the other four treatment pools.

4. Discussion

This study investigated the economic impact of various probiotic treatments on vanamei shrimp farming, highlighting the significant differences in income generated by different probiotics. Probiotics such as Lactobacillus, Trichoderma, Nitrosomonas, and their combinations were used, with the mixed treatment of Trichoderma and Nitrosomonas yielding the highest income. This outcome supports the findings of previous studies that demonstrated the benefits of probiotics in improving shrimp health, water quality, immunity, and disease resistance (Wei et al., 2021; Muahiddah et al., 2022; Liu et al., 2023).

The superior performance of the Trichoderma and Nitrosomonas combination indicates a synergistic effect, enhancing both water quality and immune response, thereby improving shrimp growth and productivity. This is consistent with the results reported by Kesselring et al. (2019) and Sumon et al. (2022), who highlighted the multifaceted benefits of mixed probiotics. Theoretically, these findings reinforce the hypothesis that probiotics enhance aquaculture profitability by fostering a healthier and more sustainable environment for shrimp, as suggested by Reid et al. (2019) and Peña Rodríguez (2021).

Practically, the study emphasizes the economic advantages for shrimp farmers using strategic probiotic treatments. The mixed treatment of Trichoderma and Nitrosomonas, despite slightly higher production costs, provided a 24% higher income compared to the Trichoderma and Lactobacillus combination, making it the most cost-effective option. This suggests that farmers should consider the cost-benefit ratio of probiotic treatments, focusing on those that offer dual benefits, such as improved water quality and enhanced immunity.

However, the study's short observation period of three months and specific experimental conditions limit its findings. Future research should explore the long-term effects of probiotics and their efficacy under diverse environmental conditions. Investigating the molecular mechanisms behind the benefits of probiotics could lead to more targeted treatments, and examining other probiotic species and combinations could provide a broader understanding of optimal strategies for shrimp farming.

In conclusion, the study confirms that probiotics can significantly enhance the economic outcomes of vanamei shrimp farming, with the mixed treatment of Trichoderma and Nitrosomonas emerging as the most effective. These findings align with existing research on probiotics in aquaculture and offer practical recommendations for maximizing returns in shrimp farming. Further research is necessary to refine these strategies and validate their applicability under varying farming conditions.

5. Conclusion

Vanamei shrimp pond business by using round ponds as a cultivation medium is an alternative cost efficiency and helps farmers who have minimal land. Meanwhile, to minimize the spread of disease, and improve water quality and shrimp growth, probiotics are needed to supply the needs of vanamei shrimp that are cultivated by considering production costs (variable). Based on variance analysis (ANOVA), giving different probiotics can have a real effect on vanamei shrimp farming income. Then, the coefficient of variation obtained in the study showed results with moderate categories. The 5% LSD test gave results that a pool with a mixture of Probiotic treatment between Trichoderma and Nitrosomonas could be the best treatment of the other four treatment pools.

Cultivation of vanamei shrimp ponds using round ponds is one of the innovations, as well as the provision of probiotics also helps in shrimp growth so it has a positive effect on income. However, the distribution of fry in each pond must also be considered so that the movement and growth of shrimp can be more optimal.

References:

Acal, C., & Aguilera, A. M. (2023). Basis expansion approaches for functional analysis of variance with repeated measures. *Advances in Data Analysis and Classification*, *17*(2), 291–321. https://doi.org/10.1007/s11634-022-00500-y

Adnan, M., Fahad, S., Zamin, M., Shah, S., Battaglia, M. L., Mohib, R., Naz, M., Saeed, B., & Saud, S. (2020). Phosphorus Supplements Improve Maize Phosphorus. *Plants 2020*, *9*(900), 1–19.

Al-Fahham, A. A. (2018). Development of New LSD Formula when Numbers of Observations Are Unequal. *Open Journal of Statistics*, *08*(02), 258–263. https://doi.org/10.4236/ojs.2018.82016

Almumtazah, N., Azizah, N., Putri, Y. L., & Novitasari, D. C. R. (2021). Prediksi Jumlah Mahasiswa Baru Menggunakan Metode Regresi Linier Sederhana. *Jurnal Ilmiah Matematika Dan Terapan*, *18*(1), 31–40. https://doi.org/10.22487/2540766x.2021.v18.i1.15465

Alvarado, G., Rodríguez, F. M., Pacheco, A., Burgueño, J., Crossa, J., Vargas, M., Pérez-Rodríguez, P., & Lopez-Cruz, M. A. (2020). META-R: A software to analyze data from multi-environment plant breeding trials. *Crop Journal*, *8*(5), 745–756. https://doi.org/10.1016/j.cj.2020.03.010

Amiin, M. K., Lahay, A. F., Putriani, R. B., Reza, M., Putri, S. M. E., Sumon, M. A. A., Jamal, M. T., & Santanumurti, M. B. (2023). The role of probiotics in vannamei shrimp aquaculture performance - A review. *Veterinary World*, *16*(3), 638–649. https://doi.org/10.14202/vetworld.2023.638-649

Amoah, K., Dong, X. hui, Tan, B. ping, Zhang, S., Chi, S. yan, Yang, Q. hui, Liu, H. yu, Yang, Y. zhi, & Zhang, H. tao. (2020). Administration of probiotic Bacillus licheniformis induces growth, immune and antioxidant enzyme activities, gut microbiota assembly and resistance to Vibrio parahaemolyticus in Litopenaeus vannamei. *Aquaculture Nutrition*, *26*(5), 1604–1622. https://doi.org/10.1111/anu.13106

Basuki, H. W., Yuniarti, Y., & Fatriani, F. (2020). ANALISA SIFAT FISIK DAN KIMIA BRIKET ARANG DARI CAMPURAN TANDAN KOSONG AREN (Arenga pinnata Merr) DAN CANGKANG KEMIRI (Aleurites trisperma). *Jurnal Sylva Scienteae*, *3*(4), 626. https://doi.org/10.20527/jss.v3i4.2346

Butt, U. D., Lin, N., Akhter, N., Siddiqui, T., Li, S., & Wu, B. (2021). Overview of the latest developments in the role of probiotics, prebiotics and synbiotics in shrimp aquaculture. *Fish and Shellfish Immunology*, *114*(May), 263–281. https://doi.org/10.1016/j.fsi.2021.05.003

Cai, X., Wen, J. shun, Long, H., Ren, W., Zhang, X., Huang, A. you, & Xie, Z. yu. (2022). The probiotic effects, dose, and duration of lactic acid bacteria on disease resistance in Litopenaeus vannamei. *Aquaculture Reports*, *26*(August), 101299. https://doi.org/10.1016/j.aqrep.2022.101299

Cai, Y., Yuan, W., Wang, S., Guo, W., Li, A., Wu, Y., Chen, X., Ren, Z., & Zhou, Y. (2019). In vitro screening of putative probiotics and their dual beneficial effects: To white shrimp (Litopenaeus vannamei) postlarvae and to the rearing water. *Aquaculture*, *498*(August 2018), 61–71. https://doi.org/10.1016/j.aquaculture.2018.08.024

Darmawan, D. (2019). *Metode Penelitian Kuantitatif*. Remaja Rosdakarya.

George Kerry, R., Patra, J. K., Gouda, S., Park, Y., Shin, H. S., & Das, G. (2018). Benefaction of probiotics for human health: A review. *Journal of Food and Drug Analysis*, *26*(3), 927–939. https://doi.org/10.1016/j.jfda.2018.01.002

Guo, Q., Yao, Z., Cai, Z., Bai, S., & Zhang, H. (2022). Gut fungal community and its probiotic effect on Bactrocera dorsalis. *Insect Science*, *29*(4), 1145–1158. https://doi.org/10.1111/1744-7917.12986

Gusni, G., Komariah, S., & Amaliawiati, L. (2023). Capital Budgeting Analysis in Assess the Feasibility of Vaname Shrimp Cultivation Investment. *Ekonomis: Journal of Economics and Business*, *7*(1), 37. https://doi.org/10.33087/ekonomis.v7i1.742

Hamsah, H., Widanarni, W., Alimuddin, A., Yuhana, M., Junior, M. Z., & Hidayatullah, D. (2019). Immune response and resistance of Pacific white shrimp larvae administered probiotic, prebiotic, and synbiotic through the bio-encapsulation of Artemia sp. *Aquaculture International*, *27*(2), 567–580. https://doi.org/10.1007/s10499-019-00346-w

Hassan, M. A., Fathallah, M. A., Elzoghby, M. A., Salem, M. G., & Helmy, M. S. (2022). Influence of probiotics on water quality in intensified Litopenaeus vannamei ponds under minimum-water exchange. *AMB Express*, *12*(1). https://doi.org/10.1186/s13568-022-01370-5

Husada, R. H. S. Y., Sari, L. A., & Sahidu, A. M. (2021). Business analysis of vaname shrimp (Litopenaeus vannamei) culture in traditional ponds with monoculture system in Sedati, Sidoarjo. *IOP Conference Series: Earth and Environmental Science*, *718*(1). https://doi.org/10.1088/1755-1315/718/1/012021

Husaeni dan, & I Ketut Agus Sudarmayasa. (2018). Pemberian Probiotik Pada Budidaya Udang Vaname (Litopenaeus vannamei) Semi Intensif Di Tambak. *Buletin Teknik Litkayasa Akuakultur*, *16*(1), 57–60.

Indrawan, R., & Yaniawati, R, P. (2016). *Metodologi Penelitian Kuantitatif, Kualitatif, dan Campuran untuk Manajemen, Pembangunan, dan Pendidikan*. Refika Aditama.

Irianto, A. (2004). *STATISTIK Konsep Dasar & Aplikasinya*. PERNADA MEDIA.

Jalilibal, Z., Amiri, A., Castagliola, P., & Khoo, M. B. C. (2021). Monitoring the coefficient of variation: A literature review. *Computers and Industrial Engineering*, *161*. https://doi.org/10.1016/j.cie.2021.107600

Kesselring, J. C., Gruber, C., Standen, B., & Wein, S. (2019). Continuous and pulse-feeding application of multispecies probiotic bacteria in whiteleg shrimp, Litopenaeus vannamei. *Journal of the World Aquaculture Society*, *50*(6), 1123–1132. https://doi.org/10.1111/jwas.12640

Khademzade, O., Zakeri, M., Haghi, M., & Mousavi, S. M. (2020). The effects of water additive Bacillus cereus and Pediococcus acidilactici on water quality, growth performances, economic benefits, immunohematology and bacterial flora of whiteleg shrimp (Penaeus vannamei Boone, 1931) reared in earthen ponds. *Aquaculture Research*, *51*(5), 1759–1770. https://doi.org/10.1111/are.14525

Larasati, L. G., Nimitkul, S., & Dewi, N. N. (2021). The effects of various doses of probiotics on growth and survival rates of white shrimp larva (Litopenaeus vannamei). *IOP Conference Series: Earth and Environmental Science*, *718*(1). https://doi.org/10.1088/1755-1315/718/1/012097

Liao, W., Lin, Z., Liao, M., Xue, Y., Zhou, J., Wang, Y., Hou, D., & Sun, C. (2022). Effects of sodium humate and probiotics on growth performance enzyme activity and microbial environment of Litopenaeus vannamei in high-density zero-water exchange systems. *Frontiers in Marine Science*, *9*(September), 1–14. https://doi.org/10.3389/fmars.2022.989325

Liu, Y., Xu, A., Liu, C., Sun, M., & Song, Z. (2023). *Effects of Chlorella pyrenoidosa Supplementation on Water Quality , Shrimp Growth Performance , and Bio fi lm Bacterial Community Structure in Litopenaeus vannamei Aquaculture Systems*. *2023*.

Makalingga, P., Suryantini, A., & Waluyati, L. R. (2019). Financial Feasibility Of The Vaname Shrimp Farming Business In The Purworejo Regency. *Agro Ekonomi*, *29*(2), 274. https://doi.org/10.22146/ae.35979

Mauladani, S., Rahmawati, A. I., Absirin, M. F., Saputra, R. N., Pratama, A. F., Hidayatullah, A., Dwiarto, A., Syarif, A., Junaedi, H., Cahyadi, D., Saputra, H. K. H., Prabowo, W. T., Kartamiharja, U. K. A., Noviyanto, A., & Rochman, N. T. (2020). Economic feasibility study of Litopenaeus vannamei shrimp farming: nanobubble investment in increasing harvest productivity. *Jurnal Akuakultur Indonesia*, *19*(1), 30–38. https://doi.org/10.19027/jai.19.1.30-38

Mirbakhsh, M., Ghaednia, B., Zorriehzahra, M. J., Esmaeili, F., & Faggio, C. (2023). Dietary mixed and sprayed probiotic improves growth performance and digestive enzymes of juvenile whiteleg shrimp (Litopenaeus vannamei, Boone, 1931). *Journal of Applied Aquaculture*, *35*(3), 823–836. https://doi.org/10.1080/10454438.2022.2032528

Mishra, P., Singh, U., Pandey, C. M., Mishra, P., & Pandey, G. (2019). Application of student's t-test, analysis of variance, and covariance. *Annals of Cardiac Anaesthesia*, *22*(4), 407–411. https://doi.org/10.4103/aca.ACA-94-19

Monier, M. N., Kabary, H., Elfeky, A., Saadony, S., El-Hamed, N. N. B. A., Eissa, M. E. H., & Eissa, E. S. H. (2023). The effects of Bacillus species probiotics (Bacillus subtilis and B. licheniformis) on the water quality, immune responses, and resistance of whiteleg shrimp (Litopenaeus vannamei) against Fusarium solani infection. *Aquaculture International*, *0123456789*. https://doi.org/10.1007/s10499-

023-01136-1

Muahiddah, N., Affandi, R. I., & Diamahesa, W. A. (2022). the Effect of Immunostimulants From Natural Ingredients on Vanamei Shrimp (Litopenaeus Vannamei) in Increasing Non-Specific Immunity To Fight Disease. *Journal of Fish Health*, *2*(2), 90–96. https://doi.org/10.29303/jfh.v2i2.1462

Noor Shah, A., Wu, Y., Iqbal, J., Tanveer, M., Bashir, S., Ur Rahman, S., Hafeez, A., Ali, S., Ma, X., Alotaibi, S. S., Shehawi, A. El, & Yang, G. (2021). Nitrogen and plant density effects on growth, yield performance of two different cotton cultivars from different origin. *Journal of King Saud University - Science*, *33*(6), 101512. https://doi.org/10.1016/j.jksus.2021.101512

Nuhasanah, S. (2019). *Statistika Pendidikan Teori, Aplikasi, dan Kasus*. Salemba Humanika.

Peña Rodríguez, A. (2021). Effect of dietary prebiotic inulin and probiotic Bacillus subtilis and Lactobacillus sp., on the intestinal microbiota of white shrimp Litopenaeus vannamei. *Biotecnia*, *23*(3), 50–57. https://doi.org/10.18633/biotecnia.v23i3.1440

Pramudia, Z., Faqih, A. R., & Kurniawan, A. (2022). Analysis of Growth and Water Quality Dynamics in vannamei white Shrimp (Litopenaeus vannamei) Cultivation Using the Millennial Shrimp Farming System in Indonesia. *Ecology, Environment and Conservation*, *28*(2), 664–671. https://doi.org/10.53550/eec.2022.v28i02.013

Purnamasari, I., Ali, M., & Habibullah, A. F. (2022). Analisis Pendapatan dan Risiko Usaha Budidaya Udang Vaname (Litopenaeus vannamei) di Desa Glagah Kecamatan Glagah Kabupaten Lamongan. *Jurnal Grouper*, *13*(1), 94–99.

Purwanto. (2010). *Metodologi Penelitian Kuantitatif untuk Psikologi dan Pendidikan* (B. Santosa (ed.)). Pustaka Pelajar.

Rakhmanda, A., Pribadi, A., Parjiyo, P., & Wibisono, B. I. G. (2021). Production performance of white shrimp Litopenaeus vannamei with super-intensive culture on different rearing densities. *Jurnal Akuakultur Indonesia*, *20*(1), 56–64. https://doi.org/10.19027/jai.20.1.56-64

Rego, M. A. S., Sabbag, O. J., Soares, R., & Peixoto, S. (2017). Risk analysis of the insertion of biofloc technology in a marine shrimp Litopenaeus vannamei production in a farm in Pernambuco, Brazil: A case study. *Aquaculture*, *469*, 67–71. https://doi.org/10.1016/j.aquaculture.2016.12.006

Reid, G., Gadir, A. A., & Dhir, R. (2019). Probiotics: Reiterating what they are and what they are not. *Frontiers in Microbiology*, *10*(MAR), 1–6. https://doi.org/10.3389/fmicb.2019.00424

Reksoatmodjo, T. N. (2007). *STATISTIKA untuk Psikologi dan Pendidikan* (A. Wijaya (ed.)). Refika Aditama.

Riduwan. (2009). *Pengantar Statistika Sosial* (Pristiwanto (ed.)). ALFABETA.

Sawyer, S. F. (2009). Analysis of Variance: The Fundamental Concepts. *Journal of Manual & Manipulative Therapy*, *17*(2), 27E-38E. https://doi.org/10.1179/jmt.2009.17.2.27e

Shafi, M. I., Adnan, M., Fahad, S., Wahid, F., Khan, A., Yue, Z., Danish, S., Zafar-Ul-Hye, M., Brtnicky, M., & Datta, R. (2020). Application of single superphosphate with humic acid improves the growth, yield and phosphorus uptake of wheat (Triticum aestivum L.) in calcareous soil. *Agronomy*, *10*(9), 1–15. https://doi.org/10.3390/agronomy10091224

Stępniak, C. (2011). Coefficient of Variation. *International Encyclopedia of Statistical Science*, 267–267. https://doi.org/10.1007/978-3-642-04898-2_177

Sugiyono. (2011). *Metode Penelitian Administrasi Dilengkapi dengan Metode R&D*. ALFABETA.

Sumiarsih, Hutabarat, J., & Rejeki, S. (2019). Development Strategy of Mini-Scale Shrimp Farming on Plastic Pond (Busmetik) in Gemilang Minajaya Fish Farming Group of Tegal City. *Russian Journal of Agricultural and Socio-Economic Sciences*, *87*(3), 68–78. https://doi.org/10.18551/rjoas.2019-03.09

Sumon, T. A., Hussain, M. A., Sumon, M. A. A., Jang, W. J., Abellan, F. G., Sharifuzzaman, S. M., Brown, C. L., Lee, E. W., Kim, C. H., & Hasan, M. T. (2022). Functionality and prophylactic role of probiotics in shellfish aquaculture. *Aquaculture Reports*, *25*(April), 101220. https://doi.org/10.1016/j.aqrep.2022.101220

Supriyanto, A., & Sari, N. M. (2020). Pembuatan Papan Partikel Dari Serbuk Gergajian Kayu Akasia Mangium (Acacia Mangium) Dan Kayu Sungkai (Peronema Canescens) Menggunakan Perekat Resin Polyester Making Particle Board from Saw Powder woods of Akasia Mangium (Acacia mangium) and Sungkai. *Jurnal Sylva Scienteae*, *03*(5), 805–817.

Suryani, & Hendryadi. (2018). *Metode Riset Kuantitatif: Teori dan Aplikasi pada Penelitian Bidang Manajemen dan Ekonomi Islam* (Kedua). Prenadamedia Group.

Truong, Q. P., Phan, T. C. T., Vu, H. H., Pham, T. T. N., Huynh, T. G., & Vu, N. U. (2021). Isolation of potential probiotic bacillus subtilis cm3.1 and its effects on the water quality and growth performance of the whiteleg shrimp litopenaeus vannamei in the mekong delta, vietnam. *AACL Bioflux*, *14*(6), 3347–3357.

Usura, A. Y., Koniyo, Y., & Yapanto, L. M. (2023). *Business Diplomacy and Economy Analysis of Vannamei Shrimp Cultivation Business ((Litopenaeus vannamei) In North Gorontalo District , Gorontalo Province*. *2*(6).

Wang, C., Tee, M., Roy, A. E., Fardin, M. A., Srichokchatchawan, W., Habib, H. A., Tran, B. X., Hussain, S., Hoang, M. T., Le, X. T., Ma, W., Pham, H. Q., Shirazi, M., Taneepanichskul, N., Tan, Y., Tee, C., Xu, L., Xu, Z., Vu, G. T., … Kuruchittham, V. (2021). The impact of COVID-19 pandemic on physical and mental health of Asians: A study of seven middle-income countries in Asia. *PLoS ONE*, *16*(2 Febuary), 1–20. https://doi.org/10.1371/journal.pone.0246824

Wang, R., Guo, Z., Tang, Y., Kuang, J., Duan, Y., Lin, H., Jiang, S., Shu, H., & Huang, J. (2020). Effects on development and microbial community of shrimp Litopenaeus vannamei larvae with probiotics treatment. *AMB Express*, *10*(1). https://doi.org/10.1186/s13568-020-01041-3

Wei, D., Zeng, S., Hou, D., Zhou, R., Xing, C., Deng, X., Yu, L., Wang, H., Deng, Z., Weng, S., Huang, Z., & He, J. (2021). Community diversity and abundance of ammonia-oxidizing archaea and bacteria in shrimp pond sediment at different culture stages. *Journal of Applied Microbiology*, *130*(5), 1442–1455. https://doi.org/10.1111/jam.14846

Won, S., Hamidoghli, A., Choi, W., Bae, J., Jang, W. J., Lee, S., & Bai, S. C. (2020). Evaluation of potential probiotics bacillus subtilis WB60, Pediococcus pentosaceus, and Lactococcus lactis on growth performance, immune response, gut histology and immune-related genes in whiteleg shrimp, Litopenaeus vannamei. *Microorganisms*, *8*(2), 1–15. https://doi.org/10.3390/microorganisms8020281

Yunita, N. I. W., Susari, N. N. W., & Sampurna, I. P. (2022). Morfometri Kuku Sapi Putih Taro di Desa Taro, Kecamatan Tegallalang, Kabupaten Gianyar, Bali. *Buletin Veteriner Udayana*, *158*, 451. https://doi.org/10.24843/bulvet.2023.v15.i03.p14

Yunus, J., Yuliana, E., & Harijati, S. (2022). Factors Affecting Production of Vanamei Shrimp Pond Farming in Pidie Jaya District-Aceh Province, of Indonesia. *International Journal of Research in Social Science and Humanities*, *03*(02), 43–52. https://doi.org/10.47505/ijrss.2022.v3.2.6