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EFFECTIVENESS OF INDEX SYSTEM FEEDING ON GROWTH RATE AND WATER QUALITY IN VANNAMEI SHRIMP (*L. vannamei*) CULTIVATION

Efektivitas Sistem Indeks Pemberian Pakan terhadap Laju Pertumbuhan dan Kualitas Air pada Budidaya Udang Vannamei (*L. vannamei*)

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ABSTRACT

Inefficient feeding in vannamei shrimp (*Litopenaeus vannamei*) cultivation has a negative impact on growth and water quality. The purpose of this study was to determine the effectiveness of index system feeding on growth rate and water quality in vannamei shrimp (*L. vannamei*) cultivation. The research method used was descriptive, the data were analyzed using the t-test statistical test. The parameters tested in this study were growth parameters including Average Body Weight (ABW), Average Daily Growth (ADG), Feed Conversion Ratio (FCR), and Survival Rate (SR). Water quality parameters include temperature, pH, Dissolved Oxygen (DO), salinity, ammonia, nitrite, nitrate, and Total Organic Matter (TOM). The results showed that there was a significant difference between the feeding index system and the anco check system. The index system is more effective in increasing the growth rate and the Feed Conversion Ratio (FCR) and Survival Rate (SR) results are obtained according to the optimum value. In the index system the average Average Body Weight (ABW) is 14.24 ± 0.68, the average Daily Growth (ADG) is 0.43 ± 0.02, the average Feed Conversion Ratio (FCR) is 1.06 ± 0.04, and the average survivak rate (SR) is 70.75 ± 5.56%. Whereas in the anco check system the average Average Body Weight (ABW) is 12.1 ± 1.13, the average Daily Growth (ADG) is 0.35 ± 0.04, the average Feed Conversion Ratio (FCR) is 1.18 ± 0.07 and the average survival rate (SR) is 59.25 ± 5.12%. Water quality during maintenance obtained optimum results according to the optimum standard of water quality for vannamei shrimp (*L. vannamei*) cultivation. Feeding the index system gives better results for the growth rate in vannamei shrimp farming, so that the feed given is more effective and efficient.

Key words: *Average Body Weight* (ABW), *Average Daily Growth* (ADG), *Dissolved Oxygen* (DO), *Total Organik Matter* (TOM).

ABSTRAK

Pemberian pakan yang tidak efisien dalam budidaya udang vaname *(Litopenaeus vannamei)* berdampak buruk pada pertumbuhan dan kualitas air. Tujuan dari penelitian ini adalah untuk mengetahui efektivitas pemberian makan sistem indeks terhadap laju pertumbuhan dan kualitas air pada budidaya udang vaname *(L. vannamei).* Metode penelitian yang digunakan adalah deskriptif, data dianalisis menggunakan *uji statistik uji-t.* Parameter yang diuji dalam penelitian ini adalah parameter pertumbuhan antara lain *Average Body Weight* (ABW), *Average Daily Growth* (ADG), *Feed Conversion Ratio* (FCR), dan *Survival Rate* (SR). Parameter kualitas air meliputi suhu, pH, *Dissolved Oxygen* (DO), salinitas, amonia, nitrit, nitrat, dan *Total Organic Matter* (TOM). Hasil penelitian menunjukkan bahwa ada perbedaan nyata antara pemberian makan sistem indeks dan sistem pemeriksaan ANCO. Sistem indeks lebih efektif dalam meningkatkan laju pertumbuhan dan memperoleh hasil *Feed Conversion Ratio* (FCR) dan *Survival Rate* (SR) yang sesuai dengan nilai optimal. Dalam sistem Indeks Berat Badan Rata-Rata (ABW), rata-rata Berat Badan Rata-rata (ABW) adalah 14,24±0,68, rata-rata *Pertumbuhan Harian* (ADG) adalah 0,43±0,02, *Rasio Konversi Pakan* (FCR) rata-rata adalah 1,06±0,04, dan *Tingkat Kelangsungan Hidup* (SR) rata-rata adalah 70,75±5,56%. Sementara itu, pada sistem anco check, rata-rata *Rata-rata Berat Badan* (ABW) adalah 12,1±1,13, rata-rata *Pertumbuhan Harian* (ADG) adalah 0,35±0,04, rata-rata *Rasio Konversi Pakan* (FCR) adalah 1,18±0,07 dan rata-rata *Survival Rate* (SR) adalah 59,25±5,12%. Kualitas air selama pemeliharaan memperoleh hasil yang optimal sesuai dengan standar kualitas air optimal untuk udang vaname *(L. vannamei).* Pemberian pakan sistem indeks memberikan hasil yang lebih baik untuk laju pertumbuhan budidaya udang vaname, sehingga pakan yang diberikan lebih efektif dan efisien.

Kata Kunci: Rata-rata Berat Badan (ABW), Rata-rata Pertumbuhan Harian (ADG), Oksigen Terlarut (DO), Total Materi Organik (TOM)

INTRODUCTION

Vannamei shrimp (*Litopenaeus vannamei*) is one of the commodities that is widely cultivated in Indonesia. The advantage of vannamei shrimp (*L. vannamei*) when compared to tiger shrimp (Panaeus monodon) is its resistance to disease and its productivity level is very high. This is seen from the nature of vannamei shrimp (*L. vannamei*) which is able to utilize the entire water column from bottom to surface so that vannamei shrimp (*L. vannamei*) can be maintained with a relatively high stocking density (Arsad *et al.,* 2017).

In the cultivation of vannamei shrimp (*L. vannamei*), feed with good nutrition is needed to support shrimp growth, besides that the feeding system is also very important in the cultivation of vannamei shrimp (*L. vannamei*) (Ulumiah *et al.,* 2020). Feed is a very important factor in vannamei shrimp cultivation because it absorbs 60-70% of the total operational costs, feeding as needed will spur the growth of vannamei shrimp (*L. vannamei*) optimally so that its productivity can be increased (Lusiana *et al.,* 2021). Feeding for its cultivation is adjusted to the nature of the shrimp in terms of the amount and frequency of feed. The age and number of stockings also determine when it comes to feeding. There needs to be precision in feeding so that shrimp do not experience excess and lack of feed (Renitasari *et al.,* 2021).

Feeding appropriate and appropriate feed will provide maximum growth results. Lack of feed can cause shrimp to fail to grow, non-uniform size, slow growth, cannibalism, and grow seemingly porous (Renitasari *et al.,* 2021). Excess feed can result in a decrease in water quality so that shrimp are stressed, defense against disease decreases, growth is stunted, and even mortality rates are high (Supono, 2017). The influence of improper water quality management can result in problems, namely increased disease and parasite attacks in cultivation which can cause crop failure (Sutarjo & Sudibyo 2020).

There are several systems in determining the amount of feeding in vannamei shrimp cultivation, including the feeding of the index system and checking the anco (Feeding tray). Based on previous research by Renitasari *et al.,* (2021), feeding with an index system can produce good growth according to the SNI target and optimal for water quality, because it has calculations that can be adjusted to the needs of the Average Daily Growth (ADG) target and can minimize the presence of residual feed so that it can overcome these problems for accuracy in feeding. The index system is the maximum feed limiter for each pond in vannamei shrimp (*L. vannamei*) cultivation which is determined based on two times the Average Daily Growth (ADG) target of cultivation. The index system is applied after the shrimp enters the age of 30 days of rearing (Ulumiah *et al.,* 2020)

Feeding with the Feeding Tray system is a system for determining the amount of feed in vannamei shrimp (*L. vannamei*) cultivation based on the adjustment of feed residue in anco (Bahri *et al.,*, 2020). Anco is usually used to prevent the occurrence of excess feed in the aquaculture production system, but it has a shortcoming in determining the right amount of daily feed (Rangka *et al.,* 2012). In addition, based on previous research by Syafaat *et al.,* (2016), feeding is only stocked and cannot be monitored how much feed is consumed by shrimp and the control device is only anco.

Based on the description above, this study aims to determine the effectiveness of index system feeding on the growth rate and water quality in vannamei shrimp cultivation (*L. vannamei*).

RESEARCH METHODS

This research was conducted for 8 weeks at CV. Sukses Indah Prima of Situbondo, East Java. The method used in this study is descriptive. The purpose of this method is to describe the symptoms of the variables used to find out the difference. Meanwhile, data analysis uses descriptive and statistical tests of t-tests to test the average of two populations that are the same or significantly different. This study compares the feeding of the index system with the feeding of the anco check system.

Data collection is in the form of primary data obtained from observation and data recording. Sampling was carried out on CV Sukses Indah Prima ponds Situbondo. Samples were taken in the anco check system plot, namely in plots A1, A2, A3, A4, and the index system feeding on plots B1, B2, B3, B4. The main parameters in this study are growth measurement including Average Body Weight (ABW), Average Daily Growth (ADG), Feed Conversion Ratio (FCR), and Survival Rate (SR). Meanwhile, the supporting parameters in this study are water quality, including. temperature, pH, Dissolved Oxygen (DO), salinity, ammonia, nitrites, nitrates, and Total Organic Matter (TOM).

Feeding

Feeding of Day of Culture (DOC) 1-30 shrimp begins with Blind Feeding. The feed used in this study was commercial shrimp feed pellets (containing 36% protein, 5% fat, 4% fiber, 12% water content and 15% ash). Starting from 31 days of age, the feeding program uses an index system, the index value is determined based on twice the Average Daily Growth (ADG) target as in the following table.

Table 1. Index system

DOC	Index (%)	Target ADG
30-40	0.55	0.225
41-50	0.6	0.3
51-70	0.7	0.35
>70	0.8	0.4

Feed needs using the index system can be determined by the following formula (Renitasari *et al.,* 2021):

$$Feed(kg) = \frac{\text{Total stocking x day to} - \text{x index}}{100.000}$$

Feeding the anco check system is carried out by utilizing anco observations, shrimp appetite observation by looking at anco checks, with the provisions as in the following table.

Table 2. Check Anco

DOC	Feed in anco (%)	Frequency of checks (Jam)
31-50	0.5	2
50<	1	1.5

Growth Sampling

Shrimp sampling was carried out at the age of 43 days until harvest with a frequency of once a week using a sampling net for four times. Sampling aims to find out the Average Body Weight (ABW) and Average Daily Growth (ADG) of shrimp during a certain Day of Culture (DOC). Average Body Weight (ABW) is the average weight of shrimp from the sampling results. Average Body Weight (ABW) can be calculated as follows (Witoko *et al.,* 2018):

$$ABW = \frac{\text{Total Sample Weight}}{\text{Number of Samples}}$$

Table 3. Target ABW Company CV. Excellent Success 2022

DOC	ABW (gr)
43	5
50	7.5
57	10
64	12.5

Average Daily Growth (ADG) is the average daily weight gain of shrimp in a certain period of time so that it can be used to determine the growth rate of shrimp. Average Daily Growth (ADG) can be calculated using the following formula (Witoko *et al.,* 2018):

$$ADG = \frac{\textit{ABW current sampling} - \textit{ABW previous sampling}}{\textit{Sampling time interval}}$$

Water Quality

Water quality measurements were carried out in situ and ex situ (laboratory). The observed quality is the physical paremeter; Brightness, Temperature, and salinity with daily frequency (Supriatna *et al.,* 2020). Chemical parameters include; Dissolved Oxygen (DO), pH, alkalinity, ammonia, nitrite, nitrate, phosphate, and Total Organic Matter (TOM) with a frequency of every three days (Putra and Manun 2014).

Data Analysis

Data analysis was carried out by independent sample t-test for Average Body Weight (ABW), Average Daily Growth (ADG), Feed Conversion Ratio (FCR), and Survival Rate (SR). Independent sample t-test is a parametric test used to determine whether there is a mean difference between two free groups or two unpaired groups with the intention that the two data groups come from different subjects. Hypothesis testing in this study uses the Independent sample t-test method. An independent sample t-test is used to determine whether two unrelated samples have different mean values. Independent sample t-test is carried out by comparing the difference between two average values with the standard error of the average difference between two samples (Ilham 2021). T test testing can be done using the help of the SPSS program (Slamet, 2014).

RESULTS AND DISCUSSION

The results of the calculation of *Average Body Weight (ABW)* during the study there was an increase every week in each treatment, The average results of *Average Body Weight (ABW)* at the end of observation were known in the plot with the feeding of the index system of 14.24±0.68 while in the plot with the feeding of the anco check, the average result was 12.1±1.13. For more clarity, the *Average Body Weight (ABW)* data can be seen in Figure 1.

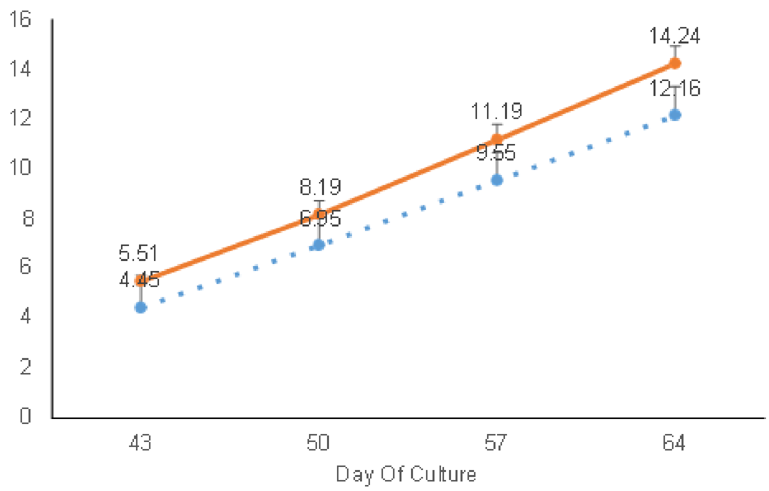

Figure1. Average Body Weight (ABW)

From this, it was then analyzed using an unpaired t test (Independent Samples T-Test) with a significance degree of 0.05 (5%) obtained the result of t calculation of > t table and a Sig.(2-tailed) value of 0.02 showing that there was a significant difference between the results of the Average Body Weight (ABW) of the feeding of the index system and the Average Body Weight (ABW) of feeding the anco check system. and independent variables have a real effect on dependent variables. The average body weight (ABW) of shrimp at the beginning of Post Larva (PL) 10 stocking was 0.63 gr, At the beginning of DOC 43 sampling there was a difference between the 2 feeding systems, In the index system there was always an increase in Average body weight (ABW in DOC 43, 50, 57, and 64 respectively by 5.51, 8.19, 11.19, and 14.24. According to the SNI standard value (8008:2014), the weight of shrimp reaches a minimum consumption size of 14 grams, while in the Cek anco system it is 4.45, 6.95, 9.55, and 12.16. The low ABW in the anco check system is caused by several factors including stocking density, improper daily feed needs, decreased shrimp appetite, and suboptimal water quality, brightness, pH and ammonia. According to the statement of Purnamasari *et al.,* (2017) that the low average weight produced is caused by a larger number of shrimp populations, so that the shrimp's space to move in getting food, shrimp appetite, less than optimal water quality and limited oxygen which causes. The increase in the average weight of shrimp produced at the end of maintenance cannot be maximized.

Feeding the index system can provide optimal results because of the accuracy of feed so that the feed given is not less than the standard weight of vannamei shrimp (*L. vannamei*) and does not exceed it. According to the statement of Ulumiah *et al.* (2020) that in the feed quantity index system in line with the daily feed needs of shrimp, feeding is efficient, and does not cause excess feed residue. According to Renitasari *et al.* (2021), using feed well, and the existence of good feed management management is also a percentage of the provision of an index system. Feeding with an index system can control the feed consumed by shrimp so that the rest of the feed is not excessive and has a good impact on the stability of water quality, According to Ilham (2021) unstable or variable water quality will have a bad impact on cultivated shrimp, as a result of which shrimp become stressed and sick so that it can interfere with their growth.

Average Daily Growth (ADG)

The results of the calculation of Average Daily Growth (ADG) during the study there was an increase every week in each treatment, The average results of Average Daily Growth (ADG) at the end of the observation were found in the plot with the feeding of the index system of 0.43±0.02 while in the plot with the feeding of the anco check, an average result of 0.35±0.04 was obtained. For more clarity, the Average Daily Growth (ADG) data can be seen in Figure 2.

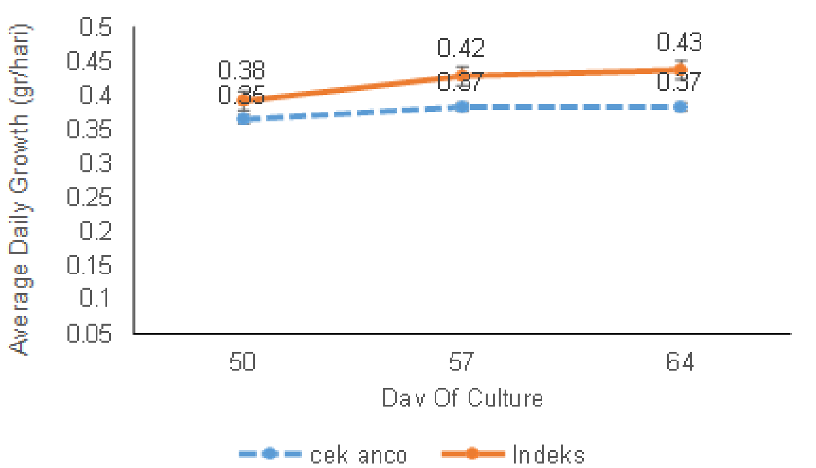

Figure 2. Average Daily Growth (ADG)

From this, it was then analyzed using an unpaired t test (Independent Samples T-Test) with a significance degree of 0.05 (5%), obtained the result of t calculation of > t table and a Sig.(2-tailed) value of 0.015, showing that there was a significant difference between the results of the Average Daily Growth (ADG) of the feeding of the index system and the Average Daily Growth (ADG) of feeding the anco check system. The average yield on index system feeding is higher than that on the anco check system feeding. In the feeding of the index system, it is known that there is an increase in Average Daily Growth (ADG) every week, in the DOC 50 index used 0.6 % and in DOC 57 the index is 0.7%, the highest Average Daily Growth (ADG) result in DOC 50 is found in plot B1 of 0.41 gr/day while the lowest is found in plot A1 of 0.31 gr/day. In DOC 57, the highest ADG is found in plot B1 of 0.43 gr/day while the lowest is found in plot A3 of 0.35 gr/day. On DOC 64 the highest ADG is found in plot B1 of 0.47 gr/day while the lowest is found in plot A1 of 0.31 gr/day. The results of both treatments have met the standard based on the ADG target (SNI No. 01-7246), which is 0.2 g per day.

The results of the calculation of Average Daily Growth (ADG) in the feeding of the index system obtained higher results when compared to the feeding of the anco check system, the high and low value of adg can be caused by the level of consumption by vannamei shrimp (*L. vannamei*) this is in accordance with the statement of Supito (2017) that not all shrimp have active movements and tend to stay at the bottom of the plot, so that the feed given is not eaten evenly by vannamei shrimp (*L. vannamei*), this affects the Average Daily Growth (ADG) value in shrimp farming. According to Witoko (2018), the growth of shrimp in addition to the aging of shrimp also affects growth because the energy absorbed from feed is not only used for growth. At the above value, the growth of shrimp is not so fast because in the maintenance medium there are pests in the form of wild fish and sea snails, this affects the growth because the feed given is eaten by several competitors in the form of wild fish and sea snails. In addition, the density of the media also increases so that shrimp have competitors in the cultivation media.

Feed Convertion Ratio (FCR)

The results of the post-harvest Feed Conversion Ratio (FCR) calculation can be found that the average weight gain of vannamei shrimp (*L. vannamei*) in plots with index system feeding is 1.06±0.04 while in plots with anco check feeding, an average result of 1.18±0.07 is obtained. For more details, see Figure 3.

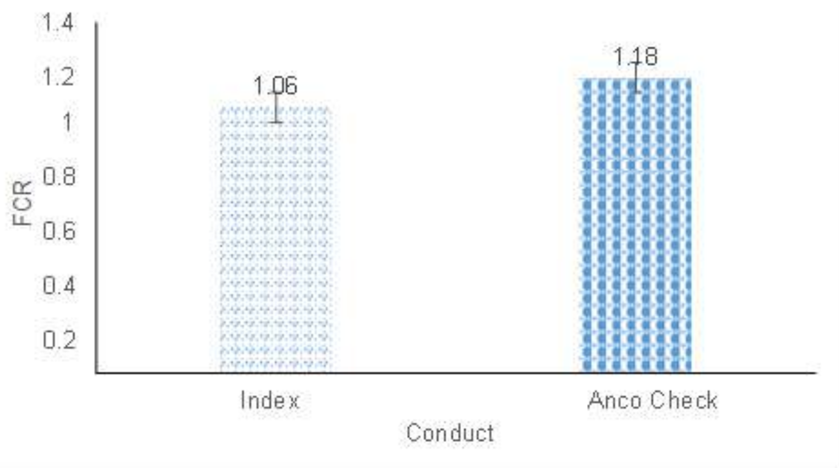

Figure 3. FCR Chart

The average feeding of the index system showed better results than the feeding of the anco check system, namely in the index system of 1.06 while in the anco check system it was

1.18. The lower the FCR value, it will have a positive effect on the savings in feed operational costs, because in an intensive shrimp farming system, feed costs contribute 60-70% to the total operational costs of cultivation (Ariadi *et al.,* 2020). The lowest Feed Conversion Ratio (FCR) is found in pool B1 of 1.02 while the highest FCR is found in pool A2 of 1.28. Feeding with an index system provides more efficient results when compared to feeding the anco check system, the feed that is given Shrimp can be consumed according to a predetermined index limit and can be consumed by shrimp normally. This is in accordance with the statement of Untara *et al.,* (2018) that feed that is consumed normally will be processed within 3-4 hours and the rest will be wasted through feces.

A low Feed Conversion Ratio (FCR) indicates that the shrimp raised use feed well, and there is good feed management management with the percentage of giving an index system. Low. Feed Conversion Ratio (FCR) is beneficial for cultivators because it can minimize costs. This is in accordance with the opinion of Sopha *et al.,* (2015) that if the value. The smaller the Feed Conversion Ratio (FCR), the better this is because the costs incurred for the purchase of feed are smaller so that the profits obtained are higher. According to Arsad (2017), in general, the FCR value in vannamei ponds (*L. vannamei*) ranges from 1.4-1.8. By knowing the value. Feed Conversion Ratio (FCR), cultivators can minimize costs.

Survival Rate (SR)

The results of the calculation of the Survival Rate (SR) during the study were known that the average weight gain of vannamei shrimp (*L. vannamei*) in the plot with the index system feed was 70.75±5.56% while in the plot with the feeding of the anco check, an average result of 59.25±5.12% was obtained. More details can be seen in Figure 4.

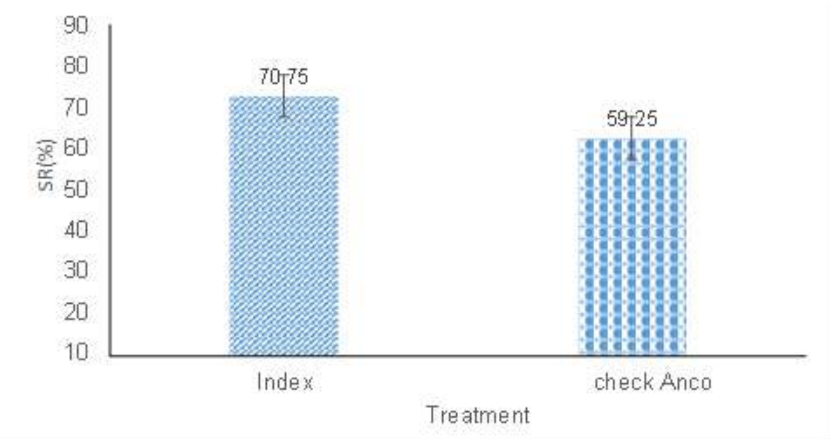

Figure 4. SR Graphics

The average yield on the index system feeding was higher than the feeding of the anco check system, which was 70.75% in the index system while in the anco check system it was 59.25%. The low SR in the anco check system is caused by the suboptimal water quality value, resulting in stressed shrimp to death. Survival Rate (SR) is the survival rate of shrimp compared to the number of stockings and is expressed as a percentage. The average result of the Survival Rate (SR) in the index system shows a higher Survival Rate (SR) when compared to the anco check system, this is in accordance with the statement of Arsad *et al.,* (2017) that the SR> value is 70%, for the SR in the medium category 50-60%, and in the low category the SR value <50% Survival rate is also important monitoring in aquaculture because it is a guideline or reference for how many shrimp are alive at the end of their maintenance period.

The highest Survival Rate (SR) is found in the B1 pool at 76% while The lowest Survival Rate (SR) is found in the A4 pool of 54%. The height and low survival rate in shrimp farming is influenced by mortality factors in shrimp caused by cannibalism and disease. According to Supono *et al.,* (2017), the low survival rate in vannamei shrimp (*L. vannamei*) cultivation can be due to the high stocking density, increasing competition in ponds. In addition, the high stocking density causes high levels of ammonia from feed residues and feces, which are toxic and poison shrimp. Feeding the index system provides better results because of the accuracy in feeding so that the feed given is consistent and does not cause excess feed residue. This is in accordance with the statement of Sopha *et al.,* (2015) that excess feed can result in a decrease in water quality so that shrimp are stressed, defense against disease decreases, growth is stunted, and even high mortality rates.

Water Quality

The water quality during maintenance is observed i.e. physical parameters including temperature, brightness, and salinity. The observed chemical parameters include pH, nitrite (NO_2), nitrate (NO_3), Ammonia (NH_3), Phoste (PO_4), Alkalinity, and Total Organic Matter (TOM). The results of water quality measurement can be seen in Table 3 as follows.

No	Parameters	Unit	Plot		Optimum Value
			Index	Check the anco	
1.	Temperature	°C	28.5±0.08	28.57±0.09	26-32 (Ariadi *et al.,* 2021)
2.	Brightness	cm			
	Morning		41±2.5	55±0.11*	35-40 (Supriatna *et al.,* 2020)
	Afternoon		37±2.44	45±0.28*	35-40 (Supriatna *et al.,* 2020)
3.	Salinity	ppt	27±0	23±4.08	15-30 (Ariadi *et al.,* 2021)
4.	DO	mg/l	4.4±0.18	4.3±0.32	>4 (Ariadi *et al.,* 2021)
5.	pH				
	Morning	-	7.87±0.05	8.05±0.11*	7.5-8.0 (Sahrijanna 2017)
	Afternoon	-	8.25±0.05	8.46±0.28	8.0-8.5 (Sahrijanna 2017)
6.	Alkalinity	ppm	133.75±4.78	149.71±22.5	100-150 (Kilawati 2015)
7.	Nitrit (NO_2)	mg/L	0.01±0	0.01±0.009	<0.1 (Makmur *et al.,* 2021)
8.	Nitrate (NO_3)	mg/L	7.2±2.28	3.5±1.6	10-20 (SOP CV. Sukses Indah Prima)
9.	Ammonia(NH_3)	mg/L	0.15±0.05	0.5±0,26*	<0.1 (Hamuna 2018)
10.	Phospat (PO_4)	ppm	1.04±0.87*	1.08±0.07*	0.5-1 (Romadhona 2016)
11.	TOM	ppm	89±19.17	89.75±6.07	<100 (Setyowati 2013)

Table 4. Water quality during the study

*(*Not at optimal value*)

Based on Table 3. Water quality during the study, it can be known that the influence of feeding with the index system has a positive effect on the waters so that the water quality value during the study is obtained according to the standard value.

Temperature

The results of the observation of average temperature during the study on both feeding systems, namely the index system and the anco check, showed results that were in accordance with the optimal range, the average temperature in the index system was 28.5±0.08 while in the ANCO check system was 28.57±0.09. According to Ariadi *et al.* (2021), the optimal water temperature for vannamei shrimp growth ranges from 26-32OC. If the temperature is more than the optimum number, then the metabolism in the shrimp's body is rapid, but if the ambient temperature is lower than the optimal temperature, then shrimp growth decreases with decreased appetite (Supriatna *et al.,* 2020). Temperature is influenced by the season, latitude and water level (Ariadi *et al.,* 2021).

Brightness

Observations of brightness in the pond from the feeding of the index system and the anco check system obtained the results of morning brightness of 41±2.5 and 55±0.11, while in the afternoon it was 37±2.44 and 45±0.28. The brightness in the pond with the feeding of the index system shows the results according to the optimal value, while the brightness in the anco check system shows the results that are not in accordance with the optimal value. Factors that affect brightness are the number of algae in the waters and the cleanliness of the water, the amount or the amount of algae will affect the brightness, the more algae the less light enters (Supriatna *et al.,* 2020).

Salinity

The results of the observation of average salinity during the study in both feeding systems, namely the index system and the ANCO check, showed results that were in accordance with the optimal range, the average salinity in the index system was 27±0 while in the anco check system was 23±4.08. According to Ariyadi *et al.,* (2021), salinity is one of the aspects of water quality that plays an important role because it affects the growth of young shrimp that are 1-2 months old require a salt content of 15-25 ppt for optimal growth. Water salinity that is too high can also cause difficulty for shrimp to change skin because the skin tends to be hard, the energy requirement for the adaptation process increases (Rahman *et al.,* 2016).

Disolved Oxygen (DO)

The results of the observation of Dissolved Oxygen (DO) during the study in both feeding systems showed optimal results, namely in the index system of 4.4±0.18 and in the ANCO check system it is 4.3±0.32. According to Makmur *et al.,* (2018), the water to be sown by shrimp must have a DO of >4 mg/L. The presence of dissolved oxygen in the waters is influenced by atmospheric pressure, temperature, salinity, water turbulence, photosynthetic activity, respiration and waste entering the water body (Paramitha *et al.,* 2014).

pH

Observations of pH in the pond from the feeding of the index system and the anco check system obtained the morning pH results of 7.87±0.05 and 8.05±0.11, while in the afternoon it was 8.25±0.05 and 8.46±0.28. The pH in the pond with the feeding index system shows the results according to the optimal value, while the brightness in the anco check system shows the results that are not in accordance with the optimal value in the morning, the factors that cause excess pH are the content of organic matter and excess feed residues from poorly controlled feeding (Makmur *et al.,* 2021). The optimal pH value range for vannamei shrimp cultivation ranges from 7.5-8.0 in the morning and 8.0-8.5 in the afternoon (Sahrijanna 2017). In this range, shrimp can experience optimal growth. The pH concentration of water affects the shrimp's appetite and chemical reactions in the water. In addition, pH that is below the tolerance range causes difficulty in changing skin, where the skin becomes soft and survival becomes low (renitasari *et al.,*, 2021).

Alkalinitas

The results of alkalinity measurements in each pond showed optimal results, the highest alkalinity level was found in plot B1 at 139 ppm while the lowest alkalinity level was found in plot B3 at 128 ppm. Alkalinity is the amount of carbonates, bicarbonates and hydroxides contained in water and is an important key because it can maintain pH levels and plankton growth (Makmur *et al.,* 2018). Based on (SNI 01- 7246-2006) the alkalinity value of water for shrimp farming Vannamei (*L. vannamei*) ranges from 100-150 ppm, the higher the pH value, the higher the alkalinity value. Alkalinity is determined by the amount of acid needed to reduce the pH. If the amount of acid added is large, then the alkalinity is high. Conversely, if the pH drops rapidly, the addition of acid will be slight, thus the alkalinity is low.

Nitrite (NO_2)

The results of the nitrite content measurement carried out in the four plots obtained an optimal result of 0.01 ppm. Nitrite is an intermediate form between ammonia and nitrates through the nitrification process, as well as between nitrates and hydrogen gas through the denitrification process (Makmur *et al.,* 2018). Excess nitrite compounds in the pond will cause a decrease in the ability of shrimp blood to bind to O2, because nitrites will react more strongly with hemoglobin resulting in a high shrimp mortality rate. According to Ariadi (2021), the factors that affect the high and low nitrite levels in ponds are due to the increasing intake of fertilizers and feeds which results in the accumulation of organic matter and water concentration.

Nitrate (NO_3)

The results of nitrate measurement in each pond obtained optimal results, the highest results were in plot B1 with a level of 10 ppm, the lowest in plot B3 with a level of 6 ppm. Nitrates are the main form of nitrogen in natural waters (Makmur *et al.,* 2018). Nitrate is one of the essential compound nutrients in the synthesis of animal and plant proteins. High nitrate concentrations in waters can stimulate the growth and development of aquatic organisms when supported by the availability of nutrients (Hamuna *et al.,* 2018). Nitrate can come from fertilization and from nitrite oxidation by Nitrobactery bacteria which will convert ammonia to nitrite and nitrite to nitrate (Jumraeni *et al.,* 2020).

Amonia(NH_3)

The results of the observation of average ammonia during the study in both feeding systems, namely the index system and the anco check, showed results that were in accordance with the optimal range in the index system while less than optimal in the anco check system, the average ammonia in the index system was 0.15±0.05 while in the anco check system was 0.5±0.26. Ammonia in waters comes from the rest of animal metabolism (excretion) and the process of decomposition of organic matter by microorganisms. In shrimp pond wastewater, ammonia comes from the shrimp excretion activity itself and the process of decomposition of organic matter from feed residues and shrimp manure during shrimp farming (Bastom, 2015).

Phosphate (PO_4)

The results of phosphate measurement in each pond show results that are still in accordance with the optimal range, namely in the index system of 1.04±0.87 and 1.08±0.07, Phosphate is an essential nutrient needed by plants in the process of growth and development (Rafiqie 2021). The low concentration of phosphate in ponds can be triggered by the high frequency of water changes during the rainy season (Ariadi *et al.,* 2021). Too low phosphate content can inhibit the growth of plankton and on the other hand, too high content will cause algae blooming so that it causes a reduction in dissolved oxygen content in the water (Kilawati, 2015).

Total Organic Matter (TOM)

The results of the measurement of Total Organic Matter (TOM) in the index system and the ANCO check system were 89±19.17 and 89.75±6.07, the results met the optimum value of <100 ppm. The value of Total Organic Matter (TOM) above 80 mg/l includes fertile waters (Setyowati 2013), the source of Total Organic Matter (TOM) in ponds comes from the accumulation of living organism particles, feces, detritus, mud and feed waste that forming turbidity in the waters (Ariadi *et al.,* 2021). According to Rafiqie (2021), the impact of the increase in Total Organic Matter (TOM) in waters does not have a direct effect on cultivated organisms, however, the problems caused by the high content of organic matter are the decrease in dissolved oxygen content and the emergence of eutrophication processes.

CONCLUSION

The results of the study showed that there was a real difference in the index feeding system and anco checks on Average Body Weight (ABW), Average Daily Growth (ADG), Feed Conversion Ratio (FCR), and Survival Rate (SR). Feeding the index system provides better results for the growth rate in vannamei shrimp cultivation, so that the feed given is more effective and efficient. The index system produces effective and appropriate feeding so that there is an increase in Average Body Weight (ABW) and Average Daily Growth (ADG) and can maintain water quality stability so as to produce optimal water quality during the study.

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