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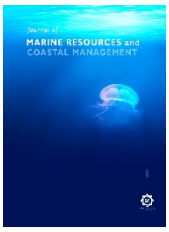

Growth performance of vannamei shrimp (*Litopenaeus vannamei*) in intensive ponds in Situbondo, East Java, Indonesia

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ABSTRACT

Vannamei shrimp (*Litopenaeus vannamei*) is an economically important aquaculture species due to its high productivity and commercial value. This study aimed to evaluate the growth performance of vannamei shrimp reared in intensive ponds in Situbondo, East Java, Indonesia. An observational approach was used, and the data were analyzed descriptively and quantitatively using Microsoft Excel. Growth performance was assessed based on average daily growth (ADG), average body weight (ABW), feed conversion ratio (FCR), and survival rate (SR). The mean ADG across the three ponds was 0.39 g/day, with pond E8 showing the highest initial ADG of 0.41 g/day before disease onset. The highest ABW was recorded in pond E7 at 35.20 g/shrimp. The mean FCR was 1.25, with pond E8 exhibiting the lowest value. SR reached 93.43% in pond E7 and 93.4% in pond E8, while pond E5 recorded a lower SR of 84.7%, which was associated with molting failure. Overall, the results indicate differences in growth performance and survival among the ponds. Disease occurrence, molting failure, and extreme weather were identified as potential factors affecting production outcomes. These findings highlight the importance of maintaining suitable culture conditions and effective health management in intensive vannamei shrimp farming.

Keywords: feed conversion ratio, growth performance, intensive aquaculture, *Litopenaeus vannamei*, survival rate

INTRODUCTION

Vannamei shrimp (*Litopenaeus vannamei*) has significant commercial value due to its advantages, including relatively high disease resistance and productivity [1]. Shrimp production increased by 13.09% from 2018 to 2019 [2]. Despite this growth, the supply of *L. vannamei* from pond aquaculture has declined and has been insufficient to meet the increasing demand for large-sized shrimp, particularly those comparable in size to lobsters.

Farmers have adopted intensive farming systems to increase shrimp production [3]. Intensive ponds are characterized by the use of full plastic lining (mulching), water pumps, paddlewheels, aerators, high stocking densities, and pellet-based diets [4]. However, high stocking densities can increase the accumulation of organic matter from uneaten feed and metabolic waste, potentially causing stress, increasing susceptibility to ectoparasite infestations, and contributing to shrimp mortality [5].

Therefore, evaluating shrimp growth performance under intensive farming conditions is essential to support effective aquaculture management. This study aimed to evaluate the growth performance of *L. vannamei* reared in intensive ponds at CV. Reksa Bumi, Situbondo, East Java, based on survival rate (SR), average body weight (ABW), average daily growth (ADG), and feed conversion ratio (FCR), while also assessing water quality and identifying potential pests and diseases. The findings are expected to provide practical information for improving shrimp farming management.

METHODS

The study was conducted from February 20 to April 20, 2024, at CV. Reksa Bumi in Buduan, Suboh District, Situbondo Regency, East Java, Indonesia. An observational method was employed to evaluate the growth performance of *L. vannamei* under intensive farming conditions. The equipment included water quality measurement instruments (thermometer, pH meter, dissolved oxygen meter, and refractometer), sampling equipment (scales, nets, anchos, and an auto-feeder), and laboratory apparatus (autoclaves, microscopes, Erlenmeyer flasks, pipettes, and measuring cups). The materials used included shrimp, feed, alcohol, distilled water, and test kits.

Growth performance was evaluated using four parameters: survival rate (SR), average body weight (ABW), average daily growth (ADG), and feed conversion ratio (FCR). Survival rate represents the percentage of shrimp surviving until the end of the observation period and was calculated using the formula described by Goddaard (1996), as cited in [6]. Average body weight represents the mean weight of individual

shrimp at the time of sampling. Average daily growth represents the average daily increase in shrimp body weight over a specified period. Feed conversion ratio was calculated based on the amount of feed supplied relative to the shrimp biomass gain, following the method described by Zonneveld et al. (1991), as cited in [7]. The formulas used for these parameters are presented in Equations (1)–(4), respectively.

Water quality was monitored twice daily, in the morning and evening, with two replicates per measurement. The parameters assessed included pH, salinity, temperature, alkalinity, ammonium, nitrite, and dissolved oxygen. Water samples were collected using a composite sampling method.

Potential pests were identified through interviews, while laboratory analyses were conducted to investigate bacterial diseases and the presence of viruses in the culture ponds.

$$SR = \frac{N_t}{N_0} \times 100\% \quad (1)$$

Where N_t is number of fish at time t (tails) and N_0 is number of fish at the start of the study (tails).

$$ABW = \frac{Net\ weight\ of\ shrimp}{The\ number\ of\ shrimp} \quad (2)$$

$$ADG = \frac{Previous\ ABW\ sampling - Current\ ABW\ sampling}{Sampling\ time\ interval} \quad (3)$$

$$FCR = \frac{Amount\ of\ feed\ provided}{Amount\ of\ total\ harvest} \quad (4)$$

RESULTS AND DISCUSSION

Stocking Density

Post-larvae (PL) stocking was carried out in the morning or at night to minimize stress on the shrimp. Prior to stocking, the post-larvae underwent temperature and salinity acclimatization. The PL bags were left floating in the pond and acclimatized for 15-30 minutes to allow for temperature equilibration. Subsequently, the bags were opened, and pond water was gradually introduced to adjust the salinity. Three people entered the pond to perform the bag-opening process. Once all the bags were opened, the PL were released into the pond. Data collection during the study involved three pond plots with varying stocking densities (Table-1).

Feed Management

Feeding is carried out four times daily: at 05.30, 09.30, 13.30, and 17.30 WIB. The use of high-quality feed enables optimal shrimp growth. The types of feed used include powder, crumble, and pellets, with sizes ranging from 0.42 to 2.4 mm. The types of feed used were listed in Table-2.

From day of culture (DOC) 1 to 27, feeding was performed manually using a small boat, while from DOC 28 until harvest, an automatic feeder was utilized. Accurate feed dosage was essential for achieving optimal Feed Conversion Rate (FCR). Dosage was carefully regulated to prevent excess feed accumulation, which could compromise water quality. Feed dosage determination combined with blind feeding and monitoring of shrimp feeding activity using a check tray (anco). Blind feeding involved a predetermined regimen starting at 2 kg per 100,000 shrimp, with a daily increment of 200 g, applied from DOC 1 to 16. Check tray monitoring was implemented from DOC 16 to harvest, with feed in the tray set at 0.5% of the total feed ration.

Average Daily Growth (ADG)

Average Daily Growth (ADG) reflects the mean daily weight gain of shrimp over a defined period and serves as a key indicator of growth rate. ADG calculations began at DOC 20, as shrimp in the initial phase were adapting, highly susceptible to stress, and too small for accurate measurement. From DOC 20 onward, increased molting frequency—often associated with stress—could affect growth. After this period, shrimp exhibited more stable and measurable growth patterns. Therefore, ADG calculations commenced at DOC 20 to ensure data accuracy. The results of ADG measurements are presented in Figure-1.

Pond E5 exhibited a consistent growth pattern throughout the cycle. Starting with an ADG of 0.09 g/day at DOC 20, the growth rate increased steadily, reaching 0.65 g/day at DOC 80. However, towards the end of the cycle, pond E5 experienced slower growth due to mortality from molting failure. Despite the molting issues, the shrimp had already reached the target size. This high and stable ADG indicated that the environmental conditions and feed in pond E5 were highly conducive to efficient daily weight gain through to harvest.

Table-1. Stocking density of each pond

Plot	Pond's area (m^2)	Amount of density (tail)	Stocking density (m^2)
E5	2.463	333.660	135
E7	2.944	403.124	137
E8	2.940	387.186	132

Table-2. Feed sizes and types

No.	Pellet code	Form	Pellet size (mm)	Shrimp weight (g/tail)
1	Nanami 0	*Powder*	< 0,42	PL – 0,61
2	Nanami 1	*Crumble*	0,42 – 0,71	0,61 – 1,44
3	Nanami 2	*Crumble*	0,71 – 0,90	1,44 – 2,34
4	Nanami 3	*Crumble*	0,90 – 1,18	2,34 – 3,35
5	Nanami 3MP	Pellet	1,0 – 2,4	3,35 – 6,21
6	Nanami 3S	Pellet	1,2 - 2.4	6,21 – 10,85
7	Nanami 3M	Pellet	1,5 – 2,4	10,85 – 18,90
8	Nanami 3L	Pellet	1,8 – 3,5	18,90 – 26,63

Table-3. Partial harvest data of Pond E5

Pond E5				
Harvest	DOC	Size	Biomass (kg)	Population
Partial 1	47	102,2	686	70.109
Partial 2	64	52,6	675	35.478
Partial 3	73	42	866	36.393
Partial 4	83	33,4	703	23.480
Total	-	-	2.930	165.460

Pond E7 also demonstrated rapid growth, particularly during the early-to-mid stages of cultivation. Starting with an ADG of 0.13 g/day at DOC 20, the pond achieved a high growth rate of 0.65 g/day by DOC 60. The ADG in pond E7 remained consistent through the end of the cycle (recording 0.36 g/day at DOC 100) demonstrating the shrimp's ability to maintain significant growth despite the extended cultivation period.

Pond E8 showed a very strong and dominant ADG during the early and middle stages of the cycle. Starting at 0.13 g/day at DOC 20, the ADG peaked at 0.65 g/day at DOC 70. This figure indicates that, prior to the IMNV outbreak, the shrimp in pond E8 were growing at an optimal rate. However, because the pond was harvested at DOC 87 due to the IMNV infection, this high growth rate could not be fully sustained through the final phase. The average ADG across the three ponds was 0.54 g/day. The previous result [8] also reported an ADG of 0.14 g/day for shrimp in an intensive farming system.

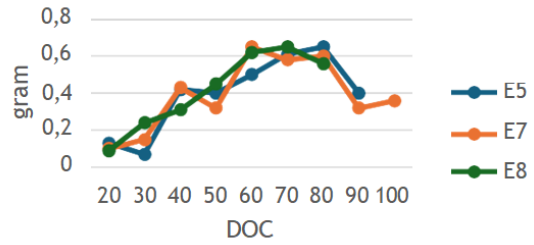

Figure-1. Average Daily Growth (ADG)

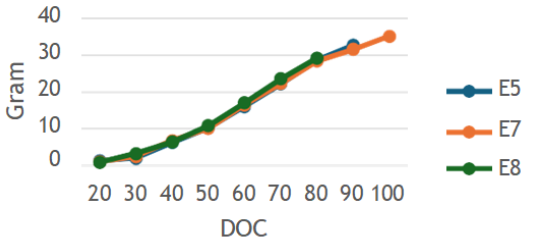

Figure-2. Average Body Weight (ABW)

Average Body Weight (ABW)

ABW refers to the mean weight of shrimp obtained through sampling. Technicians assigned to specific blocks do not have a specific target value for ABW. ABW calculations were performed during each scheduled sampling event, which took place every 10 days. However, if issues arose regarding the shrimp's health, sampling may be conducted at the technician's discretion. Sampling was carried out using the "wet sampling" method, which involved using a net to capture the shrimp and returning them to the pond after weighing and counting. The ABW values for the shrimp were shown in Figure-2.

The ABW results for pond E5 indicated a stable growth throughout the cycle. Starting with an average weight of 1.33 g/individual at DOC 20, the shrimp continued to grow, reaching 32.72 g/individual by DOC 90. This demonstrated that the culture conditions in Pond E5 successfully supported consistent shrimp biomass accumulation for the end of the rearing period. However, this rapid growth occurred alongside a decline in stocking density caused by mortality. Mortality in Pond E5 was attributed to molting failure caused by stress from adverse weather conditions that destabilized water quality.

Pond E7 recorded the highest ABW. Although it started with a slightly lower weight of 1.06 g/individual at DOC 20 compared to Pond E5, the shrimp in Pond E7 exhibited an excellent and consistent growth rate, reaching 35.20 g/individual by DOC 100. This confirmed that Pond E7 successfully created an optimal environment, enabling the shrimp to attain the largest individual size among the three ponds, particularly given the longer culture duration.

Pond E8 demonstrated the potential for very rapid growth early in the cycle, starting with an average weight of 0.93 g/individual at DOC 20. The shrimp in this pond reached an ABW of 28.39 g/individual by DOC 80. Despite the strong initial growth rate, the pond was harvested early at DOC 87, with a final size of 30.21 g/individual—the smallest among the ponds. This indicated that the rapid early growth could not be sustained to achieve a larger final size. Consequently, although the shrimp in Pond E8 grew quickly at the start, an IMNV outbreak caused significant growth retardation during the final culture phase, prompting an early harvest and resulting in a final shrimp size smaller than the initial growth would have suggested.

The ABW values across the three ponds were considered optimal according to [9]; optimal ABW values allow shrimps to thrive with a growth rate of 1-1.5 g/week. The observed ABW values were influenced by optimal feeding practices. This aligned with the findings who noted that *L. vannamei* exhibited weekly weight gains when the feed provided met their protein requirements (18-35%) [7]. Additionally, stocking density influenced growth. This is consistent with the statement by [9] that high population density restricted the space available for movement, access to food, and living area, while also limiting oxygen availability. Consequently, the final average body weight achieved at the end of the rearing period is suboptimal.

The FCR recorded for Pond E5 during the cultured period was 1.26. Despite Pond E5 having the lowest survival rate (SR), the FCR remained favorable. This suggests either that the shrimp that died has consumed little feed or the surviving shrimp exhibited

excellent feed efficiency. In other words, the surviving shrimp converted feed quite efficiently despite the mortality. However, had the mortality occurred among shrimp that had already consumed a significant amount of feed, the FCR would likely have been higher. The optimal FCR in Pond E5 was attributed to a decline in stocking density caused by molting failure, which allowed the remaining shrimp to consume more feed and grow faster.

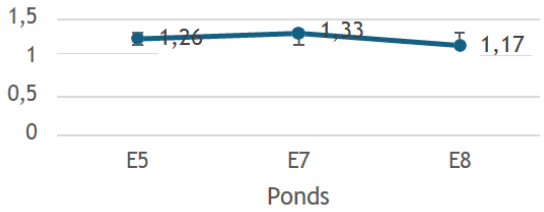

Figure-3. Feed Conversion Rate (FCR)

Conversely, Pond E7—despite achieving the best SR—recorded the highest FCR. Shrimp cultured for longer periods tend to exhibit higher FCRs because the feed required for maintenance increased over time, while the relative growth rate slowed during the final phase.

Pond E8 recorded the lowest FCR among the three ponds. This outcome resulted from early harvesting, implemented to prevent the spread of disease after shrimp began exhibiting illness and mortality. Consequently, the FCR remained low, although the shrimp were smaller. A lower FCR combined with higher weight gain indicates superior shrimp growth [10]. The average FCR across the three ponds was 1.25, which is considered favorable for shrimp farming and aligns with [11], who reported that the typical FCR for *L. vannamei* ranges from 1.4 to 1.8.

Survival Rate (SR)

The survival rate (SR) results showed that Pond E7 achieved the highest and most consistent performance at 93.43%, indicating a stable and safe environment for shrimp survival during the primary growth phase. Pond E5 had a lower SR of 84.7%, suggesting factors contributing to increased mortality, such as stress-induced molting failure due to fluctuating hot, dry weather. Pond E8, which was affected by IMNV, exhibited a high SR of 93.4% due to early harvest following a sudden disease outbreak at DOC 70. As a result, shrimp from Pond E8 were harvested at a smaller size.

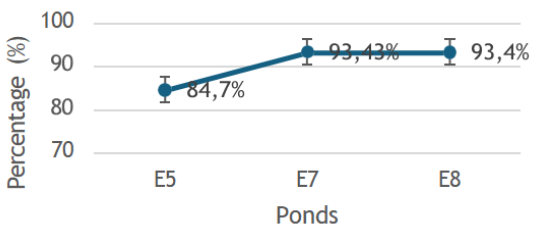

Figure-4. Survival Rate (SR)

Water Quality Monitoring

Temperature

Temperature measurements during the study showed an average range of 29-32°C. The lowest temperature, 28°C, was recorded in the 13th week. Water temperature played a crucial role in the chemical and biological processes occurring within the water. Temperature significantly influenced oxygen consumption, growth, and shrimp survival in aquaculture environments [12]. The temperature values recorded in this study fell within the optimal range for shrimp growth and survival. The ideal temperature range for successful shrimp farming is 20-30°C [13]. Temperatures that were either too high or too low affected shrimp feed consumption. Higher water temperatures increased appetite and the rate of waste excretion, whereas lower temperatures reduced appetite. The temperatures below 26°C or above 33°C influenced shrimp feed consumption [14].

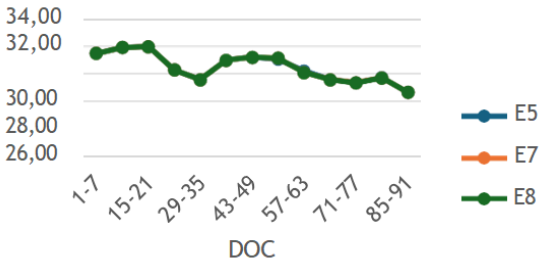

Figure-5. Temperature measurement of shrimp ponds

pH

pH measurements were taken twice daily at 05.30 and 14.30 WIB. The average pH values for the plots ranged from 7.5 to 8.5. The optimal pH range for Vannamei shrimp farming is 7.5-8.5 [15]. However, individual pH measurements occasionally decreased slightly below the lower threshold, reaching 7.4, particularly in Pond E8 on DOC 57-70—due to extreme hot weather and rainfall. The pH measurement graph was presented in Figure-6.

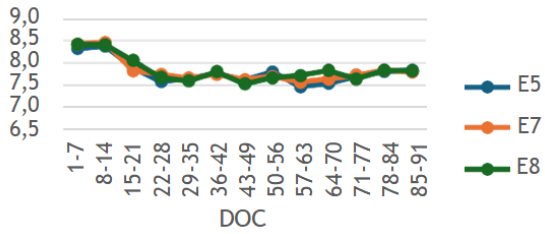

Figure-6. pH measurement of shrimp ponds

Based on the graph in Figure-6, pH values in the morning tended to be lower than those in the afternoon. This decrease was attributed to CO_2 accumulation resulting from nighttime respiration and the decomposition of organic matter. Conversely, during the day, CO_2 levels dropped as plankton utilized the gas for photosynthesis. pH levels tended to be lower in the morning than in the afternoon [16]. This occurred because CO_2 levels from nighttime respiration were high; when this CO_2 reacted with water (H_2O), it released H+ ions, creating acidic conditions and causing the pH to drop—hence the lower

pH readings observed in the morning. Conversely, during the day, CO_2 levels were lower as the gas is utilized by plankton for photosynthesis. This process produced O_2, which interacted with H_2O to release OH- ions, thereby making the water alkaline and causing the pH to rise, resulting in higher pH readings in the afternoon.

Salinity

Pond salinity was measured daily in the morning. Salinity measurements ranged from 25-32 ppt (average 27 ppt) for Plot E5, 23-33 ppt (average 26 ppt) for Plot E7, and 24-33 ppt (Average 27 ppt) for Plot E8. These salinity ranges aligned with the company's Standard Operating Procedure (SOP), which specified an optimal salinity of 15-30 ppt. The optimal salinity range for *L. vannamei* (whiteleg shrimp) farming was 15-25 ppt [15]. A graph of salinity measurements for Plots E5, E7, and E8 is shown in Figure-7.

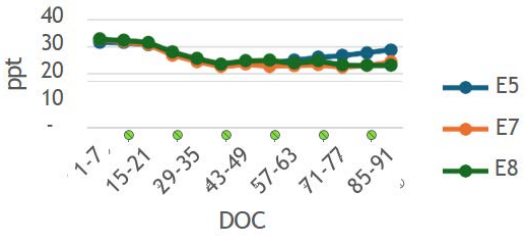

Figure-7. Salinity measurement of shrimp ponds

Figure-7 shows a decrease in salinity during the sixth week. This decline was caused by high rainfall, which reduced the salt concentration within the ponds. The influx of rainwater diluted the salt content in the plots. Salinity levels decrease with rainfall due to the introduction of freshwater into ponds, thereby altering salt concentrations [9]. Excessive feeding can also contribute to reduced salinity, as uneaten feed accumulates on the pond bottom. High salinity levels can also be associated with low dissolved oxygen in the water. A drop in salinity softened the shells of Vannamei shrimp due to mineral deficiency, potentially inhibiting their growth. Salinity levels in plots E5, E7, and E8 fluctuated between low and high values. To address low salinity, seawater can be drawn from a reservoir and pumped through PVC piping into the ponds. This is consistent with the findings that the optimal salinity range for growth is 10–30 ppt [17].

Dissolved Oxygen (DO)

DO measurements were taken weekly. Results during the study showed DO levels in plot E5 ranged from 4.9 to 5.9 mg/L, with an average of 4.9 mg/L. In Plot E7, DO ranged from 3.4 to 5.6 mg/L, with an average of 4.5 mg/L. Meanwhile, DO in Plot E8 ranged from 3.7 to 5.5 mg/L, with an average of 4.5 mg/L. Across all three plots, the lowest DO levels were recorded in the seventh week. The results of the dissolved oxygen (DO) measurements are shown in Figure-8.

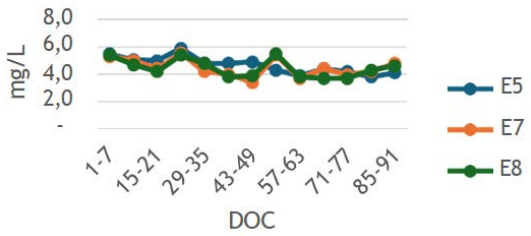

Figure-8. DO measurement of shrimp ponds

The DO value required by SNI 8008:2014 [18] is >4 mg/L. The average dissolved oxygen measurement across the tree plots was 4.9 mg/L. The lowest overall dissolved oxygen measurement was recorded in Pond E7 during the seventh week, at 3.4 mg/L. Ideally, dissolved oxygen levels in the pond should be maintained above 4 mg/L; when levels drop below this threshold, shrimp compete for oxygen, causing feeding to cease and making them more susceptible to stress and disease [19].

Alkalinity

Alkalinity is a crucial water quality parameter in *L. vannamei* farming. It acted as a pH buffer against changes caused by biological activity or the addition of chemicals (such as acids and bases), helping to stabilize daily pH fluctuations that could otherwise affect shrimp health. Additionally, alkalinity provided bicarbonate ions (HCO_3^-) that facilitate the shrimp's shell formation (molting) process. Alkalinity also played a vital role in nitrification—a biological process in which bacteria oxidize ammonia to nitrite and subsequently to nitrate [20].

The alkalinity measurement method involved taking a 50 mL water sample and adding two drops of phenolpthalein (PP) indicator. The sample is observed for a pink color; if a pink color appears, the sample is titrated with 0.2 N sulfuric acid (H_2SO_4) until it returns to its original color. If the sample does not turn pink upon the addition of the PP indicator, methyl orange (MO) indicator is added immediately, and the sample is titrated until it turns light orange. Alkalinity measurement results from DOC 4 to DOC 20 are shown in Figure-9.

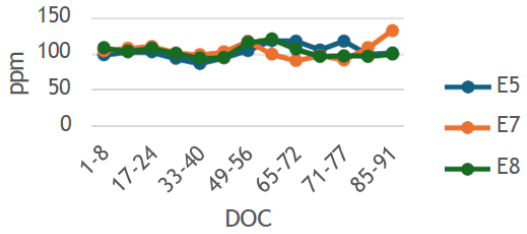

Figure-9. Alkalinity measurement of shrimp ponds

Alkalinity measurements were conducted every four days. Figure-9 showed that alkalinity values ranged from 87-119 ppm (average 102 ppm) for Plot E5, 91-118 ppm (average 103 ppm) for Plot E7, and 94-121 ppm (average 105 ppm) for Plot E8. The optimal alkalinity range for vannamei shrimp farming is 100-150 mg/L [18]. Consequently, values in Plots E5, E7, and E8 fell below the optimal threshold for shrimp grow-out. Low alkalinity indicated potential abnormalities in the shrimp's molting and growth processes. Excessively low alkalinity can lead to molting failure, decreased pH, and

increased nitrite levels in the water, all of which can jeopardize shrimp survival [21]. Remedial measures included applying quicklime from the reservoir, increasing mineral dosage in the ponds, and adding 2-4 cm of fresh water daily [22].

***Nitrite* (NO_2)**

NO_2 is a breakdown product of the nitrification process—specifically the conversion of ammonia (NH_3) to nitrate (NO_3)—and is toxic to shrimp. Nitrite levels were measured using a test kit. The measurement procedure involved taking a 5 mL water sample and adding the NO_2 test kit reagents to the sample. Afterwards, homogenize the mixture, waited for 5 minutes, and determine the nitrate value by matching the color against the provided reference chart. The nitrite measurement results are shown in Figure-10.

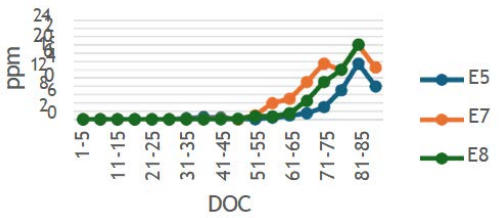

Figure-10. Nitrite measurement of shrimp ponds

Nitrite measurements were conducted every five days. The results indicated that nitrite concentrations in the plot were well-controled. However, a spike in nitrite levels to 0.3 ppm occurred in Plot E5 on day 31. The optimal nitrite level, in accordance with SNI 8008:2014 was <1 mg/L. The rose in nitrite on day 36 was a consequence of increased ammonium levels during the preceeding week and indicated that the second phase of the nitrification process was either suboptimal or disrupted, leading to nitrite accumulation in the water. The safe threshold for nitrite in aquatic environments was no more than 1 mg/L [21]. Although the overall nitrite level of 0.05 ppm remained low, this temporary spike highlights the need for vigilance and prompted corrective action. Measures taken included increasing dissolved oxygen levels via aerators, reducing feed, added probiotics, or performed water exchanges to prevent adverse effects on the shrimp.

***Ammonium* (NH_4)**

Ammonium (NH_4) is formed from the breakdown of proteins, leftover feed, and shrimp metabolic byproducts in pond water. At high pH levels, ammonium can dissociate into ammonia (NH_3), which is toxic to shrimp. Ammonium levels are measured using a test kit. The measurement procedure involves pouring 5 ml of the water sample into a clean tube, adding 3 drops of Reagent 1, and mixing thoroughly. Then, add 3 drops of Reagent 2 and mix thoroughly. Finally, add 3 drops of Reagent 3, mix thoroughly, compare the sample color with the color chart, and record the result.

Ammonium measurements are conducted every five days. Ammonium levels in plot E5 ranged from 0.3 to 1.5 ppm (average 0.7 ppm); in plot E7, they ranged from 0.3 to 1.5 ppm (average 0.7 ppm); and in plot E8, they ranged from 0.3 to 1.5 ppm (average 0.6 ppm). While ammonium is relatively harmless at low pH levels, it can convert into ammonia—which is highly toxic to shrimp—at high pH levels. Average values differed across plots due to variations in the timing of ammonium increases. The overall average value for the three plots was 0.7 ppm. The ammonium (NH_4) content in water tolerated by cultured organisms (including phytoplankton) falls within the range of 0–1.04 mg/L [23]. The graph above shows a simultaneous increase in ammonium levels at DOC 36. This is attributed to the accumulation of organic matter from uneaten feed and feces, combined with insufficient activity by decomposing bacteria. Management measures include siphoning and water circulation.

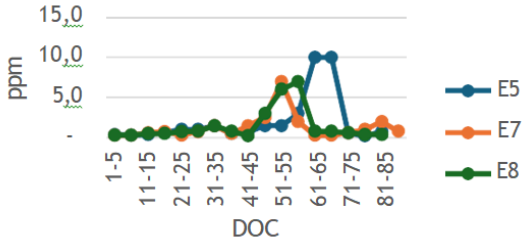

Figure-11. Ammonium measurement of shrimp ponds

Partial Harvest

Harvesting is conducted in both partial and total stages. Partial harvesting is performed to reduce the load on the culture medium and accelerate growth [24]. It involves removing a portion of the shrimp using a net without reducing the water volume. Harvesting takes place in the morning, as lower water temperatures help minimize stress on the shrimp. This process is carried out at specific Days of Culture (DOC) stages, as the shrimp's increasing size leads to higher density, resulting in competition for oxygen, feed, and space [25]. Data regarding partial harvesting are presented in the Tables 3–6.

The primary objective of the vannamei shrimp harvest was to optimize production and manage disease risks in the ponds. Pond E5 was harvested at 95 DOC with a total biomass of 3.827 kg, yielding 204.737 shrimps at an average size of 30.3 shrimps/kg. This pond utilized a cumulative feed amount of 8.494 kg. Meanwhile, Pond E7 had the longest culture duration—harvested at DOC 108—yet achieved the highest biomass at 5.380 kg and a harvest count of 124.280 shrimps. It also produced the largest shrimps, averaging 26 shrimps/kg. Feed consumption for Pond E7 totaled 12.239 kg. Conversely, Pond E8 exhibited the five days. Ammonium levels in plot E5 ranged from 0.3 to fastest culture cycle, being harvested at DOC 87. This pond produced a harvest biomass of 4.865 kg and yielded the highest number of shrimp (161.031), although the individual shrimp size was the smallest of the three groups at 33.1 shrimps/kg. Pond E8 used a cumulative feed amount of 9.546 kg.

Pests

Pests identified at the farm included crabs, shellfish, and birds. Lizards were occasionally observed, primarily in the wastewater treatment facility (IPAL). Biosecurity measures to prevent pest intrusion included installing bamboo fencing around pond perimeters and placing netting over water inlet pipes and sedimentation ponds.

Table-4. Partial harvest data of Pond E7

Pond E7				
Harvest	DOC	Size	Biomass (kg)	Population
Partial 1	47	110	868	95.480
Partial 2	64	54,3	1.411	76.617
Partial 3	73	44	935	41.140
Partial 4	85	35,3	633	22.344
Partial 5	98	29	575	16.675
Total	-	-	4.422	252.256

Table-5. Partial harvest data of Pond E8

Pond E8				
Harvest	DOC	Size	Biomass (kg)	Population
Partial 1	47	104	909,5	94.588
Partial 2	64	50,4	1.352	68.140
Partial 3	73	41	1.028,5	42.168
Total	-	-	3.290	204.896

Table-6. Total harvest data

No.	Plot	DOC	Size (tail/kg)	Total harvest biomass (kg)	Total harvest population (tail)	Cummulative feed (kg)	SR (%)	FCR
1.	E5	95	30,3	3.827	115.958	8.494	84,3	1,26
2.	E7	108	26,0	5.380	124.280	12.239	93,4	1,33
3.	E8	87	33,1	4.865	161.031	9.546	93,4	1,17

Disesases

The primary disease affecting shrimp during the culture period at the farm was Infectious Myonecrosis Virus (IMNV). In Pond E8, shrimp were infected by IMNV, which targets the muscles and hepatopancreas of vannamei shrimp. Infection was associated with extreme weather fluctuations, particularly alternating hot and rainy conditions that induce stress, which can be exacerbated by partial harvesting. Management strategies included siphoning, removal of dead shrimp, and mineral supplementation. If a significant number of shrimps appeared unhealthy, the entire pond was harvested.

CONCLUSIONS

The growth performance of vannamei shrimp in Ponds E5, E7, and E8 was reflected by average ADG values of 0.39 g/day for E5 and E7, and 0.41 g/day for E8. The ABW values were 32.72, 35.20, and 30.21 g/shrimp for E5, E7, and E8, respectively. FCR values were 1.26, 1.33, and 1.17 for E5, E7, and E8. These results indicate significant growth and successful cultivation. Survival rates were 84.7% for E5, 93.43% for E7, and 93.4% for E8. Water quality parameters measured during the rearing period included temperature, pH, salinity, dissolved oxygen (DO), alkalinity, ammonium, and nitrite. Water temperature remained within the optimal range for shrimp grow-out (29–32°C). The average pH during the grow-out period ranged from 7.5 to 8.5, and salinity ranged from 23 to 33 ppt. DO levels ranged from 3.4 to 5.9 mg/L. Average alkalinity ranged from 87 to 121 ppm, with average ammonium and nitrite levels at 0.25 ppm and 0.05 ppm, respectively. These water quality parameters are considered suitable for the grow-out of *L. vannamei*.

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