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# GROWTH ANALYSIS OF VANNAMEI SHRIMP (*Litopenaeus vannamei*) CULTIVATED INTENSIVELY IN HDPE AND CONCRETE ROUND POND AT BPBAP UJUNG BATEE

Analisis Pertumbuhan Udang Vaname (*Litopenaeus vannamei*) yang Dibudidayakan Secara Intensif Pada Media Kolam Bundar HDPE dan Beton di BPBAP Ujung Batee

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**ABSTRACK**

Intensive cultivation of whiteleg shrimp (*Litopenaeus vannamei*) is now being developed in the aquaculture industry in Indonesia. Efforts to increase the success of whiteleg shrimp cultivation continue made by business actors including BPBAP Ujung Batee. This study aims to analyze the growth rate of whiteleg shrimp intensively cultivated in HDPE and concrete round pond media at BPBAP Ujung Batee. The results of this study can be used as information and references regarding the selection of the right container for intensive whiteleg shrimp cultivation. The study was conducted from June to August 2024. The method in this study was a survey method, where data collection was carried out through direct observation in the field. The parameters observed in this study were Mean Body Weight (MBW), Average Daily Growth (ADG), biomass, survival rate (SR), and feed conversion ratio (FCR). In addition, measurements of water quality parameters were also carried out in the form of temperature, pH, Dissolved Oxygen (DO), salinity, ammonia, alkalinity, nitrite, nitrate, and phosphate. The results of the study showed that the MBW, ADG, Biomass, and SR values of vaname shrimp cultivated in concrete pond media were higher than those in HDPE ponds. The results also showed that the FCR value in concrete ponds (1.4) was lower than the FCR in HDPE ponds (1.5). This means that the FCR of concrete ponds is better than the FCR of HDPE ponds. Water quality parameters showed different results between HDPE ponds and concrete ponds. In HDPE ponds, the water quality parameters that were in the optimal range were pH, DO, and phosphate, while in concrete ponds they were temperature, DO, and phosphate.

**Keyword:** concrete pond, HDPE pond, round pond, shrimp growth

**ABSTRAK**

Budidaya udang vaname (*Litopenaeus vannamei*) secara intensif kini terus dikembangkan dalam industri akuakultur di Indonesia. Upaya untuk meningkatkan keberhasilan budidaya udang vaname terus diusahakan oleh pelaku usaha termasuk BPBAP Ujung Batee. Penelitian ini bertujuan untuk menganalisis tingkat pertumbuhan udang vaname yang dibudidayakan secara intensif pada media kolam bundar HDPE dan beton di BPBAP Ujung Batee. Hasil penelitian ini dapat membantu pembudidaya dalam memilih wadah yang tepat untuk budidaya udang vaname secara intensif. Penelitian dilaksanakan dari bulan Juni hingga Agustus 2024. Metode pada penelitian ini adalah metode survei, dimana pengumpulan data dilakukan melalui observasi langsung di lapangan. Parameter yang diamati pada penelitian ini adalah *Mean Body Weight* (MBW), *Avarage Daily Growth* (ADG), biomassa, tingkat kelangsungan hidup (SR), dan rasio konversi pakan (FCR). Selain itu juga dilakukan pengukuran parameter kualitas air berupa suhu, pH, *Dissolved Oxygen* (DO), salinitas, amonia, alkalinitas, nitrit, nitrat, dan fosfat. Hasil penelitian menunjukkan nilai MBW, ADG, Biomassa, dan SR dari udang vaname yang dibudidayakan pada media kolam beton lebih tinggi dari pada kolam HDPE. Hasil penelitian juga menunjukkan bahwa nilai FCR pada kolam beton (1,4) lebih rendah dari pada FCR kolam HDPE (1,5). Hal ini berarti FCR kolam beton lebih baik dibandingkan FCR kolam HDPE. Parameter kualitas air menunjukkan hasil yang berbeda antara kolam HDPE dan kolam beton. Pada kolam HDPE, parameter kualitas air yang berada pada kisaran optimal yaitu pH, DO, dan fosfat, sedangkan pada kolam beton yaitu suhu, DO, dan Fosfat.

**Kata Kunci:** kolam bundar, kolam HDPE, kolam semen, pertumbuhan udang.

## INTRODUCTION

Fishery cultivation activities are increasingly developing, one of which is the cultivation of whiteleg shrimp (*Litopenaeus vannamei*). Data from FAO (2020) shows that the total world production of whiteleg shrimp reached almost five million tons in 2018 and production is expected to continue to increase. Indonesia itself is one of the countries in Southeast Asia with the largest total production of cultivated whiteleg shrimp in the world (Anderson *et al*., 2017). NOAA Fisheries (2022) even noted Indonesia as the second largest country exporting whiteleg shrimp to the American market. According to Mangampa and Suwono (2016), the increase in production for this commodity is due to whiteleg shrimp having competitive prices and the production system can be carried out intensively or super intensively with high stocking densities.

Vannamei shrimp cultivation offers various advantages, including high appetite, good resistance to disease attacks, high survival rate, can be cultivated at high density, and a fairly short maintenance time, which is around 90 to 100 days per cycle (Purnamasari *et al*., 2017). In addition to the advantages, there are also problems faced in intensive and super-intensive vannamei shrimp cultivation activities, namely the presence of disease-causing pathogens and environmental management which are the biggest factors in failure in the enlargement cycle (Andreson *et al*., 2017). In addition, waste produced from intensive vannamei shrimp cultivation activities will also have an impact on decreasing water quality (Portley, 2016) and will cause disease transmission to the commodity itself (FAO, 2000).

The problems faced in the cultivation of vaname shrimp must be overcome by implementing appropriate and sustainable technology. One step that can be taken to prevent disease attacks on vaname shrimp is to use a round pond as a cultivation medium. Oca and Masalo (2013) stated that round ponds create a more stable flow pattern, even distribution of dissolved oxygen and metabolites and are effective in self-cleaning. In addition, round ponds

with a drain in the middle are naturally able to remove solids better, where small circulation tends to collect solids in the middle (Malone, 2013).

The types of construction commonly used for vaname shrimp cultivation in Indonesia are soil, concrete, and High Density Polyethylene (HDPE). This type of construction will affect the production results of vaname shrimp cultivation because there is an interaction between the cultivated organisms and water, which will affect water quality and shrimp growth (Rizky *et al*., 2022). The Ujung Batee Brackish Water Aquaculture Center (BPBAPUB) is a government institution under the auspices of the Ministry of Maritime Affairs and Fisheries, which is responsible for implementing cultivation techniques in brackish waters, including seeding activities, fish maintenance, and efforts to preserve fishery resources and the environment in the Aceh Province. The circular pond media for enlarging vaname shrimp used at BPBAP Ujung Batee is a circular HDPE pond and concrete.

Therefore, this study aims to analyze the growth rate of vaname shrimp intensively cultivated in HDPE and concrete round pond media at BPBAP Ujung Batee. The findings in this study can serve as a source of information and reference in determining the most appropriate type of container for intensive vaname shrimp cultivation.

## RESEARCH METHODS

### Time and place

The research was conducted from June to August 2024 at the Ujung Batee Brackish Water Aquaculture Center (BPBAPUB), Aceh Besar Regency, Aceh Province.

### Tools and materials

The materials used in this study were F1 vaname shrimp larvae stage PL 9, *Gold Coin* brand pellet feed with 36% protein and probiotics. The tools used were a circular pool media made of concrete and *High Density Polyethylene* (HDPE) measuring 80 m3, a water wheel, *aerotube*, digital scales, nets, pH meters, DO meters, refractometers and anco.

### Research methods and data collection

The method in this study is a survey method. Data collection is carried out through direct observation in the field.

### Research procedures

*Preparation of research container*

The containers used are concrete pool containers with a circular pool area of 80 m2 and a *High Density Polyethylene* (HDPE) tarpaulin pool measuring 80 m2. Container preparation activities consist of drying, cleaning the inside of the pool, filling with water, and growing plankton until the pool is ready for spreading the fry.

*Preparation of shrimp fry*

The shrimp fry used are vanemei shrimp (*Litopanaeus vannamei*) with PL 9 stage. The number of fry released is 27,500 for each container. The fry are F1 fry that have been equipped with SPF (*Specific Pathogen Free*) certificate.

*Acclimatization of shrimp larvae*

The fry are acclimatized first so that the fry can adapt to their environment. The fry are spread in the morning at 07.30 WIB, when the temperature is still cool.

*Feeding*

Frekuensi The frequency of feeding is done 4 times a day, namely at 08.00, 11.00, 17.00, and 21.00 WIB. The feeding method is adjusted to the size of the shrimp. Feeding on DOC 1 to 30, the feeding method applied uses blind feeding. While on DOC 30 until harvest, the feeding method is based on the sampling target *Average daily growth* (ADG).

*Maintenance management*

Shrimp maintenance is carried out for 90 days. Siphoning is carried out every 2 days at 09.00 WIB. Water changes of 5-10% are carried out every time siphoning is carried out to maintain the sterility of the maintenance water. Probiotics in the pond can be applied according to the standards used and the dose can be adjusted according to the condition of the bacterial population and the development of shrimp weight.

*Shrimp sampling*

Pengambilan Sampling was carried out using anco when the shrimp entered the age of 30 days after spreading (DOC 30). Furthermore, sampling was carried out periodically every 10 days with the same method. The sample consisted of 10 to 30 shrimp, which were then weighed to evaluate shrimp growth.

**Observation parameters**

*Shrimp growth rate*

*Mean Body Weight* (MBW) is the average weight of shrimp from sampling results, using the Haliman and Adiwijaya (2005) formula as follows:

$$\mathrm{MBW} = \frac{\mathrm{ABW}}{\mathrm{MBW}}$$

Information:

MBW = *Mean Body Weight*
ABW = Total weight of sample (g)
MBW = Number of samples (tails)

*Avarage daily growth* (ADG) is the daily weight growth rate of shrimp within a certain period of time using the Haliman and Adiwijaya (2005) formula as follows:

$$\mathrm{ADG} = \frac{\mathrm{Wt} - \mathrm{Wo}}{\mathrm{t}}$$

Information:

ADG = *Avarage daily growth*
Wt = MBW previous sampling
Wo = Current MBW sampling
t = Sampling time interval

*Survival rate (SR)*

*Survival rate* (SR) s the level of shrimp survival compared to the number of stockings and is expressed as a percentage using the Haliman and Adiwijaya (2005) formula as follows:

$$SR = \frac{Nt}{No} \times 100\%$$

Information:
SR = *Survival Rate* (%)
Nt = Number of shrimp at the end of the study (tail)
No = Number of shrimp at the beginning of the study (tail)

*Shrimp biomass at the end of maintenance*

Biomass is the total weight of shrimp in the pond. It can be calculated using the Haliman and Adiwijaya (2005) formula as follows:

$$Biomass = \frac{N \times W}{1.000}$$

Information:
Biomass = Total weight of shrimp in the pond (Kg)
N = Harvest population (tail)
W = Average weight of shrimp (g)

*Feed Conversion Ratio (FCR)*

*Food Convertion Ratio* (FCR) is defined as the comparison between the weight of feed eaten and the increase in shrimp weight that occurs. The FCR value can be calculated based on the Zonneveld et al. (1991) equation as follows:

$$FCR = \frac{F}{W}$$

Information:
FCR = *Feed Convertion Ratio*
F = Amount of feed given (kg)
W = Total harvest amount (kg)

*Water quality parameters*

Water quality parameters observed during the study included pH, temperature, salinity, dissolved oxygen (DO), ammonia, nitrite, nitrate, alkalinity and phosphate. Measurement of water quality parameters in the form of pH, temperature, salinity, and dissolved oxygen (DO) was carried out every two days. While water quality parameters in the form of ammonia, alkalinity, nitrite, nitrate, and phosphate measurements were carried out once a week.

**Data analysis**

The resulting data is processed using excel and tabulated in the form of a table. Furthermore, the data is presented in the form of graphs and tables and analyzed descriptively.

## RESULTS

**Growth Rate**

The growth rate is calculated to see the condition of the shrimp during maintenance. The growth rate of shrimp during cultivation can be observed from the results of the calculation of the average shrimp weight (MBW) and the daily shrimp weight growth (ADG). The growth

rate of vaname shrimp cultivated in HDPE and concrete round ponds is presented in Figure 1 (MBW) and Figure 2 (ADG). The average shrimp weight (MBW) (Figure 1) in HDPE and concrete round ponds continued to increase during the cultivation period from the beginning of maintenance to harvest with maintenance for 90 *Day of Culture* (DOC). The results of observations showed that the daily shrimp weight growth rate (ADG) (Figure 2) in HDPE round ponds fluctuated from DOC 30 to DOC 60, but after DOC 60 the value continued to decrease until DOC 80 then increased again until harvest time (DOC 90). Meanwhile, the daily shrimp weight growth rate (ADG) in concrete round ponds during the maintenance period also fluctuated in DOC 30 to DOC 70, where DOC 70 was the highest daily shrimp weight growth. Furthermore, after DOC 70 to DOC 90, the daily shrimp weight growth rate continued to decline

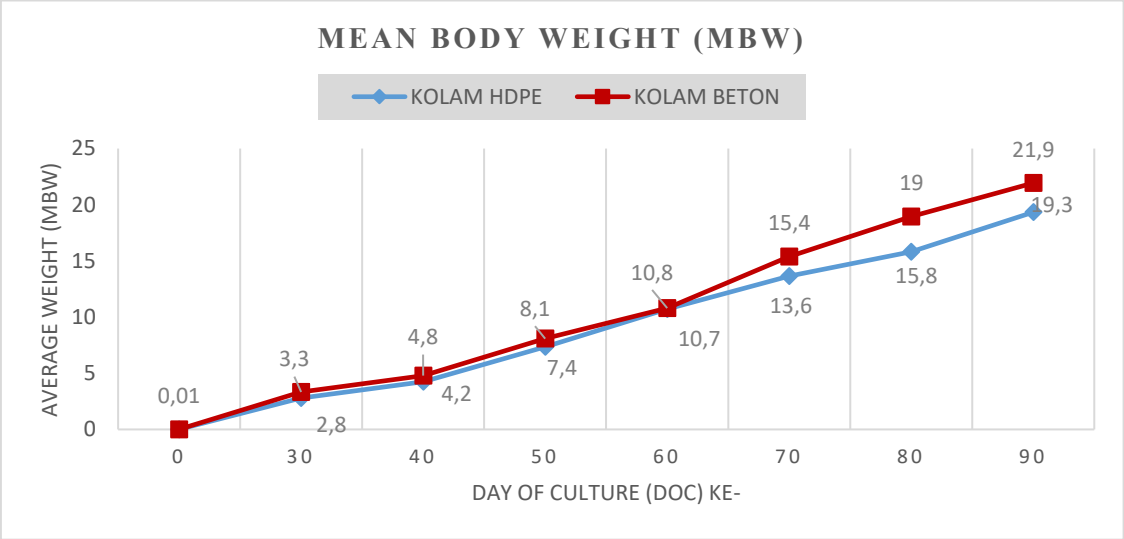


Figure 1. Average body weight of vaname shrimp per DOC

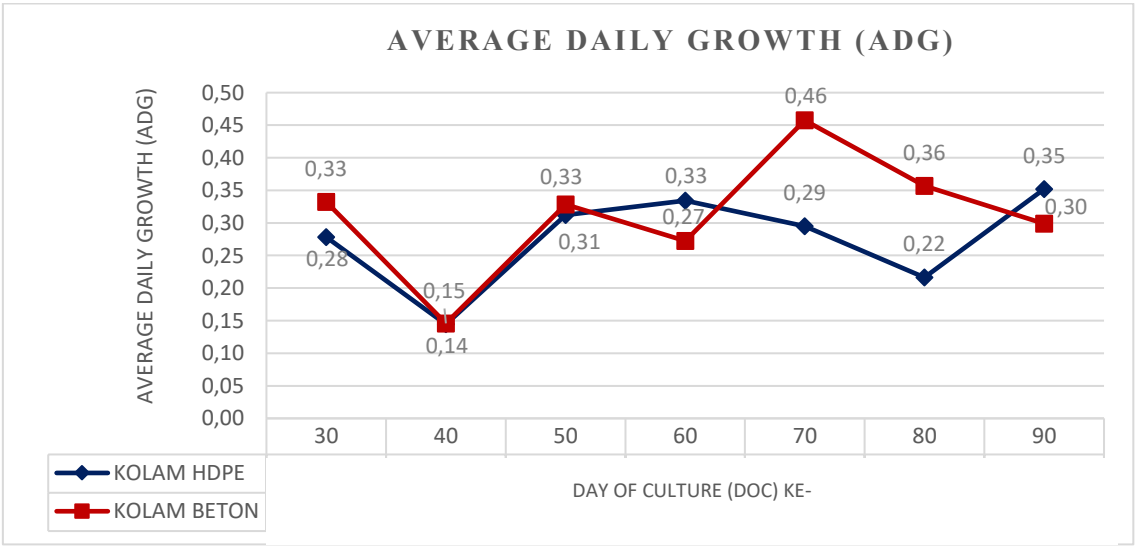


Figure 2. Average daily growth of vaname shrimp

**Biomass, Survival Rate, and Feed Conversion Ratio of Vaname Shrimp**

The results of the study (Table 1) showed that the biomass value, survival rate (SR) and feed conversion ratio (FCR) of vaname shrimp cultivated in HDPE and concrete round ponds were also different. Where vaname shrimp cultivated in concrete ponds had higher biomass value and survival rate, and lower feed conversion ratio compared to HDPE ponds.

Table 1. Biomass, SR, and FCR values at the end of the cultivation period

| Kolam | Biomassa (kg) | SR (%) | FCR |
|---|---|---|---|
| HDPE | 424,88 | 80,05 | 1,5 |
| BETON | 485,74 | 80,65 | 1,4 |

**Water Quality Parameters**

Table 2. Average water quality parameter values during the study

| Water Quality Parameters | Kolam | | Kisaran Optimal* |
|---|---|---|---|
| | HDPE | Beton | |
| pH | 7,5 | 7,2 | 7,5 – 8,5 |
| Suhu (°C) | 27,6 | 29,8 | 28 - 30 |
| Salinitas (ppt) | 33 | 33 | 26 – 32 |
| DO (mg/L) | 5,14 | 4,60 | >4 |
| Amonia (mg/L) | 0,29 | 0,15 | ≤ 0.1 |
| Alkalinitas (mg/L) | 163 | 163 | 100-150 |
| Nitrit (mg/L) | 1,075 | 1,197 | ≤ 1 |
| Nitrat (mg/L) | 5,36 | 5,2 | 0,5 |
| Fosfat (mg/L) | 0,6 | 0,3 | 0,1-5 |

*Sumber: SNI (2016) for Intensive Vaname Shrimp Enlargement

Water quality parameters during the vaname shrimp maintenance period showed different results between HDPE ponds and concrete ponds. Based on the research results presented in Table 2, the average water quality parameter values that are in the optimal range for intensive vaname shrimp rearing in HDPE ponds based on SNI (2016) are pH, DO, and phosphate. While in concrete ponds, they are temperature, DO, and phosphate.

## DISCUSSION

The average weight of shrimp in both ponds, namely HDPE and concrete, increased during the 90-day cultivation period. The body weight of well-growing vaname shrimp will generally increase by 1-1.5 grams per week (Supono, 2006). Based on the results of observations during the study, the body weight of vaname shrimp cultivated in both types of ponds increased by more than 1.5 grams per 10 DOC. This shows that vaname shrimp grow optimally during the rearing period. According to Wafi *et al*. (2021), shrimp growth will be optimal if during the maintenance period the quality of the pond water and the nutrients from the feed provided are maintained and met properly.

The average daily shrimp weight growth rate fluctuated during the maintenance period. Although the fluctuation pattern is different between shrimp reared in HDPE ponds and

concrete ponds. In HDPE ponds, the average daily weight growth rate fluctuated up to DOC 60 and then continued to decrease up to DOC 90. Meanwhile, for concrete ponds, the average daily weight growth rate continued to fluctuate up to DOC 90. This is thought to be due to differences in daily water quality values from the two pond media. Halim *et al*. (2021) stated that the average daily growth rate of whiteleg shrimp will fluctuate along with fluctuations in daily water quality parameter values, so periodic water quality control is needed. Fluctuations in water quality parameter values in the two cultivation media are different due to differences in heat absorption and conduction capabilities which will affect several water quality parameters such as temperature, dissolved oxygen and ammonia levels in each pond (Effendi, 2007). Furthermore, according to Febriani *et al*. (2018), the growth rate of shrimp is influenced by internal factors including genetics and physiology, while external factors include diet, water quality and density. According to Martini (2017), good water quality parameters will affect the performance of the growth rate of vaname shrimp.

Biomass, SR and FCR of vaname shrimp cultivated in concrete ponds have better values compared to vaname shrimp in HDPE ponds. This is thought to occur because in concrete ponds the average temperature value is in the optimal range according to SNI (2016). While the average temperature in HDPE ponds is less than the optimal range. Effendi (2007) stated that concrete ponds are quite good conductors and absorbers of heat and are able to retain heat so that they can keep the pond water warm after sunset. He also stated that temperatures that remain warm and optimal are one of the most important factors in influencing metabolism, growth, oxygen consumption, moulting cycles, immune responses and survival.

Akmal *et al*. (2022) stated that low pond temperature conditions will result in decreased shrimp appetite due to the slowing down of the shrimp's metabolism rate. Water temperature is one of the factors that will affect chemical reactions in water and biochemical reactions in the body of whiteleg shrimp. According to Nurhasanah *et al*. (2021), temperature will affect the high and low FCR values. Therefore, maintaining the water temperature during the maintenance period of whiteleg shrimp so that it remains in the optimal range is very important. The FCR value of shrimp is 1.5 in HDPE ponds and 1.4 in concrete ponds. Bahri *et al*. (2020) stated that the FCR value that is still in the effective category for whiteleg shrimp is in the range of 1.1-1.5, the lower the FCR value obtained, the better.

Nilai The average ammonia value in both ponds was not in the optimal range according to SNI (2016), which is ≤ 0.1 mg/L. However, the ammonia value in the HDPE pond (0.29 mg/L) was higher than in the concrete pond (0.15 mg/L). Higher ammonia levels will reduce the blood's affinity for binding oxygen (Farabi and Latuconsina, 2023). Ammonia comes from accumulated feed residue and shrimp feces accumulated in the water (Suhendar *et al*., 2022). High ammonia levels in vaname shrimp cultivation are toxic, which will irritate the shrimp in the gills so that the process of absorbing dissolved oxygen will also be disrupted (Yunarty *et al*., 2022). In this condition, the shrimp's appetite will also decrease, resulting in slowing down the increase in shrimp body weight so that the biomass value of vaname shrimp at the end of the maintenance period is lower in HDPE ponds compared to concrete ponds (Akmal *et al*., 2022).

The survival rate of whiteleg shrimp in concrete ponds is higher than in HDPE ponds, namely 80.65 (concrete ponds) and 80.05 (HDPE ponds). The results of research by Rakhfid *et al*. (2017) showed that the survival rate was influenced by competition between individuals for space and food. According to Febriani *et al*. (2018), growth is influenced by internal factors including genetics and physiology and external factors including diet, water quality and density. Shrimp survival is greatly influenced by proper feeding management and optimal water quality management in the maintenance media (Yustianti *et al*., 2013). The survival rate of whiteleg shrimp is categorized as good if the SR value reaches >70%, for the medium

category it reaches 50-60%, and the low category is <50% (Bahri et al., 2020). So based on the results of the study, the SR value of whiteleg shrimp kept in concrete and HDPE ponds is included in the good category, namely the value is >80%.

## CONCLUSION

The growth rate of vaname shrimp intensively cultivated at BPBAP Ujung Batee in concrete round pond media is higher than in HDPE round pond media. The MBW, ADG, Biomass, and SR values in concrete pond media are higher than in HDPE ponds. In addition, the FCR value in concrete ponds is also better than in HDPE ponds.

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