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The Effect of Using an Autofeeder on Vannamei Shrimp (*Litopenaeus vannamei*) Growth in Intensive Ponds at Cv. Cemara Sewu Sumber Rejeki, Cilacap

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Abstract

The use of automatic feeding equipment can increase the productivity of vannamei shrimp cultivation and harvest yields. This research aimed to determine which of the three feeding methods (manual, 120° autofeeder, and 360° autofeeder) produces greater growth and production results for vannamei shrimp. The shrimp used came from Sura Tani Pemuka which were stocked from 23-25 July 2022 at PL (post larval) age 11. When using a 360° autofeeder with a total area of 5,880 m^2 and a density of around 169 individuals/m^2. When using a 120° autofeeder with a total area of 2,840 m^2 and a density of around 166 fish/m2. The manual method is used with a total area of 2,500 m^2 and a density of around 187 individuals/m^2. The research method was carried out by means of descriptive observation and analysis. Data collection was carried out during shrimp sampling activities, checking water quality, and harvesting. The research results showed that the use of a 360° autofeeder, 120° autofeeder, and manual resulted in sequential growth performance including: survival rates of 39.37%, 51.47%, and 32.47%; average weight growth of 21.53 gr/head, 17.47 gr/head, and 10.12 gr/head; daily weight growth of 0.31 gr/day, 0.25 gr/day and 0.16 gr/day; and, feed conversion ratios were 1.84, 1.73 and 2.23. The harvest results achieved using the 360° autofeeder, 120° autofeeder, and manual method reached 4558.32 kg, 3670.18 kg, and 1294.965 kg, respectively.

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Introduction

The cultivation of vannamei shrimp (*Litopenaeus vannamei*) is one of the leading fisheries commodities which has great potential and has great prospects in increasing the country's foreign exchange through exports (Pantjara *et al.*, 2015). The production of vannamei shrimp in Indonesia accounts for 77% of all Asian production (Dahlan *et al.*, 2017). The advantages of vannamei shrimp are high productivity, high survival rate, ability to be cultivated in all types of water ponds from bottom to surface, ability to be cultivated at high stocking densities, ability to tolerate environmental changes, ability to withstand disease attacks, and relatively high growth faster. The advantages of vannamei shrimp make it easy for cultivators to maintain and care for them (Mustofa, 2020).

The intensive pond is a type of shrimp pond with complex design and layout calculations and a high shrimp stocking density of 100-300 individuals per m2. In intensive ponds, ponds with HDPE (high-density polyethylene) plastic need, water pumps, water wheels, aerators, high stocking rates, and 100% pellet feed (Nababan *et al.*, 2015). The activities in intensive ponds begin with the drying stage, then the cleaning of the bottom, the elimination of pests, the application of fertilizer, the altering of the water, the spreading of the fry, their care, and ultimately their harvest (Rusmiyati, 2010). Characteristics of intensive shrimp ponds, such as pond area ranging from 0.2-0.5 ha/plot. The pond plot is made entirely of concrete or the walls are made of concrete while the bottom of the pond still uses an earthen base. Pond plots are made of concrete or soil covered with HDPE (high-density polyethylene) plastic. The pond plot is square and equipped with a drainage channel in the middle. There is a mixing pond to mix fresh water and seawater before being put into the pond. There is a sewage pipe carried by the wind and rainwater in the corner which is installed permanently. Using an aeration system to add dissolved oxygen (DO) supply. The frequency of water changes is more often done using a pump (Amri & Kanna, 2008).

Feeding plays an important role in vannamei shrimp survival and growth and therefore influences the harvest. Feeding that is managed regularly, scheduled and on time will produce satisfactory harvest results (Kurniawan *et al.*, 2016). The factor of good feeding is that it is done regularly and according to needs. Feeding management using automatic feeders is an important technology in increasing the productivity of vannamei shrimp cultivation. Less feed waste is thrown into the waters using automatic feeding equipment compared to the manual method (spreading feed around the pond), so the use of shrimp feed is more efficient (Yi *et al.*, 2018). The use of an automatic feeder machine helps in providing shrimp feed to maintain water quality. By providing regular feeding, the maintenance period for vannamei shrimp is more efficient. Automated feeder machines have technology that allows for monitoring, allowing them to adjust feeding to meet environmental conditions. Spreading food around the pond (manually) does not require large costs compared to using an automatic feeder machine. Manual feeding can be controlled better, compared to using an automatic feeder machine. So, a lot of farmer involvement is needed in monitoring and controlling feeding (Alviani *et al.*, 2020b).

Automatic feeding equipment distributes feed and regulates feeding frequency. Another function of automatic feeding equipment is to reduce the effort and time of cultivators in feeding (Prijatna *et al.*, 2018). Automatic feeding equipment is a technology that makes it easier for pond farmers to feed shrimp efficiently, on time, and in a measured manner. Automatic feeding equipment requires electric power, this is because there is a driving motor whose job is to throw the feed and a microcontroller whose job is to set the time according to the RTC (real-time clock) in dispensing the feed (Kordi, 2010). There are many types of automatic feeding equipment, ranging from home scale for aquarium containers to company scale for ponds or ponds. In automatic feeding equipment, human labor is still required for filling feed, setting the feed schedule, and dispensing frequency. Meanwhile, feeding times can be done just using a mobile phone application or settings from the control panel. The types of materials generally used in making auto feeder equipment are stainless steel and PVC plastic (Alviani *et al.*, 2020a).

Materials and methods

Time and Location

This research conducted from September 14th to January 10th 2023 at CV. Cemara Sewu Sumber Rejeki, Block A, Jetis Village, Nusawungu District, Cilacap Regency, Central Java Province.

Research Methods

The methods used in this study were observation and active participation. Data collection was conducted during shrimp sampling, water quality checking, and harvesting activities. Then, the data obtained will be analyzed descriptively. Pond preparation procedures during enlargement in CV. Cemara Sewu Sumber Rejeki is done by (1) cleaning the material in the pond. (2) repairing damaged pond equipment. (3) the pond is filled with reservoir water until the height reaches 30 cm and left for 24 hours. (4) 2 liters of Benzalkonium Chloride (BKC) was applied per 1000 m2 into the pond, then left for 24 hours to kill microbes. (5) Clean the bottom and walls of the pond again, then rinse with tank water. (6) Repair any holes in the bottom and walls of the pond. (7) clean the inlet and outlet

Procedures for checking water quality in CV. Cemara Sewu Sumber Rejeki during enlargement is carried out in several stages, namely (1) check the brightness and color of the water every day to determine water quality. (2) analyze the chemical composition of water by measuring the amount of dissolved oxygen (DO) in it, temperature, and pH every day. (3) monitor water quality biologically every day by paying attention to plankton and bacteria. (4) monitor water quality weekly by checking total ammonia nitrogen (TAN), total organic matter (TOM), hardness, alkalinity, and ammonium levels. (5) treat the area with bacterial application, lime application, and mineral application

Sample data collection procedures during enlargement at CV. Cemara Sewu Sumber Rejeki is done in the following way. (1) shrimp samples were taken using a sampling net. (2) put the shrimp sample into a bucket containing a little water. (3) shrimp samples in the bucket are put into a basket containing rice that has been measured with digital scales to drain the water. (4) weigh the shrimp sample using a digital scale to determine its weight and record it. (5) After weighing, put it back into the bucket containing a little water to count the number of shrimp samples to be recorded. (6) After recording, determine the size of the shrimp sample based on the weight and number of shrimp samples.

The feeding procedure at CV Cemara Sewu Sumber Rejeki during enlargement is carried out according to the following procedure. (1) monitor feeding using anco, with a level of 1%. (2) feed is stored in a warehouse lined with pallets (first in first out). (3) The feed used has a high protein content, low price, and low ash content. (4) the form of feed given is in accordance with the age of vannamei shrimp farming. (5) monitoring of feeding hours for auto feeder filling and distribution arrangements.

Maintenance procedures during enlargement at CV. Cemara Sewu Sumber Rejeki is carried out in the following ways, namely (1) monitoring and determining feed management according to the age of cultivation, weather, and pond conditions. (2) monitoring water quality regularly, both daily and weekly. (3) cleaning the bottom of the pond by suction and monitoring shrimp mortality every day. (4) provide biological or chemical treatment to maintain water quality. (5) monitor the health, density, and growth of vannamei shrimp. (6) monitor pond conditions for damage or theft. (7) supervise the harvest process and record data during cultivation.

The observed growth performance of vannamei shrimp included survival rate (SR), average weight growth of shrimp per head (Mean Body Weight/MBW), daily weight gain (Average Daily Growth/ADG), and water quality during cultivation. Several water quality parameters were observed such as temperature (°C), salinity (ppt), dissolved oxygen (mg/L), acidity (pH), ammonia (mg/L), and nitrite (mg/L).

Observations on the growth performance of vannamei shrimp were carried out between ponds that were fed using the manual method and ponds that were fed using an autofeeder, either using a 120° autofeeder or a 360° autofeeder.

Survival Rate (SR)

According to Mudjiman (1983), survival rate is the percentage of the number of fish or shrimp at the end of rearing which is based on the number of fish or shrimp at the start of rearing. The way to calculate the survival rate is by using the following formula:

$$SR = \frac{N_t}{N_o} \times 100$$

Where:

SR = Survival rate (%)

N_t = Number of live shrimp at the end of rearing (ind)

N_o = Number of live shrimp at the start of rearing (ind)

Feed Conversion Ratio (FCR)

According to Zonneveld *et al.* (1991), the feed conversion ratio can be interpreted as the ratio between the weight of feed eaten during grow-out and the weight gain by shrimp during grow-out. The way to calculate the feed conversion ratio is by using the following formula:

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

Where:

FCR = Feed Convertion Ratio

F = Feed given during maintenance (gr)

B = Biomass (gr)

Average Body Weight (ABW)

Accorfing to Hermawan (2012), average weight is the average weight of shrimp per fish based on sampling results. The calculation is done by taking a sample of shrimp and weighing it using a scale, then calculating it using a formula:

$$ABW = \frac{\sum b}{\sum e}$$

Where:

ABW = Average Body Weight (gr/ekor)

Σ_b = Total weight of sample (gr)

Σ_e = Number of samples (ekor)

Average Daily Growth (ADG)

According to Haliman and Adijaya (2005), average daily weight gain is the average weight gain per day in a sampling time period.

$$ADG = \frac{ABW_{II} - ABW_{I}}{t}$$

Where:

ADG = *Average Daily Growth* (gr/hari)

ABW_I = Average weight in previous sampling (gr)

ABW_{II} = Average weight at last sampling (gr)

t = Time interval (days)

Size

According to Colin *et al.* (1993), shrimp size can be interpreted as the size of the shrimp based on the number of shrimp contained in 1 kg of shrimp weight.

$$size = \frac{1000}{MBW_{II}}$$

Where:

Size = Shrimp size (gr)

MBW_{II} = *Mean Body Weight* (gr)

Data Analysis

Several data points were collected in this research, including survival rate (SR), average body weight (ABW), average daily growth (ADG), feed conversion ratio (FCR), and water quality information during cultivation. In this study, the data was analyzed descriptively and using the arc-sin transformation on data containing percentages, presented in graphs and tables, and compared with other studies.

Results and Discussion

Survival Rate

The percentage of survival during cultivation was calculated using the results of the three feeding methods. The use of a 120° autofeeder has the highest survival rate with a percentage of 51.47%, followed by a 360° autofeeder with a percentage of

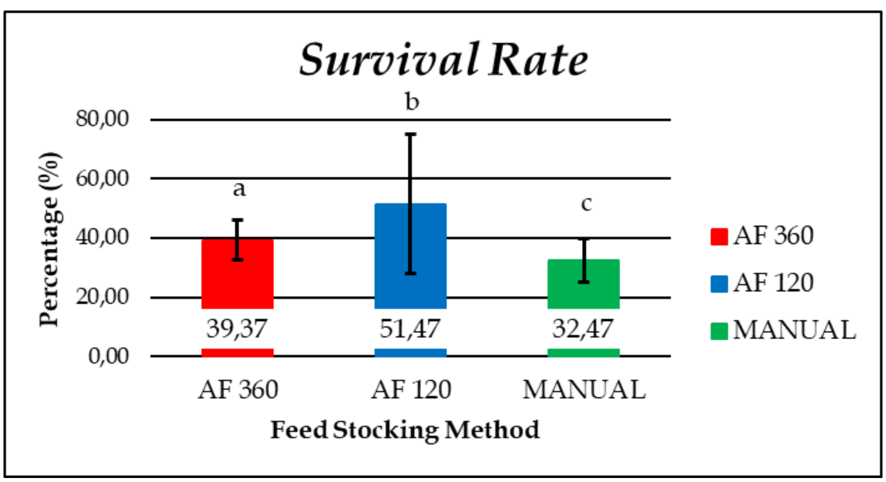

Figure 1. Survival Rate Graph

Note: AF 360° (automatic feeder 360°); AF 120° (automatic feeder 120°)

Table 1. Survival Rate

Pond	Plot	Netto	Actual	($\bar{x}$ ± SD) Per Plot	($\bar{x}$ ± SD) Per Pond
AF 360 (%)	A2	48,69	40,24	41,82 ± 5,98[a]	39,37 ± 6,61[a]
	A3	39,42	32,58	36,78 ± 4,84[a]	
AF 120 (%)	A13	47,49	38,54	40,98 ± 6,33[b]	51,47 ± 23,51[b]
	A17	91,54	67,24	63,00 ± 17,18[b]	
MANUAL (%)	A15	24,49	20,99	28,48 ± 2,47[c]	32,47 ± 7,50[c]
	A16	37,62	32,20	36,22 ± 3,83[c]	

Note: AF 360° (*automatic feeder* 360°); AF 120° (*automatic feeder* 120°).

39.37%, and the lowest is the manual method with a percentage of 32.47%. The differences in survival rates that occur are due to several things, such as water quality, feeding, pond area, and different density levels. More complete information regarding differences in survival rates can be seen in **Error! Reference source not found.**.

According to Yustianti *et al.* (2013), factors that influence survival rates are feeding management and water quality management. Another factor that can influence is the density of a pond. The level of shrimp density affects the level of shrimp competition for food, space, living space, and oxygen. The way to overcome this is by carrying out a partial harvest. Thus, it can provide wide space for movement (Purnamasari *et al.*, 2017). Shrimp cannibalism can occur if they experience stress or lack of feed (Hidayat *et al.*, 2013).

The highest survival rate results were obtained when using a 120° autofeeder, then using a 360° autofeeder, and the lowest using the manual method (Table 1). According to Widigdo (2013), survival rates are categorized as low, medium, and good. The low survival rate is in the range of <50%. The general survival rate is in the range of 50-60%. The high survival rate is in the range of >70%. According to Rokhmulyenti et al. (2023), cultivating vannamei shrimp using automatic feeders provides the best yields of up to 97% compared to manual feeding. The higher the survival rate, the higher the shrimp harvest will be and the production costs will be more efficient. The survival rate of vannamei shrimp is influenced by water quality, temperature, amount of feed given, handling of shrimp during cultivation, as well as the level of detection of shrimp in ponds (Anton *et al.*, 2022).

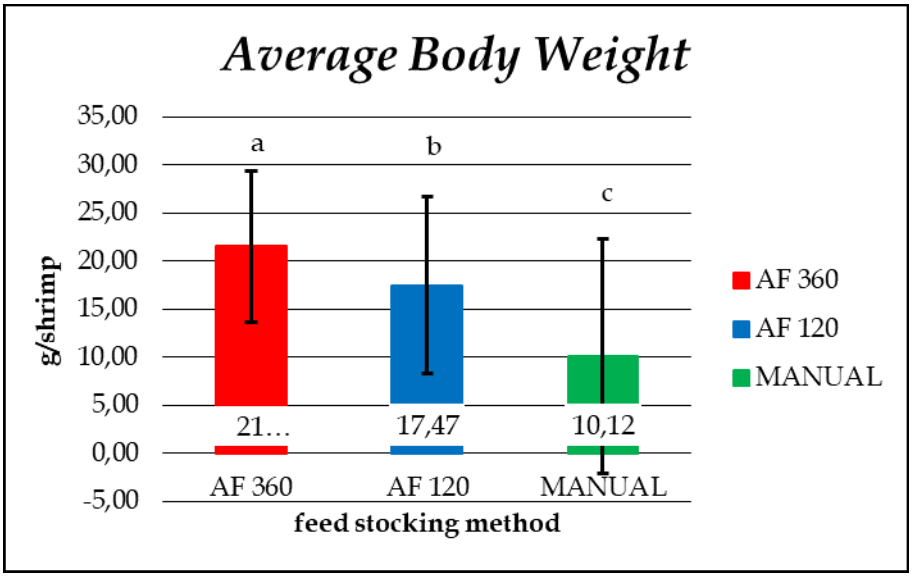

Figure 2. Average Body Weight

Note: AF 360° (automatic feeder 360°); AF 120° (automatic feeder 120°)

Average Body Weight

Based on the observations during cultivation the three feeding methods led to average growth in body weight. Using the 360° autofeeder got the highest average body weight of around 21.53 gr/head, followed by the 120° autofeeder at around 17.47 gr/head, and the lowest from the manual method got around 10.12 gr/head. Differences in average weight growth occur due to different pond areas and density levels. Information regarding the comparison of average weight growth can be seen in Figure 2.

Based on the Indonesian National Standards (2014), vannamei shrimp production during cultivation with an average weight growth value of at least 14.5 gr/head is included in the good growth category. The average weight growth value obtained using a 360° and 120° autofeeder is higher than the minimum value. However, using the manual method, the average weight growth value is below the minimum value. One of the abilities of vannamei shrimp is to use the water column as a place to live so that the living space of vannamei shrimp becomes wider (Briggs *et al.*, 2004). So, differences in stocking density will affect growth. Allen (1974), declared that shrimp growth will be reduced by an increase in stocking density.

The results for AF 360° were 21.53 + 7.85 gr/head, and the results for AF 120°

Table 2. Average Body Weight

POND	AF 360 (gr/ind)		AF 120 (gr/ind)		MANUAL (gr/ind)	
PETAK	**A2**	**A3**	**A13**	**A17**	**A15**	**A16**
PP 1	11,11	12,20	11,49	10,70	12,12	11,24
PP 2	15,04	16,67	15,38	13,99	0,00	18,87
PP 3	20,41	20,00	20,00	19,05	0,00	0,00
PP 4	29,81	28,57	0,00	25,77	0,00	0,00
PT	30,10	31,40	30,89	27,40	28,88	30,12
($\bar{x}$ ± SD) Per Plot	21,29 ± 8,57[a]	21,77 ± 8,06[a]	15,55 ± 11,33[c]	19,38 ± 7,24[c]	8,20 ± 12,70[d]	12,04 ± 12,89[d]
($\bar{x}$ ± SD) Per Pond	21,53 ± 7,85[a]		17,47 ± 9,19[b]		10,12 ± 12,23[c]	

Note: AF (*Automatic Feeder*); $\bar{x}$ (Rata-Rata); SD (Standard Deviation); PP (Partial Harvest); PT (Total Harvest); A2 (plot 2); A3 (plot 3); A13 (plot 13); A15 (plot 15); A16 (plot 16); A17 (plot 17)

were 17.47 + 9.19 gr/head. The manual method yields 10.12 ± 12.23 gr/head. Based on Table 2 above, data on average body weight growth during cultivation. In each pond, 2 sample plots were taken to collect data on average body weight growth based on harvest time. The highest results of average body weight were obtained when using a 360° autofeeder, then using a 120° autofeeder, and the lowest using the manual method. Ponds using manual methods have lower values when compared to ponds using automatic feeders. A feeder that feeds with a little bit more frequency is better than one that feeds with a little bit more frequency because it feeds little by little with less effort. Thus, the feed given can reduce the loss of important nutrients in the feed because food that is too long becomes dissolved in water and can be used by shrimp as energy and also for growth (Samawi *et al.*, 2021). Another factor that can influence the increase in average body weight according to Purnama (2003) is shrimp stocking density. The higher the stocking density, the lower the average body weight growth rate, and vice versa.

Average Daily Growth

Based on the results of observations from the three feeding methods, average daily growth during cultivation was obtained. The highest average daily growth value in the feeding method using a 360° autofeeder is around 0.31 gr/day, followed by a 120° autofeeder around 0.25 gr/day, and the lowest using the manual method is around 0.16 gr/day. The differences in daily weight growth that occur are caused by density levels, water temperature, and feeding management. More complete

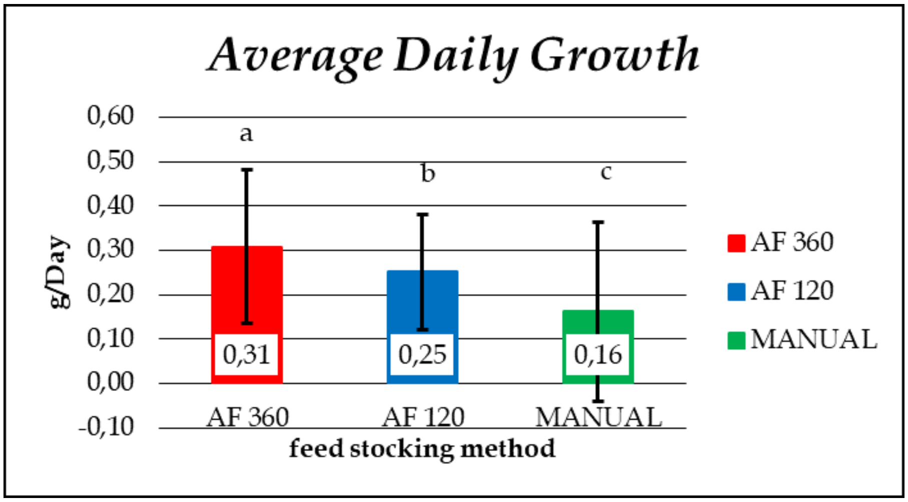

Figure 3. Average Daily Growth

Note: AF 360° (automatic feeder 360°); AF 120° (automatic feeder 120°).

information regarding the comparison of daily weight growth can be seen in Figure 3.

According to Purnamasari *et al.* (2017), the daily weight growth of vannamei shrimp can be categorized as having good growth with a growth rate ranging from 1-1.5 gr/week or 0.1-0.2 gr/day. One factor that influences daily weight growth is the level of shrimp density in the pond. When shrimp density is low, it will be easier for shrimp to find a place to live, food, and oxygen. So, shrimp are easier to grow (Witoko *et al.*, 2018). Dense populations cause the need for food, living space and

Table 3. Average Daily Weight Growth Table

POND	AF 360 (gr/hari)		AF 120 (gr/hari)		MANUAL (gr/hari)	
PLOT	**A2**	**A3**	**A13**	**A17**	**A15**	**A16**
PP 1	0,16	0,17	0,16	0,16	0,18	0,17
PP 2	0,33	0,37	0,32	0,27	0,00	0,31
PP 3	0,38	0,24	0,33	0,36	0,00	0,00
PP 4	0,59	0,54	0,00	0,42	0,00	0,00
PT	0,02	0,28	0,34	0,15	0,55	0,42
($\bar{x}$ ± SD) Per Plot	0,30 ± 0,22[a]	0,32 ± 0,14[a]	0,23 ± 15[b]	0,27 ± 12[b]	0,15 ± 0,24[c]	0,18 ±0,18[c]
($\bar{x}$ ± SD) Per Pond	0,31 ± 0,17[a]		0,25 ± 0,13[b]		0,16 ± 0,20[c]	

Note: AF (Automatic Feeder); $\bar{x}$ (Average); SD (Standard Deviation); PP (Partial Harvest); PT (Total Harvest); A2 (plot 2); A3 (plot 3); A13 (plot 13); A15 (plot 15); A16 (plot 16); A17 (plot 17) oxygen to be limited. Thus, the average weight increase of shrimp is not optimal (Zahrani, 2022).

Based on Table 3 above, data on average body weight growth during cultivation. At AF 360° the results were 0.31 ± 0.17 gr/day. At AF 120° the results were 0.25 ± 0.13 gr/day. The manual method produces results of 0.16 ± 0.20 gr/day. The best results from the average daily growth of vannamei shrimp were obtained when using a 360° autofeeder, followed by using a 120° autofeeder, and the lowest using the manual method. The average daily growth results of vannamei shrimp are influenced by the season during cultivation, namely the rainy season with different weather conditions every day, thus affecting the shrimp's appetite. Low water temperatures reduce shrimp appetites compared to normal water temperatures (28-30 °C). Growth in each period can be different, depending on body condition, feed given, and environmental factors (Edhy *et al.*, 2010). According to (Khasani dan Sopian, 2013), one indicator of the functioning of the metabolic system in the body is growth, both increase in weight and length. According to (Huet, 1971), the factor that influences shrimp growth is feed, because it functions as a source of energy to increase growth and survival. Cultivated shrimp can also be supported by providing good feed management and maintaining good water quality.

Feed Convertation Rasio

During cultivation, a feed conversion ratio was calculated based on observations from the three feeding methods. The highest feed conversion ratio value for the manual method is around 2.23, followed by using a

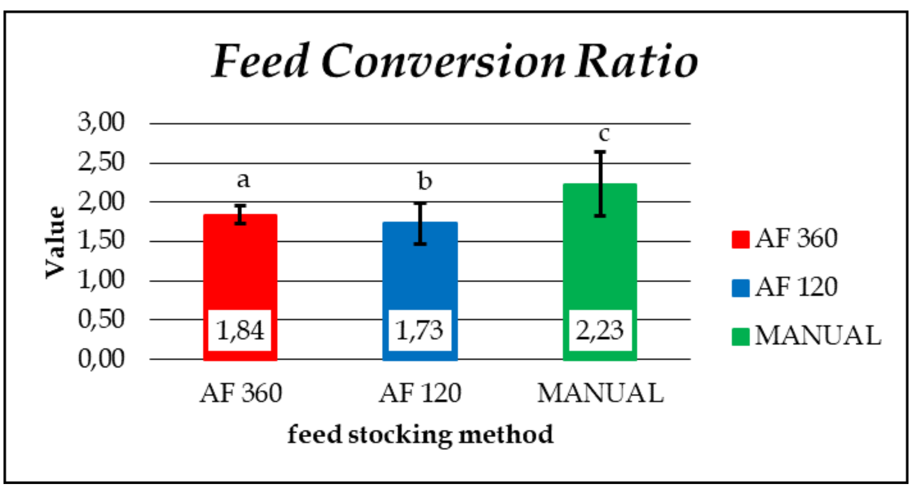

Figure 4. Feed Convertion Ratio Graph

Note: AF 360° (automatic feeder 360°); AF 120° (automatic feeder 120°).

Table 4. Feed Convertion Ratio

Pond	**Plot**	**FCR** (Value)	**($\bar{x}$ ± SD) Per Pond**
AF 360	A2	1,76	1,84 ± 0,11[a]
	A3	1,92	
AF 120	A13	1,92	1,73 ± 0,26[b]
	A17	1,55	
Manual	A15	2,51	2,23 ± 0,40[c]
	A16	1,95	

Note: AF 360° (*automatic feeder* 360°); AF 120° (*automatic feeder* 120°); FCR (*feed conversion ratio*).

360° autofeeder around 1.84, and the lowest using a 120° autofeeder is around 1.73. Differences in feed conversion ratio values are caused by temperature, water flow, and feeding. More complete information regarding the comparison of daily weight growth can be seen in Figure 4.

One of the characteristics of vannamei shrimp is that they are nocturnal or active at night. The frequency of feeding can be estimated by taking these characteristics into account to obtain the ideal feed conversion ratio (FCR) or conversion value (Kordi, 2010). According to Supono (2017), the feed conversion ratio value which is categorized as good for intensively cultivated vannamei shrimp is at a minimum value of around 1.4 and a maximum value of around 1.8. So, the limit value for the feed conversion ratio in intensive ponds is 1.4-1.8. The smaller the FCR value, the greater the profit that will be obtained. Conversely, the greater the FCR value, the less profit will be obtained (Boyd dan Clay, 2002).

According to Ridlo and Subagiyo (2013) the higher the FCR means that more feed is not converted into shrimp biomass. According to Sukenda *et al.* (2011), shrimp infected with IMNV (infectious myonecrosis virus) disease result in high mortality. When shrimp are sick, the shrimp's appetite level will decrease. As a result, the feed conversion ratio is increased. According to Supono (2008), factors that influence the value of the feed conversion ratio during maintenance are good for feed management including selecting the type of feed, the nutritional content of the feed, the size of the feed, determining the correct dose, frequency and time of feeding, as well as the method of administration and strict monitoring. Feed consumption levels can be monitored through anchor checks (feeding tray checks) in order to determine unconsumed feed, health levels, and shrimp survival as well as the condition of the pond bottom (Ghufron *et al.*, 2018).

The best results for the feed conversion ratio values were obtained when using a 120° autofeeder, then using a 360° autofeeder, and the lowest using the manual method (Table 4). According to Anton *et al.* (2022), explains that if the value of the feed conversion ratio is smaller, it indicates that the costs incurred will also be smaller, resulting in high profits. If the feed conversion ratio value obtained during cultivation is too high, there is an indication that there is an excess amount of feed (overfeeding). The high levels of feed waste and shrimp feces will affect water quality and reduce shrimp appetites.. This is the opinion of Lamidi and Asmanelli (1994), explaining that providing sufficient amounts of feed on time will accelerate growth. The availability of balanced feed is crucial for good growth, maintaining health, and reducing feed conversion rates.

Water Quality During Cultivation

Water quality parameters were observed based on results from measurements obtained during vannamei shrimp cultivation. The values of water quality parameters during vannamei shrimp cultivation obtained in the cultivation media were measured, such as dissolved oxygen (4.25-4.32 mg/l), salinity (23.92-25.29 ppt), nitrite (0, 04-0.05ppm), and ammonia (0.01 ppm) are in ideal conditions. Different for brightness (39.55-40.21 cm), temperature (27.32-29.42 °C), and pH (7.76-8.15) which are in less-than-ideal conditions.

The brightness of water is a measure of the clarity of a body of water. The higher the brightness value, the deeper the ability of light to penetrate the water. The brightness of the water is influenced by fine materials floating in the water such as plankton, microorganisms, detritus, as well as mud and sand (Hargreaves, 1999). The watercolor for cultivating vannamei shrimp is light green and light brown, with ideal conditions being in the range of 30-35 cm. Water brightness is identical to plankton density and watercolor (Effendi, 2003).

The ideal temperature for vannamei shrimp is around 28-30 °C. Changes in pond water temperature are influenced by the weather, so they will have a direct effect on the shrimp's appetite. Apart from that, changes in water temperature can also be influenced by the density of particles at the bottom of the pond (Sulistinarto, 2008).

The degree of acidity (pH) is a water quality parameter in determining the degree of acidity of a pond. The ideal pond water pH level ranges from 7.6 to 8.1 (Buwono,

Table 5. Water Quality Parameters during Cultivation

PLOT	Brightness		Temperature		pH	
	Morning	Afternoon	Morning	Afternoon	Morning	Afternoon
	30-35 cm		28-30 °C		7,6-8,1	
AF 360	40,00	39,55	27,45	29,35	7,78	8,15
AF 120	40,21	39,84	27,52	29,42	7,76	8,10
Manual	39,93	39,56	27,32	29,21	7,76	8,10
$\bar{x}$ ± SD	40,05 ± 0,15	39,65 ± 0,17	27,43 ± 0,10	29,33 ± 0,11	7,77 ± 0,01	8,12 ± 0,03
	39,85 ± 0,26		28,38 ± 1,04		7,94 ± 0,19	

1994). According to Haliman and Adijaya (2005), the pH value in the afternoon is higher compared to the pH value in the morning. This is caused by photosynthetic activity by natural food in the afternoon, for example, phytoplankton which absorbs carbon dioxide levels. Meanwhile, in the morning, carbon dioxide levels are abundant which is produced from the breathing of vannamei shrimp at night.

The dissolved oxygen content DO (dissolved oxygen) affects shrimp body metabolism. Good dissolved oxygen levels are not less than 4 mg/l. During the day, the dissolved oxygen values obtained tend to be high because plankton photosynthesis is taking place which produces oxygen. Conversely, dissolved oxygen values at night are lower than during the day (Kordi, 2010).

The salinity of water plays an important role for vannamei shrimp growth because it influences its growth. The ideal salinity level during cultivation is around 15-30 ppt. The level of salinity in the pond will affect the level of osmoregulation of vannamei shrimp. The higher the salinity, the slower the growth of vannamei shrimp will be because the metabolic process is disturbed due to the energy used in the osmoregulation process (Sulistinarto, 2008).

The survival of vannamei shrimp is threatened by high levels of nitrite (NO2) in ponds. Because it will affect the blood by oxidizing hemoglobin to become methemoglobin which is unable to transport oxygen. Nitrification can be greatly influenced by the amount of oxygen dissolved in ponds. The ideal nitrite level during cultivation is no more than 0.1 ppm (Suharyadi, 2011).

The ammonia (NH3) content is inorganic nitrogen that can dissolve in water. Ammonia compounds come from the nitrite content which changes through the nitrogen fixation process. Ammonia can turn into ammonium (NH4) which is formed through the degradation of organic nitrogen (protein and urea) or inorganic nitrogen (dead plants and aquatic biota) by microbes and fungi (Connell dan Miller, 1995).

Harvest Production

Based on the harvest results during vannamei shrimp cultivation, observation results were obtained from partial harvest to total harvest in cycle 15. The total tonnage in ponds using a 360° automatic feeder was 9,116.64 kg. The total tonnage in ponds that use a 120° automatic feeder is 7340.36 kg. The total tonnage in ponds that distribute feed manually is 2589.93 kg. The results of partial harvest tonnage and total harvest can be seen in Table 6.

The harvesting process involves two stages: partial harvesting and total harvesting. The partial harvest of shrimp occurs when the pond's carrying capacity is almost reached, reducing the concentration of shrimp in the pond to increase the shrimp's growth potential. According to the results of Iskandar *et al.* (2022), shows that the survival rate of shrimp shows good performance, namely in the range of 85%. The number of shrimp taken during partial harvest is 25% of the total number in the pond. Several factors can affect harvest results, including stocking density, pond area, water quality, and disease.

Conclusion

Based on the results above, it can be concluded that the 360° auto feeder shows a survival rate of 39.37%, an average body weight growth of 10.12g/head, and an

Table 6. Harvesting tonnage

POND	PLOT	HARVEST (Kg)				
		PARTIAL 1	PARTIAL 2	PARTIAL 3	PARTIAL 4	TOTAL
AF 360°	A2	287,5	406,2	471,85	300,55	5096,31
	A3	322,22	364,3	472,16	310,01	4020,33
AF 120°	A13	201,35	247	288,91	-	3274,6
	A17	349,92	410,65	300,92	382,47	4065,76
MANUAL	A15	82,05	-	-	-	1033,5
	A16	86,3	153,04	-	-	1556,43

Note: AF (Automatic Feeder); A2 (plot 2); A3 (plot 3); A13 (plot 13); A15 (plot 15); A16 (plot 16); A17 (plot 17).

average daily weight growth of 0.31g/day, along with a feed conversion ratio of 1.84. Growth performance on the 120° auto feeder shows a survival rate of 51.47%, average body weight growth of 17.47 gr, average daily growth of 0.25 gr/ days, and a feed conversion ratio of 1.73. Growth performance using the manual method shows a survival rate of 32.47%, average body weight growth of 17.47 gr/head, and average daily growth of 0.25 gr/day, and a feed conversion ratio of 2.23. Thus, the use of 360° and 120° autofeeders is an effective way to improve growth performance during vannamei shrimp cultivation. Apart from that, the harvest using the 360° autofeeder was 4,558.32 kg. The harvest yield when using a 120° autofeeder is 3,670.18 kg. The harvest yield using the manual method was 1,294.965 kg. So, using a 360° auto feeder can increase the yield of vannamei shrimp.

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