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EVALUATION OF TIGER SHRIMP (*Penaeus monodon* Fabr.) HATCHERY MANAGEMENT AT THE BRACKISHWATER AQUACULTURE DEVELOPMENT CENTER, JEPARA, CENTRAL JAVA

Evaluasi Manajemen Pembenihan Udang Windu (*Penaeus monodon* Fabr.) di Balai Besar Perikanan Budidaya Air Payau Jepara, Jawa Tengah

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ABSTRACT

The success of tiger shrimp production is influenced by the availability of quality postlarvae. The objective of this study was to evaluate biotechnical aspects of tiger shrimp hatcheries to produce quality postlarvae and analyse the economic aspects of tiger shrimp hatchery business in BBPBAP Jepara. The method used in this research was a case study method. Analysis of data used include analysis of biotechnical aspects of tiger shrimp hatchery maintenance and spawning broodstock, broodstock feed management, larval and post larvae rearing management, and water quality and health management. Analysis of economic aspects that include, cost analysis, revenue, income, and business feasibility analysis which includes, Payback Period (PP), and Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (B/C Ratio). The results showed that tiger shrimp broodstock tiger shrimp comes from nature, spawning using the ablation method, the feed used is fresh feed, the type of feed used, and the type of feed used. feed used in the form of fresh feed, the type of feed for larvae and tiger shrimp larval and post larvae consisted of phytoplankton, artemia, and artificial feed. The economic aspects analysed include business capital of IDR 1,063,000,000.00/year, fixed costs of IDR 216,300,000.00/year, production costs of IDR 368,670,000.00/year, income of IDR 960,000,000.00/year and profit IDR 375,030,000.00/year. The results of business feasibility analysis including the PP value of 1,9 years, PP (discount factor 6,16%) of 3,04 years, the NPV value of IDR 156,237,555.00, the B/C ratio of 1.64 and the IRR value 19.64%.

Keywords: Biotechniques, Financial Analysis, Hatcheries, Management

ABSTRAK

Keberhasilan produksi udang windu dipengaruhi oleh ketersediaan benih yang berkualitas.

Tujuan penelitian ini adalah untuk mengevaluasi aspek bioteknik pembenihan udang windu untuk menghasilkan benih yang berkualitas dan analisis aspek ekonomi usaha pembenihan udang windu di BBPBAP Jepara. Metode yang digunakan dalam penelitian ini yaitu metode studi kasus. Analisis data yang digunakan diantaranya analisis aspek bioteknis pembenihan udang windu pemeliharaan dan pemijahan induk, manajemen pakan induk, manajemen pemeliharaan larva dan benih, manajamen pakan larva dan benih, pengelolaan kualitas air dan kesehatan. Analisis aspek ekonomi yang meliputi, analisis biaya, penerimaan, pendapatan, dan analisis kelayakan usaha yang meliputi, *Payback Period* (PP), *Net Present Value* (NPV), *Internal Rate of Return* (IRR), *Benefit Cost Ratio* (B/C Ratio). Hasil penelitian menunjukan bahwa induk udang windu berasal dari alam, dipijahkan menggunakan metode ablasi, pakan induk yang digunakan berupa pakan segar, jenis pakan larva dan benih udang windu terdiri dari fitoplankton, artemia, dan pakan buatan. Aspek ekonomi yang dianalisis meliputi biaya investasi sebesar Rp 1.063.000.000,00/tahun, biaya tetap Rp 216.300.000,00/tahun, biaya produksi Rp 368.670.000,00/tahun, penerimaan Rp 960.000.000,00/tahun, dan keuntungan Rp 375.030.000,00/tahun. Hasil analisis kelayakan usaha meliputi nilai PP sebesar 2,83 tahun, PP (suku bunga 6,16%) sebesar 3,04 tahun, nilai NPV sebesar Rp 1.676.449.682,00, B/C ratio sebesar 1,64 dan nilai IRR sebesar 19,64%.

Kata Kunci: Bioteknik, Analisis Finansial, Pembenihan, Manajemen

INTRODUCTION

Tiger prawn (*Penaeus monodon* Fabr.) is one of the important economic shrimp commodities, an endogenous species of Indonesia that is widely cultivated in traditional Indonesian ponds. The growth of shrimp production in Indonesia is dominated by the whiteleg shrimp species (*Litopenaeus vannamei*), while tiger prawn production has stagnated (Asmild et al., 2024). Global tiger prawn production has experienced low growth with an increase from 631 thousand tons in 2000 to 717 thousand tons in 2020 (FAO, 2022). One of the advantages of tiger prawns is their large size, reaching 28 grams per head (Sahu et al., 2013), so they are in demand in the international market with an average export price of 40% higher than whiteleg shrimp in 2020 (respectively 11.49 USD/kg and 8.23 USD/kg) (DGoPC, 2021). The demand for tiger prawns is quite high, with the main markets including the United States (40%), Southeast Asia (28%), the European Union (13%), and Japan (6%) (Muthu et al., 2024).

Currently, various efforts have been made to increase tiger prawn production throughout Asia, led by Vietnam, China, India, and Indonesia (Jory, 2023). Seeds are one of the production factors that play an important role in supporting the success of tiger prawn cultivation in ponds. Currently, the demand for tiger prawn seeds has not been able to meet the needs of farmers in Indonesia. Several factors that can affect the success of tiger prawn seeding activities include broodstock maintenance management which includes broodstock selection based on age and size, endocrine manipulation, genetic variation, feed management, maintenance water quality and management of larvae and seeds produced (Racotta et al., 2003; Chimsung, 2014).

Efforts to increase production in tiger prawn seeding activities require management that meets economic feasibility. Tiger shrimp hatchery activities have great potential if supported by good management that includes biotechnical and economic aspects. Commercial management of tiger shrimp hatchery business is one of the main challenges in supporting tiger shrimp cultivation production activities on a large scale. In addition, information on cost assessment and business feasibility is still limited, especially regarding methods to increase cost efficiency, profitability, financial feasibility while maintaining the quality of the seeds produced. With the development of hatchery management, it is expected to produce quality, sustainable tiger shrimp seeds, and the fulfillment of seed demand is expected to further increase national tiger shrimp production. The Center for Brackish Water Aquaculture

(BBPBAP) Jepara is a representation of the Fisheries and Marine Service which develops tiger shrimp cultivation that meets the criteria of quantity, quality and continuity. The purpose of this study was to evaluate tiger shrimp hatchery management in terms of biotechnical and economic aspects of tiger shrimp hatchery.

METHODS

The method in the evaluation research of tiger shrimp seed management uses a case study method that is analyzed descriptively and structured. The research location is at the Center for Brackish Water Aquaculture Development (BBPBAP) Jepara, Central Java. The data collected are primary and secondary data. The data collection method is the observation method to obtain information and data regarding the biotechnical and economic aspects of tiger shrimp seeding. The data analysis used to evaluate tiger shrimp seeding management is as follows: (1) Evaluation of the biotechnical aspects of tiger shrimp seeding which include maintenance and spawning of broodstock, broodstock feed management, broodstock water quality management, maintenance of larvae and fry, management of larval and fry feed, management of water quality and health of larvae and fry; (2) Analysis of economic aspects which include costs, revenues, income and financial feasibility.

a. Cost Analysis

Total production cost is the sum of fixed cost and variable cost (Luthfi et al., 2018):

$$TC = TFC + TVC$$

Description:

TC (Total Cost)	: Total cost (IDR)
TFC (Total Fixed Cost)	: Total fixed cost (IDR)
TVC (Total Variable Cost)	: Total variable cost/production cost (IDR)

b. Revenue

Revenue of tiger shrimp hatchery business is obtained from the sale of seeds to consumers (Luthfi et al., 2018):

$$TR = (Q \times P)$$

Description:

TR	: Revenue (IDR)
Q	: Number (tiger shrimp seeds PL25) (tail)
P	: Selling price (tiger shrimp seeds PL25/tail) (IDR)

c. Revenue is obtained from the margin between revenue and total costs (Luthfi et al., 2018):

$$Pd = TR - TC$$

Description:

Pd	: Revenue (IDR)
TR	: Revenue (IDR)
TC	: Total costs (IDR)

Business feasibility analysis consists of Payback Period (PP), Net Present Value (NPV), Internal Rate of Return (IRR) and Benefit Cost Ratio (B/C Ratio) (Luthfi et al., 2018; Charalambides et al., 2024):

a. PP (Payback Period):

$$PP = \frac{\text{Initial investment}}{\text{Annual Cash Flow}}$$

Description:

If PP < 5 years, then the business is feasible, PP > 5 years, then the business is less feasible to be pursued

b. NPV

$$NPV = \sum_{t=1}^{n} \frac{CFt}{(1+i)^t} - Co$$

Description:
CFt : cash flow per year in period t
Co : initial investment in year 0
i : interest rate (Bank Indonesia discount factor in November 2024: 6.16%)
t : year n
n : number of years
If, NPV >1: then the business is feasible, NPV <1: then the business is not feasible

c. IRR

$$IRR = i1 + \frac{NPV1}{NPV1 - NPV2}(i1 - i2)$$

*i*1 : 1st interest rate
*i*2 : 2nd interest rate
NPV1 : NPV at 1st interest rate
NPV2 : NPV at 2nd interest rate
Interest rate (discount factor) of Bank Indonesia in November 2024: 6.16%

d. B/C Ratio (Benefit Cost Ratio)

$$B/C\ Ratio = \frac{Revenue}{Total\ Cost}$$

Description: If B/C Ratio > 1: then the business is feasible, B/C Ratio <1: then the business is not feasible.

RESULT

1. Biotechnical Aspects of Tiger Prawn Seeding

Tiger prawn broodstock comes from broodstock caught from Pangandaran. Tiger prawn broodstock from nature has a striped abdomen pattern, slightly reddish or brownish in color. Shrimp that are ready to be used as broodstock are those that already meet the criteria as in Table 1. The criteria for tiger prawn broodstock according to RSNI (2024) are as follows: (a) broodstock comes from catches from natural waters with clear fishing areas or breeding results must be equipped with a Certificate of Origin issued by a competent authority; (b) body shape: cephalothorax is shorter than the abdomen; (c) body completeness is good, no defects, genitals (petasma or telikum) are not damaged and there are no cracks in the back; (d) shrimp move actively normally, maxilliped, legs and tail also move actively; (e) healthy body, no parasites, no spots and moss, no excessive mucus, carapace is not soft and not porous, gills are clean and not swollen, the white part of the tail is not reddish; and free of pathogens or Specific Pathogen Free (SPF) according to SNI (2006). The location of the broodstock maintenance and spawning tank is indoors, must be quiet and clean, with low light intensity/dark. Male and female broodstock are kept in the same place simultaneously. The stocking density of broodstock maintenance is 1-2 tails/m^2 according to RSNI3 9267-3:20yy (RSNI, 2024). The ratio of male and female broodstock is 1:2.

Table 1. Broodstock Criteria at BBPBAP Jepara

Parameter	Broodstock Criteria at BBPBAP Jepara		Broodstock Criteria RSNI3 9267-1:20yy (RSNI, 2024)	
	Male	Female	Male	Female
Age (Years)	≥ 1	≥ 1	≥ 1	≥ 1
Length (cm)	≥ 20	≥ 24	Nature: ≥ 16 Breeding: ≥ 16	Nature: ≥ 22 Breeding: ≥ 21
Head length (cm)	≥ 7	≥ 9		
Weight (g)	≥ 80	≥ 125	Nature: ≥ 70 Breeding: ≥ 70	Nature: ≥ 150 Breeding: ≥ 100
Eggs HR (%)	-	≥ 80 %	-	-
Fecundity	-	≥ 400,000	-	-
Gonad maturity after ablation (days)	-	≥ 7	-	-

The number of nauplii produced per female broodstock in BBAPBAP Jepara using the ablation method: 540,000-637,500. This number is higher than the minimum quality of SNI 01-6402-2006 broodstock, which is 300,000 nauplii/female broodstock (SNI, 2006). In the larval rearing tank, nauplii will become zoea stage after 48-53 hours (zoea 1-3), zoea will become mysis stage after 96-120 hours (Mysis 1-3), and mysis will become PL after 120-150 hours (FAO, 2007). The feed given to tiger prawn larvae consists of phytoplankton, zooplankton and artificial feed. Larvae and seeds/post larvae (PL) are given various types of feed in overlapping phases between one type of feed and another to meet nutritional needs (Table 2). In the zoea phase, artificial feed has been introduced to the shrimp. Phytoplankton given to the larvae are the types of *Skeletonema costatum* and *Tetraselmis* sp. The artificial feed given starts at the zoea-I stage. The dosage of artificial feed can be seen in Table 3.

Table 2. Schedule of Commercial Feed, Phytoplankton, and Artemia for Tiger Shrimp Larvae at BBPBAP Jepara

Stadium	Water Volume	Commercial Feed	Fitoplankton		Artemia	Vitamin (ppm)
	(m^3)	Dose (ppm/day)	Dose (ppm/1x feed)	(cells/ml/ day)	(tail artemia/ fry/day)	
Nauplius	7.0					-
Zoea 1	7.0	2.5	0.3	60,000		2.5
Zoea 1-2	7.5	3.0	0.4	90,000		3.0
Zoea 2	8.0	3.0	0.4	100,000		3.5
Zoea 3	8.5	4.5	0.6	120,000		4.0
Z-M	9.0	4.5	0.6	120,000		4.5
Mysis 1	9.5	5.0	0.6	120,000		4.5
Mysis 2	10.0	5.0	0.6	120,000		5
Mysis 3	10.0	6.0	0.8	100,000	5	5
M-PL	10.0	6.0	0.8	100,000	10	5
PL 1	10.0	6.5	0.8	100,000	15	5
PL 2	10.0	6.5	0.8	100,000	20	5
PL 3	10.0	7.0	0.9	100,000	40	5
PL 4	10.0	7.0	0.9	-	50	5
PL 5	10.0	7.5	0.9	-	60	5
PL 6	10.0	7.5	0.9	-	60	5

Stadium	Water Volume	Commercial Feed	Fitoplankton		Artemia	Vitamin (ppm)
	(m^3)	Dose (ppm/day)	Dose (ppm/1x feed)	(cells/ml/ day)	(tail artemia/ fry/day)	
PL 7	10.0	8.0	1.0	-	60	5
PL 8	10.0	8.0	1.0	-	60	-
PL 9	10.0	9.0	1.1	-	60	-
PL 10	10.0	9.0	1.1	-	60	-
PL 11	10.0	10.0	1.3	-	60	-
PL 12	10.0	10.0	1.3	-	60	-

Table 3. Dosage of Commercial Feed for BBPBAP Jepara Zoea-PL12

Stadium	Water Volume	Commercial Feed 1 x feed	Commercial Feed 1 day	Frip-#1 car	Frip-#2 CD	Frip-PL-150	Frip-PL-300	Amount of Feed
	(m^3)	(ppm)	(ppm)	(g)	(g)	(g)	(g)	(g)
Nauplius								
Zoea 1	7	0.4	2.5	18				18
Zoea 1-2	7.5	0.5	3.0	23				23
Zoea 2	8	0.6	3.5	28				28
Zoea 3	8.5	0.7	4.0	17	17			34
Z-M	9	0.8	4.5	20	20			41
Mysis 1	9.5	0.8	4.5	21	21			43
Mysis 2	10	0.8	5.0		38	13		50
Mysis 3	10	0.8	5.0		38	13		50
M-PL	10	0.9	5.5		41	14		55
PL 1	10	0.9	5.5		14	41		55
PL 2	10	1.0	6.0		15	45		60
PL 3	10	1.0	6.0		15	45		60
PL 4	10	1.1	6.5			65		65
PL 5	10	1.1	6.5			65		65
PL 6	10	1.2	7.0			70		70
PL 7	15	1.2	7.5			19	56	75
PL 8	15	1.3	8.0			30	90	120
PL 9	15	1.3	8.5			32	96	128
PL 10	15	1.4	8.5				128	128
PL 11	15	1.4	9.0				135	135
PL 12	15	1.4	9.0				135	135
PL 13	15	1.5	9.0					
PL 14	15	1.5	9.0					
PL 15	15	1.5	9.0					

The initial temperature of nauplius spreading is 29-31°C after reaching the zoea stage, the temperature is increased to 30-33°C, because at temperatures <29°C the larvae's appetite decreases or their metabolism is low. The temperature is maintained using a 1000 watt/380 volt heater and the tub is covered with a tarpaulin so that the temperature is stable and not affected by air temperature or rainwater. Every morning the tarpaulin is opened half way so that morning sunlight can enter. Salinity is maintained at 30-35 ppt. Siphoning is done if there is a lot of dirt at the bottom of the tub, especially during the zoea stage. Water circulation for stages> PL 3 is

5-20% per day. Based on the data obtained (Table 4), the water quality in the larval maintenance media is in accordance with the RSNI range (2024).

Table 4. Water Quality Data for Larvae Maintenance Tanks at BBPABAP Jepara

Sample Code	DO (mgL^{-1})	pH	TOM (mgL^{-1})	NH_3 (mgL^{-1})	NO_2 (mgL^{-1})	NO_3 (mgL^{-1})
K1	4.41	7.7	126.4-133.84	0.002-0.063	0.004-0.005	0,787
K2	5.01	7.8	113.76-149.68	0.002-0.058	0.001-0.016	Tt
K3	4.26	7.9	123.24-186.36	0.001-0.043	0.001-0.051	Tt
K4	4.85	7.8	129.56-178.45	0.040-0.089	0.002-0.008	Tt
K5	4.13	7.8	123.24-141.27	0.033	0.001	Tt
K6	4.85	7.6-7.8	135.88-153.86	0.033	0.009	Tt
K7	4.04	7.6-7.8	123.24-178.45	0.003-0.031	0.003-0.029	Tt
*RSNI	≥4.00	7.5-8.5	-	≤0.5	≤1	≤1

Note: Tt = not detected; *RSNI3 9267-3:20yy (RSNI, 2024)

2. Economic Aspect Analysis

The economic aspect analysis is calculated based on the cost analysis consisting of investment costs (Table 5), fixed costs (Table 6), production costs (Table 7), and total operational costs. After that, the analysis of income and profit is calculated per year from 5 tiger shrimp larvae and seed maintenance tanks with a volume of 15 m3. Tiger shrimp seeding from this capacity is able to produce PL 25 as many as 1,600,000 per maintenance cycle. The average price of PL 25 is IDR 60/head with a maintenance period of ±35 days. Seeds or tocolan are distributed to farmers in Sidoarjo, Gresik, Demak, and Kalimantan.

The analysis of the economic aspect of tiger shrimp seeding aims to clearly describe the capital or investment needed for the operation of a tiger shrimp seeding business to generate profits. Where in this analysis consists of PP (Payback Period), NPV (Net Present Value), B/C Ratio, and IRR (Internal Rate of Return) (Table 8). The economic aspect is in the form of an investment of IDR 1,063,000,000.00, fixed costs of IDR 216,300,000.00 per year, production costs of IDR 368,670,000.00 per year, income of IDR 960,000,000.00 per year and profit from cultivation of IDR 375,030,000.00 per year. The results of the feasibility analysis of the tiger shrimp seed business at BBPBAP Jepara obtained a PP value of 2.83 years, Payback Period (PP) with an interest rate (6.16%) of 3.04 NPV value of IDR 1,676,449,682.00, B/C Ratio value of 1.64 and IRR value of 19.64%.

Table 5. Investment Costs for Tiger Shrimp Seeding Activities

Component	Amount	Unit	Price (IDR)	Total Price (IDR)
Land (m^2)	1000	m^2	500,000	500,000,000.00
Broodstock Maintenance Tank	2	piece	2,000,000	4,000,000.00
Egg Hatching Fiber	4	piece	500,000	2,000,000.00
Larva Maintenance Tank	5	piece	2,500,000.00	12,500,000.00
Phytoplankton Culture Tank	5	piece	2,000,000.00	10,000,000.00
Artemia Hatching Container	6	piece	500,000.00	3,000,000.00
Sedimentation Tank, Filter and Water Reservoir	1	piece	50,000,000.00	50,000,000.00
Sea Water Sterilization Tank	1	piece	50,000,000.00	50,000,000.00
Fresh Water Sterilization Tank	1	piece	50,000,000.00	50,000,000.00
Suction Pump (Sea-Sedimentation-Reservoir)	2	piece	15,000,000.00	30,000,000.00

Component	Amount	Unit	Price (IDR)	Total Price (IDR)
Distribution Pump to Broodstock	1	piece	5,000,000.00	5,000,000.00
Distribution Pump to Larvae and Plankton	2	piece	15,000,000.00	30,000,000.00
Blower + Generator	1	piece	50,000,000.00	50,000,000.00
Tarpaulin (Cover)	5	piece	300,000.00	1,500,000.00
Vehicle	1	unit	60,000,000.00	60,000,000.00
Aeration Network	1	unit	20,000,000.00	20,000,000.00
Electricity Network	1	unit	25,000,000.00	25,000,000.00
Main Building	1	unit	50,000,000.00	50,000,000.00
Pump And Blower House	1	unit	20,000,000.00	20,000,000.00
Warehouse	1	unit	20,000,000.00	20,000,000.00
Office	1	unit	50,000,000.00	50,000,000.00
Field Equipment	1	unit	20,000,000.00	20,000,000.00
Total Investment Cost				1,063,000,000.00

Table 6. Fixed Costs of Tiger Prawn Breeding Activities

Component	Amount			Price (IDR)	Total (IDR)
Subsection leader salary	10 cycle/year	1	people	5,000,000.00/month	60,000,000.00
Employee salary	10 cycle/year	3	people	2,500,000.00/month	90,000,000.00
Equipment and machine maintenance		1	package	10,000,000.00	10,000,000.00
Depreciation of investment other than land	10 % investment/year	1	package	56,300,000.00	56,300,000.00
Total Fixed Costs					216,300,000.00

Table 7. Production Costs of Tiger Prawn Seed Production

Component	Amount	Unit	Price (IDR)	Total (IDR)
Tiger Prawn Broodstock	30	tail	200,000.00	6,000,000.00
Squid	100	kg	50,000.00	5,000,000.00
Sea Worms	100	kg	25,000.00	2,500,000.00
Frippak#1 CAR	20	can	1,000,000.00	20,000,000.00
Frippak# 2 CD	30	can	985,000.00	29,550,000.00
PL + 150	80	can	850,000.00	68,000,000.00
PL + 300	90	can	690,000.00	62,100,000.00
Artemia	40	can	800,000.00	32,000,000.00
Phytoplankton Seeds	10	package	190,000.00	1,900,000.00
Vitamins	10	package	500,000.00	5,000,000.00
Probiotics	40	kg	50,000.00	2,000,000.00
Disinfectants	10	pc	842,000.00	8,420,000.00
Phytoplankton Fertilizer Packages	50	kg	24,000.00	1,200,000.00
Packaging Packages	10	cycle	500,000.00	5,000,000.00
Electricity + Fuel	12	month	120,000,000.00	120,000,000.00

Total production costs	368,670,000.00

Table 8. Feasibility Analysis of Tiger Shrimp Seeding Business

No	Information	Value
1	Payback Period (PP)	2.83 years
2	Payback Period (PP) with interest rate (6.16%)	3.04 years
3	Net Present Value (NPV)	IDR 1,676,449,682.00
4	B/C Ratio	1.64
5	Internal Rate of Return (IRR)	19.64%

DISCUSSION

1. Evaluation of Biotechnical Aspects of Tiger Prawn Hatchery

a. Maintenance and Spawning of Broodstock

Unilateral ablation of the eye is a technique used to accelerate ovarian maturation and shorten the pre-spawning period in *P. monodon* (Semchuchot et al., 2023) by removing one eyestalk to promote several metabolic activities that improve reproductive performance (Caillouet, 1972). The drastic increase in reproductive performance is due to the reduction of neurohormones produced in the X-organ sinus gland complex in the eye (Webster et al., 2012). The X-organ sinus gland complex, located inside the eye, is the main neuroendocrine gland in crustaceans (Chang, 1992). Removal of the eyestalk can increase the number of spawnings and the number of eggs and nauplii produced per female compared to non-ablated females (Aktas and M. Kumlu, 1999). This is assumed to be due to decreased levels of gonadal inhibitory hormones (GIH) and molting (MIH) (Dall et al., 1990). Fertilization occurs externally and fertilized eggs are 0.3 mm in diameter (FAO, 2009).

The ablation process is carried out by tying a rope to the shrimp eye stalk so that it is easy to cut the eye stalk with sterile scissors. Then a glowing iron is attached to the wound from the cut to speed up the drying process, after which the broodstock is soaked for a while in PK (potassium permanganate) at 100-200 ppm to prevent infection. The broodstock that is ready to be ablated is the female broodstock that is not molting (changing skin) and the skin has hardened. The broodstock that has been ablated begins to mature gonads around 4-6 days, so TKG sampling must be carried out every afternoon or evening after the broodstock is ablated. Ovarian development from level II to level III takes 3-5 days depending on the quality of the water and the type of food given (Nurdjana, 1979). TKG sampling is done to observe the ventral abdomen to observe the dark green color/ovary that develops in the back area (TKG I-IV). When it has reached TKG III, it is marked by ovaries that swell in three places on the abdominal segment. The development of the ovaries is clearly visible on the head that resembles a crescent moon on the left and right (Murtidjo, 2003), then the broodstock is moved to the egg hatching container. Egg release occurs around 24.00 - 03.00 in the morning.

The egg release and hatching container or fiber is filled with clean seawater with a salinity of 30-31 ppt, a temperature of around 31^{o}C with a water height of around 80-100 cm with the end of the water inlet pipe closed using a filter bag that functions to filter dirt and large organic materials. The egg hatching tank is given EDTA (ethylene diamine tetra acetic acid) at a dose of ±8-10 ppm. The administration of EDTA functions to bind existing organic materials and stimulate eggs to hatch. In order not to inhibit the development of eggs or embryos. The dosage of EDTA depends on the condition of the water, if the water is rather cloudy the dosage can be increased to 10 ppm. The ideal use of EDTA is 3-5 ppm. The eggs that have been obtained are transferred into a fiber hatching tub.

The eggs produced by each female shrimp broodstock are 200,000-700,000 with an egg diameter of 254-28 µm. The number of eggs/broodstock according to SNI 01-6402-2006 is ≥150,000 eggs (SNI, 2006). The color is clear yellow and the nature is to stick to the walls or bottom of the tub, so after spawning the aeration must be turned on quite large so that the eggs can be stirred and float. The eggs will hatch within 12-16 hours.

b. Broodstock Feed Management

Nutritional factors play an important role in stimulating shrimp sexual maturation, increasing fertility, and producing high-quality seeds. Several studies have shown that fresh feed (e.g. shellfish, squid, polychaeta worms, artemia) can support the success of shrimp broodstock reproductive performance (Chimsung, 2014). The feed given to tiger broodstock at BBPBAP Jepara is squid slices mixed with paprika + vitamins and sea worms/*Nereis* sp. (polychaeta). Fresh feed is given 10-15% of biomass, while for ablated shrimp 30% of biomass. Giving polychaeta feed can improve shrimp reproductive performance due to its high nutritional content, high levels of unsaturated fatty acids (e.g. arachidonic acid), and the presence of reproductive hormones (Meunpol et al., 2005). Polychaeta is not only a source of HUFA (High Unsaturated Fatty Acid), reproductive hormones such as progesterone (P4) and 17α-hydroxyprogesterone to stimulate the development of shrimp oocytes (Meunpol et al., 2007), and prostaglandin E2 (PGE2) which has a positive effect on oocyte maturation, especially during the final stages of maturation and ovulation (Meunpol et al., 2010). While fresh squid is a source of docosahexaenoic acid (DHA) (> 12%) and has a high protein content (> 80%) (Chimsung, 2014).

c. Broodstock Water Quality Management

Water quality in broodstock maintenance is maintained at a salinity of 30-31 ppt, a temperature in the range of 31ºC and a water height of 40-60 cm. The water in the maintenance media is replaced by 50%-100% per day according to water quality conditions. Siphoning is carried out every day and observations of water quality parameters such as dissolved oxygen (DO) and pH are carried out every 2 weeks (in coordination with the BBPBAP Jepara Aquatic Chemistry Lab) with DO levels >4 mgL^{-1} and pH 7.8-8.2. The water quality for broodstock maintenance at BBPBAP Jepara is in accordance with the standards set by RSNI3 9267-3:20yy, namely temperature: 28ºC-31ºC; salinity 28-35 ppt; minimum DO level 4 mgL^{-1} and pH 7.5-8.5 (RSNI, 2024).

d. Maintenance of Larvae and Seeds

The nauplii that are spread are of good quality, namely dark brown in color, actively moving up and down, positive phototaxis or attracted to light, and are on the surface and water column. The larval maintenance tank is filled with seawater until it reaches a height of 70-80 cm. The stocking density of shrimp larvae (nauplii stage) is around ± 80-100 larvae/liter. At BBPBAP Jepara, 1-1.5 million larvae are stocked in a 10-15 m^3 tank and the stocking is done in the dark, namely in the afternoon or evening. Acclimatization is carried out before the nauplii are stocked into the larval maintenance tank.

Sampling is carried out every three days (at the change of stages) to estimate the survival rate of shrimp. Based on density sampling data for nauplii maintenance, the survival rate of tiger shrimp (SR) from nauplii to PL5 is 26.67%. While SR PL5-PL25 is 80%. Larvae are observed periodically using transparent containers to determine the health of the larvae, the adequacy of feed based on intestinal morphology, the level of larval development, the condition of live feed, population estimation and observing the condition of particles contained in the maintenance media.

e. Larval and Seed Feed Management

Live feed in the form of *Skeletonema* sp. given to larvae starting from zoea I to PL3 stages twice a day, namely in the morning and afternoon/evening after one hour of artificial feeding. The dose is adjusted according to the age of the larvae. *Tetraselmis* sp. is given to larvae >PL3. In addition to being an additional source of food, *Tetraselmis* sp. in the media is a protector of the larvae from direct sunlight intensity. Zooplankton in the form of artemia which is given from mysis 3 to PL15 stages, *Artemia* sp. is given twice a day, namely in the morning at 09.00 WIB and at night at 23.00 WIB, one hour after artificial feeding. Vitamins are given in the maintenance of tiger shrimp larvae to increase the resistance of the larvae. Vitamins are given starting from zoea 1-PL3 stages with a dose of 0.5 ppm/day. Mixed vitamin administration (vitamin A, Vitamin D2, d1-tocopherol, Vitamin K3, thiamine HCL, riboflavin, pyridoxine, Vitamin B12, ascorbic acid, biotin, felic acid, innositol) is done by dissolving it in seawater. While artificial feed is given 7 times per day (08.00 WIB, 12.00 WIB, 15.00 WIB, 19.00 WIB, 22.00 WIB, 02.00 WIB and 05.00 WIB). Larvae at the nauplius stage do not need to be fed because they still have egg yolk reserves.

f. Water Quality Management and Health of Larvae and Fry

According to FAO (2007), in larval maintenance, the tank should only be filled to 50 percent of its full capacity with clean, disinfected, and filtered seawater, maintained at a salinity of 30-35 ppt and a temperature of 28-30°C before being filled with nauplii. During the vulnerable zoea stage (3-5 days depending on temperature), the water is not replaced because the larvae are very sensitive, and the water quality must remain good because the shrimp biomass is low and the feed is mostly live algae that do not pollute the water. In the early PL stage, replacement can reach 30-40%/day, the need for water replacement can increase if high levels of waste, ammonia, nitrite, and/or bacteria are found.

Disease prevention includes sterilization of the tank and equipment with chlorine, sterile seawater, control of water quality so that it does not fluctuate, using quality feed and nauplii. To prevent the growth of fungi, antifungals are used (Treflan 0.05 ppm/day, every 07.00 am) from zoea 1 to PL 5 stages. Probiotics are given to prevent disease. Probiotics are used at a dose of 5 ppm/day which is given after artificial feed is given. These probiotics are given from zoea-1 to PL-5. Probiotics play a role in preventing disease and improving host health, suppressing pathogens or modifying the shrimp's immune system so that they can contribute to protection against infection (Muthu et al., 2024) and increasing survival rates (Sriwulan et al., 2019).

2. Analysis of Economic Aspects

a. Analysis of Costs, Revenues and Benefits

The investment cost required for tiger shrimp breeding activities is IDR 1,063,000,000.00. The fixed costs for one year used in tiger shrimp breeding are IDR 216,300,000.00. Fixed costs are not affected by the rate of production and do not change due to the increase in production volume. The largest fixed costs come from labor costs and investment depreciation. While the production cost is IDR 368,670,000.00. The largest production costs come from feed and electricity. Income from the sale of tiger shrimp seed production (PL25) is IDR 960,000,000.00 year^{-1}. The target market is farmers in Brebes, Demak, Gresik, Sidoarjo and Kalimantan. Income can be increased by increasing the survival rate of seeds because based on the results of the interview, the market is still short of seed supply. While the profit from production is obtained from income after being reduced by total costs, which is IDR 375,030,000.00 year^{-1}.

b. Business Feasibility Analysis

PP (Payback Period) analysis is used to calculate the time required to return the initial investment from the project cash flow where a shorter payback period indicates a faster return on investment (Charalambides et al., 2024). The estimated PP value for the tiger shrimp hatchery business in this study was 2.83 years, while the PP value if taking into account the interest rate (6.16%) increased to 3.04 years. According to Charalambides et al., (2024), a payback period of up to six years is generally acceptable for aquaculture businesses.

Net present value (NPV) takes into account the time value of money by discounting future cash flows to their present value, allowing for a comprehensive evaluation of the profitability of the business (Charalambides et al., 2024). The NPV value obtained from the tiger shrimp hatchery activity in the estimated range of 10 years. The NPV value for the tiger shrimp hatchery business is positive, which is IDR 1,676,449,682.00. A positive NPV value indicates that the cash flow generates surplus value. This indicates that the tiger prawn hatchery business has the potential to generate profitable returns and achieve financial success, exceeding the minimum threshold. The increase in NPV value with higher production capacity indicates economies of scale and greater profitability as production levels increase (Charalambides et al., 2024). This indicates the potential for large-scale tiger prawn hatchery operations to achieve greater financial returns.

The internal rate of return (IRR) represents the discount rate at which the NPV becomes zero, providing insight into the potential rate of return on investment (Charalambides et al., 2024). A higher IRR indicates a more attractive investment opportunity. In aquaculture activities, feed costs, labor costs, and operational costs can significantly reduce project profitability and generate negative NPV values, while income has a positive impact because it increases the rate of return and profit (Charalambides et al., 2024). The IRR obtained in tiger prawn hatchery activities at BBPBAP Jepara is 19.64%. The IRR value can be increased by increasing the survival rate of the shrimp seeds produced or increasing the scale of production, so that it can increase income. According to Asmild et al. (2024), in shrimp production, the level of economic profit depends on the scale of production.

The Benefit cost ratio (B/C ratio) analysis aims to evaluate the economic potential of a business and can be used to assess the financial feasibility of a business. The B/C ratio in tiger shrimp seeding activities is 1.64, which means that the B/C Ratio value is greater than 1, so the business activity is considered feasible to continue. The B/C Ratio value of 1.87 indicates that every IDR 1.00 spent on total production costs will generate IDR 1.64.

CONCLUSION

Biotechnical aspects that are important factors in supporting the success of tiger prawn seeding activities at BBPBAP Jepara include maintenance and spawning of broodstock, broodstock feed management, maintenance of larvae and seeds, management of water quality and health of larvae and seeds. In addition, based on the results of the economic aspect analysis, the tiger prawn seeding business is feasible to be run. The feasibility value of the business can be increased by increasing the amount of production by increasing the survival rate of tiger prawn larvae and seeds.

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