PROBIOTIC TIGER SHRIMP *(Penaeus monodon)* FARMING AT DIFFERENT STOCKING DENSITY AND ITS COST BENEFIT ANALYSIS

A Thesis

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Sumitra Sarkar

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Approved as to style and content

By

(Signature of the Head)

Dr. Khandaker Anisul Huq

Professor

Fisheries and Marine Resource Technology Discipline

Khulna University, Khulna, Bangladesh

Declaration

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The results presented in this thesis with the above mentioned title are entirely of the candidate's own investigations and no part of the results has been accepted for any degree nor is it being concurrently submitted for any degree.

Sumitra Sarkar

(Signature of the Candidate)
Sumitra Sarkar
Roll No: MS- 080616
Session: 2007-2008

(Signature of the Supervisor)
Dr. Khandaker Anisul Huq
Professor
Fisheries and Marine Resource Technology Discipline
Khulna University, Khulna, Bangladesh

DEDICATED

TO

MY BELOVED FAMILY MEMBERS

Acknowledgement

All praises are to the supreme God whose mercy keeps me alive and enable to pursue my education and complete my project work.

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Sumitra Sarkar

Abstract

Shrimp aquaculture production in much of the world is depressed by disease. So probiotics farming has tremendous scope for controling various diseases. Determination of suitable stocking density of shrimp for probiotic farming is very necessary because of profit. In this present study different stocking densities ponds were cultured by using various probiotics and compared them with each other. Per Kg production cost were lower in 10 pcs/m2 compared with 5 pcs/m2 and 15 pcs/m2. . FCR was low (1.3) in 5 pcs/m2 densities and high (1.6) in 15 pcs/m2 densities. Survival of 5 pcs/m2 densities shrimps were 70%, 10 pcs/m2 densities shrimps were 60% and in 15 pcs/m2 densities shrimps were 48%. By cost benefit analysis of this culture, it is easy to say which density culture is most profitable and suitable. This present study showed that 10 pcs/m2 densities were most profitable (159010 Tk, profit 63%), 15 pcs/m2 densities were not so profitable (124013 Tk, profit 37%) because of slow growth and 5 pcs/m2 densities were not so profit (68295 Tk, profit 40%) because of high production cost and low production. So we can easily conclude that 10 pcs/m2 cultures were most profitable in semi-intensive probiotic shrimp farming system.

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List of Abbreviations

ABW-Average Body Weight

ADG- Average Daily Gain

ATDP-Agro-based Technology Development Project

CP- Cheron Phokphand

DO- Dissolve Oxygen

DoC- Day of Culture

FCR- Feed Conversion Ratio

CHAPTER - 1

INTRODUCTION

1. Introduction

In recent times, shrimp culture all over the world has been frequently affected by viral and bacterial disease inflicting huge loss (Karuna Sagor et al, 1994). Pathogenic micro-organism implicated in the out break are virus, bacteria, algae, fungus and protozoan parasites. For preventing and controlling disease antibiotics, pesticides and others chemicals are used which possibly create antibiotic resistant bacteria, persistence of pesticide and other toxic chemicals in aquatic environment and cause human health hazard. For that reason probiotic farming is a guideline for environment friendly and successful shrimp culture avoiding antibiotic residue. This farming method implemented in our country by CP Aquaculture Limited, Thailand. This farming system is mainly done by using various probiotic products which contain beneficial micro-organism like *Bacillus sp. Rhodobacter sp. Rhodococcus sp, Streptococcus sp.* etc. They are marketing probiotic into three groups name viz. Soil Probiotic (commercial name-Super Biotic & Super PS), Water Probiotic (commercial name-P^{H} Fixer & Super Biotic) and Nutrient Probiotic (commercial name-Zymetin) (See product information in appendix).

Proper pond and water quality management is essential for successful and quality shrimp production. Maintaining a good culture environment through proper management practices can reduce the risk of disease and increase production and acceptability of shrimp. Therefore, it is essential to implement and follow good aquaculture management practices to ensure shrimp quality.

The main purpose of aquaculture is to improve the production of aquatic biomass to fulfil increasing demand day by day and intensive aquaculture is a must now-a –days. Stocking density is the major concern for mono-culture. Some times excellent fish fry do not perform satisfactory unless correct stocking practices.

In general the stocking density and growth of fish are very much related. The optimum stocking density ensures sustainable aquaculture providing Proper utilization of feed, maximum production, sound environment and health. Although individual growth of fish is high, proper utilization of water body is not possible at the low stocking density.

In comparison to low stocking density, high stocking density exerts many negative impacts such as competition for food and shelter and rapid out break of disease if occurred. Therefore it is important to optimize the stocking density for the target species in Aquaculture for desired production.

In aquaculture, like other from of husbandry, feeding is crucial for its viability and success. Feed cost as well as fertilizers is one of the largest operational costs in Aquaculture (De Silva and Dary, 1992). Therefore, the act of feeding may be pointed as one of the most important element in the culture practice. The practice of feeding in an aquaculture system involves selection of appropriate ration sizes (the amount of feed supply), determining the feeding frequency (how many times the organism should be feed in a day), and timing of meal and efficient broadcasting of the pre-determined ration to the culture system.

Coastal shrimp farming in Bangladesh has a long history and is largely extensive in nature. More than 70% of the shrimp producers in the country produce shrimp using traditional farming technique. Farmers typically do not evaluate seed quality, stock largely without understanding of optimal density. Pond preparation, fertilization or feeding is rare and inconsistent (ATDP 11, 2005).

Shrimp farming mainly takes place in the districts of greater Chittagong, Noakhali, Barisal, Bagerhat, Bhola, Perojpur, Patuakhali, Satkhira and Khulna. Bagerhat and Khulna district is the most productive zone for Bagda (*Penaeus monodon*) culture. Probiotic farming system practices at Paikghaca, Koira and Dakop in Khulna district, Kaligong, Shamnagor, Debhata and Satkhira Sadar in Satkhira District, and most of the thana of Bagerhat district.

Good quality Seed that means mother check PCR tested negative PL and good quality feed is necessary for probiotic shrimp farming. Good quality feed helps to increase ADG

(Average Daily Gain), Survival and Production, and decrease DoC (Day of Culture), Production Cost and FCR (Feed Conversion Ratio).

Objectives of the Study

- To know about probiotic shrimp farming system
- To compare the production performance in different stocking densities
- To analyze cost benefit of probiotic farming in different stocking densities

CHAPTER - 2

LITERATURE REVIEW

2. LITERATURE REVIEW

Before conducting an experiment, it is very important to review the past research works which are related to the proposed study. The objective of this chapter is to review the past research works which are relevant to the present study.

In Bangladesh, a few studies have so far been made to evaluate the growth, survival and production of *P. monodon* under the semi- intensive probiotic framing with formulated feed in high stocking density.

Hossain (1987) observed some physio- chemical parameters of tide- feed shrimp ponds.

Mahamud et al. (1993) studied the limnology of the experimental shrimp ponds in Chadpur.

Hossain et al. (1992) studied the effect of stocking densities on the growth, survival and production of black tiger shrimp in brackish water ponds.

Rengpipat et al. (1998a,b) reported that Probiotics are now commonly used in Thailand to promote shrimp's disease resistance and as an alternative to antibiotics.

Soundarapandian et al. (2008) studied that applied probiotic in culture ponds of *p. monodon* and was compared with control ponds (without probiotic) the Average Body Weight (ABW), the total production and survival were higher in probiotic applied ponds and Feed Conversion Ratio (FCR) were lower in probiotic ponds. The shrimp of control ponds were seriously affected with various viral diseases.

Rengpipat et al.(1998a) experimented that Probiotic feeds were prepared by mixing fresh Bacillus S11 with commercial shrimp feed pellets at a ratio of Bacillus to shrimp feed = 1:3 (wet weight). The mixture were oven-dried at 37 °C for 1–2 h before storing in sealed plastic bags at - 20 °C until used. Final concentration of Bacillus S11 in treatment feeds was determined to be approximately 10^{10} CFU/g feed.

Abraham et al. (2007a) concluded that probiotic plays a vital role in growth, survival and production of the shrimp by maintaining good water parameters through out the culture periods.

Havenaar et al. (1992) studied that the use of beneficial bacteria (probiotics) to displace pathogens by competitive processes is being used in the animal industry as a better remedy than administering antibiotics and is now gaining acceptance for the control of pathogens in aquaculture.

Moriarty, D.J.W. (1990) said that *Vibrio* grow attached to algae, and may reach high population densities after being ingested with the algae and then excreted with lysed algae in fecal pellets by zooplankton; they are gut bacteria in fish and shrimps as well as zooplankton.

Smith, V H (1993) studied that Luminous *Vibrio* were completely eliminated from the water column and from the sediment of ponds in Indonesia when probiotic strains selected for their direct inhibitory effect were used. In contrast, *Vibrio* numbers increased markedly from around 20 to over 200 cfu/ml in shrimp ponds where antibiotics were used in the feed. Survival, and thus production, was high in all ponds where probiotics were used.

CHAPTER - 3

MATERIALS & METHODS

3. MATERIALS AND METHODS

Probiotic shrimp farming techniques introduced by CHERON PHOKPHAND (CP) Company were followed for this study. In this technique it is important to monitor various factors like shrimp production using supplementary feed, mortality, survivility, growth rate, average daily growth (ADG), feed conversion ratio (FCR) and the water quality parameter which are mostly related with pond productivity.

3.1 Study area and Study Period

The study was conducted in Pranti Shrimp Farming, Koira, Khulna. This area was selected because of suitability of climatic condition and soil fertility, which are helpful for probiotic shrimp farming. The study was conducted during March to July, 2009.

3.2 Types of data collection

Data on physical condition of the pond (soil condition, dike construction, water depth etc), pre-stocking management (pond preparation, water culture for stocking), post-stocking management (proper feeding, water quality management, use of probiotic in proper way etc) and production of the shrimp after harvest were collected.

3.3 Process of data collection

Total culture system was supervised by own observation. All the required data were collected in regular basis by direct observation. pH and temperature were collected two times (morning 6.00 am and afternoon 4.00 pm) in every day, DO was collected 5.00 am and 12.00 am, and sampling was done in seven days interval. DO and pH were checked by using test kit, and thermometer was used for measure temperature. Water quality parameters ($p^{H,}$ DO, alkalinity etc) were collected in regular basis.

3.4 Description of the Probiotic Culture System in Different Stocking Density

Culture period of three stocking density was 120 days. Continuous stocking was not done; PL was stocked in a definite time. PL was cultured at two times in a year (from March- June and July to November).

3.4.1 PROBIOTIC FARMING FOR STOCKING DENSITY UP TO 15 Pcs/m^2

A. WATER PREPARATION (21-30 days)

1. SUPER PS at 10-20 L/ha /Time for Wet Pond Preparation
2. Eradication of virus carriers by using CHLORINE (30 ppm)
3. MOLASES, RICE BRAN and YEAST (2:1: 0.01) fermentation at 20-25 Kg/ha/day for 1 week to enhance p^H stability
4. P^H FIXER at 6 Kg/ha/for every 4 days for two weeks for stable water p^H
5. DOLOMITE at 50-60 Kg/ha used in 2 or 3 doses depending on P^H

B. POST LARVE (PL) CULTURE (120-130 days)

1. SUPER BIOTIC at 3 Kg/ha/once a week for 6 weeks to reduce Pathogenic Bacteria
2. SUPER PS at 10 L/ha/once a week for 16 weeks to improve pond bottom
3. ZYMETIN at 10 g/Kg feed /one meal daily for 16 weeks to prevent Luminescense bacteria in the gut and to avoid White Feaces
4. MUTAGEN at 10 g/Kg feed /one meal daily to help for increasing feed intake
5. VITAMIN C-150 at 5 g/Kg feed/one meal daily for better growth

C. HARVEST (Targeted Average Body Weight 30-35 gm)

3.4.2 PROBIOTIC FARMING FOR STOCKING DENSITY UP TO 10 Pcs/m^2

A. WATER PREPARATION (21-30 days)

1. SUPER PS at 10-20 L/ha /Time for Wet Pond Preparation
2. Eradication of virus carriers by using CHLORINE (30 ppm)
3. MOLASES, RICE BRAN and YEAST (2:1: 0.01) fermentation at 20-25 Kg/ha/day for 1 week to enhance p^H stability
4. P^H FIXER at 6 Kg/ha/for every 4 days for two weeks for stable water p^H
5. DOLOMITE at 50-60 Kg/ha used in 2 or 3 doses depending on P^H

B. POST LARVE (PL) CULTURE (120-130 days)

1.SUPER BIOTIC at 2 Kg/ha/once a week for 6 weeks to reduce Pathogenic Bacteria

2.SUPER PS at 5 L/ha/once a week for 16 weeks to improve pond bottom

3. ZYMETIN at 10 g/Kg feed /one meal daily for 16 weeks to prevent Luminescense bacteria in the gut and to avoid White Feaces

4. MUTAGEN at 10 g/Kg feed /one meal daily to help for increasing feed intake

5. VITAMIN C-150 at 5 g/Kg feed/one meal daily for better growth

C. HARVEST (Targeted Average Body Weight 35-40 gm)

3.4.3 PROBIOTIC FARMING FOR STOCKING DENSITY UP TO 5 Pcs/m^2

A. WATER PREPARATION (21-30 days)

1. SUPER PS at 10-20 L/ha /Time for Wet Pond Preparation
2. Eradication of virus carriers by using CHLORINE (30 ppm)
3. MOLASES, RICE BRAN and YEAST (2:1: 0.01) fermentation at 15 Kg/ha/weekly thrice for 1 week to enhance p^H stability
4. DOLOMITE at 50-60 Kg/ha used in 2 or 3 doses depending on P^H

B. POST LARVE (PL) CULTURE (120-130 days)

1. SUPER PS at 2.5 L/ha/once a week for 16 weeks to improve pond bottom
2. ZYMETIN at 10 g/Kg feed /one meal daily for 16 weeks to prevent Luminescense bacteria in the gut and to avoid White Feaces
3. MUTAGEN at 10 g/Kg feed /one meal daily to help for increasing feed intake
4. VITAMIN C-150 at 5 g/Kg feed/one meal daily for better growth

C. HARVEST (Targeted Average Body Weight 40-45 g)

3.5 General description of the pond

Nine ponds were selected to accommodate the experiment, which was near about similar in size. Every treatment contains three replicates. Average depth of the water was from 0.9-1.5 meter. Dyke of the pond was improved. Soil condition of the pond was clay-loamy.

3.6 Pond preparation for stocking

- Preparation of pond bottom without loofe and black soil
- Pond bottom dried in 2 month before watering
- Enclose the pond with good fencing to prevent entry any type of animal like crab, snake, frog, cow and other unnecessary live organism
- Use SUPER PS for Wet Pond Preparation
- Apply rock lime or agriculture lime in pond bottom before pump water
- Fill water into the pond upto 5 ft with good filtration (2 or 3 places) to prevent entry of crustacean and fish eggs and other unnecessary organism
- Settle water in pond 3 days after complete pumping to hatch the eggs into the pond with aeration
- Apply bleaching at 60 ppm in evening to eradicate all virus carriers from the pond and spray bleaching water in slope and dike to kill the carrier
- Aeration and other necessary materials set up in pond before bleaching treatment
- After bleaching total pond and pond area should be highly restricted to avoid any type of contamination
- Next day onward drug chain every day in all area of pond between 8-11 am and run aerator during drugging to reduce the residual effect of bleaching and also for prevent growth of filamentous algae
- Wait 5 days for de-chlorination and then start application for water culture to make suitable water for PL stocking
- Use per acre 5-10 Kg molasses, 2.5-5 Kg rice bran and 50-100 gm yeast powder dissolve in more water in 24 hours and apply its juice everyday upto 7 days continuous in presence of aeration to develop good plankton in pond water for better survival

3.7 Stocking management

During stocking the following things were maintained;

- Water quality management
- Construction of nursery ground
- Ensure mother tested PCR negative PL for stocking
- Proper acclimatize for good survival
- Maintain stocking density

The above points are discussed in result section.

3.8 Post stocking management

- Proper feeding
- Regular check tray monitoring
- Weekly sampling
- Proper monitoring for shrimp health and water quality
- Availability of aeration
- Harvesting

The above points are discussed in result section.

3.9 Data analysis

3.9.1 Survival rate calculation

Survival rate was calculated as follows:

$$\% \text{ Survival Rate} = \frac{\text{Number of Shrimp at final}}{\text{Number of Shrimp at Initial}} \times 100$$

3.9.2 Growth monitoring

During morning sampling was done for growth monitoring. By using balance shrimp weight was taken and then divided it by shrimp number.

$$\text{Body Weight} = \frac{\text{Weight of shrimp}}{\text{Number of shrimp}}$$

3.9.3 Average Daily Growth (ADG)

$$\text{ADG} = \frac{\text{Present Weight} - \text{Previous Weight}}{\text{Time interval of both Weighing}}$$

3.9.4 Feed Conversion Ratio (FCR)

$$\text{FCR} = \frac{\text{Total feed used (in Kg)}}{\text{(Total final shrimp weight in Kg} - \text{Total initial shrimp weight in Kg)}}$$

3.9.5 Calculation of tray feed

$$\text{Tray feed (gm/Kg feed/meal)} = \frac{\text{Liftnet Percent (from record book)} \times 16{,}000}{\text{Area of the pond (M2)}}$$

3.9.6 Cost Benefit Analysis

All the documents of the cost of the culture and sell were records, from these data easily calculated cost benefit of the culture.

3.10 PHYSICAL CONDITION OF THE PONDS

3.10.1 Pond Size

I choose 9 different ponds in different size. I tried my best for same density culture; pond size was near about same. The total production of shrimp per pond increase directly with pond sizes (Molla et al., 1986). Under most circumstances 1 to 2 acre are the most efficient for semi intensive culture where the stocking density is < 30 Pcs/m2 (Hansell, 1993). In this experiment, all the ponds were medium in size which given below;

Table 1: Area of the culture ponds

Pond no	Area (Ha)
4B	0.29
5A	0.32
5B	0.31
6	0.42
7	0.39
8	0.44
9	0.52
10	0.55
11	0.54

3.10.2 Soil Condition of the Pond

All the ponds soil was clay loamy, no sandy or peat soil was found. Clay and clay loamy is the best quality of soil for shrimp culture, because of their good water retention capacity (Paul, 1996). Soil which consists of silt or clay or mixtures of these with a small portion of sand normally have good water retention capacity (New and Singholka, 1985).

3.10.3 Water Depth

In dry season, the water depth of the culture ponds was maintained between 0.8 to 0.9 m in average. In this time re-watering was done from reservoir pond with proper treatment. Water depth was raised in rainy season, and then average depth was 1.0 to 1.2 m which is very much suitable for culture. Average depth of water in pond should be about 0.9 meter, with a minimum of 0.75 m and a maximum of 1.2 to 2 m (New and Singhola, 1985).

3.11 POND PREPARATION FOR STOCKING

3.11.1 Removal of bottom black soil

Black soil of the bottom was totally removed before entering water into the ponds. After removing black soil, all ponds were drying properly with sun shine. Then by using soil P^H tester, P^H of the soil was calculated. It was found at recommended level so that no liming was needed at pond preparation time.

3.11.2 Dike preparation

Dike was prepared properly to prevent the leakage of the water. The slope ratio was near about 1: 2. The wide of the dike was 1 m and the height of the dike was 1 m above of the maximum water level. Dike should be high enough to prevent flooding during heavy rains. They should be between 0.3 to 0.5 m above the maximum water level (1.5 to 1.8 m). It is essential to stop leakage and seepage to prevent virus contamination (Hansell, 1993). Top level of the dike should be at least 7-9 feet so that it is 3-4 feet higher than maximum tidal level (Paul, 1996).

3.11.3 Fencing and Bio-security maintain

Fencing was made in around the every pond to prevent entering snake, crab, domestic animal etc. with 1.5 feet high. In every pond dike and gate disinfect (Potash) was kept in pot which helped the persons to remove various carrier. In every times of entering into farm area hand and foot wash was always practiced.

3.11.4 Watering

Water entered into the pond by inlet from Koira River which located near the farm with 4 times filtration. 3 times filtration was done in outlet with filter net in small mesh size and 1 time filtration was done through filter net at the time of entering water into pond. This filtration resist for entering the eggs and larvae of unwanted species. There was also a reservoir pond. The water of the reservoir pond was disinfected with 60 ppm bleaching and this water further entered into the pond when water depth was decreased.

3.11.5 Predator control

60 ppm bleaching was applied in the afternoon after 3 days of watering to control the undesirable species like fish, crustacean, mollusk, reptile etc. after 3 days of bleaching the water of the pond was totally plankton free, virus carrier free. Then chain racking and properly aeration was run to de-chlorination of the bleaching.

3.11.6 Water Quality Management

3 days after bleaching, water culture was begun. At the very begging P^H of the water was measured with P^H test kit. Then Dolomite at 20 kg/acre was applied at one day interval up to 7 days. Then applied Molasses, Rice bran, Yeast fermentation (20 Kg : 10 Kg : 0.2 Kg/acre) for 1 week to enhance P^H stability. Also applied probiotic products like Super Biotic (3 Kg/ha) and P^H Fixer (5 Kg/ha) for stable water and to reduce pathogenic bacteria. By the application of above things in 20-25 days, the water color, phyto-plankton, Zoo-plankton, Benthos and others necessary organism was available in the pond water which was fully ready for stocking of PL.

CHAPTER - 4

RESULTS & DISCUSSION

4. RESULTS AND DISCUSSION

4.1 STOCKING MANAGEMENT

4.1.1 Water quality management

In Probiotic culture system water quality was maintained properly. In total culture period water quality parameter which were measured are shown in following ranges

Table 2: Water parameter of the ponds

Water Parameter	Measured Ranges
Temperature	25° C- 32° C
P^H	7.3-8.7
Salinity	12-26 ppt
Dissolve Oxygen (DO)	3.5-6.0 ppm
Alkalinity	110-180 ppm
Hydrogen Sulfide (H_2S)	0.1-0.3 ppm
Ammonia	0.01-0.1 ppm
Transparency	45-55 cm

Source: Regular observation

4.1.2 Nursery pond construction

Nursery pond is very necessary for culture that helps to proper feeding for small PL, which increases survivility. The nursery area is usually 5 to 10% of the total pond area (Chanratchakool et al., 1994). In this culture there were four nurseries ground N1, N2, N3 and N4 which area were respectively 0.4 H, 0.45 H, 0.28 H and 0.32 H.

4.1.3 Sources of PL

PL was collected from the Gazi Fish Hatchary, Kailashjong, Dacop, Khulna. These PL were mother check PCR tested negative, which were virus free.

4.1.4 Criteria of good PL

General conditions of the PL at the hatcery were checked like activity, size, color etc. The PL was actively swimming against the swirling water current, uniform in size and uniform body color.

4.1.5 PL transportation

The PL was transported within short time, which was not more than 6 hours. Poly bags were packed with low density of PL for minimal stress. From Gazi Fish the PL was transported with river channel by engine boat. Every poly contained 2000-2300 pcs of PL and the size was PL_{15}

4.1.6 Stocking of PL

4.1.6.1 Stocking Time

PL were stocked into the ponds in the month of March. Before stocking all the parameters of the water were measured which were almost near about susceptible level. PL were stocked in the early of the morning.

4.1.6.2 Acclimatization

To equalize the temperature and parameter proper acclimatize is necessary. Some confined area of the pond identified with rope and shade and poly-bags of the PL were kept in to adjustment the temperature by spreading water on the bags like rainfall. After 5 minutes the clips of the bags were opened and folded to equalize the Salinity and P^H of with showering the water into the bags within 45 minutes and then release the PL in the pond water. Two hapa were set in the two side of the pond in which 200 PL release for calculation of hapa survival rate of this PL by counting first three days which helped for feed adjustment in this new stock.

4.1.6.3 Stocking in nursery pond

Firstly PL were stocked in nursery pond with following stocking density in four nursery ponds.

Table 3: Stocking in Nursery Ponds

Pond No.	Area (M^2)	Stocking (pcs)	Stocking Density (Pcs/M^2)	Hapa Survival (%)
N1	4000	80,000	20	80
N2	4500	1,75,000	38.9	82
N3	2800	1,25,000	44.6	75
N4	3200	1.40,000	43.75	78

4.1.6.4 Stocking in Grow-out pond

After nursing with 25-35 days PL wrer transferred into 9 grow out ponds in which 3 ponds with 5 pcs/m2, 3 ponds with 10 pcs/m2 and 3 ponds with 15 pcs/m2.

Table 4: Stocking in Grow-out ponds

Pond no	Area (Ha)	Stocking (pcs)	Stocking Density (Pcs/m2)
4B	0.29	14,500	5
5A	0.32	16,000	5
5B	0.31	15,500	5
6	0.42	42,000	10
7	0.39	39,000	10
8	0.44	44,000	10
9	0.52	78,000	15
10	0.55	82,500	15
11	0.54	81,000	15

4.2 POST STOCKING MANAGEMENT

4.2.1 Feeding Management

4.2.1.1 Feed type

In close system culture feed cost is a large operational cost for this good feed management and good quality feed is necessary. In this experiment CP (Cheron Pokphand) supplementary feed of NASA group were used which formulated by CP group, Carala, India with following ingredient fish meal, shrimp head meal, cod liver oil, squid meal, broken rice, soybean meal, wheat flour, cholesterol, phospolipids, vitamins and minerals (Leaflet of NASA Feed).

Table 5: Different types of CP feed and its composition

Feed Code	Day of Culture	Feed Types	Protein min (%)	Fat min (%)	Fiber max (%)	Moisture max (%)
2001	1-10	Fine Crumble (Nursery)	40	5	4	12
2002	11-30	Crumble (Starter)	40	5	4	12
2003	31-50	Crumble (Starter)	40	5	4	12
2004-S	51-70	Pellet (Grower)	38	5	4	12
2004	71-110	Pellet (Grower)	38	5	4	12
2005	111-rest	Pellet (Finisher)	38	5	4	12

Source; Leaflet of NASA feed

4.2.1.2 Feeding Program

Feed management was done with following feeding scheme of CP authority. In the very fast day 2 Kg feed was used for every 1, 00000 pcs of PL. Feeding program for tiger shrimp Age 1-50 Days as follows:

Table 6: Feeding Schedule at 1-50 days of culture

Age (days)	Feed increase/day/1,00000 pcs	Feed (Kg) /day	Feed code
1		2.0	2001
2-10	400	2.4-5.6	2001
11-30	600	6.2-17.6	2002, 2003
31-50	500	18.1-27.6	2003, 2004

After 50 days four check trays were set in every pond for regular feed and health monitoring. In this time feeding were managed in following schedule;

Table 7: Feeding Schedule at 50-145 days of culture

Age (days)	MBW (gm)	% feed	Feed code	% Liftnet	Checktray time(hours)	Meal (time)	Size of shrimp (Pcs/kg)
50-55	6-7	5.5-5.3	2004-S	2.4	2.0	4	200-143
55-60	7-8	5.3-5.1	2004-S	2.6	2.0	4	143-125
60-65	8-9	5.1-4.9	2004	2.6	2.0	4	125-111
65-70	9-10	4.9-4.7	2004	2.8	2.0	4	111-100
70-77	10-12	4.7-4.5	2004	3.0	2.0	4	100-83
77-83	12-14	4.5-4.2	2004	3.1	2.0	4	83-72
83-90	14-16	4.2-4.0	2004	3.2	2.0	4	72-63
90-97	16-18	4.0-3.7	2005	3.3	2.0	4	63-56
97-104	18-21	3.7-3.4	2005	3.4	2.0	4	56-48
104-110	21-24	3.4-3.2	2005	3.6	2.0	4	48-42
110-117	24-27	3.2-3.0	2005	3.7	2.0	4	42-37
117-124	27-30	3.0-2.7	2005	3.9	2.0	4	37-33
124-131	30-33	2.7-2.5	2005	4.0	2.0	4	33-30
131-138	33-36	2.5-2.3	2005	4.1	2.0	4	30-29
138-145	36-40	2.3-2.1	2005	4.2	2.0	4	29-25

Source: Record book of CP feed of NASA brand

4.2.1.3 Feeding Schedule

In this study four times in a day feeding was given in 6.00 am, 11.00 am, 5.00 pm and 10.0 pm respectively at 25%, 20%, 30% and 25% of the total feed in that day. Everyday in 5.00 pm feed nutrient probiotic (Mutagen-10gm/Kg feed and Zymatine -5 gm/Kg feed) and Vitamin C-50 at 5 gm/Kg feed was added.

4.2.1.4 Check Tray Monitoring

Check tray were used to ensure that supplied feed was properly consumed or whether the supplied feed was increased or decreased depending on check tray report in every two hours interval of feeding. Four trays were set in every pond.

4.2.2 Sampling and Health monitoring

Periodic sampling is very vital for successful shrimp culture. It is recommended to do weekly to check the health condition as well as to estimate the growth of shrimps. Sampling also helps to know the ABW and this would help in estimating the total biomass in the pond for better feed management.

After 30 days of stocking 1st sampling was done when the average body weight was near about 3.5 gm to 4.5 gm. Sampling is done at the collection of the shrimp in different places of the pond and then taken this in sampling bag by measuring with balance. Generally sampling was done in 7 days interval and all the sampling report recorded. Not only the growth monitoring but also the health conditions of the shrimp were checked in sampling. For this in 2 or 3 days interval cross checking was done to identified their body color, gill condition, moulting situation, carapace condition and overall their total health. If Zoothonium, black gill were found in the shrimp body then applied Agriculture lime and Super PS.

4.2.3 Water Quality and Health Management

To maintain water quality stability of p^H is very necessary. For this regular checking of P^H was done , if it was below the optimum level then applied Dolomite (20 Kg/acre), if it was higher than optimum level then applied Molasses, Rice bran and Yeast (10 Kg : 5 Kg : 0.1 Kg per acre) , before application it must be fermented by soaking water in previous day. To improve alkalinity applied agricultural lime in 8-10 Kg/acre. To reduce pathogenic bacteria in the pond water applied Super Biotic at 2 or 3 Kg/ha/once a week (depending on density) for 6 weeks and to improve pond bottom Super PS was applied in once a week for 16 weeks (doses depends on density).

4.2.4 Aeration

In 5 pcs and 10 pcs density two long arms aerator was set and in 15 pcs density four long arms aerator was set. Aerator helps to maintain DO as well as growth by mixing water into aerobic condition. Aerator serves to counter act oxygen depletion and stabilize diurnal dissolved oxygen level (Mohanty, 1996). In 5 pcs density, aerators only run in night from 7 p.m. to 9 p.m. and 1 a.m. to 4 a.m. In 10 pcs and 15 pcs density, aerator started after two hours of feeding and stopped 30 minutes before feeding (average 11-12 hours aeration).

4.2.5 Harvest

After 140 days of stocking complete harvesting was done by draining out the water through outlet by pumping. The average body weight of the shrimp were 40 gm/pcs in 5 pcs density, 34 gm/pcs in 10 pcs density and 28 gm/pcs in 15 pcs density.

4.3 DATA ANALYSIS

4.3.1 Production

Table 8: Production of different ponds

Pond no.	Area (Ha)	Density (Pcs/M2)	Production (Kg)	Survivality
4B	0.29	5	435	75%
5A	0.32	5	499	80%
5B	0.31	5	445	70%
6	0.42	10	845	61%
7	0.39	10	852	64%
8	0.44	10	870	56%
9	0.52	15	1115	49%
10	0.55	15	1075	48%
11	0.54	15	1085	48%

Comparison of production in different stocking density which I found in my study given below;

Table 9: Average per Hector Production in different stocking density

Density (Pcs/m2)	Total production (Kg)	Production per Hector (Kg)	Average Production (Kg)
5	435	1500	1498
	499	1559	
	445	1435	
10	845	2012	2058
	852	2185	
	870	1977	
15	1115	2144	2036
	1075	1954	
	1085	2009	

4.3.2 Survivality Analysis

Average survivality was 70%, 60% and 48% in 5 pcs/m2, 10 pcs/m2 and 15 pcs/m2 densities, respectively. Survival rate was depend on water quality, feeding, monitoring, pond ecology etc. (Chakraborty, 1993). Shrimp cultured in semi-intensive system with formulated feed 70% survivality is good. (Chakraborty, 1993). Krantz and Norris (1975) stated that Survival rates of 60% to 80% are to be expected for *Penaeus monodon* under suitable rearing condition.

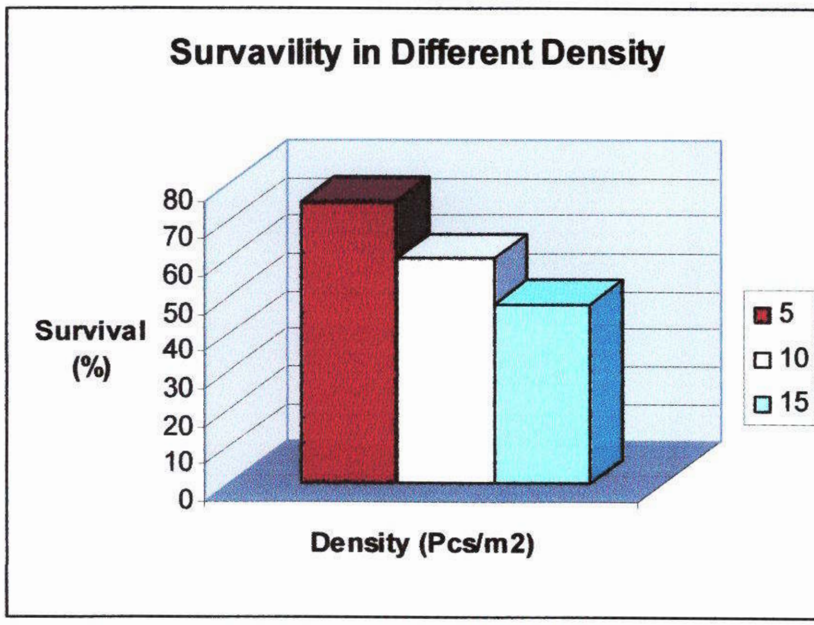

Fig. 1: Survivability of shrimp in different stocking densities

4.3.3 Feed Conversion Ratio (FCR) Analysis

How much feed is required for production of 1 Kg of shrimp is called FCR. The following table shows the FCR value of the present study. FCR was low (1.3) in 5 pcs/m2 density and high (1.6) in 15 pcs/m2 densities (shown in Fig.2). Chekait (1995) observed the Feed Conversion Ratios were varying 1.5 to 1.55 when microencapsulated diets are used. Saha et. al., (1999) observed that the FCR of 1.31 to 1.58 in low saline ponds and 1.35 to 1.68 in high saline ponds.

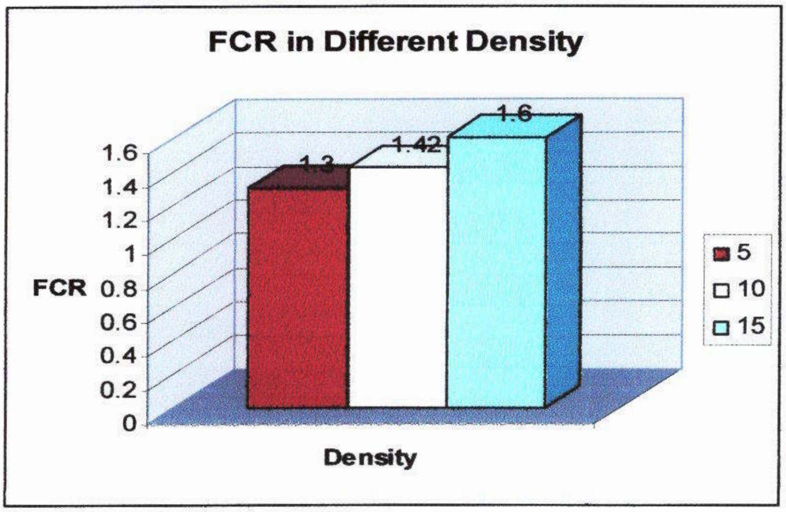

Fig. 2: Feed Conversion Ratio in Different stocking densities

Table10. Feed Conversion Ratio (FCR) in different ponds

Density (Pcs/m2)	Pond no.	FCR	Average FCR
5	4B	1.32	1.3
	5A	1.28	
	5B	1.30	
10	6	1.42	1.42
	7	1.43	
	8	1.40	
15	9	1.58	1.6
	10	1.6	
	11	1.62	

4.3.4 Average Body Weight

Price of the shrimp depends on the body weight. Big size (40 gm/pcs) shrimp had a good selling price. ABW in 5 Pcs/m2 was the highest (40 g/pcs) in the present study.

Table11: Average Body Weight (ABW) in different ponds

Density (pcs/m2)	Pond no.	ABW (gm)	Body weight Average	Average Daily Gain (ADG)
5	4B	40	40	0.285
	5A	39		
	5B	41		
10	6	33	34	0.24
	7	34		
	8	35		
15	9	29	28	0.2
	10	27		
	11	28		

4.3.5 Cost Benefit Analysis

Cost benefit analysis is very necessary for any business. By cost benefit analysis of a culture, it is easy to say which density culture is most profitable and suitable. Details cost benefit analysis is shown in appendix part of this thesis. From this analysis it is clear that 10 pcs/m2 densities was most profitable. A density of 15 pcs/m2 was not so profitable because of slow growth and high operational cost, and 5 pcs/m2 densities was less profitable because of low production. So we can easily conclude that 10 pcs/m2 cultures were most profitable in probiotic farming system.

Table12: Cost-benefit in different stocking densities

Density (Pcs/m2)	Production	Production (Ha)	ABW	FCR	Total Cost	Total Profit	Profit Percent
5	460 Kg	1498 Kg	40 g	1.3	1,70,905 Tk	68,295 Tk	40%
10	856 Kg	2058 Kg	34 g	1.42	2,51,870 Tk	1,59,010 Tk	63%
15	1090 Kg	2036 Kg	28 g	1.6	3,33,787 Tk	1,24,013 Tk	37%

4.3.5.1 Cost Analysis

The production cost included fixed cost and total operational cost. Fixed cost contains pond construction cost, aerator establishment cost, blue net fencing, tray, catwalk, cast net and land harri. Operational cost contain pond preparation cost, disinfection cost, chemical cost, probiotic cost, PL purchasing cost, labor cost, aeration (Electricity and Diesel) cost, maintenance cost, harvest etc. Per Kg production cost was lower (294 TK/Kg) in 10 pcs/m2 compared with 5 pcs/m2 (371 TK/Kg) and 15 pcs/m2 (306 Tk/Kg).

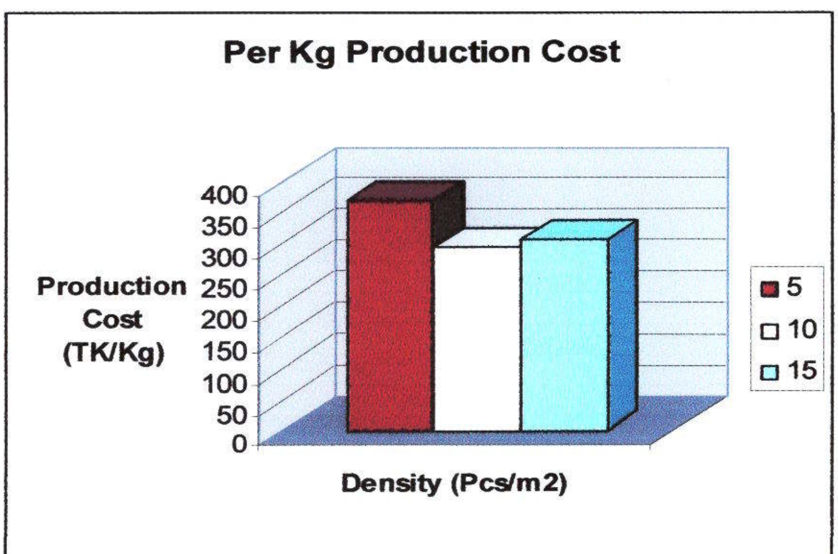

Fig. 3: Production cost in three different stocking densities

Table13: Cost of different densities ponds

Density (Pcs/m2)	Average production	ABW	FCR	Fixed Cost (TK)	Operational Cost (TK)	Total Cost (TK)	Per Kg Production Cost (Tk)
5	460 Kg	40 g	1.3	36,125	1,34,780	1,70,905	371
10	856 kg	34 g	1.42	37,645	2,14,225	2,51,870	294
15	1090 Kg	28 g	1.6	41,297	2,92,490	3,33,787	306

4.3.5.2 Profit Analysis

The average per hector production was highest in 10 pcs/m2 culture among three stocking density and profit percentage was also high in 10 pcs/m2 density (shown in Fig.4). So we concluded that 10 pcs/m2 cultures were suitable for semi-intensive probiotric shrimp farming. Because in 5 pcs/m2 density average per hector production was not higher in comparison with others two and 15 pcs/m2 density was not so profitable because of slow growth (Average Body Weight was very lower than the others two densities).

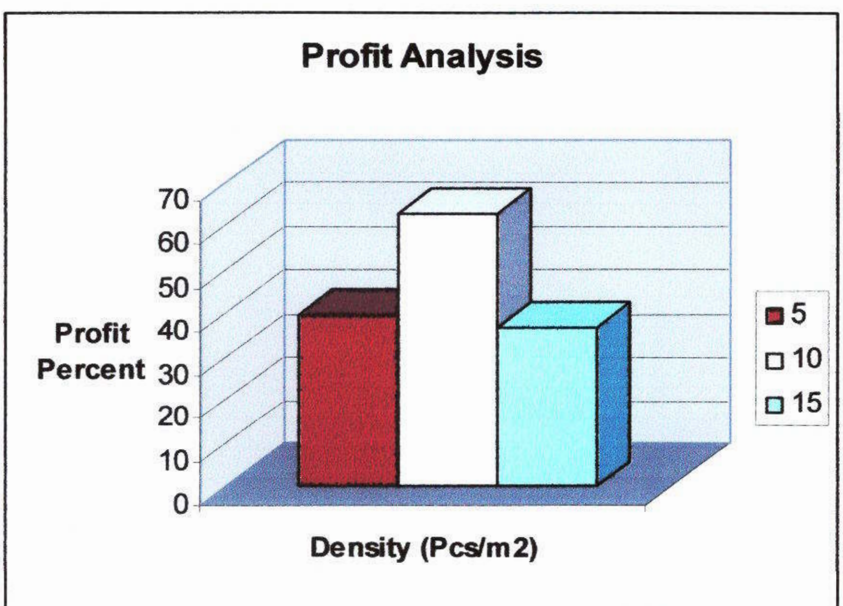

Fig. 4: Profit percent in three different stocking densities

Table14: Profit in different stocking densities

Density (Pcs/m2)	Total Income (TK)	Total Cost (TK)	Total Profit (TK)	Profit Percent
5	2,39,200	1,70,905	68,295 Tk	40%
10	4,10,880	2,51,870	1,59,010 Tk	63%
15	4,57,800	2,92,490	1,24,013 Tk	37%

Conclusion

In probiotic shrimp farming good quality seed, proper management, good quality feed and effective probiotics (water probiotics, soil probiotics and nutrient probiotics) play vital role. In probiotic shrimp farming identification of suitable stocking densities is very important for the perspective of cost benefit analysis.

In this study the average per hector production was highest in 10 pcs/m2 culture among three stocking density (5 pcs/m2, 10 pcs/m2 and 15 pcs/m2) and profit percentage was also highest in this stocking density. So the general conclusion obtained from the present study is that probiotics plays an important role in growth and production but it is very necessary to identify the suitable and profitable stocking density. This study identified that in our management system and environmental condition 10 pcs/m2 stocking density is suitable because of lowest per Kg production cost and highest profit percentage.

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APPENDIX

Appendix
COST BENEFIT ANALYSIS

Average Cost Benefit Analysis of 5 pcs/m2 density
Average Area=3000m2, Average Production= 460 kg, FCR=1.3, ABW= 40 g

A. FIXED COST — COST TK

1. Pond Construction & Land Hurry	64,500
2. Aerator 2 set small Long arm 3500tk x 2	70,000
3.Blue net surround the pond	5000
4. Check tray, Catwalk, Cast net and other fixed cost	5000
Total fixed cost for one acre and will use for 2 years (4 Crops)	1,44,500
Per crop fixed cost involve (1,34,500 tk/4 Crops)	36,125

B. OPERATIONAL COST — COST TK

1. Pond preparation	1,000
2.Disinfection cost 270 kg bleaching x 35tk /kg	9,450
3.Molases, Rice bran and other Organic fertilizer	3,000
4.Chemical cost ((Dolomite, CaO etc)	4,500
5.Shrimp PL 15000 Pcs x 0.5 tk/ PL	7,000
6.Feed cost 460 Kg x 1.3 =598 Kg x 85 tk/Kg	50,830
7.Probiotic (super ps 40 lit and other Probiotic)	10,000
8. PH test Kit 1 pcs and others	1,500
9. Electricity/ Diesel & Mobil (550 Hrs @ 50 tk/ Hrs 1st month –1hrs, 2nd-2hrs, 3rd-5hrs, 4 th&5th- 6hrs with two arms	27,500
10. Labor @ 3500/tk/month for 6 month ÷ 2 (2Ponds in 1 man)	10,500
11. Harvest and transportation	4,500
12. Others related cost	5,000
Operational cost per crop =	1,34,780

Total income from production 40 gm size 460kg × 520 tk/kg	**2,39,200**
Total cost including fixed cost per crops (36,125+1,34,780) Tk	**=1,70,905**
Profit per crop in shrimp culture	**68,295**
Profit	**40%**

Average Cost Benefit Analysis of 10 pcs/m2 density
Average Area= 4160 m2, Average production= 856 Kg, FCR= 1.42, ABW= 34 g

A. FIXED COST **COST TK**

1. Pond Construction & Land Hurry	70,080
2. Aerator 2 set small Long arm 3500tk x 2	70,000
3.Blue net surround the pond	5500
4. Check tray, Catwalk, Cast net and other fixed cost	5000
Total fixed cost for one acre and will use for 2 years (4 Crops)	1,50580
Per crop fixed cost involve (1,34,500 tk/4 Crops)	37,645

B. OPERATIONAL COST **COST TK**

1. Pond preparation	1,500
2.Disinfection cost 370 kg bleaching x 35tk /kg	12,950
3.Molases, Rice bran and other Organic fertilizer	3,500
4.Chemical cost ((Dolomite, CaO etc)	5,000
5.Shrimp PL 41,000 Pcs x 0.5 tk/ PL	20,500
6.Feed cost 856 Kg x 1.42=1215 Kg x 85 tk/Kg	1,03,275
7.Probiotic (super ps 50 lit and other Probiotic)	14,000
8. PH test Kit 1 pcs and others	1,500
9. Electricity/ Diesel & Mobil (620 Hrs @ 50 tk/ Hrs 1st month –2hrs, 2nd-3hrs, 3rd-4hrs, 4 th&5th- 6hrs with two arms	31,000
10. Labor @ 3500/tk/month for 6 month ÷ 2 (2Ponds in 1 man)	10,500
11. Harvest and transportation	5,500
12. Others related cost	5,000
Operational cost per crop =	2,14,225

Total income from production 34 gm size 856kg × 480 tk/kg	**4,10880 TK**
Total cost including fixed cost per crops (37,645+2,14,225) Tk	**=2,51,870 TK**
Profit per crop in shrimp culture	**1,59,010 TK**
Profit	**63%**

Average Cost Benefit Analysis of 15 pcs/m2 density
Average Area= 5160 m2, Average production= 1090 Kg, FCR= 1.6, ABW= 28 g

A. FIXED COST — COST TK

1. Pond Construction & land Hurry	84,690
2. Aerator 2 set small Long arm 3500tk x 2	70,000
3.Blue net surround the pond	5500
4. Check tray, Catwalk, Cast net and other fixed cost	5000
Total fixed cost for one acre and will use for 2 years (4 Crops)	1,65,190
Per crop fixed cost involve (1,34,500 tk/4 Crops)	41,297

B. OPERATIONAL COST — COST TK

1. Pond preparation	2,000
2.Disinfection cost 450 kg bleaching x 35tk /kg	15,750
3.Molases, Rice bran and other Organic fertilizer	4,000
4.Chemical cost ((Dolomite, CaO etc)	7,000
5.Shrimp PL 77,000 Pcs x 0.5 tk/ PL	38,500
6.Feed cost 1090 Kg x 1.6=1744 Kg x 85 tk/Kg	1,48,240
7.Probiotic (super ps 80 lit and other Probiotic)	20,000
8. PH test Kit 1 pcs and others	1,500
9. Electricity/ Diesel & Mobil (680 Hrs @ 50 tk/ Hrs 1st month –2hrs, 2nd-3hrs, 3rd-5hrs, 4 th&5th- 6hrs with two arms	34,000
10. Labor @ 3500/tk/month for 6 month ÷ 2 (2Ponds in 1 man)	10,500
11. Harvest and transportation	6,000
12. Others related cost	5,000
Operational cost per crop =	2,92,490

Total income from production 28 gm size 1090kg × 420 tk/kg	**4,57,800 TK**
Total cost including fixed cost per crops (41,297+2,92,490) Tk	**=3,33,787 TK**
Profit per crop in shrimp culture	**1,24,013 TK**
Profit	**37%**

Probiotic Product Information

SUPER BIOTIC (WATER PROBIOTIC FOR VIBRIOSIS CONTROL)

Out break of Vibriosis mainly by luminescence bacteria is more in summer due to high temperature and high salinities. CP Group scientists in Thailand have done intensive research and found out special strain of Bacillus to have great inhibitory abilities against luminescent vibrio and have named it as SUPER BIOTIC.

COMPOSITION:

Baccillus sp. 10 cfu /g product. This strain of Bacillus was scientifically proven to have great inhibitory abilities luminescent Vibrio.

DIRECTION FOR USE:

Condition	Vibrio count	Doses
For prevention	Les than 100 cfu/ml	3kg/ha/week
At high salinities & high temperature	100-500 cfu/ml	6kg /ha/week
Vibrio out break & weak shrimp	More than 500 cfu/ml	12kg/ha/week

Mix 1kg of Super Biotic with 4litre of clean water and leave the mixture for 6-12 hours prior to use. Broadcast all over the pond or in front of the paddlewheel during the morning time.

P^H FIXER (WATER PROBIOTIC)

P^H Fixer is the best remedies in maintaining water quality and P^H stability of the pond water. This product has *Bacillus* Strain that inhibit the multiplication of pathogenic vibrio. It helps to restore stable microbial and balance the ecosystem after water treatment, thus maintaining a natural environment suitable for PL stocking.

Composition

New strain of *Bacillus sp.* 10^9 CFU/ gm, microbial media and buffer mixture.

Direction for Use:

After water treatments apply 4-6 Kg of product per hector once every 4 days for 2 weeks before stocking. Mix clean pond water (2 Kg fixer per 20 liters of pond water) and stir for 5-10 minutes and broadcast through the pond or in front of paddle wheel aerator during noon.

SUPER PS (SOIL PROBIOTIC)

Super PS is a beneficial microbial culture aimed to improve shrimp growth and pond bottom condition. It is composed mainly on *Rhodobacter* and *Rhodococcus* that is designed to biodegrade soluble organic pollutants of the pond.

Composition

Rhodobacter sp and *Rhodococcuss sp* in 10^9 CFU/ml

Direction for Use

Apply 4 lit/acr at 9 am to11 am in a sunny day. Mix super ps with sand and if P^H below 7 then mix super ps with Dolomite until the sand or Dolo remove all the liquid and spread it through the feeding line.

ZYMETIN (FEED PROBIOTIC FOR BALANCED GUT MICRO FLORA)

Zymetin is beneficial bacteria that aim to improve the health of the shrimp. It is usually mixed with feed to inhibit the growth of pathogenic bacteria in the gut. It also improve the appetite of the shrimp to increase growth rate and reduce FCR.

Composition

1. *Streptococcus faecalis*
2. *Bacillus mesentericus*
3. *Clostridium butyricum*
4. Protease
5. Lipase
6. Beer Yeast

Dosage

Use Zymetin at 5 gm/ Kg feed, mix zymetin first with fresh water and then mixed properly with feed.

Water Quality Parameters of Different ponds

Table 1: pH of Different densities pond

DOC	5 Pcs/m2 density	10 pcs/m2 density	15 pcs/m2 density
1	8.2 ±0.5	8.1 ±0.6	8.3 ±0.6
7	8.2 ±0.4	8.2 ±0.7	8.4 ±0.7
14	8.1 ±0.4	8.3 ±0.8	8.4 ±0.8
21	8.3 ±0.3	8.2 ±0.5	8.5 ±0.5
28	8.2 ±0.2	8.3 ±0.4	8.6 ±0.4
35	8.3 ±0.3	8.2 ±0.4	8.6 ±0.4
42	8.4 ±0.4	8.1 ±0.3	8.5 ±0.3
49	8.2 ±0.1	8.1 ±0.7	8.6 ±0.7
56	8.4 ±0.6	8.2 ±1.1	8.4 ±1.1
63	8.4 ±0.3	8.2 ±0.9	8.5 ±0.9
70	8.3 ±0.8	8.3 ±0.5	8.9 ±0.5
77	8.4 ±0.7	8.4 ±0.7	8.8 ±0.7
84	8.2 ±0.9	8.5 ±0.9	8.5 ±0.9
91	8.3 ±0.7	8.4 ±0.3	8.6 ±0.3
98	8.2 ±0.2	8.5 ±0.5	8.5 ±0.5
105	8.4 ±0.4	8.3 ±0.8	8.6 ±0.8
112	8.5 ±0.5	8.2 ±0.5	8.7 ±0.5
119	8.4 ±0.3	8.1 ±0.1	8.8 ±0.1
126	8.5±0.3	8.2 ±0.2	8.6±0.2
133	8.5±0.2	8.3 ±0.3	8.7±0.3

Source: Field Survey

Table 2: DO in different densities pond

DOC	5 pcs/m2	10 pcs/m2	15 pcs/m2
1	4.3 ±0.5	4.2 ±0.3	4.1 ±0.3
7	4.4 ±0.4	4.2 ±0.2	4.2 ±0.2
14	4.3 ±0.4	4.3 ±0.3	4.0 ±0.3
21	4.4 ±0.3	4.4 ±0.1	4.2 ±0.1
28	4.5 ±0.2	4.3 ±0.2	4.1 ±0.2
35	4.4 ±0.3	4.3 ±0.3	4.0 ±0.3
42	4.3 ±0.4	4.5 ±0.2	3.8 ±0.2
49	4.5 ±0.1	4.2 ±0.2	4.0 ±0.2
56	4.6 ±0.6	4.1 ±0.3	3.9 ±0.3
63	4.4 ±0.3	4.3 ±0.1	3.6 ±0.1
70	4.5 ±0.8	4.1 ±0.1	3.5 ±0.1
77	4.0 ±0.7	4.0 ±0.2	3.7 ±0.2
84	4.2 ±0.9	4.2 ±0.2	3.6 ±0.2
91	4.5 ±0.7	4.3 ±0.3	3.5 ±0.3
98	4.4 ±0.2	4.5 ±0.2	3.4 ±0.2
105	4.4 ±0.4	4.2 ±0.2	3.0 ±0.2
112	4.5 ±0.5	4.1 ±0.1	3.5 ±0.1
119	4.0 ±0.3	4.3 ±0.3	3.5 ±0.3
126	4.0±0.2	4.2±0.2	3.0±0.1
133	4.0±0.3	4.1±0.3	3.5±0.1

Source: Field Survey