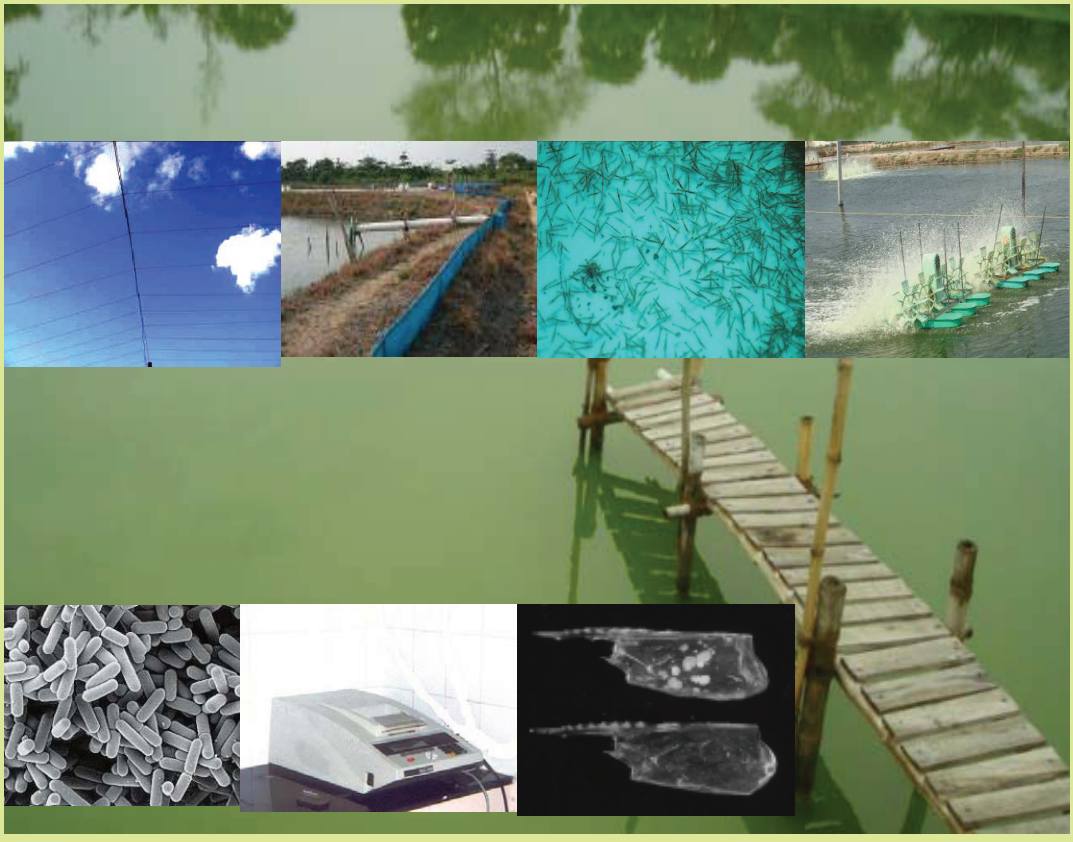
CIBA Technology Series: 5

BIOSECURE SHRIMP FARMING TECHNOLOGY



केन्द्रीय खारा जलजीव पालन अनुसंधान संस्थान
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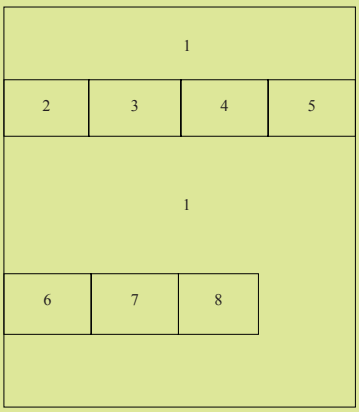

1. Biosecure shrimp culture pond
2. Birdnet
3. Crab fencing
4. Certified disease free seed
5. Aeration
6. Probiotic *Lactobacillus* sp.
7. PCR machine for WSSV detection
8. WSSV spots in carapace

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BIOSECURE SHRIMP FARMING TECHNOLOGY

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BIOSECURE SHRIMP FARMING TECHNOLOGY

In light of the devastating disease problems currently plaguing the global shrimp farming industry, water exchange has apparently become a risky management option for maintaining acceptable water quality. The biosecure shrimp farming system is an evolving culture practice which provides means to achieve a higher degree of biosecurity. Biosecurity in aquaculture is the sum of all procedures in place to protect living organisms from contracting, carrying, and spreading diseases and other non-desirable health conditions, with biotherapeutic agents like probiotics.

The Central Institute of Brackishwater Aquaculture (CIBA) has developed a Biosecure Shrimp Farming Technology (BSFT) based on three years of study, which includes several yard experiments and two pond trials, involving investigations on utilization of biotherapeutic agents, water and sediment quality parameters in relation to modifications in culture practices. It differs from conventional farming with regard to practices on water utilization, biosecurity measures followed and in addressing disease concerns without the use of antibiotics and chemotherapeutics. In a way, this is a modification of the widely practiced zero water exchange system relying more on increased provisions of biosecured environment even in the absence of reservoir ponds. It is also advantageous over the existing zero water exchange system due to reduction in disease risks and input costs. The technology has been successfully tested in on-station field trials with improved productivity and feed conversion ratio (FCR) achieved by using defined biotherapeutic agents. This technology is more suitable for states like West Bengal, Orissa, Kerala, Karnataka, Goa and Maharashtra, since it takes advantage of good monsoon precipitation.

Culture pond with good plankton bloom

The biosecure shrimp farming technology can be applied to extensive, semi-intensive or intensive shrimp aquaculture. The salient features of this technology are:

- High scoring for biosecurity compared to conventional farming and zero water exchange systems
- Reduced operational costs (no use of antibiotics, chemicals, water exchange and related feed costs)
- Use of efficient biotherapeutic agents
- Reduced risk of disease outbreaks
- Growth and production performance at par or better than conventional farming and zero water exchange systems
- Better feed conversion efficiency as there is no loss of *in situ* nutrients
- Efficient water budgeting and utilization of harvested rainwater
- Better profitability and rate of return

Farming technology

The following gives the various steps to be followed with regard to site selection and pond design, biosecurity features, pond preparation, stocking, water and soil quality monitoring, feeding strategy, health management, harvesting and post harvest measures. These are steps unique for BSFT along with standard procedures followed in conventional farming.

Site selection and pond designing

- Good monsoon precipitation is one of the prerequisites for this farming to compensate evaporation or seepage loss throughout the culture period.
- Site must be free from pollution by industrial effluents and domestic discharge.
- Good quality brackishwater (salinity 10- 25 ppt, temperature 25-31^{o} C) and optimum soil quality parameters are essential.
- Electricity and communication accessibility is indispensable as this technology requires heavy aeration throughout the production cycle.
- Rectangular pond with strong non porous high dykes is recommended.
- Sluice gate of the simple type with minimum cost compared to the heavy structural investment required in conventional system can be used.

Biosecurity features

- With minimal or zero water exchange a high degree of pathogen exclusion is maintained.
- Biosecurity barriers or fences around the pond, prevention of the carrier/vectors including birds, disinfection of intake water, avoidance of cross contamination, use of certified healthy seeds, quality feed, use of allowable chemotherapeutics, strict feeding management, water quality monitoring and overall hygiene including that of the equipment and personnel are some of the in-built features of this farming system.
- A key step in BSFT is the introduction of a defined microbial community in to the culture environment which can work synergistically to enhance the overall productivity of the shrimp ponds without resorting to commercial probiotics.

Pond preparation

- Pond preparation is to be started with the drying of the pond bottom till it cracks and surface soil scraped to remove the black soil accumulated from the previous crop since it results in the deposition of considerable load of organic matter.
- Soil amendment measures like lime application must be practiced (depending on soil pH) similar to any other conventional shrimp farms.
- Water intake is to be done after proper screening and a higher depth of at least 1.5 m is maintained unlike conventional systems.
- Disinfection is recommended with application of Calcium hypochlorite ($Ca(OCl)_2$ @ 60 ppm.
- Optimum natural productivity should be maintained using inorganic fertilizers (Urea: SSP: 2:1 @ 3 ppm) in frequent doses, if necessary; yeast based extract or some good biotherapeutic agents like *Bacillus* spp. can also be used for start up a good bloom.

Stocking

- Ponds should be stocked with healthy seeds (postlarvae) from a certified hatchery.
- 12 nos./m^2 postlarve is considered ideal for the BSFT system.

- Proper acclimatization is to be done to avoid any kind of stress during stocking.
- The crop should be scheduled to take advantage of the monsoon rain.

Water and soil quality monitoring

- Maintain a stable environment with effective recycling of nutrients and other metabolites through the use of farm made probiotics.

Aeration in a shrimp pond

- Good aeration is required for supporting the detritus food chain and effective mineralization of the higher level of organic matter in this closed system. .
- Parameters influencing productivity like alkalinity, pH and dissolved oxygen are to be maintained within optimum range.
- Nutrients like phosphate and nitrate are maintained at higher levels in the BSFT system throughout the culture, resulting in optimum levels of natural productivity.

Feeding strategy

- Feed requirement is to be appropriately estimated through regular sampling (growth and survival) and check tray observation.
- Over feeding should be avoided at any cost to prevent eutrophication and associated additional operational costs.
- During molting or any other stressful conditions, restricted feeding should be adopted.
- The pond bottom in the feeding area should be monitored periodically and if necessary bottom treatment including application of lime mixed with sand is to be adopted.

Health management

- Periodical health monitoring with due consideration to proper biosecurity measures is required.
- Beneficial microorganisms (such as *Lactobacillus* spp*, Bacillus* spp*, Pseudomonas* spp. and probiotic yeast *Saccharomyces* spp.) are to be applied as either in single/multi-strain for effectively controlling the pathogenic microorganisms and maintaining the water quality parameters in the optimum range.
- Best management practices (BMPs) like care for preventing pathogen carriers, pond bottom managements, certified healthy seeds, quality feeds and non use of antibiotics /chemicals must be incorporated in the practices followed.

Harvesting and Post harvest measures

- There should be minimum stress during harvesting.
- After chill killing, the shrimps must be packed in good quality ice and must be transported to processing factory which adopts Hazard Analysis Critical Control Point (HACCP) principles.

Shrimp harvest from a BSFT pond

Production performance

Field trials were conducted following this technology at Kakdwip Research Centre of CIBA with tiger shrimp *P. monodon* stocked @ 12 nos./m^2 in ponds ranging from 0.2 - 0.38 ha for four to five months of culture. The performance of the shrimp in terms of growth and feed conversion ratio was better than that of the control ponds. There was substantial gain in the production level (8-10 %) and better Food Conversion Ratio (FCR) (lowered by 10-11 %) in BSFT ponds compared to that of the conventional farming (Table 1).

Table 1. Performance of black tiger shrimp in biosecure shrimp farming system compared with conventional farming system

Parameters	First Year		Second Year		Advantage (percent scale)
	Conventional	BSFT	Conventional	BSFT	
Average seeded area	2750	2895	2750	2895	-
Stocking density (nos/m^2)	13	13	12	12	-
Productivity (kg/ha/crop)	2349	2494	2880	3109	8-10%
FCR	1.58	1.42	1.55	1.4	10-11%

Economics

Table II: Economic evaluation of BSFT system as compared to that of the conventional system (water spread area - 1 ha)

Economic parameters	Conventional (₹)	BSFT (₹)
Operational cost		
Desilting and related expenditure	₹ 40,000/-	₹ 25,000/-
Disinfection (Calcium hypochlorite) 1200kg @ ₹ 22/kg	₹ 26,400/-	₹ 26,400/-
Pond preparation (Fertilizers, Lime etc.)	₹ 3000/-	₹ 3,000/-
Seeds 1.2 lakh @ 0.5/ Postlarve	₹ 60,000/-	₹ 60,000/-
Feed cost: 4.03 tons; FCR: 1.55 for conventional and 3.92 ton 1.4 for BSFT @ ₹ 55/kg	₹ 2,21,650/-	₹ 2,15,050/-
Lime and other chemical inputs (Farm made probiotics for BSFT)	₹ 30,000/-	₹ 35, /000-
Water exchange and related expenses	₹ 15,000/-	
Labor and other management cost	₹ 35,000/-	₹ 30,000/-
Harvesting and related expenditure	₹ 15,000/-	₹ 15,000/-
Total operational cost	**₹ 4,46,000/-**	**₹ 4,09,450/-**
Total Fixed costs (Lease, depreciation and other charges)	**₹ 50,000/-**	**₹ 50,000/-**
Total cost	₹ 4,96,050/-	₹4,59,450/-
Cost of production (per kg)	**₹ 190.8/-**	**₹ 164.05/-**
Revenue		
Production (ton)	2.4 to 2.8	2.50 to 3.1
Revenue @ ₹ 240/kg	₹ 6,24,000/-	₹ 6,72,000/-
Rate of return over operational cost	***28.7 %***	***51.9 %***
Breakeven production (kg/ha)	***2067***	***1914***
Breakeven price (₹/kg)	***172/-***	***146/-***

The BSFT system developed by CIBA ensures a low cost of production (₹ 160 to 165/kg) compared to a relatively higher cost of production (₹ 185 to 190/kg) when conventional farming systems is followed. The better rate of returns (over 50 %) could be achieved by following this

technology compared to a rate of return of 29 % in the conventional one. The BSFT system developed by CIBA ensured low breakeven cost of production (₹ 146/kg shrimp) compared to relatively higher breakeven cost of production (Rs 172/kg) in the conventional system as practised locally. The benefits are mostly due to the cut down on input costs including feeding costs and a higher productivity achieved there in.

Conclusion

This biosecure shrimp farming system is a better farming practice for the coastal ecosystem for its high scoring on biosecurity measures and avoidance of antibiotics and banned chemicals. Effective recycling of nutrients and other metabolites which results in a stable environment are features of this system. A reduced level of nitrogenous metabolites and better water quality could be maintained even with no water exchange. This BSFT system is amenable for control of disease through best management practices. This evolving farming practice with all its biosecurity features and effective utilisation of biotherapeutic agents can pay rich dividends with reduction in input cost coupled with higher level of production, besides its environment friendly features of utilising harvested rainwater.

Healthy shrimp

BIOSECURE SHRIMP FARMING TECHNOLOGY

Site Selection

PRE STOCKING

- Prestocking measures (drying, scraping and (amendment of soil)
- Biosecurity barriers or fence around and over the pond
- Strict prevention of carriers or vectors in to the culture system

STOCKING

- Disinfection of the intake water and high water depth
- Stock with high-health certified seed after proper quarantine measures

FEED ENVIRONMENT HEALTH

- Strict feeding regime using quality feed
- Soil and water quality monitoring – Proper aeration
- Health management (biotherapeutic agents' use and with zero tolerance to antibiotics)
- Follow personnel hygiene along with disinfection of farm related equipments

HARVEST

- Healthy harvest

Transfer of Technology

This methodology can be transferred to stakeholders including farmers, associations, entrepreneurs, consultants, various departments of State and Central governments, environmental conservationists and consumers through demonstrations and trainings.

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