Advances in
SHRIMP AQUACULTURE
MANAGEMENT

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Dedicated to . . .

Dr. M.DEVARAJ
Ex-Dean of FC&RI, Tuticorin
Ex-Director of CMFRI, Kochi

☆ A silent reformer!
☆ A committed Scientist!
☆ An industrious individual!
☆ An administrator with vision for Fisheries Development!
☆ A teacher of exemplary teaching skill!
☆ A personality of down to earth simplicity!
☆ A technologist with the human touch!
☆ A great inspiring force in my carrier!

– S. Felix
Foreword

Shrimp aquaculture is still a significant economic activity in India although its rapid expansion has been curbed by judicial and environmental hurdles. There is no other aquaculture group which has attracted as much technological sophistication and investment as the shrimp and prawn. This is ample testimony to the potential and viability of shrimp aquaculture. Sustained growth of this sector calls for adoption of ecofriendly and biosecure farming practices at all levels including the hatchery, nursery and production stages as defined by the Aquaculture Authority of India.

This book written by Dr. S. Felix, Professor, Fisheries Biotechnology Centre of Fisheries College and Research Institute, Thoothukudi reflects the enormous experience and expertise of the author in shrimp aquaculture for over 25
years. The biosecure model for shrimp nursery practices he has introduced in India requires to be upscaled through their adoption by the industry. The chapters on nutrition, health care, bioremediation, water quality management and advanced farming systems deal with many vital areas of concerns in shrimp aquaculture.

I am sure that this book would immensely benefit the students, teachers, scientists, farmers, and the industry.

Dr. M. Devaraj, Ph.D.
Ex-Director, CMFRI
Shrimp aquaculture since its introduction in India as a commercial venture 25 years back has contributed immensely to the development of aquaculture sector in our country in general and export market promotion in particular. Despite its phenomenal growth, it’s true that the sector is yet to see its peak performance. The fact remains that India is nowhere near China, the No. 1 ranked country today in farmed shrimp production. This was due to the fact that shrimp farmers in our country are still following their own practices mainly through seeing and learning from their neighboring farms. Farmers learn on trial and error basis and always try to correct the technical errors by themselves. There is hardly any institute-industry linkage or institute-industry-line department interactions/dialogues existing in our country, neither to address the problems nor for seeking remedies.
Unfortunately we have with us, industrious but at the same time argumentative farming community, talented but self-doubting scientific fraternity and to cap-it-all an exploiting commercial business houses all together have driven shrimp farming in India to a point, beyond that it is not able switch gears for its growth.

Shrimp farming has been witnessing tremendous changes in other countries, including smaller and economically weaker (compared to India) nations. Transformation and technical boom such as SPF & SPR stocks, biosecurity, indoor shrimp houses, zerowater concept, green house mechanism etc. are being introduced successfully. But we are not prepared to change a bit of our farming practices. ‘Who is to bell the cat’ to restore this ‘industry of potential returns’ from the clutches of ‘business houses of only commercial interests’ !.

A professional approach, with technical back-up, and management strategies could alone help this sector to come out of the present serious problems in which it is entangled.

This book could be a tool to bring about that realization in our shrimp farming sector, at the earliest as this sector has been proved to be the ‘queen of all aqua farming practices’ in the world.

This book deals with conventional and extensive farming practices, to the advanced farming practice such as raceway technology. It has been prepared particularly for the students who want to know the ‘basics of shrimp farming’. The modern approaches in shrimp farming such as bioremediation, immunostimulants, probiotics, biosecurity, PCR in disease diagnosis, intensive culture technologies, etc. are dealt in detail. It’s a comprehensive
reading material covering wider aspects of shrimp farming and could be an information package for the students too.

Now that its over 30 years since the inception of Fisheries Colleges in our country, the professionals are started filling the strategic positions in various capacities including the farming sector. Its definitely going to change the scenario in the days to come. The experienced campaigners of this sector with the fisheries professionals should be able to raise this Golden Sector of Shrimp Farming in India, to newer heights of prosperity and to the point of highest economic returns.

S. Felix

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Abbreviations Used

WSSV: White Spot Syndrome Virus
MBV: Monodon baculo virus
IHHNV: Infectious Hypodermal Haematopoietic Necrosis Virus
YHD: Yellow Head Disease
TSV: Taura Syndrome Virus
PCR: Polymerase Chain Reaction
RT-PCR: Reverse Transcriptase PCR
YHDBV: Yellow Head Disease Baculo Virus
DNTPs: Deoxynucleotide triphosphates
BWSS: Bacterial White Spot Syndrome
TEM: Transmission Electron Microscopy
LDPE: Low density polyethylene
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>HDPE</td>
<td>High density polyethylene</td>
</tr>
<tr>
<td>GSM</td>
<td>Grams per square meter</td>
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<tr>
<td>PL</td>
<td>Post larvae</td>
</tr>
<tr>
<td>UV</td>
<td>Ultra Violet</td>
</tr>
<tr>
<td>RSF</td>
<td>Rapid Sand Filter</td>
</tr>
<tr>
<td>PVC</td>
<td>Polyvinyl chloride</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
</tr>
<tr>
<td>H2S</td>
<td>Hydrogen sulphide</td>
</tr>
<tr>
<td>ANF</td>
<td>Anti nutritional factor</td>
</tr>
<tr>
<td>IPNV</td>
<td>Infectious pancreatic necrosis virus</td>
</tr>
<tr>
<td>SOD</td>
<td>Superoxide dismutases</td>
</tr>
<tr>
<td>BMN</td>
<td>Baculovirus midgut gland necrosis</td>
</tr>
<tr>
<td>GAV</td>
<td>Gill Associated virus</td>
</tr>
<tr>
<td>BSD</td>
<td>Bacterial shell disease</td>
</tr>
<tr>
<td>AADS</td>
<td>Ascorbic acid deficiency syndrome</td>
</tr>
<tr>
<td>CMS</td>
<td>Cramped muscle syndrome</td>
</tr>
<tr>
<td>CW</td>
<td>Constructed Wetlands</td>
</tr>
<tr>
<td>RAS</td>
<td>Recirculatory aquaculture system</td>
</tr>
<tr>
<td>SPF</td>
<td>Specific pathogen free</td>
</tr>
<tr>
<td>SPR</td>
<td>Specific pathogen resistant</td>
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Dr. S. Felix is the Professor of Department of Aquaculture at Fisheries College and Research Institute (Tamil Nadu Veterinary and Animal Sciences University, Chennai), Tuticorin, Tamilnadu. He has over 27 years of experience in shrimp aquaculture research. He had his training abroad on hi-tech-biosecured shrimp farming systems in USA as an FAO Fellow. The raceway facility he has prototyped and demonstrated for shrimp farming was the first of its kind for India.

The ‘Maritech Research Centre’ established by him at Tuticorin represents a number of state-of-art facilities for innovative mariculture activities. He has published 4 books, 12 manuals and over 100 research papers / reports, mostly on shrimp aquaculture research.

The technologies developed by him through funded projects (DBT, ICAR, NADP, etc.) include MSCD feed for shrimp larvae, raceways for shrimp brood and nursery management, LDPE lined growouts, proPO for shrimp immunostimulants, etc. The countries he has visited include USA and Australia.
Different types of aquaculture systems are adopted for shrimp farming in India. The nature of site, species to be cultured, sustainability of source water, management practices, etc. make the shrimp farmers to decide the culture system to be selected. Generally three types of culture systems have been found to be ideal for undertaking shrimp farming. They are earthen ponds, lined earthen ponds and biosecured raceway systems.

The characteristics of these systems and their management practices are to be taken into account while selecting the site.

I. Criteria for Site Selection

(1) Earthen and Lined Earthen Ponds

The site suitability for constructing the farm for the above systems may be the same for both earthen and lined
earthen ponds. The type and construction of shrimp ponds would largely depend on the type of management and species cultured.

A. Ecological Factors

(a) Water Quality

It includes all the physico-chemical and microbiological characteristics of the water. Certainly pH is an important aspect, and pH of water on, or adjacent to, the pond site should be within the range of 7.8 to 8.3. Water with a good growth of phytoplankton can usually be considered productive. If the water carries an excessive amount of sediment, a trap may have to be built into the water supply system. The amount of dissolved oxygen present near the bottom of the source of water to be used should be determined.

(b) Salinity

The normal salinity of water during high tide at different seasons of the year should be known. Especially important for rivers and canals is the subsurface intrusion of salt water under the freshwater. The depth of the top of the wedge at different tidal stages during normal weather should be ascertained. Also important is whether or not the tidal wedge persists during floods. The frequency of floods should be known. Just as important is the duration of freshwater conditions during flooding if the water source for the farm is a brackish water canal or creek.

(c) Tidal Characteristics

The tidal characteristics in relation to land elevation at the proposed site should be determined. This is critical to determine the tidal flow of the site which will decide the
type of pumping to be used to fill the ponds, the elevation of the pond bottom, dike height, etc. In general, places where the tidal fluctuation is moderate, between 2 and 3 m, are most suitable for brackish water fish farms using the advantages of tidal flow to fill the ponds. Places where tidal fluctuations are more, over 4 m, are not suitable sites for pond construction because very large and expensive dikes would be required to prevent flooding during high tide. Also it would be more difficult to hold water in the ponds during low tides since due to the higher pressure, water loss and erosion from seepage, crab holes, etc., the seepage rate would be increased. Areas with slight tidal fluctuation, 1 m or less, are also not suitable for tidal ponds, because the ponds could not be filled or drained properly. So, if ponds are to be constructed in areas where the tide is less than 2 m or more than 3 m, the pump-fed-systems should be considered.

Actual measurements should be made at the pond site to determine the high and low tide benchmarks. One must keep in mind that tidal fluctuation is much less at certain times of the year. Tide tables should be consulted to determine these factors. Highest tides during past floods and storms also should be known. Sometimes the only way to acquire this information is from local residents. Wave action during normal tides, storms and monsoons should be known.

**(d) Currents Prevailing in the Immediate Water Source Area**

Knowledge of currents is important for planning erosion control measures to protect the dikes and the main gate as well as to determine the probability of sediment deposition in water control structures. Shifting mud or sand