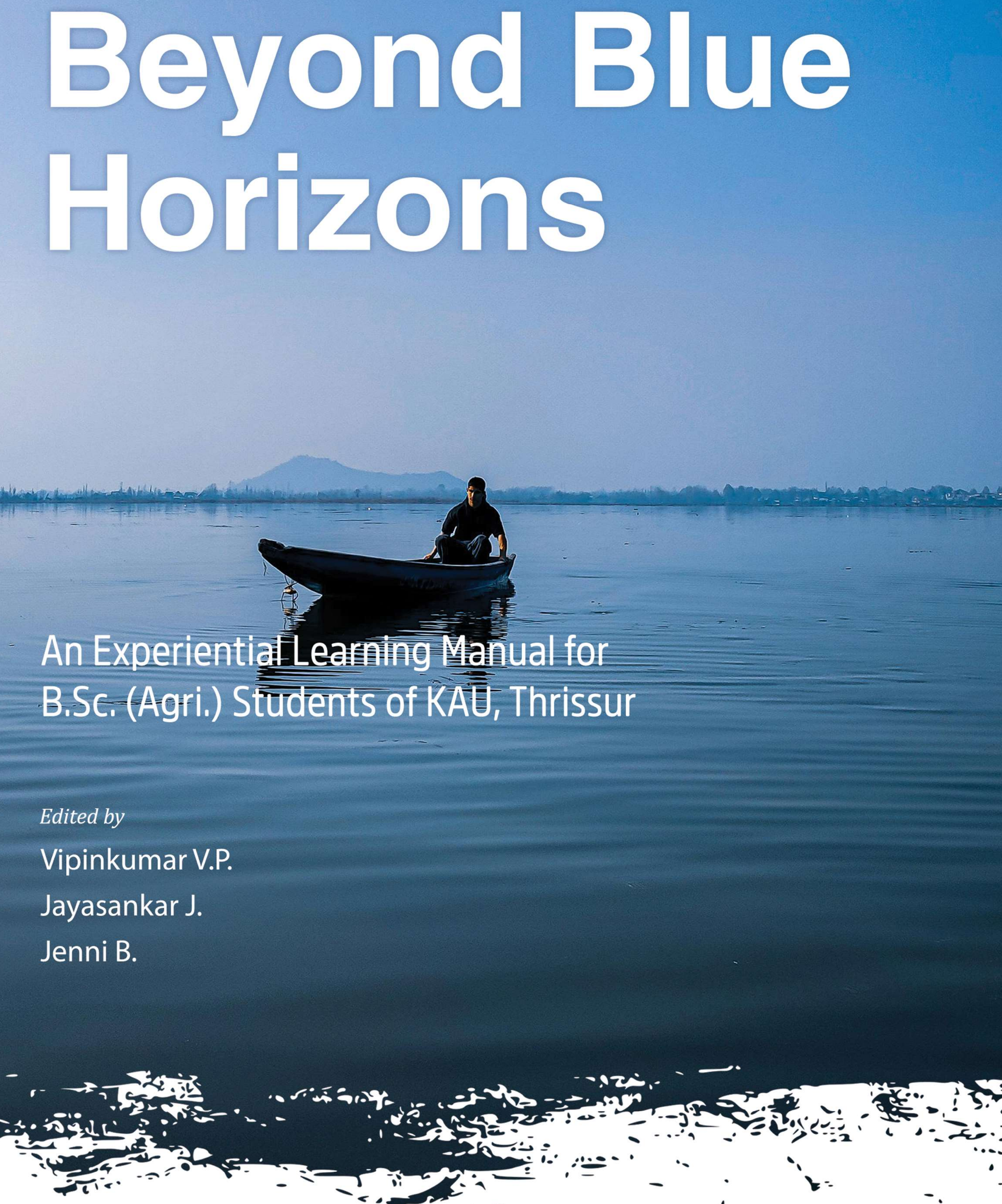
Beyond Blue Horizons



An Experiential Learning Manual for B.Sc. (Agri.) Students of KAU, Thrissur

Edited by

Vipinkumar V.P.

Jayasankar J.

Jenni B.

ICAR-Central Marine Fisheries Research Institute

(Department of Agricultural Research and Education, Government of India)

P.B. No. 1603, Ernakulam North P.O., Kochi - 682 018

भाकृअनुप ICAR

सी एम एफ आर आइ CMFRI

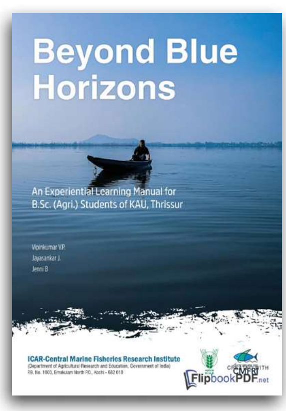
Beyond Blue Horizons

An Experiential Learning Manual for B.Sc. (Agri.) Students of KAU, Thrissur

Edited by

Vipinkumar V.P.
Jayasankar J.
Jenni B

ICAR-Central Marine Fisheries Research Institute
(Department of Agricultural Research and Education, Government of India)
P.B. No. 1603, Ernakulam North P.O., Kochi - 682 018



Beyond Blue Horizons
Training Manual for BSc (Agri) students of Kerala Agricultural University

Edited by:
Vipinkumar.V.P.
Jayasankar J.
Jenni B.

Research Guidance:
Dr.Grinson George, Director, ICAR-CMFRI

Cover design and Layout:
Abhilash P.R.

Data Processing & Editorial Assistance:
Ambrose T.V., Smitha R.X., Athira P.V., Sary P.S., Binitha K. Vijayan and Vinitha Babu

Citation:
Vipinkumar. V.P., Jayasankar J. and Jenni B. 2025. Beyond Blue Horizons: Training Manual for BSc (Agri) students of Kerala Agricultural University, ICAR-Central Marine Fisheries Research Institute, Kochi, 151p.

FOREWORD

It is with great pleasure and deep satisfaction that I present this foreword to the Training Manual of the Science Camp titled “Beyond Blue Horizons: An Experiential Training Manual for B.Sc. Agriculture Students.” Conducted from July 14 to 18, 2025, at the STI Hub Digital Training Hall, ATIC, ICAR-CMFRI, Kochi, this programme exemplifies our continued commitment to innovative, experiential, and interdisciplinary learning in agriculture and allied sectors.

Organized by ICAR-Central Marine Fisheries Research Institute through its Agricultural Technology Information Centre (ATIC), the training served as a dynamic platform for B.Sc. Agriculture students from the College of Agriculture, Vellanikkara, Thrissur. The thematic focus on integrating field-based experiences with advanced laboratory analyses reflects a progressive approach to education—one that fosters a seamless continuum between knowledge generation, validation, and application. Such initiatives are vital in equipping students with the skills and perspectives required to address emerging challenges in agriculture and fisheries.

I place on record my sincere appreciation to Dr. Vipinkumar V.P., Principal Scientist and ATIC Manager, ICAR-CMFRI, for his exemplary leadership, meticulous planning, and unwavering dedication in organizing this programme. His efforts, along with those of the entire team, have ensured the successful conduct of this Science Camp, setting a high standard for future capacity-building initiatives.

The programme was thoughtfully designed to bridge the gap between theoretical understanding and practical application. It offered participants a rich blend of innovative lectures on emerging topics, hands-on training sessions, field exposure visits, and institutional interactions. The opportunity to access advanced laboratories, aquarium facilities, and the museum at CMFRI significantly enriched the learning experience. Equally important were the interactive sessions with farmers, which fostered meaningful exchanges between academia and practitioners, grounding scientific knowledge in real-world contexts.

Such experiential learning opportunities are invaluable in enabling students to appreciate the dynamic flow of information from field observations to laboratory insights, ultimately supporting informed decision-making and innovation in production systems. I am confident that the knowledge and exposure gained through this Science Camp will contribute significantly to the academic growth and professional development of the participants.

I extend my warm congratulations to all the students and faculty members who actively engaged in this programme. Your enthusiasm, curiosity, and commitment to learning are truly commendable. May this experience inspire you to strive for excellence and contribute meaningfully to the advancement of agriculture and fisheries.

I am confident that this training manual will serve as a lasting resource, capturing the essence of the programme and reflecting the collective efforts that made this initiative both impactful and memorable.

Dr. Grinson George
Director, ICAR-CMFRI
Kochi

PREFACE

It is with immense pleasure and a deep sense of fulfilment that I present this compendium, "Beyond Blue Horizons: A Training Manual for B.Sc. Agriculture Students of Kerala Agricultural University." This volume encapsulates a unique and inspiring journey of experiential learning, meticulously designed and conducted at the STI Hub Digital Training Hall, ATIC, ICAR-CMFRI, Kochi, from July 14 to 18, 2025.

Envisioned as a transformative academic engagement, this Science Camp brought together bright and inquisitive B.Sc. Agriculture students from Kerala Agricultural University, Thrissur, and guided them through a rich continuum of learning—from field-level realities to the precision of laboratory analytics. At a time when agriculture is rapidly transitioning into a data-driven and innovation-led enterprise, the programme provided a vibrant platform for students to explore the convergence of traditional knowledge systems with modern scientific advancements, with a special emphasis on the fisheries sector.

The training was thoughtfully structured to deliver an immersive and practice-oriented learning experience. Through a dynamic blend of expert lectures, hands-on sessions, field exposure visits, institutional interactions, and meaningful dialogues with farmers, participants were encouraged not only to learn but to question, analyse, and innovate. The focus was on nurturing scientific curiosity, strengthening practical competencies, and inspiring a forward-looking approach to sustainable agriculture and fisheries development.

This manual, comprising ten thoughtfully curated chapters, reflects the thematic depth and diversity of the programme. It covers a wide spectrum of subjects including integrative analytics, digital interventions, field diagnostics, and emerging marine agri-technologies. What makes this volume particularly engaging is its strong practical orientation—each chapter offers insights, methodologies, and experiences that readers can readily connect with and apply. The concluding chapter, featuring the comprehensive report prepared by the students, stands as a testament to their active engagement and the effectiveness of the experiential learning model adopted during the camp.

I place on record my sincere gratitude to Dr. J. Jayasankar, Head of the FRAEE Division, and Dr. B. Jenni, ACTO, ATIC, for their scholarly contributions, editorial excellence, and steadfast support as co-editors of this compendium. Their efforts have been instrumental in shaping this manual into a valuable and enduring academic resource.

As the Course Director and Chief Editor, I consider this compendium not merely as a documentation of an event, but as a celebration of collaborative learning and an invitation to explore the vast and promising interface between agriculture and fisheries sciences. While this endeavour represents only a beginning—a glimpse into a much larger horizon—it is my earnest hope that this volume will inspire readers to delve deeper, think innovatively, and contribute meaningfully to this evolving domain.

I warmly invite students, researchers, academicians, and practitioners to engage with the chapters that follow—rich in practical insights, field-based observations, and scientific perspectives—and to draw inspiration for future learning and innovation.

Dr. Vipinkumar V. P.
Principal Scientist & ATIC Manager
ICAR-CMFRI, Kochi

CONTENTS

Edible Oyster farming

6

Vidya R., Vipinkumar V.P. and Jenni B.
ICAR-Central Marine Fisheries Research Institute, Kochi-682018, Kerala

Introduction

As nutritionally rich health foods, bivalves like mussels and oysters are crucial to sustainable aquaculture and offer a significant solution for meeting the growing protein needs of the human population.

Edible Oyster farming in India

In India, edible oysters are a highly sought-after delicacy, with increasing demand for oyster meat in various parts of India, particularly in the states of Kerala, Karnataka, Goa, and Maharashtra. The oyster farming technology, pioneered by the Central Marine Fisheries Research Institute, is recognized for its simplicity and ease of adoption. A concerted effort to popularize this technology has been undertaken by the Central Marine Fisheries Research Institute (CMFRI) since 1993. Kerala was the first state to commercialize this technology, and it has since benefited many coastal villagers. These farming activities contributed to a significant increase in national production of farmed oysters, which rose from nil to 140 tonnes in the year 2000.

Culture Technology

Critical factors in oyster aquaculture, such as seed collection and harvesting periods, are fundamentally governed by the species' biological life cycle. An oyster farmer can gain a practical understanding of these factors through direct observation and hands-on experience.

Seed Collection

Oyster farming in Kerala primarily utilizes the species *Crassostrea madrasensis*, commonly known as the Indian backwater oyster. The ideal locations for this aquaculture are estuaries with a salinity range of 10-30 parts per thousand (ppt). The acquisition of oyster seeds is a crucial step in the process. This is achieved by placing suitable collectors, known as cultch, in the water column during the appropriate period. The cultch serves as a substrate for oyster larvae to settle. During the spawning season, these spat collectors are strategically suspended from racks to optimize seed collection.

Preparation of cultch

Cultch is the term used for spat / seed collector. For suspended method of oyster culture cultch made of oyster shells have been found to be ideal.

The preparation of cultch involves several steps:

1. **Cleaning and Preparation**: Empty oyster shells are manually cleaned to remove any fouling organisms. They are then washed to eliminate silt and other debris.
2. **Assembly**: A small hole is drilled into each shell, allowing them to be threaded onto a **3mm diameter nylon rope**.
3. **Spacing**:
    - For the **grow-out phase**, shells are spaced 15 to 20 cm apart, resulting in a density of approximately five shells per meter of rope. These prepared strings are referred to as **rens**.
    - For initial **seed collection**, shells are strung continuously without spacing, at a density of 10 to 15 shells per meter. After the spat have attached, the shells are removed and restrung to the ideal grow-out density of five shells per meter.
4. **placing the cultch for seed collection**

The timing of cultch placement is a critical factor for the success of oyster farming operations. The ideal period for deploying spat collectors is approximately **7 to 10 days after the peak spawning event**. This timing is determined by assessing the gonadal development of adult oysters and by monitoring the abundance of early larval stages in the plankton. Environmental conditions are also crucial. Strong water currents can interfere with larval settlement, leading to a poor yield of collected spat. Therefore, selecting a period with favorable, less turbulent water conditions is essential for maximizing seed collection.

Selection of farm site

For site selection several factors are to be considered

	Parameter	***Range***	***Methodology for determination of the parameter***
1	Salinity (ppt)	10 to 38	By titration or refractometer
2	Depth (m)	1.5 – 4	By sounding or manual
3	Temperature ^{0} C	23- 34	Using thermometer
4	Dissolved oxygen mg/l	3 – 5	Winkler method or by using probe

5	pH	6.5 – 8.5	pH meter or pH paper
6	Turbulence due to wave (m)	< 0.5 to 1	By observation and local enquiry
7	Water current m / second	1 – 5	Current meter or from literature
8	Clarity (m)	0.5 –1.5	By Sechii disc
9	Availability of seed	Within 100 m	By enquiry / observation
10	Local market	Average to good	By enquiry / observation
11	free from various pollution like	Faecal	By enquiry / observation
		Industrial	
		Agriculture	
		Sewage	
		Retting	
		Oil	

Farming methods:

Oyster culture methods are broadly classified into two categories: **bottom culture** and **off-bottom culture**.

Off-bottom culture techniques, which include the use of rafts, racks, longlines, and stakes, offer significant advantages over traditional bottom culture. The benefits of off-bottom culture methods are as follows:

- **Accelerated Growth and Increased Yield**: Oysters cultivated in off-bottom systems exhibit relatively rapid growth and produce a higher meat yield.

- **Optimal Use of Space**: These methods facilitate the efficient, three-dimensional utilization of the culture area, maximizing productivity per unit of surface area.

- **Consistent Feeding**: The biological processes of the oyster, such as filtration feeding, occur independent of tidal fluctuations, ensuring a more consistent food supply.

- **Reduced Environmental Impact and Predation**: Problems associated with silting and predation are significantly minimized.

On bottom culture

Oyster cultivation can be carried out in either intertidal or subtidal zones, directly on a hard substrate. For intertidal culture, a minimum submergence period of **16 hours** is recommended to ensure a sufficient food supply for the oysters. In this method, oyster seeds attached to collectors are placed on the bottom and allowed to grow to market size.

This approach, however, has several disadvantages:

- **Increased Vulnerability**: The oysters are more exposed to benthic predators.
- **Siltation**: There is a higher risk of silt accumulation, which can negatively affect growth and survival.
- **Lower Production**: The yield is generally lower compared to other methods.

For example, the estimated production for this method is **5 tonnes per hectare per year** in the U.S. and **7.5 tonnes per hectare per year** in France. This specific method has yet to be widely experimented with in India.

Rack and Ren method

Racks for oyster farming are typically constructed in water depths ranging from **1 to 2.5 meters**. There are several variations in rack design.

Rack Types

- **Single-Beam Rack**: This design consists of a single beam that is secured to the tops of posts driven into the seabed. A series of these single beams are arranged in a row.
- **Crossbeam Rack**: In this configuration, a crossbar is placed on top of single posts. Two long beams are then secured to the ends of these crossbeams.

In an oyster farm, the shell strings (ren) are suspended from these rack structures.

Rack and Tray Method

Single, cultch-free spat, which have been reared in a nursery to a size of approximately **25 mm**, are transferred to trays measuring **40 x 40 x 10 cm**. The trays, which have a density of **150 to 200 oysterlings**, are constructed with a synthetic twine of an appropriate mesh size. These trays are then suspended from a rack system

Stake culture

A stake is driven into the substratum and on the top end one nail and on the sides two nails are fixed. The nail holds in position a shell with spat attached. The stakes are placed 60 cm apart. In this method, the nursery rearing of spat is carried on the same stake. For about two months the spat on the top end of the stake are covered by a piece of velon screen.

Farm management

Regular monitoring of the farms is crucial. Key aspects to check include the replacement of damaged farm structures and the re-suspension of any loosened rens that have fallen to the estuary bottom. Periodic checks are therefore essential to address these issues.

Harvest of oysters

Oysters are harvested at their peak condition, which is typically when the gonads are ripe just before spawning. In the Vembanad and Chettuva estuaries along the Kerala Coast, the ideal harvesting time is usually in May. For Ashtamudi Lake, the optimal period is from August to October. Harvesting is carried out manually.

Post Harvest Processes

Depuration

Following harvest, depuration is a necessary process to cleanse oysters of bacterial loads, faeces, sand, silt, and other contaminants accumulated in their digestive systems, as they are filter feeders.

The oysters are placed in cleaning tanks with a continuous flow of filtered seawater for 24 hours, with about 10-20% of the water being replaced constantly. After 12 hours, the tanks are drained, and the oysters are cleaned with a strong jet of water to remove any accumulated faeces. The tanks are then refilled with filtered seawater, and the flow is maintained for an additional 12 hours.

After this 24-hour period, the tanks are drained again and flushed with a jet of filtered seawater. The oysters are then held for approximately one hour in seawater with a chlorine concentration of 3 ppm, followed by another wash in filtered seawater before being prepared for market.

These depurated oysters are primarily sold as live shell-on oysters in the local market. Meat from depurated oysters can be shucked after steaming to render the shucking easy.

Products of oysters

- Live oyster
- Frozen oysters
- Canned oysters
- Smoked oysters
- Oyster stew