

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

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



Edited by

Vipinkumar V.P.

Jayasankar J.

Jenni B

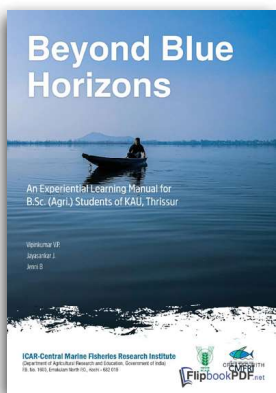


ICAR-Central Marine Fisheries Research Institute

(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.



A handwritten signature in black ink, appearing to read 'Vipinkumar V. P.', written over a light blue background.

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

CONTENTS

| | | |
|-----|--|---------|
| 1. | Reinventing Empowerment: Case Studies on SHGs and Gender Transformation <i>Vipinkumar V.P., Reshma Gills., Swathilekshmi P.S., Sanal Ebeneezar., Anuja A.R., Saju George and Jenni B.</i> | 1-39 |
| 2. | Methodological Frameworks and Tools for Social Science Data Collection <i>Reshma Gills., Vipinkumar V.P., Ramachandran C., Saju George and Ambrose T.V.</i> | 40-53 |
| 3. | Effects of Climate Change on Marine Fisheries <i>Grinson George., Ratheesh Kumar R and Nanda Kishore</i> | 54-62 |
| 4. | Marketing and Value Chain Development in Agriculture: An Indian Perspective <i>Anuja A. R. and Vipinkumar V.P.</i> | 63-72 |
| 5. | Mussel farming <i>Vidya R., Vipinkumar V.P. and Jenni B.</i> | 73-76 |
| 6. | Edible Oyster farming <i>Vidya R., Vipinkumar V.P. and Jenni B.</i> | 77-82 |
| 7. | Farmer Producer Organizations (FPOs) and Fish Farmer Producer Organizations (FFPOs) in India: Opportunities, Challenges, and the Way Forward <i>Saju George, Vipinkumar V.P., Anuja A. R., Jenni B. and Ambrose T.V.</i> | 83-89 |
| 8. | Unlocking India's Blue Economy Pathways Through Mariculture <i>Suresh, V. V. R., Rajesh N. and Bobby Ignatius</i> | 90-95 |
| 9. | The Future of Primary Data Collection in Socio-Economic Agricultural Surveys: Leveraging Online and Artificial Intelligence platforms <i>Anuja A. R., Vipinkumar V.P. and Saju George</i> | 96-105 |
| 10. | <i>Applications of GIS in Natural Resource Management</i> <i>Shelton Padua and Grinson George</i> | 106-111 |
| 11. | <i>Black Soldier Fly larvae based Biovalorization: Transforming Waste into Sustainable Wealth</i> <i>Sanal Ebeneezar., Linga Prabu D., Sayooj P., Chandrasekar S., Adnan H. Gora., Vipinkumar V. P. and Kajal Chakraborty</i> | 112-117 |
| 12. | Role of Probiotics in Aquaculture Nutrition and Health Management <i>Anusree V. Nair., Sayooj P. and Parvathy S.</i> | 118-124 |
| 13. | <i>Advances In the Use of Alternative Protein Sources for Fish Feeds</i> <i>Sayooj P., Anusree V. Nair and Parvathy S.</i> | 125-131 |

| | | |
|-----|---|---------|
| 14. | <i>Disease diagnosis in marine fish and shellfish</i> <i>Sumithra T.G. and Krupesha Sharma S.R.</i> | 132-136 |
| 15. | <i>STI Hub in Fisheries: Igniting Innovation for a Sustainable Future</i> <i>Vipinkumar V.P., Reshma Gills, Ramachandran C., Bobby Ignatius, Aswathy N., Anuja A.R., Rajesh N., Jayasankar J., Swathilekshmi P.S., Vidya R., Sanal Ebenezer, Saju George, Jenni B., Athira P.V., Sary P.S., Binitha K.V., Smitha R.X. and Ambrose T.V.</i> | 137-141 |
| 16. | <i>Report of the Training Programme</i> <i>BSc (Ag) students of Kerala Agricultural University</i> | 142-151 |

Unlocking India's Blue Economy Pathways Through Mariculture

8

Suresh, V. V. R., Rajesh, N. and Bobby Ignatius
ICAR-Central Marine Fisheries Research Institute, Kochi-682018, Kerala
E-mail: sureshvr5644@gmail.com

Mariculture, the farming of marine organisms in salt water, is central to India's blue economy. It offers opportunities to enhance food security, create livelihoods, and reduce pressure on capture fisheries. This article shows you its progress, key enablers, and future pathways, highlighting how science, policy, and community action can

Oceans and the Blue Economy

The oceans are not just vast stretches of saltwater or sources of seafood; they are the lifeblood of our planet. They regulate climate, absorb carbon, and sustain biodiversity. They drive global trade and transport, supply renewable energy, and provide resources ranging from minerals to medicines. For billions of people, oceans are a source of food, jobs, and cultural identity. In India, the ocean is more than a natural boundary—it is a gateway to economic growth and community well-being. Tapping into this potential responsibly through mariculture and other blue economy initiatives is essential for balancing prosperity with sustainability.

Defining the Blue Economy

The blue economy means using ocean resources sustainably for food, energy, transport, tourism, and livelihoods while conserving ecosystems. It balances economic growth with social equity and environmental protection. For India, it offers pathways to feed its growing population and create millions of coastal jobs.

The term blue economy refers to the sustainable use of ocean resources for economic development, improved livelihoods, and ecosystem health. It emphasises balancing growth with sustainability, ensuring that benefits are shared by coastal communities while protecting marine ecosystems for the future. Globally, the blue economy is estimated to be worth trillions of dollars annually, and its importance will grow as populations expand and climate challenges intensify. For India, with over ≈11,000 km of coastline, the blue economy is both an opportunity and a responsibility. One of the strongest pillars of this framework is mariculture, the farming of

marine organisms in seawater. Mariculture directly addresses the blue economy's goals by increasing food supply, generating jobs, reducing pressure on wild fish stocks, and supporting allied industries such as feed, biotechnology, and processing.

Mariculture Landscape in India

Early Steps

India's mariculture journey began in the 1970s with experimental seaweed and bivalve farming by CMFRI in Tamil Nadu. This was followed by advances in shrimp farming and finfish breeding. These early successes demonstrated that marine farming could complement capture fisheries and support coastal livelihoods.

Present Status

Did You Know?

India's coastline: ≈11000 km
Exclusive Economic Zone: 2.3 million km²
Estimated mariculture potential: 4–8 million tonnes annually
Current production: 0.1 million tonnes
Wide gap shows immense room

Despite a mariculture production potential of 4–8 million tonnes annually, India currently produces only about 0.1 million tonnes through mariculture. The species under culture include cobia, pompano, sea bass, mussels, oysters, clams, shrimp, crabs, and several ornamental fish. Seaweed and pearl culture add further diversity. Clearly, mariculture in India is still at a formative stage, but the building blocks—technologies, institutions, and policy frameworks—are getting in place.

Why Mariculture Matters for the Blue Economy

- It contributes directly to food security and nutrition.
- It provides alternative livelihoods for fishers affected by declining catches.
- It opens new export markets, including ornamental fish and seaweed products.
- It can be designed to be climate-friendly, especially through integrated systems and seaweed farming.

Foundations for Growth

India's Priority Species

Finfishes: Cobia, pompano, groupers, sea bass, snappers.

Molluscs: Mussels, oysters, clams, gastropods.

Crustaceans: Shrimps, crabs.

Ornamental fishes: Clownfish, damsels, butterflyfish.

Seaweeds: 5 species

Species Prioritization

A national exercise has identified over 70 promising species, including finfishes, molluscs, crustaceans, and ornamental fishes. Prioritisation ensures investment and training are focused on species that combine ecological sustainability with market potential.

Hatcheries and Seed Production

Captive breeding has been achieved for more than a dozen finfish species, several shellfish, and 25+ ornamental species. Seed banks and broodstock facilities are being scaled up, ensuring a reliable and quality seed supply for future expansion.

Farming Systems Driving the Blue Economy

Sea Cage Farming

Circular or square cages anchored in the sea are already producing 2–3 tonnes of fish per cycle in coastal states. Returns of Rs. 1.5–2.5 lakh per crop have made cage farming popular among fishers' cooperatives.

Farming Systems

Sea cage farming: High yields, quick returns.

IMTA: Combines fish, shellfish, seaweeds for eco-balance.

RAS: Onshore tanks, controlled farming.

Seaweed farming: Low investment, short cycles, strong livelihood link.

Bivalve culture: Oysters and mussels for food and livelihoods.

Integrated Multi-Trophic Aquaculture (IMTA)

IMTA combines finfish, shellfish, and seaweed. Recycling nutrients reduces environmental impacts and increases income. In Palk Bay, Tamil Nadu, farmers adopting IMTA have doubled their seaweed yields while producing fish in cages.

Recirculating Aquaculture Systems (RAS)

RAS are land-based tanks with advanced water recycling. They are vital for broodstock maintenance, seed production, and farming high-value species in controlled environments.

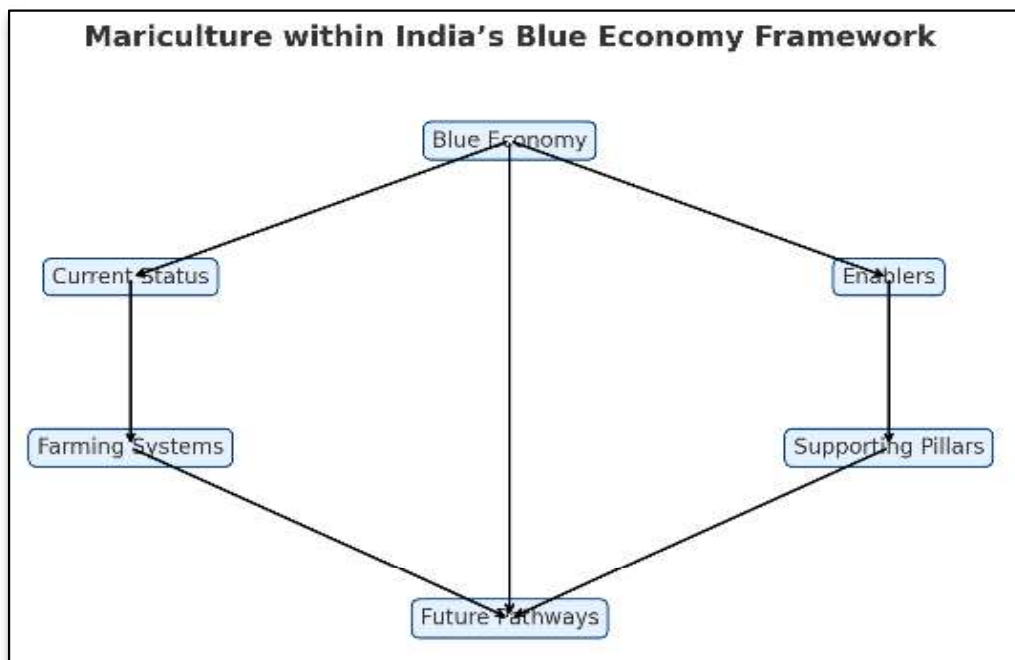
Seaweed Farming

Seaweed farming has low input costs and provides raw material for food, cosmetics, and pharmaceuticals. It is also climate-positive, absorbing carbon and reducing nutrient loads in seawater. Women's self-help groups in Tamil Nadu have demonstrated its economic and social potential.

Bivalve Culture

Oysters and mussels, farmed using racks and rafts, are popular in Kerala, Karnataka, Goa, and Maharashtra. These activities have engaged thousands of women's groups and provide a model of community-based mariculture within the blue economy.

Supporting Pillars for Sustainability



- **Feeds and Nutrition:** Alternatives to fish meal are being developed to lower costs and ensure ecological sustainability.
- **Animal Health Management:** National surveillance and diagnostic tools are strengthening disease prevention.
- **Certification and Standards:** Green certification, particularly for ornamental fishes, is being promoted for eco-friendly production and international market credibility.

- **Value Chains:** Infrastructure such as cold storage, insulated transport, and processing facilities is essential to reduce post-harvest losses and boost farmer incomes.

Policy Support and Future Pathways

Mariculture Policy focusing on location leasing systems, mariculture parks, certification, insurance, and market support is a major prerequisite for driving mariculture growth. By dedicating even 1% of India's coastal waters to cage culture, India could produce over 4 million tonnes of marine fish annually by 2050.

Future pathways include

Vision 2050

If just 1% of India's coastal waters are used for cage culture. Potential harvest: 4 million tonnes of fish annually, making mariculture a future pillar of India's blue economy.

- Establishing dedicated mariculture parks with common infrastructure.
- Promoting public-private partnerships for investment and technology scaling.
- Integrating mariculture with climate action through seaweed-based carbon capture.
- Empowering coastal communities and women's groups with training and ownership.
- Linking mariculture to global markets for seafood, nutraceuticals, and ornamental products.

Blue Economy Opportunities Ahead

Mariculture connects directly with the goals of the blue economy:

Mariculture to Blue Growth

- Expands seafood supply
- Generates rural and coastal jobs
- Supports women's self-help groups
- Provides raw materials for industries
- Contributes to carbon sequestration
- Reduces pressure on wild

- Economic growth through the seafood, seaweed, and ornamental fish trade.
 - Social development by creating jobs and supporting fisher communities.
 - Environmental balance by reducing pressure on capture fisheries and promoting climate-friendly practices.
- If scaled responsibly, mariculture can become a flagship sector for India's blue economy, positioning the country as a leader in sustainable ocean-based development.

Conclusion

India's journey in mariculture has moved from small experimental beginnings to a stage where commercial expansion is realistic. By aligning mariculture with the principles of the blue economy—sustainability, inclusivity, and innovation—India can meet its seafood needs, generate employment, and strengthen its role in global marine trade. Unlocking India's blue economy will require science-driven planning, supportive policies, and active community participation. Mariculture is the bridge that can connect India's ocean wealth with its people's prosperity, ensuring a secure and sustainable future.