

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



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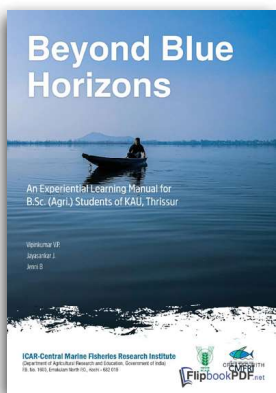


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Beyond Blue Horizons
Training Manual for BSc (Agri) students of Kerala Agricultural University

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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

Applications of GIS in Natural Resource Management

10

Shelton Padua and Grinson George

ICAR-Central Marine Fisheries Research Institute, Kochi-682018, Kerala

Geographic information system (GIS) is a tool for making and using spatial information and it is mainly concerned with location of the features as well as properties/attributes of those features. It helps us gather, analyse and visualize spatial data for different purposes. A GIS quantifies the locations of features by recording their coordinates which are the numbers that describe the position of these features on Earth. The uniqueness of GIS is its ability to do spatial analysis. GIS helps us analyse the spatial relationships and interactions. Sometimes, GIS proves to be the only way to solve spatially-related problems and it is one of the most important tools that aid in decision making process. GIS basically helps to answer three questions; How much of what is where? What is the shape and extent of it? Has it changed over time? How the different variables interact over space and time?

Globally, on an average, GIS tools save billions of dollars annually in the delivery of goods and services through proper route planning. GIS regularly help in the day-to-day management of many natural and man-made resources, including sewer, water, power, and transportation networks. GIS help us identify and address environmental problems by providing crucial information on where problems occur and who are affected by them. It also helps us identify the source, location and extent of adverse environmental impacts. GIS enable us to devise practical plans for monitoring, managing, and mitigating environmental damages. Human impacts on the environment, conflicts in resource use, concerns about pollution, and precautions to protect public health have spurred a strong societal push for the adoption of GIS.

GIS is composed of hardware, software, data, humans and a set of organizational protocols. The selection and purchase of hardware and software is often the easiest and quickest step in the development of a GIS. Data collection and organization, personnel development and the establishment of protocols for GIS use are often more difficult and time consuming endeavours. A fast computer, large data storage capacities and a high quality, large display form the hardware foundation of most GIS. GIS software provides the tools to manage, analyse, and effectively display and disseminate spatial information. GIS as a technology is based on geographic information science and is supported by the disciplines like geography, surveying, engineering, space science, computer science, cartography, statistics etc.

In GIS, we handle the spatial and attribute data sets. Spatial data describes the absolute and relative location of geographic features while the attribute data describes characteristics of the spatial features. These characteristics can be quantitative and/or qualitative in nature. Attribute data is also referred to as tabular data. Vector and raster are two different ways of representing spatial data. Raster data is made up of pixels (or cells), and each pixel has an associated value. A digital photograph is a simple example of a raster dataset where each pixel value corresponds to a particular colour. In GIS, the pixel values may represent elevation above/below sea level, or chemical concentrations, or rainfall etc. The key point is that all of this data is represented as a grid of (usually square) cells. Vector data consists of points, lines, and polygons. The individual points are stored as pairs of (x, y) co-ordinates. The points may be joined in a particular order to create lines, or joined into closed rings to create polygons, but all vector data fundamentally consists of lists of co-ordinates that define vertices, together with rules to determine whether and how those vertices are joined.

As with many other systems, GIS basically works on the principle of '*GIGO*' that is *garbage in garbage out*. Hence the quality of data that you feed into GIS is very important and it determines the quality of the end products. But, when used wisely, GIS can help us live healthier, wealthier, and safer lives.

We use GIS & RS for locating the potential fishing zones (PFZ), identifying and monitoring of different marine habitats, mangrove areas, oceanic variables like sea surface temperature (SST), ocean colour (chlorophyll a content), ocean currents etc. which otherwise would not be possible to collect information from such a vast area.

Two examples of the applications of geoinformatics on is given below.

I. Potential Fishing Zones (PFZ) Identification

PFZ are the are the possible zones of fish aggregation indicated by satellite-derived sea surface temperature (SST) and chlorophyll-a (Chl-a). In 1999, Space Applications Centre (SAC), Indian Space Research Organization, Ahmedabad developed the techniques to generate the PFZ advisories using SST and Chl-a data. The biological productivity is considered to be higher in regions where strong SST fronts are observed.

A front is a boundary between two distinct water masses. The water masses are defined by moving in different directions, i.e. on one side of the front the water is generally moving in one way, and on the other side of the front, the water is

moving in another. The water masses on either side of a front may also have different temperatures, salinities, or densities.

In frontal regions where SST gradients are large and rapid changes takes place in SST. The high resolution infrared daily SST data are used to identify such regions. Apart from this, the chlorophyll data which is sensed by the satellite as ocean colour is used as a direct marker of biological productivity. Regions in which SST gradients occur along with a higher chlorophyll concentration are considered to be strong potential for fishing. The figures below show the SST fronts, chlorophyll fronts and sample PFZ map.

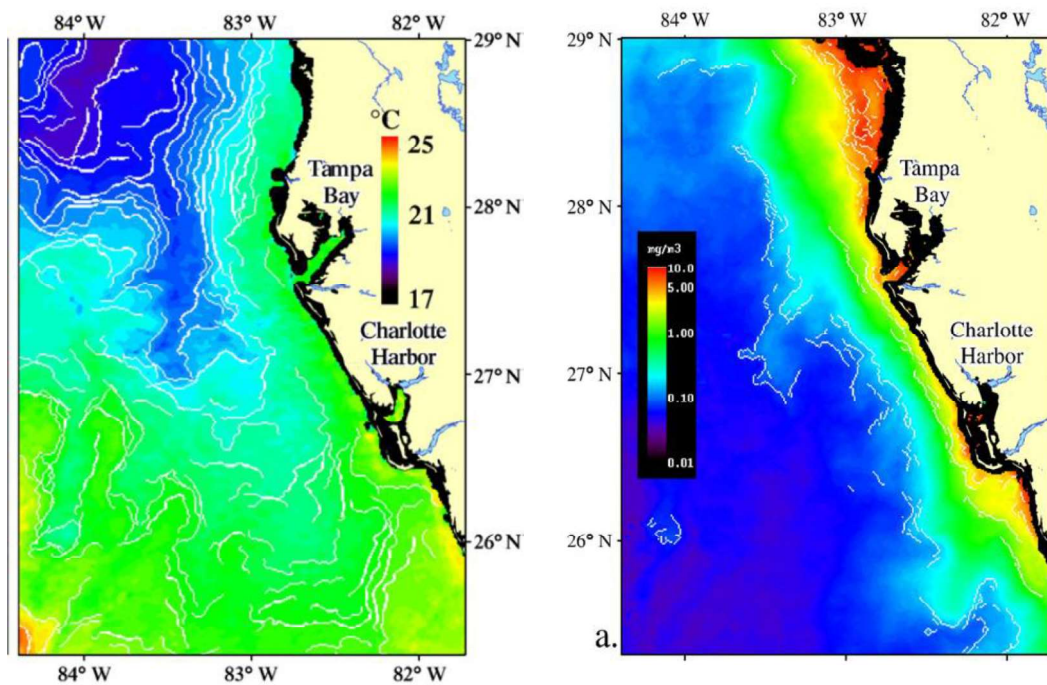


Fig 1. Satellite derived SST map showing the thermal fronts (Left) and Chlorophyll a map showing the chlorophyll fronts (Right) (Wall et al., 2008).

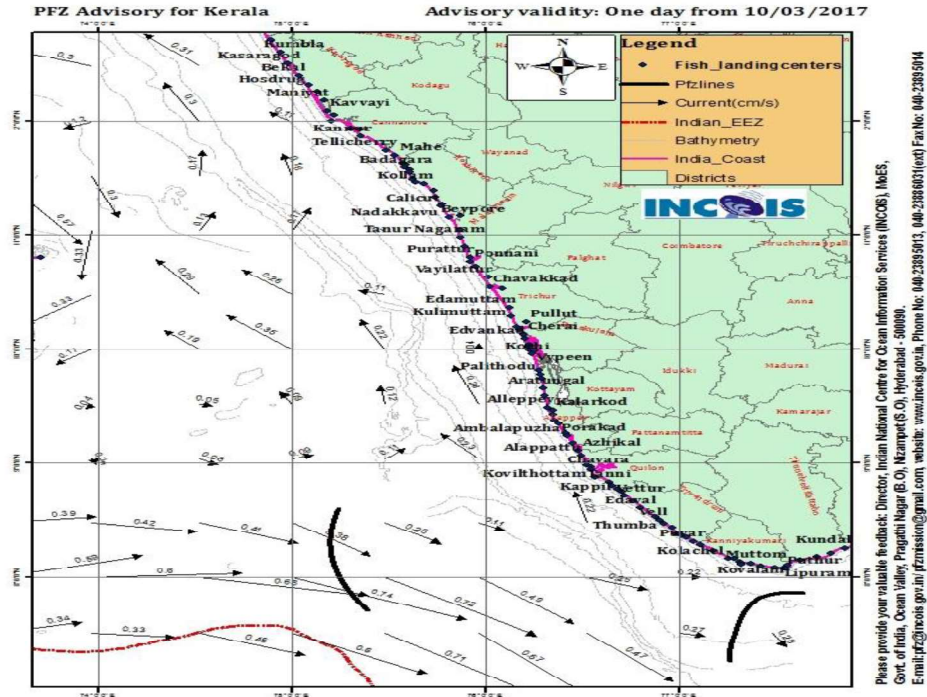
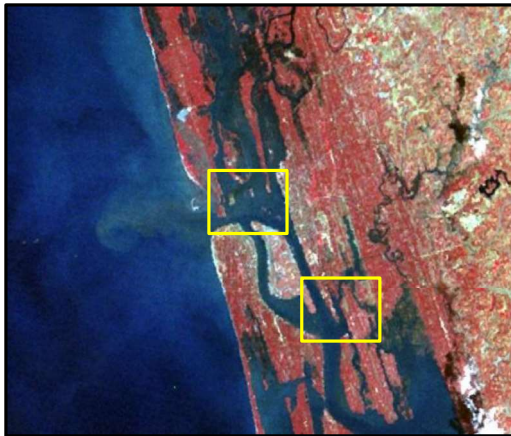


Fig 2. PFZ map of Kerala coast prepared by INCOIS, Hyderabad. The thick black curved line indicates the PFZ.

II. Monitoring the coastal habitats

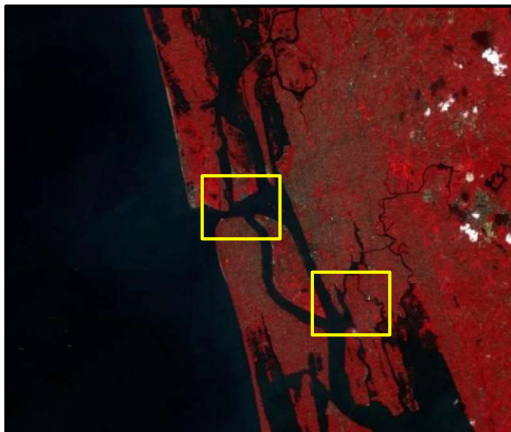
The most important advantage of Remote Sensing is its synoptic view and repetitively. Due to this advantage we can use it monitor different areas of earth with comparatively less efforts. The below satellite images show how the coastal areas of Ernakulam has changed over time.



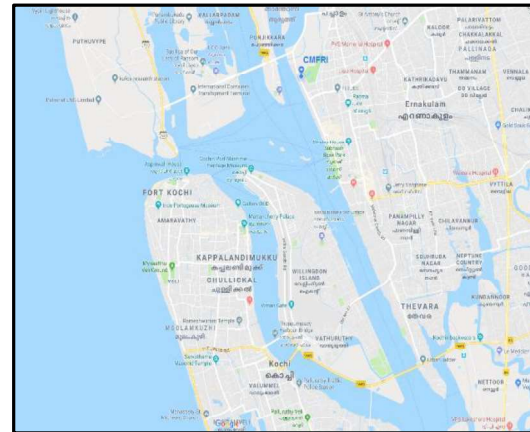
Landsat 1 image of Ernakulam, 1973



Landsat 5 image of Ernakulam, 1990



Landsat 8 image of Ernakulam,



Google Map of the Corresponding

Fig 3. The three images above show the utility of satellite remote sensing in monitoring the earth surface / our environment. The yellow box indicates the areas where drastic changes had taken place.

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