ICT Applications to enhance profitability of fisheries based enterprises

V.Chandrasekar

V.Geethalakshmi

A.K.Mohaty

G.Arul Oli

G.Bhaskar

ICAR - Central Institute of Fisheries Technology (CIFT), Kochi

Tamil Nadu Dr.J.Jayalaithaa Fisheries University (TNJFU), Nagapattinam

&

National Institute of Agricultural Extension Management (MANAGE), Hyderabad

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ICAR-Central Institute of Fisheries Technology

Dr. V.Chandrasekar, Senior scientist

Dr. V.Geethalakshmi,Principal Scientist

Dr. A.K.Mohaty, Principal Scientist

Tamil Nadu Dr.J.Jayalaithaa Fisheries University

Dr. G.Arul Oli, Asst Professor

National Institute of Agricultural Extension Management

Dr. G.Bhaskar, SG. Asst Director (IT)

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Chief Editor: Chandrasekar V

Editors: G. Arul Oli, G. Bhaskar, Geethalakshmi V & A.K. Mohanty

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This e-book is a compilation of resource text obtained from various subject experts of Central Institute of Fisheries Technology, Cochin-29, Kerala, India & MANAGE, Hyderabad, on “ICT applications to enhance profitability of fisheries based enterprises”. This e-book is designed to educate extension workers, students, research scholars, academicians related to Fishery extension about the ICT applications to enhance profitability of fisheries based enterprises. Neither the publisher nor the contributors, authors and editors assume any liability forany damage or injury to persons or property from any use of methods, instructions, orideas contained in the e-book. No part of this publication may be reproduced or transmitted without prior permissionof the publisher/editors/authors. Publisher and editors do not give warranty for any error or omissions regarding the materials in this e-book.

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Preface

I'm delighted to introduce the instructional handbook "ICT Applications to Enhance Profitability of Fisheries-based Enterprises." This comprehensive manual explores how ICT-driven applications can disseminate knowledge, meticulously crafted by ICAR Fisheries institutes, NGOs, and private industries. Encompassing diverse mobile apps and digital platforms, it underscores ICT's significance in fisheries, sensitizing stakeholders in fishing, fish processing, and marketing to enhance efficiency and profitability. In this digital era, fisheries digitization offers a promising future.

The book delves into ICT's transformative potential, offering insights for fisheries professionals, entrepreneurs, policymakers, and researchers. Authored by experts, its chapters cover a spectrum of tailored ICT applications, addressing core challenges in fisheries.

Visionary chapters spotlight mobile apps in training, enhancing value addition, quality assessment, seafood innovation, and shrimp aquaculture in saline regions. The manual covers fish farming empowerment, aquaculture, real-time data for fishing communities, marketing, and decision support systems.

Navigating aquaculture health, drying methods, aquatic animal health, intelligent shrimp aquaculture, ERP software, microcredit apps, fishing tools, and fish landing data management, these chapters offer techniques to enhance financial viability through ICT solutions.

My heartfelt thanks to the experts and practitioners contributing to this book. I'm confident it will foster innovation, equipping fisheries-based enterprises for sustainable growth. I extend my appreciation to ICAR - Central Institute of Fisheries Technology (CIFT), TNJFU, and MANAGE for collaborative efforts in shaping "ICT Applications to Enhance Profitability of Fisheries-based Enterprises." I encourage readers to embrace ICT's transformative role, steering innovation, profitability, and sustainability in fisheries enterprises.

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1. Digitalization in fisheries vision for the future

A.K.Mohanty & Chandrasekar V.

Introduction:

Digitalization has transformed the agriculture and fisheries sectors by integrating ICT with a data ecosystem, aiming to make farming practices profitable, sustainable, and provide safe, nutritious, and affordable food. In fisheries, digitalization focuses on timely information delivery to stakeholders, saving resources. ICT and data integration create interconnected platforms, empowering stakeholders to access and exchange information effortlessly. Fishermen benefit from informed decisions on weather, fish stocks, and sustainable practices. Wholesalers and retailers improve inventory management, ensuring steady supply chains and product quality. Digitalization fosters collaboration, transparency, and trust. Auctioning agents use digital platforms for fair auctions, enhancing market efficiency. Processors streamline operations with real-time information, improving productivity. Digitalization aims to ensure consumers receive safe, nutritious, and affordable food. Digital platforms enable tracing fish origin and quality, empowering informed choices and reinforcing trust. The integration of ICT and data ecosystems reshapes farming practices, striving for profitability, sustainability, and food delivery. This chapter introduces digitalization's impact on fisheries, empowering stakeholders in a rapidly evolving landscape.

The global perspective on the digital transformation of the food system showcases technology's revolution in production, processing, distribution, and consumption. Smart farming optimizes practices, precision agriculture maximizes yields, and blockchain ensures traceability. Online marketplaces and AI-driven analytics provide personalized nutrition. Digital tools enhance efficiency, sustainability, and resilience. However, challenges like technology access and data privacy must be addressed for inclusive transformation.

Opportunities for ICT intervention in fisheries:

India's fisheries sector is crucial to its economy, encompassing food security, employment, and foreign exchange earnings. However, it faces challenges like unsustainable practices, limited information access, and inefficient value chains. This report explores the potential of ICT

interventions to enhance productivity, sustainability, and profitability. ICT solutions revolutionize fishing operations by providing real-time data on weather, currents, and fish stocks. Mobile apps and web platforms offer weather forecasts, aiding trip planning. Satellite tech identifies productive fishing zones, optimizing catch rates. ICT bridges the gap between fishermen and markets, eliminating intermediaries. Digital platforms improve auction processes, ensuring fair prices. ICT enhances traceability, product quality, and storage conditions. It aids fisheries management through GIS mapping and data analysis. India's fisheries sector contributes significantly to food supply, nutrition, foreign exchange, and employment.

Huge oppertunities in rural India:

To achieve sustainability in the fisheries sector, various strategies and measures are required. Key approaches include increasing aquaculture production and diversification, improving the utilization of existing fisheries resources, minimizing post-harvest losses, implementing information knowledge management through ICT, strengthening marketing linkages, translating policy directives into actionable programs, and empowering small-scale fishers with technology (FAO, 2016). Increasing aquaculture production and diversifying the range of cultivated species helps reduce pressure on wild fish stocks and meet seafood demand sustainably. Utilizing existing fisheries resources efficiently through responsible fishing methods and bycatch reduction techniques prevents overfishing and promotes stock replenishment. Minimizing post-harvest losses through proper handling, storage, and processing techniques maximizes resource utilization. Information knowledge management via ICT allows stakeholders to make informed decisions on resource management and market strategies. Strengthening market linkages facilitates efficient supply chains. Translating policy directives into actionable programs requires effective governance and enforcement mechanisms. Empowering small-scale fishers with technology and capacity-building programs enhances their skills and sustainability practices. These strategies, implemented through collaboration between stakeholders, contribute to a sustainable and responsible fisheries industry.

Information knowledge management in fisheries:

Information knowledge management in the fisheries sector covers crucial information supporting various aspects of the industry, including fish culture, fishery management, aquaculture, fishing techniques, and more. Access to this information enables stakeholders to adopt sustainable practices, enhance productivity, and gain insights into government schemes and support services. Timely access to disease management and quality control information ensures fish health and product standards. Weather forecasting aids in safe fishing planning. Traceability systems ensure transparency from catch to market. Market information helps understand trends, preferences, pricing, and distribution. Overall, information knowledge management empowers stakeholders to make informed decisions, enhance productivity, ensure quality and safety, and seize market opportunities, contributing to sector growth and sustainability.

Extension in fisheries

Extension services in the fisheries sector utilize specialized and general-purpose applications to enhance productivity and decision-making. Specialized applications like sonar aid in locating fish and identifying optimal fishing grounds. GPS enables precise navigation, ensuring safe and efficient fishing. Mobile apps and phones revolutionize trading, information exchange, and emergency communication. Tailored radio programming disseminates important updates to fishing communities. AI and ML automate fish processing, improving quality control. Web-based platforms provide valuable information and networking resources. Expert systems offer information on emerging technologies and best practices. Decision support systems enable access to critical information for weather conditions, market prices, and sustainable practices. These systems optimize productivity, manage risks, and facilitate informed decision-making.

KIRAN

The digital transformation of the food system represents a global perspective on how technology is revolutionizing the way food is produced, processed, distributed, and consumed. From farm to fork, digital innovations are reshaping every aspect of the food supply chain. Smart farming technologies optimize agricultural practices, precision agriculture maximizes crop yields, and blockchain ensures traceability and transparency. Online marketplaces and e-commerce

platforms facilitate direct farmer-to-consumer connections. Artificial intelligence and data analytics enable personalized nutrition and predictive modeling. By leveraging digital tools, the food system becomes more efficient, sustainable, and resilient. However, challenges such as access to technology and data privacy must be addressed to ensure equitable and inclusive digital transformation for all stakeholders across the globe.

Agropedia:

Agropedia, developed by IIT Kanpur, is an online platform serving as a comprehensive resource for agricultural information exchange. Launched as part of the NAIP projects of ICAR, it focuses on knowledge management through the identification, capture, storage, and processing of agricultural knowledge using IT tools. The platform aims to enhance accessibility and usability of agricultural knowledge, empowering stakeholders in the sector. One notable feature is the dissemination of knowledge in multiple languages, promoting inclusivity by breaking language barriers. Agropedia serves as a one-stop resource, facilitating knowledge dissemination and supporting stakeholders in the agricultural sector.

M4Agrinet

In collaboration with CAU Imphal, Media Lab Asia (MAsia) has initiated the "Mobile Based Agricultural Extension System in North-East India (m4AgriNEI)" project. Its primary objective is to empower farmers by providing timely and accurate information through a mobile-based agricultural extension system. The project aims to assist approximately 5000 farmers in 50 villages across three districts of Meghalaya over a span of 2 years. Through personalized advisory services, farmers will receive guidance on various aspects of agriculture, including crop cultivation, pest management, soil health, weather patterns, and market trends. By leveraging mobile technology, the project aims to bridge the information gap and enhance agricultural productivity, livelihoods, and sustainability in the targeted regions. The mobile-based system ensures that farmers, even in remote areas, have access to the right information when they need it, enabling them to make informed decisions and adopt best practices. By empowering farmers with knowledge and tailored recommendations, the m4Agri-NEI project strives to contribute to the overall development of the agricultural sector in North-East India.

e-Chaupal

In 2000, ITC Limited introduced and implemented an expert system in the fisheries sector across multiple states in India, including Madhya Pradesh, Haryana, Uttaranchal, Karnataka, Andhra Pradesh, Uttar Pradesh, Maharashtra, Rajasthan, and Kerala. This system targets farmers engaged in fisheries and serves as an interactive computer program that simulates expert consultation. Leveraging artificial intelligence technology, it provides solutions and guidance across various subjects related to fisheries. By utilizing the expert system, farmers can access a comprehensive platform that offers informed suggestions and recommendations to address challenges in the sector. With its integration of artificial intelligence, the expert system enhances problem-solving capabilities and promotes sustainable practices, supporting farmers in improving productivity and sustainability in the fisheries sector.

Category	No. of expert Systems
Fish identification	4
Fisheries management	24
Aquaculture management	26
Fish diseases diagnosis and health management	30
Fisheries information management	2
Fish product marketing	5
Total	91

Aquaculture Management

Aquaculture management encompasses the planning, implementation, and monitoring of activities involved in the controlled cultivation and rearing of aquatic organisms. It involves various aspects such as site selection, species selection, feeding, water quality management, disease control, and sustainable production practices. Effective management involves considering factors like water availability, quality, temperature, and selecting suitable species. Proper feeding regimes and water quality monitoring are crucial. Disease control measures and sustainable practices, such as minimizing waste and environmental impact, are also important. Sound

aquaculture management is essential for optimizing production, minimizing environmental impact, and meeting the global demand for seafood responsibly and sustainably.

Expert system	Developed by	Importance
AQUASITE	Canada	Selection of ideal site for undertaking marine coastal aquaculture Considers the full range of site assessment criteria and the main species of interest for mariculture in the Atlantic Region of Canada.
SCHUBERT AUDIT		Trout farms to breed fish of defined quality for consumption and restocking Methodology under use in the industry and the quality audit to comply with laws on the management of fish farms.
70RIAX	UMECORP	The Tilapia mozambique culture in intensive aquaculture is monitored and controlled, providing guidance to operators and predictive advice for complex problems. It also forecasts events and provides warnings for system managers to handle unforeseen situations.

Fisheries management

Expert systems in fisheries management utilize advanced computer-based technology and artificial intelligence to optimize decision-making and resource utilization. They offer recommendations for sustainable practices, stock assessments, and conservation measures, analyzing complex data and reducing complexity and uncertainty. By processing real-time data and enabling proactive management, expert systems contribute to the long-term viability of fisheries resources. Overall, they enhance efficiency and sustainability in fisheries management.

Expert system	Importance
CANOFISH	Demonstrated the strength, necessity and utility Information on management of multispecies fishery resources
PISCES	Controls the introduction of exotic fish species into the waters in Southern Africa
ProTuna and MRAG Ltd, ProFish	ProTuna expert system was intended for the management of tuna fisheries ProFish expert system was a more generalized fisheries management expert system that provided a broader range of advice on fishery characteristics, current management measures concerning the most likely resource species in the target area

Expert disease diagnosis and health management

Expert disease diagnosis and health management in the field of agriculture and aquaculture involves the application of specialized knowledge and advanced technology to identify, diagnose, and manage diseases affecting crops, livestock, and aquatic organisms. Through the use of diagnostic tools, data analysis, and expert systems, professionals in the field can accurately identify diseases, assess their severity, and develop effective treatment strategies. This expertise enables timely interventions, disease prevention measures, and the implementation of appropriate health management practices to mitigate the impact of diseases on agricultural and aquacultural systems.

Name of the Expert system	**Importance**
AQUADOC	For diagnosis of various fish diseases
SALMEX	To diagnose diseases of farmed salmonid fishes in seawater
SEDIP	For diagnosing diseases in freshwater and seawater fish
Fish Doctor	Diagnosis of various fish disease
FINES	For diagnosis of nutritive diseases of farm fish

Fisheries Information Management

Fisheries Information Management involves the collection, storage, analysis, and dissemination of data and information related to the fisheries sector. It encompasses various aspects such as fish stock assessments, catch statistics, fishing effort, vessel monitoring, market trends, and regulatory compliance. Effective fisheries information management systems ensure accurate and timely data collection, efficient data processing, and accessible information for stakeholders. This information is crucial for evidence-based decision-making, sustainable fisheries management, market planning, resource allocation, and policy development in the fisheries sector.

Expert system	**Developed by**	**Importance**
AQUAREF	National Agricultural Library's Aquaculture	Reference-related to aquaculture information inquiries

	Information centre, US.	Automated system developed for storage and access on micro-computers. Developed to improve access to basic resource tools and information in aquaculture
REGIS		Provides information on aquaculture of the Sub-Saharan Africa region in an easy-to-use form. It presents a descriptive summary of African aquaculture, covering areas such as consumption and production statistics, extension, training, credit programmes, associations, government policy and legislation, and development projects

Fish product marketing

Fish product marketing involves the strategic planning and implementation of activities to promote and sell fish and fishery products in the market. It encompasses various aspects such as market research, product positioning, branding, pricing, distribution, and promotional strategies. Effective fish product marketing aims to create awareness, generate demand, and increase sales of fish products among consumers. This may involve targeting specific market segments, developing attractive packaging, highlighting quality and sustainability attributes, and utilizing various marketing channels such as retail, e-commerce, and direct sales.

Expert system	**Developed by**	**Importance**
STRATEX		Aids in decision making in trade offish and fisheries products by supporting the choice of market segments and export trade of raw and manufactured fish products in Norway
APPFSS (Aquatic Products Price Forecasting Support System)	China Agricultural University	Provide decision aids to price forecasting to avoid market imbalance Combines models, data, expert knowledge and a user interface and helps aquaculture industry to predict market price and related information
Case Based Reasoning		Forecasting the price of aquatic products and constructs a forecasting system

(CBR)		Developed to predict the fishery market in Jiangxi Province in China, to forecast Danish ex-vessel seafood prices, and to forecast aquatic products

Scopes of ICT interventions in Fisheries:

ICT interventions in fisheries have a broad scope, encompassing multiple levels within the sector. At the macroscopic level, ICT supports monitoring and enforcement through satellite tracking and remote sensing tools, addressing issues like IUU fishing. On fishing vessels, ICT aids operations with fish finders, weather forecasting, and communication systems, optimizing fishing efforts and safety. Onshore, ICT manages the supply chain with traceability systems, inventory software, and e-commerce platforms, improving product movement and market access. ICT assists in market analysis, pricing, and connecting fishers with consumers. These interventions modernize the sector, enhance compliance, operational efficiency, and market opportunities, contributing to sustainability and profitability.

Strategic ICT intervention in small-scale fisheries

ICT intervention in small-scale fisheries empowers fishers in localized communities by addressing their specific challenges and enhancing their capabilities. Market information and access are improved through mobile apps and web platforms, enabling real-time prices, buyer identification, and connections to larger markets. Knowledge dissemination enhances productivity and sustainability through sharing best practices, weather updates, and fishing techniques. ICT strengthens community networks, promoting collaboration and collective problem-solving. Online platforms and social media foster knowledge sharing and peer learning. ICT also supports resource management through mobile data collection and geospatial technology, enabling fishers' participation in decision-making and sustainable fisheries management. These interventions enhance the profitability, productivity, and sustainability of small-scale fisheries.

ICT interventions in small-scale fisheries along value chain

ICT interventions along the value chain of small-scale fisheries have a significant impact on enhancing efficiency, connectivity, and sustainability within these communities. These interventions leverage information and communication technologies to address the unique

challenges faced by small-scale fishers at different stages of the value chain. For production, ICT tools like mobile applications and sensor-based technologies provide real-time weather updates, GPS navigation systems, and fish tracking tools, enabling informed decisions on fishing grounds, timing, and techniques. This improves catch efficiency, reduces costs, and minimizes environmental impacts. In post-harvest management, ICT interventions facilitate better handling, processing, and storage practices through guidance on proper techniques and conditions. This preserves fish quality, reduces losses, and enhances product value. ICT also connects small-scale fishers with markets through online platforms, e-commerce systems, and mobile applications, enabling direct access to buyers, transparent pricing, and market demand analysis. Bypassing intermediaries, fishers can negotiate better prices, expand their customer base, and enhance market reach. Additionally, ICT supports traceability and certification systems, assuring consumers about the origin, quality, and sustainability of fish products. This builds trust, opens new market opportunities, and promotes sustainable practices. By integrating ICT along the value chain, small-scale fishers overcome information access and market connectivity limitations, empowering them with knowledge and decision-making capabilities while contributing to economic and social development and promoting sustainability.

2. Mobile applications for sample testing and training facilities at ICAR-CIFT

Chandrasekar V, Geethalakshmi V and A.K.Mohanty

ICAR – CIFT, Kochi.

vcsecon@gmail.com

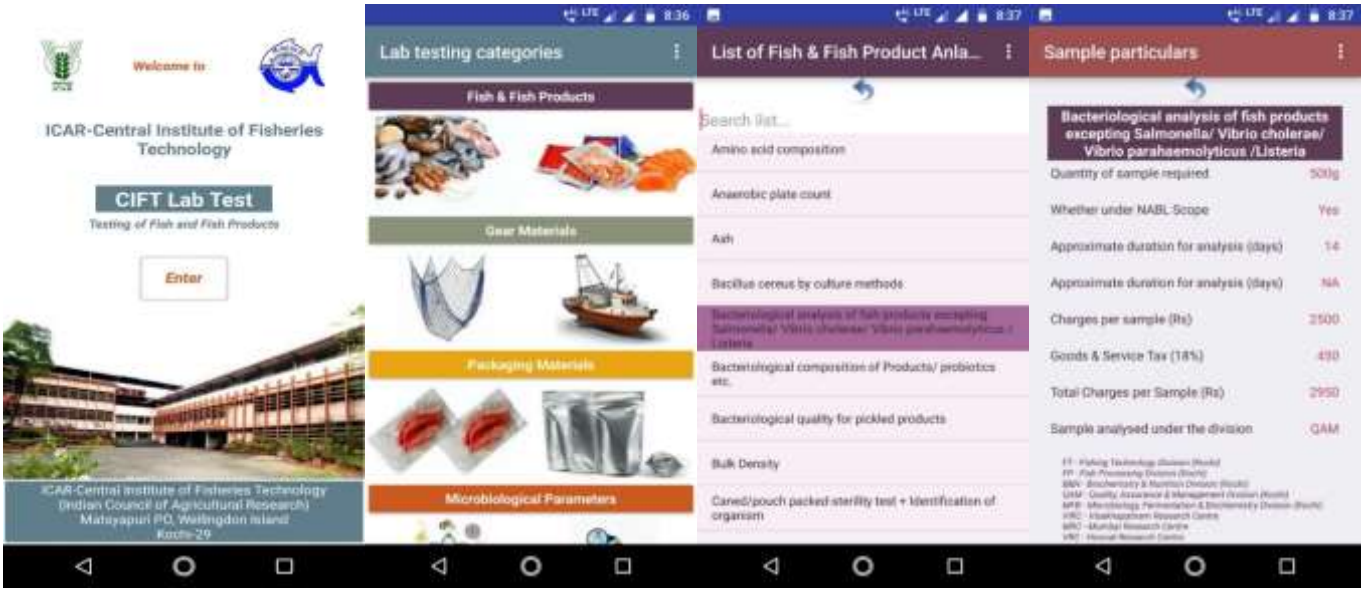
ICAR-CIFT had a significant role in establishing a harmonious relationship with the fishing and fish processing industries addressing the problems in all parts of India, since its inception. It had a historical background of conducting research work related to fishing technologies as well as fish processing technologies and significantly contribute to the modernization of seafood industries and make a profitable venture to make India one of the major exporters of seafood products in the world. CIFT has a NABL-accredited full-fledged referral laboratory mainly to meet the different countries' quality standards of the seafood export industries present along the coastal states of India export to various EU and Non-EU countries. It acts as one point solution for testing all marine fishery products of commercially important varieties of all finfish and shellfish-based products including their packing technologies such as samples mainly for export as well imported from India. Apart from various types of training related to fishing and fish-based value addition technology about the fishing vessel, harvesting, handling, gears, value additions, waste management, quality control, HACCP etc. By knowing the importance of IIDS, Extension Information and Statistics division of ICAR-CIFT, Kochi recently developed two informative interactive mobile applications **"CIFT Lab Test"** (various categories of sample testing facilities available in ICAR-CIFT) and **"CIFTraining"** (various categories of training programs provided by the ICAR-CIFT) along with online payment facilities.

"CIFT Lab Test" android-based informative application related to sample testing service facilities available in ICAR-CIFT laboratories:

ICAR-CIFT developed android based mobile application mainly a knowledge link between researchers and various fisheries stakeholders. This will be highly useful to provide effective information, by reducing the cost, time & energy of the fishermen by using the smart mobile phone application *Wimalasena H.D et al (2016).* This application mainly intends to provide information related to different categories of sample testing and analysis with respect to 228 parameters, which will be highly useful for the different stakeholders such as fishermen (boat owners, fishing gear),

aquaculture farmers, fish processing industries (both EU & Non-EU countries export industries), fisheries students, research scholar, state fisheries personals, fisheries entrepreneurs and other stakeholders Fig 2., *Biswajit, et al (2017), Balaji G, et al (2017)* Archana et al, (2020), through an interactive Information Dissemination System (IIDS). The different categories of sample testing laboratory facilities are available in the ICAR-CIFT Kochi, Kerala as well as all other 3 research centers such as Veraval (Gujarat), Visakhapatnam (Andhra Pradesh) and Mumbai research center (Maharashtra). The various sample categories such as fish and fish-based products, fishing gear materials, packaging materials, microbiological parameters, quality parameters of ice and water samples etc. Each sample information contains the quantity of sample required for the analysis, whether the particular sample is under the NABL scope or not, approximate duration required for completion of sample analysis (days), Critical control points i.e acceptable level of contamination, amount charged per sample (Rs), Goods and service tax (Rs), Total amount charged per sample (Rs) and finally the particular sample to be analyzed under which division were also mentioned and center name Fig1. This real-time android-based mobile application, information available 24X7 times is working in online mode efficiently in a good network coverage area. Whenever any periodical changes such as addition and deletion are done by the host institute in sample particulars as well as a list of samples display under each category which will be automatically updated on the user's mobile. Finally, the user can click the payment link which directly connects to the SBI collect portal of ICAR-CIFT using the portal they can select the category of sample test fee and payment can be made. The leaflet broacher link as well as the mobile application APK file downloading from the Google play store link were also mentioned below.

Figure1: Screenshot of information delivered by "CIFT Lab Test" mobile application



Leaflet link:

https://krishi.icar.gov.in/Technology/downloadpatent?action=download&fileName=mediaResourceUpload1575358598_CIFT%20Lab%20Test%20final.pdf

***Web Location/URL*:**

https://play.google.com/store/apps/details?id=com.vcsecon.CIFT_Lab_Test

"CIFTraining" mobile phone applications based information on various training programmes conducted at ICAR-CIFT:

The **"CIFTraining"** provides a complete package of information systems on ICAR-CIFT Training programs at Kochi Kerala, as well as all other 3 research Centre labs such as Veraval (Gujarat), Visakhapatnam (Andhra Pradesh) and Mumbai research Centre (Maharashtra). This is an information-based android mobile application that has been designed and developed using the online platform and used a visual blocks language (block-based programming language) as a source component to program android application behavior. This App is highly useful for fisheries students, researchers, industry personnel, state extension personnel, fisheries-based entrepreneurs, fishers and other stakeholders in the sector to access online information 24X7 times regarding different types of training programs in the field of Fishing Technology, Fish Processing, Biochemistry & Nutrition, Microbiology, Quality control, Engineering and Ex-tension & Economics. The "CIFTraining" Mobile App has embedded a total list of 68 types of clientele-based training programs available in ICAR-CIFT, which contain 60 regular training courses along with 2 comprehensives, 3 specialized and 3 certified courses covering the themes of seven divisions. The "CIFTraining" mobile app will help the stakeholders to search and see the list of training available and once select their training of interest, the detailed information is displayed were shown in figure 3. The major fisheries-related beneficial stakeholders are fisheries graduates, researchers, industry personnel, state extension personnel, fisheries-based entrepreneurs, fishers and the general public. The leaflet broacher link as well as the mobile application APK file downloading from the google play store link were also mentioned below

Leaflet link:

https://krishi.icar.gov.in/Technology/downloadpatent?action=download&fileName=mediaResourceUpload1575358554_CIFTraining.pdf

***Web Location/URL*:**

https://play.google.com/store/apps/details?id=com.vcsecon.CIFT_Training_new

Figure 3: Screen shot information delivered by "CIFTraining" mobile application.

Reference:

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3. Mobile and Web Applications for Value-Added Fish Products and Quality Assessment of Fish

Joshy C G, Senior Scientist

Joshy.cg@icar.gov.in

Introduction

Technology empowers the research and development organizations to seamlessly serve the end-users. ICAR - Central Institute of Fisheries Technology (ICAR-CIFT) has designed and developed different types of value-added fish products and fish quality assessment systems for the better utilization of fishery resources; to support the livelihood of fishers, entrepreneurs and stakeholders Value addition is remarkably enhancing the profitability of fish processing industry; and quality assessment is satisfying the demands of the consumer with a better quality and safe fish. Moreover, value added fish products boost the livelihood and entrepreneurship options of the weaker sections of the society and also enhance the nutritional security of the consumers. The know-how of the value-added fish products and quality assessment of fresh fish is being transferred to the stakeholders through teaching, training and agribusiness incubation programs.

In this era of digitalization and online services, development of user friendly information and communication technologies (ICT) would enhance the effective dissemination of technologies or informations to the users to enhance their knowledge, to enable the consumers or stakeholders to evaluate the quality of fish on-site and to help the entrepreneurs or stakeholder to plan, design and execute the development of value added fish products.

CIFTFISHPRO

CIFTFISHPRO is a web and android mobile based information system on a wide range of value added fish products developed by ICAR-CIFT to support the small or medium scale entrepreneurs to enhance their knowledge for the better utilization of fishery resources. The application inventories all the essential ingredients and the stage wise method of preparation of the value added fish products.

The series of value added fish products includes coated fish products (fish cutlets, fingers, burger, balls etc.), wrapped fish products (fish momos, kebabs, samosa and rolls), marinated products (fish and prawn pickles), extruded products (fish kure and noodles), cured products (dried fish and prawn) and other products like fish sausage and prawn chutney powder etc.

One of the key features of the application is that it will help the user to quantify the ingredient requirements as the product is scaled up as well as to estimate the approximate cost of production for a given quantity of raw fish. In addition, the system gives the user the option to enter the input costs of the components and the user has a general idea of the total costs incurred while up-scaling the product. The application also contains an ask the expert contact form that enables the users to communicate their doubts and queries along with the user's name and email so that the experts at CIFT can answer their queries instantly.

CIFTFISHPRO is designed and developed using HyperText Preprocessor (PHP), Hypertext Markup Language (HTML) and Cascading Style Sheets (CSS) and the algorithm for product up-scaling has been implemented using JavaScript (JS).

The information system is a web application accessible from any arbitrary platform using the Internet that would help entrepreneurs or stakeholders to optimally plan, design and execute the development of value added fish products. It is an interactive and user friendly application with simple and easy navigation options; the web version is available at http://ciftfishpro.cift.res.in/index.php and the android application can be downloaded from google play store at https://play.google.com/store/apps/details?id=com.icar_ciftfishpro&hl=en_IN&gl=US.

FISHQCheQ

FISHQCheQ is a demerit score based non-destructive and cost-effective fish quality index (FQI) system for assessing the quality or freshness of fish, which is available as web and mobile applications. With the overwhelming usage of internet assisted applications worldwide, options for the onsite evaluation of fish quality are feeble; while this responsive and feasible web based application is accessible across various online platforms enabling the consumers or stakeholders a

seamless evaluation of the fish quality, on the site. The fish quality assessment system evaluates the demerit score by considering the five general characteristics of fish ie; the appearance of fish and the conditions of its eye, gill, belly and vent. The user can assess the fish quality based on the various sub-characteristics derived from the five major quality characteristics of fish on a demerit scale and the application automatically calculates the quality index score in the range of 0 to 1 with a quality description, as output. The quality index score 0 and 1 represents excellent and worse quality of fish, respectively.

The home page of the mobile application contains three components viz: FQI home page, Instructions for FQI and Assessment of FQI. The home page provides an introduction about FQI; Instructions for FQI provides instructions on how should be the quality assessment of fish is being done and user has to read it thoroughly and Assessment of FQI is the page where user has to select the available demerit score as input for each quality attribute based on the quality evaluation of the fish. Finally, the users have to click on '*compute FQI'*, then the system will give the FQI score in the range of 0 to 1 with a quality description like fish quality is 'excellent', 'very good', 'good', 'moderate', ' moderate to bad' and 'bad to worse'. The user can take this as an indicator on quality of fish and decide whether to buy or not to buy fish.

FISHQCheQ is designed and developed using HyperText Markup Language (HTML), Cascading Style Sheets (CSS) and Bootstrap framework. A modified algorithm has been incorporated for computing the fish quality index using JavaScript (JS).

The web application of the fish quality index system can be accessed from any internet assisted devices using a web browser to support the consumer or stakeholder with an on-site evaluation of fish quality either at fish markets or farms before purchasing them. The web version is available at link http://cift.res.in/ and the android application can be downloaded from google play store at https://play.google.com/store/apps/details?id=com.cift.fishqcheq&hl=en

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4. ICT Applications Developed by MPEDA for Seafood Sector

Neenu Peter, Deputy Director

The Marine Products Export Development Authority, Kochi

Email: neenupeter@mpeda.gov.in

The Marine Products Export Development Authority (MPEDA) was established by an Act of Parliament during 1972 with the mandate to promote, by such measures as it thinks fit, the development of the marine products industry with special reference to exports". The Act empowers MPEDA to regulate exports of marine products and take all measures required for ensuring sustained, quality seafood exports from the country. MPEDA, with its head quarters at Cochin has a network of field offices, Trade promotion offices, Quality control laboratories, ELISA screening laboratories, Aqua one centers.

MPEDA works closely with all the stakeholders in the seafood value chain starting from farmers, fishermen, feed mills, hatcheries, processors and the counterparts in the importing nations. The details of services available to the various stakeholders can be accessed at the official website of MPEDA: https://mpeda.gov.in/.

Most of the services are operated through Web applications which has been significantly helpful in optimum utilization of resources and time of the organization as well as the stakeholders. The major applications developed for the sector are detailed below:

1. **Registration of Exporters and Processing entities like Processing plants, Storage premises, Handling centres etc**:

Every application for registration as an exporter of marine products or Processing entities must be submitted through the Online Registration portal of MPEDA with relevant documents and application fee.

Field office concerned, on receipt of application along with necessary enclosures for registration as per guidelines, will process the same. In case of Processing entities, it must be ensured that building and premises are constructed as per the standards laid down by the European

Union/MPEDA and approved by the Inter Departmental Panel wherein a freezing unit or any other processing machinery is installed for processing marine products in any form. The officer recommending the applicant/entity for registration is responsible for any omission or commission.

Application can be submitted though the URL http://e-mpeda.nic.in/registration/Reg_login.aspx

2. Export facilitation certificates

i. **Catch certificates**:

As per the EU Regulation 1005/2008, it is an obligation on the exporting nation to prevent, deter and eliminate, illegal, unreported and unregulated (IUU) fishing. MPEDA started validating Catch certificates from 01 January 2010 onwards.

MPEDA has deployed Harbour Data collectors (HDC) in various fishing harbours/Landing centres all over India for fetching the real time catch data from the fishing vessels to ensure the traceability requirements of the importing countries. As part of e-governance MPEDA switched over to online validation of catch certificate fully (submission of application by the exporter to the Issue of online certificate by MPEDA office with digital signature) from 01st April 2019 onwards.

Registered Exporter can apply DS 2031 certificate through online by using URL https://c-cert.mpeda.gov.in/

ii. DS 2031 Certificates:

As per the Section 609 of the US public law 101-162, exporting Nations must provide the DS 2031 certificate for exporting to USA for clearing the shrimp consignments. It certifies that the shrimp consignment was harvested in a manner not harmful to sea turtles and it is harvested by aquaculture.

MPEDA was issuing manual DS 2031 for the past several years. MPEDA developed online software and started issuing DS 2031 certificates digitally to the exporters from April 2020 with digital signature and QR Code for proving the authenticity of the certificates and with the approval

of the US govt. These online certificates reduce the hardships of exporters and facilitates the promotion of the seafood exports.

Registered Exporter can apply DS 2031 certificate through online by using URL http://e-mpeda.nic.in/registration/Reg_login.aspx

3. e stat package:

e-stat is web-based package which provides marine exports data of India. It facilitates exporters to enter their shipping bills in semi-automatic way by uploading CBIC -ICEGATE system generated shipping bill pdf. It also facilitates shipping bill entry in manual and excel upload in case user prefers or has custom shipping bill from non-EDI custom.

Exporters can see their basic export data information and graphical representations. MPEDA field offices could reconcile shipping bill once submitted by exporters under their jurisdiction, and further, e-stat system automatically facilitates export data at different levels.

e-stat facilitates to zoom-in export data at item, market/country, port, state wise data, such different levels as well as time scales e.g. day, week, month, year or custom. e-stat has dashboard on the first page which show cases graphical representation of basic export statistics of a selected fiscal year in the form of Pie chart/bar chart/ area chart/ column chart.

It facilitates export information in Quantity, INR, US$ and Unit value forms at different levels. It is ideal for preparation of market intelligence report and enables stakeholders to prepare their own customize reports and save it, to readily use in future.It is one stop platform for stakeholders to see marine exports of India since April 1995.

4. Aquaculture farm enrolment:

Based on the demand of importing nations especially European Union on the traceability and quality of products exported from India, MPEDA initiated an enrolment programme for aquaculture farms in 2012. The database encompasses information of aquaculture farms and hatcheries which culture exportable varieties of fish and shellfish. Each aquaculture farm enrolled with MPEDA is identified by a Unique Identification number or FARMID and representative

geographical coordinates of the farm. The enrolment database is linked to Pre-Harvest Test (PHT) system, National Residue Control Plan (NRCP) portal and DS-2031 online certificates portal which are operated by MPEDA.

About 53750 aqua farms (approximately 1.0 lakh hectares) and 380 hatcheries (28000 million) are enrolled with MPEDA after two levels of verification. The location details of farms tagged with major attributes are sent from head office to RDs/SRDs/Labs as kml files which can be viewed in Google earth application. Enrolled farms and hatcheries are monitored by officials through field visits.

An image of a shrimp farm in Andhra Pradesh and a view of this farm in Google earth application after enrolment

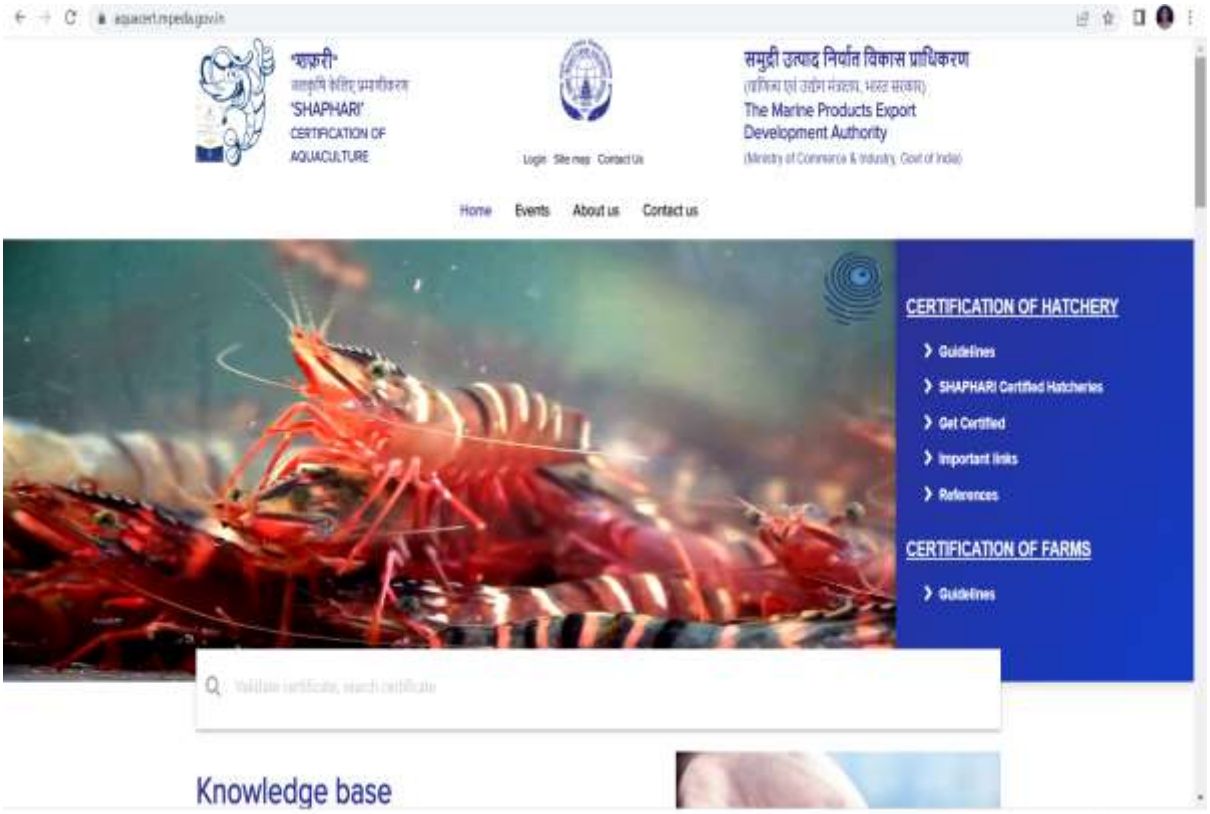
5. Pre Harvest Test (PHT):

In order to ensure antibiotic free raw material for export production, MPEDA introduced pre harvest screening of aquacultured shrimps for banned antibiotics like Chloramphenicol and Nitrofuran metabolites. 16 ELISA screening laboratories are operating in the country for facilitating testing of banned antibiotics in farmed shrimp.

An enrolled farmer can submit request for PHT online which will be processed for sample collection, lab analysis and issue of certificates by the concerned ELISA lab.

6. **Aquaculture certification programme for hatcheries & farms:**

A national level aquaculture certification programme which is in compliance with FAO guidelines for certification is being operated. This is a voluntary programme and is operated fully through an Online platform by performing audits of entities by empanelled auditors and testing of produce for the presence of banned antibiotics and pathogens.



Online Shaphari portal of MPEDA

7. E Santa:

MPEDA- National Centre for Sustainable Aquaculture (NaCSA) has taken the initiative to build a bridge between Aqua farmers and buyers to interact directly and buy the produce directly from farmers. It led the idea to form an e-commerce platform to help the society farmers and developed eSanta portal for a cosy environment among seller and buyer with help of NaCSA. Each step in the eSanta process is captured electronically, and all transaction data is routed through ESCROW

account, reducing risk and time for completion of the process between seller (aqua farmer) and buyer (exporter).

Apart from the above online applications, all MPEDA offices are working on e-office platform. The digital era has transformed the work life in an entirely new direction and has added to the capabilities of the personnel involved in all sectors including the seafood sector.

5. m-Jhinga for Shrimp Aquaculture in Inland Saline Areas

Neha Wajahat Qureshi and Ananthan P.S

Fisheries Economics, Extension and Statistics Division, ICAR-CIFE, Mumbai

Introduction

What is Soil Salinization?

Soil salinization is a serious ecological threat affecting the agricultural output in arid and semi-arid environments of more than 100 countries across the world, with varying degrees of negative impact on the socioeconomic welfare of farming communities (Ansal and Singh, 2019). Salinization is recognized as the main threat to environmental resources and human health in many countries, affecting almost 1 billion hectare worldwide representing about 7% of earth's continental extent, approximately 10 times the size of a Venezuela or 20 times the size of France (Wicke et al., 2011; Ivushkin et al., 2019). Salinity is one of the major constraints in sustainable food production in many parts of the world. About one third of the cultivable land under irrigation in the world is presently known to be under the influence of salinity. The major inland saline lands of the world are found in arid, semi-arid and low-lying and poorly drained regions, where high concentrations of salts accumulate in the soil (Barman, 2017; Ansal and Singh, 2019). Around 1,200 million hectare land across the world has been documented to be affected by salt, which has impacted their agricultural output, and consequently the rural economies of many developing countries, including India (Ansal and Singh, 2019).

Salinization may be either primary or secondary. Former is caused naturally by insufficient rainfall, consequently poor leaching of soluble salts and/ or restricted drainage due to geographical and topographical characteristics whereas later is a consequence of excessive water inputs via incorrect irrigation and leaching of soils in the absence of appropriate drainage systems, which causes a rapid raising of the groundwater table. The intensive irrigation of agricultural lands with underground saline water, without the adequate provision of drainage (natural or man-made), has led to serious problem-water-logging or the rise of the underground water table and over the years it has transformed fertile lands into non-productive wastelands. Salt affected soils in inland areas have an accumulation of salt to an extent that it adversely affects the yield of normal crops and has major economic, social and environmental consequences, threatening the viability of various rural

communities (Beresford et al., 2001; Williams, 2001; Singh et al., 2013). The main cause of soil salinization in both coastal and inland states is water logging, indiscriminate use of inorganic fertilizers and over irrigation (Singh et al., 2017).

Salt affected soils are categorized into two broad categories i.e. saline and alkaline (sodic), and the classification is based on electrical conductivity (EC) of the soil solution that detects osmotic problems and exchangeable sodium percentage (ESP) indicative of a physical dispersion problem (Singh et al., 2017). Saline groundwater can be found just below the surface, at nearly 200 m depth, widely distributed in semi- arid and arid regions where rainfall is less and the rate of evapotranspiration is high (Singh et al., 2017). It may also occur in regions of greater rainfall as a result of underground salt deposits, connate water of marine origin and saltwater intrusion in coastal areas. Inland saline water has adversely affected the agricultural outputs and environment in different parts of the world such as USA, Australia, India, China and Israel (Allan, et al. 2001). The salinity of the inland saline water ranges from 10-25 ppt with high levels of Ca2+ and Mg2+, low levels of K2+, which has resulted in high water hardness.

Global Status of Soil salinization

Currently 1128 M ha of land is salt affected globally, of which 76 M ha are affected by human induced salinization and sodification (Hossain, 2019). Middle East (189 m ha) followed by Australia (169 m ha) and North Africa (144 m ha) are the major salt affected areas. South Asia, including India, has about 52 m ha salt-affected area (Wicke et al., 2011; Mandal, 2018).

Majority of global area (~85%) is only slightly to moderately affected by high salt concentrations while the remainder 15% suffers from severe to extreme limitations for crop cultivation (Wicke et al. 2011). In Australia, over 60% of saline groundwater sources ranges from 5 to 40 ppt, a range suitable for culture of many euryhaline species. In USA, 2/3 of total landmass is affected by salinization, in Vietnam, around 1 million hectare (3% of total landmass) of soil have been affected by salinization while in Thailand, inland salinity is distributed in the north-east region of the country. In Israel, inland saline aquaculture, known as ‘desert aquaculture’, began operating commercially in the late 1980s and is characterized by raising finfish in brackish water from deep

aquifers, (Burnell, 2009). Commercial aquaculture production using inland saline groundwater occurs in the USA, Israel, India and Australia (Allan, 2009)

Indian Status of Soil Salinization

There are about 6.73 million ha of salt-affected lands and 1.93 million hectares kilometres area with ground saline water (Lakra, 2014; Lakra et al. 2014) prevalent mainly in the arid and semi-arid regions of Rajasthan, Haryana, Punjab, Gujarat, Uttar Pradesh, Delhi, Andhra Pradesh, Maharashtra, Karnataka, Tamil Nadu and Andaman & Nicobar (Singh, 2009). About 1.20 million hectares (or 12 lakh ha)of this land are located in the non-coastal Indo-Gangetic plains in northern India and covering seven states, including Punjab, Haryana, Rajasthan Bihar Uttar Pradesh Madhya Pradesh and Jammu and Kashmir.

In some parts of India, the soil has become saline and so unproductive, due to excessive irrigation and overuse of chemical fertilizer and these lands are not useful for any agricultural crop. Due to non-utilization of ground saline water, the water table in these areas is rising with an alarming rate causing secondary salinization and water logging conditions with poor quality water. Salinization of inland waters of India, particularly in the north-west region is increasing at an alarming rate due to both natural and anthropogenic activities and has major social, economic and environmental consequences (Dhawan et al. 2010).

According to estimates, the present area under salt-affected soils in country would almost treble to 20 million ha by 2050 (Sharma et al. 2014a). The problem of poor quality waters would also significantly increase in the foreseeable future due to planned expansion in irrigated area and intensive use of natural resources to fulfill the food and other livelihood requirements of an increasing population (Sharma et al. 2011). About 40% of inland saline soil is contributed by Haryana, Punjab, Rajasthan and Uttar Pradesh where 41-84% of the groundwater is also saline. .

Impact of Soil Salinization

Salinization is recognized as the main threat to environmental resources and human health in many countries, affecting almost 1 billion ha worldwide representing about 7% of earth's continental extent, approximately 10 times the size of a Venezuela or 20 times the size of France

(FAO/IIASA/ISRIC/ISS-CAS/JRC, 2008; Wicke et al. 2011; Ivushkin et al. 2019). The main detrimental impact of salinization is yield losses as it threatens the continued existence of agriculture in some regions and countries (Eynard et al., 2005).

It is estimated that due to salt-affected soils, India loses annually 16.84 million tonnes of farm production resulting in annual losses of 230 billion INR in India (Mandal et al., 2010; Thimmappa et al., 2015; Sharma et al. 2015). Among the various states, Uttar Pradesh accounted the highest production loss (7.69 million) followed by Gujarat (4.83 million tonnes) (Mandal, 2018). Building up of salinity in the adjoined agriculture field and fresh water reservoirs due to seepage of saline water from the aquaculture farm is a serious concern and needs to be addressed by policy makers (Singh, 2009). In such areas, the culture of white leg shrimp, *Penaeus vannamei* in inland saline ponds has been found as a practical and profitable venture. Productions of ***P. vannamei*** on commercial scale have been attempted in many locations in the states of Punjab and Haryana.

Inland saline aquaculture and CIFE

Inland saline aquaculture is defined as land-based aquaculture using saline groundwater, occurs in several countries including Israel, the USA, India and Australia. A range of species have been evaluated for culture in saline groundwater namely euryhaline finfish (e.g. *Lates calcarifer, Sparus auratus, Dicentrarchus labrax, Argyrosomus japonicus*), crustaceans (e.g. *Penaeus monodon, Penaeus vannamei, Marsupenaeus japonicus*), molluscs (e.g. *Saccostrea glomerata*), diadromous species such as salmonids (e.g. *Oncorynchus mykiss*) and salt-tolerant freshwater species, both finfish (e.g. *Oreochromis niloticus, Bidyanus bidyanus*) and crustaceans (e.g. *Macrobrachium rosenbergii*).

In India, ICAR-Central Institute of Fisheries Education (CIFE) has developed a technology for culture of Pacific white shrimp (*Penaeus vannamei*) using inland saline groundwater (Lakra 2014; Lakra et al., 2014). Besides CIFE, Central Soil Salinity Research Institute (CSSRI) Karnal also has made vigorous efforts to demonstrate the practical feasibility of commercial fish culture in extreme saline environment at Haryana (CSSRI, 2013). CIFE Rohtak Centre at Lahli successfully tested the technology in salt-affected areas in Haryana in 2012-2013. The trials of ISA were initiated in 2014 in around 20 acres of Rohtak and Hisar districts of Haryana, in 2019 more than

450 farmers from different states have adopted the technology in about 1000 acres with production of 22000 tonns with average productivity of 2.2 tonns/ acre.

Culture of *P. vannamei*

Pacific white shrimp, *Penaeus vannmei* has become a game changer in Indian shrimp farming in recent years. Since its commercial introduction in the year 2009, the farming of this exotic species has gained tremendous momentum in India owing to its faster growth rate, tolerance to high stocking density, lower dietary protein requirement and tolerance to wide ranges of salinity and temperatures. Following its tremendous success in coastal states, successful maiden attempts were made by Central Institute of Fisheries Education to develop package of practices for profitable aquaculture for the utilization of fragile and degraded resources. Experimental trials were initiated by CIFE at its Rohtak Centre in Haryana in May, 2012 and in Punjab a preliminary trial in 2013, the first pilot project farming Pacific white shrimp (*Penaeus vannamei*) started in Fazilka in 2014.

The major challenges were the quality of ground saline water because of ionic imbalance. Inland saline waters invariably have low levels of potassium and high levels of calcium and variable concentrations of magnesium in comparison to natural sea water. Inland saline waters are characterized by low potassium (8.5-17 ppm) and magnesium (350-400 ppm) levels compared to seawater (K, 320-340 ppm Mg-590-610 ppm) causing an imbalance in Na+/K+ ratio while calcium (120-150 ppm) is higher than that of seawater (100-120 ppm). Hence, fortification of potassium and magnesium has been attempted by many researchers for making *P. vannamei* farming possible in ISA (Roy et al., 2010). With the continuous technical support from GADVASU, CIFE and State Fisheries Department the water logged and saline affected lands both in Punjab and Haryana, the saline aquaculture has got boosted a lot over the last 5 years.

ICAR-CIFE has established a lead in transforming degraded saline soils into highly remunerative shrimp farms and looks forward to integrate the twin vital global thrusts of renewable energy and waste utilization into aquaculture systems. Our most remarkable achievements include the commercial culture of marine tiger shrimp and Pacific white shrimp using inland saline water in Haryana and Giant freshwater prawn seed production and culture technology. The area under

culture is 800 acres in Haryana, 45 acres in Punjab, 20 acres in Rajasthan and 10 acres in Delhi. The average production per acre is 2-3 tonnes. The cumulative revenue generated by these 4 states is estimated to be more than Rs. 100 crore over the years.

ICT Application: M-Jhinga

There is a manifest demand from farmers and other stakeholders in shrimp value chain for technical and market information as well as skill sets that is timely, credible, regularly updated and user-friendly. Application of technology should be user-friendly for easy adoption by the farmers. Information and Communication Technology (ICT) to a large extent will help making the right information available at right time and the right place to farmers and other stakeholders in the value chain. ICAR-CIFE, as the key proponent of inland saline aquaculture, has the responsibility and opportunity to fulfil these unmet needs. Harnessing ICT based applications and tools would capitalise on Govt. of India's Digital India and Skill India initiatives, and help to double the farmers' income. In this context, ICAR-CIFE has developed a mobile application namely m-Jhinga.

m-Jhinga is a dynamic mobile application developed by ICAR-CIFE for shrimp aquaculture in inland salt affected areas under the aegis of a mega project funded by Govt. of India and World Bank under the ambit of National Agricultural Higher Education Project (NAHEP).

App Logo and URL

https://play.google.com/store/apps/details?id=in.kultivate.icarcife&hl=en&gl=US

It has 9 self-explanatory modules and it provides detailed advisory to farmers on setting up new shrimp farms, growing healthy shrimp crop and current market price trends. The app also helps farmers to self-identify problems and ask the experts when they are not sure. The app also provides a platform to check actual and forecasted weather info. There are many helpline numbers also for technical and Government support.

Application Layout

- **Nine modules**
  - **Advisory**
  - **Weather**
  - **Market**
  - **FAQs**
  - **Ask experts**
  - **Diagnostics**
  - **My Pond**
  - **Regulation and Support**
  - **Helpline**

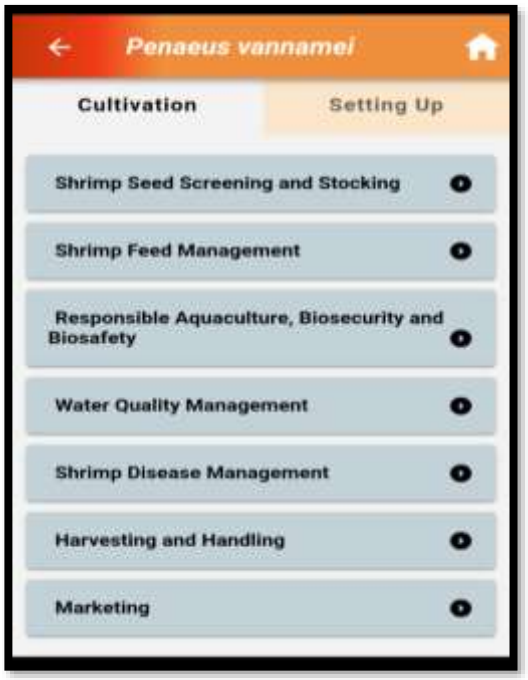
m-Jhinga doubles as a digital notebook for tech savvy farmers to record and track their ponds, shrimp stocks, water quality. They can record daily inputs, harvests and expenses.

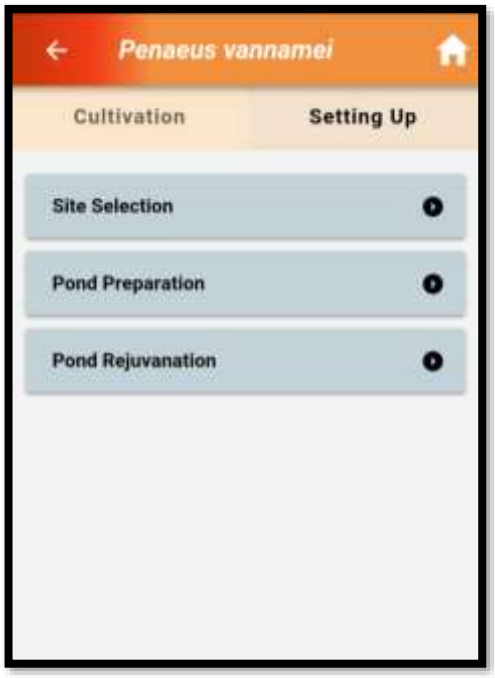
The app helps farmers to keep a tab on News and Events & Training Info related to aquaculture. Currently more than 650 farmers are using it and daily we receive 3-4 queries from farmers which are answered by experts. This app has the potential to embark upon the new realms of achieving blue revolution in Inland salt affected areas.

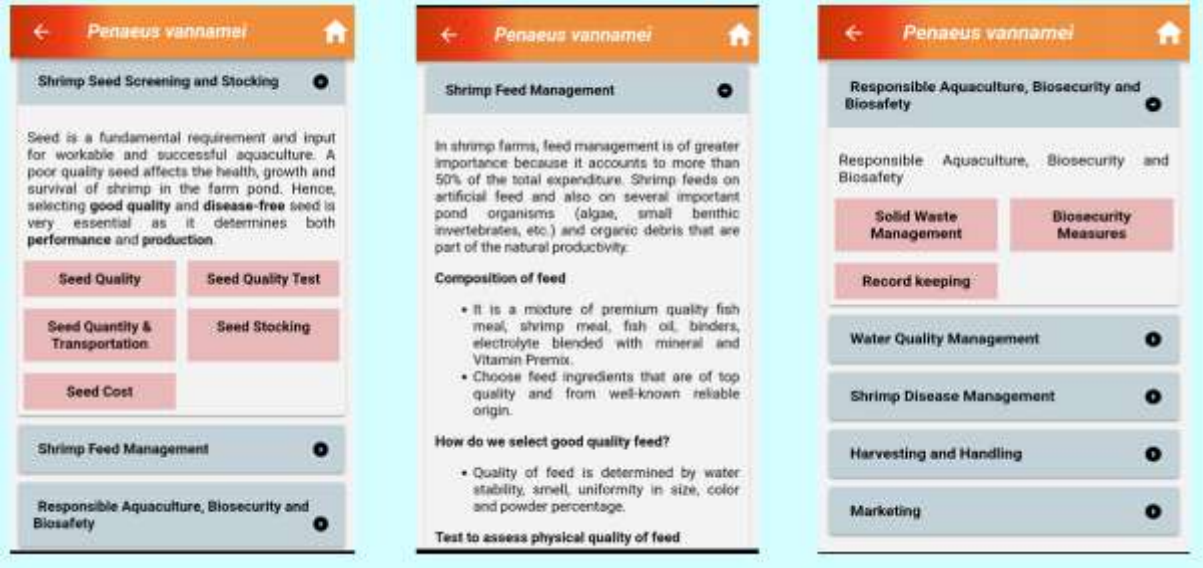
This app has the potential to help create an enabling environment for the shrimp farmers in inland saline areas to follow “Better Management Practices” and enhance the shrimp production sustainably.

Features and Functions of App

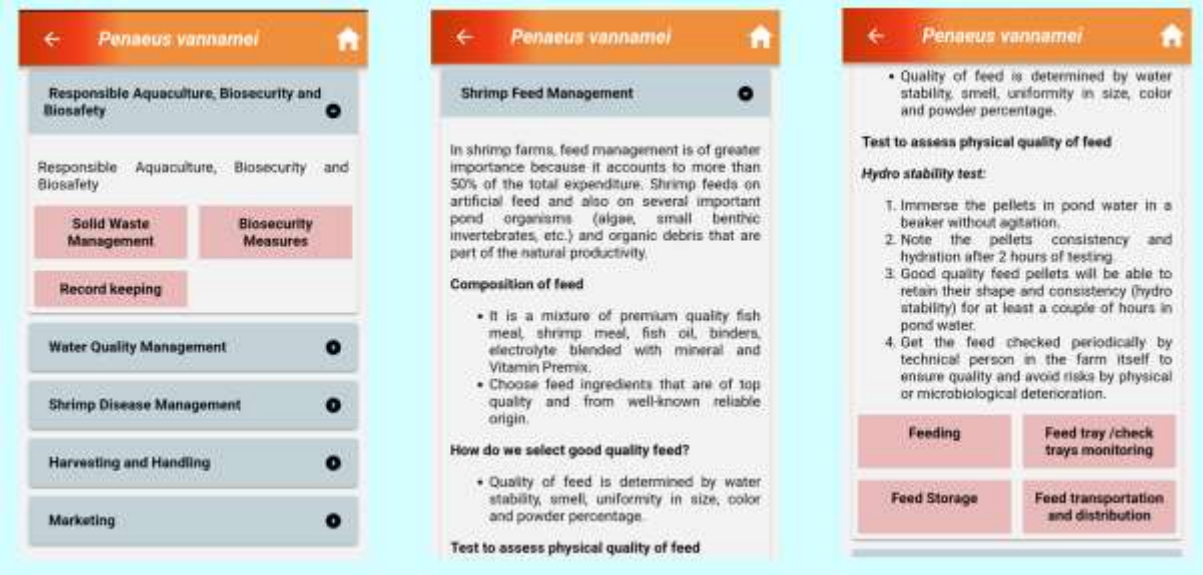
1. **Advisory:** Module will have all the basic technology practices right from the pond preparation to the harvesting of shrimp



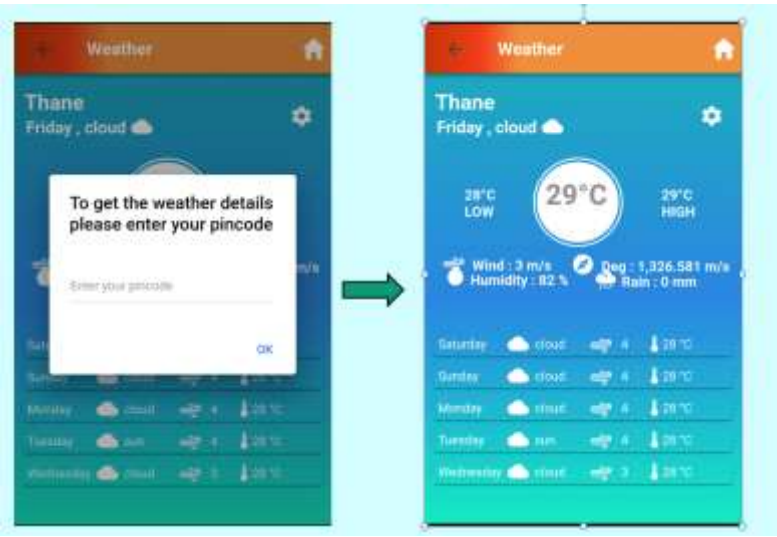



Penaeus vannamei
Shrimp Seed Screening and Stocking
Seed is a fundamental requirement and input for workable and successful aquaculture. A poor quality seed affects the health, growth and survival of shrimp in the farm pond. Hence, selecting good quality and disease-free seed is very essential as it determines both performance and production.
Seed Quality
Seed Quality Test
Seed Quantity & Transportation
Seed Stocking
Seed Cost
Shrimp Feed Management
Responsible Aquaculture, Biosecurity and Biosafety
Penaeus vannamei
Shrimp Feed Management
In shrimp farms, feed management is of greater importance because it accounts to more than 50% of the total expenditure. Shrimp feeds on artificial feed and also on several important pond organisms (algae, small benthic invertebrates, etc.) and organic debris that are part of the natural productivity.
Composition of feed
It is a mixture of premium quality fish meal, shrimp meal, fish oil, binders, electrolyte blended with mineral and Vitamin Premix.
Choose feed ingredients that are of top quality and from well-known reliable origin.
How do we select good quality feed?
Quality of feed is determined by water stability, smell, uniformity in size, color and powder percentage.
Test to assess physical quality of feed
Penaeus vannamei
Responsible Aquaculture, Biosecurity and Biosafety
Responsible Aquaculture, Biosecurity and Biosafety
Solid Waste Management
Biosecurity Measures
Record keeping
Water Quality Management
Shrimp Disease Management
Harvesting and Handling
Marketing


Penaeus vannamei
Water Quality Management
Water quality management is an essential component of shrimp pond management. Pond water quality is a critical point in production process and must be controlled within the physical, chemical and biological parameters. These parameters should be suitable and maintained within acceptable ranges for shrimp development. The quality of water available at the site has a strong influence on the success of the shrimp farm. In any shrimp farming, management of water quality is of primary consideration particularly in ponds with higher stocking rates. Degradation of water quality is detrimental/ harmful to shrimp growth and survival and will lead to disease outbreaks, eventual mortality and poor quality harvested shrimp.
Water Quality Parameters
Application of Probiotics
Guidelines
Penaeus vannamei
Shrimp Disease Management
Health management is one of the most important aspects in shrimp farming. Shrimp health assessment should be carried out under a weekly basis. Epidemic disease outbreak in shrimp pond is caused by poor management practices which weakens the shrimp immune system. As shrimp farming is done in open environment under uncontrolled condition, chances of disease outbreak is high. Viruses, bacteria and parasites are the major causes of diseases in shrimp aquaculture.
The list of shrimp Diseases are as follows:
White Spot
IHHV
Vibriosis
White Fecal Matter
Brown Gill
Black Gill
Running Mortality Syndrome
Body Cramp / White Muscle
Penaeus vannamei
Harvesting and Handling
Successful harvesting can be achieved if shrimp is harvested in good condition within a short period of time. The harvesting technique should not damage or excessively contaminate the shrimp with waste. Rapid harvesting will reduce the risk of bacterial contamination and the shrimp will still be fresh when reaching the market.
Growth and survival
Growth of shrimp should be regularly checked after every 15 days. The average weight should be recorded and the population is checked for survival.
Harvesting
Transportation of shrimp
Marketing



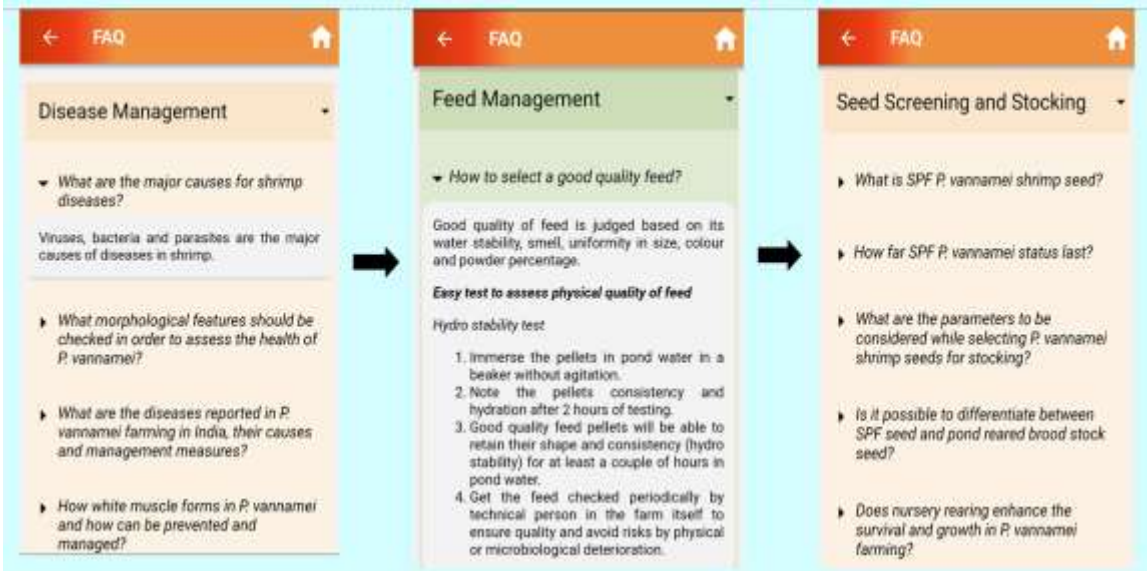
2. **Weather:** Gives instant access to present weather conditions and forecast for next 5 days Information is taken from the public domain.



3. **Market:** The price/ quantity information about fish / shrimp in important markets from 2 to 3 pre-determined sources is displayed in the app. Farmers can view price trends for the produce and plan sale of the produce

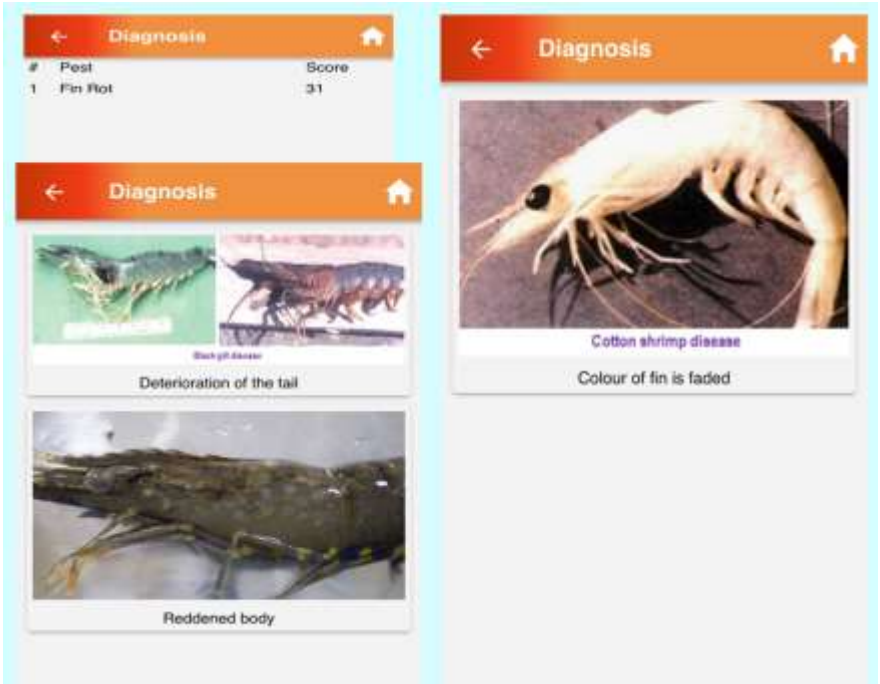
4. FAQs (Frequently Asked Questions)

Set of frequently Asked Questions along with answers is displayed in a user friendly (touch and drop/ drop down) interface.



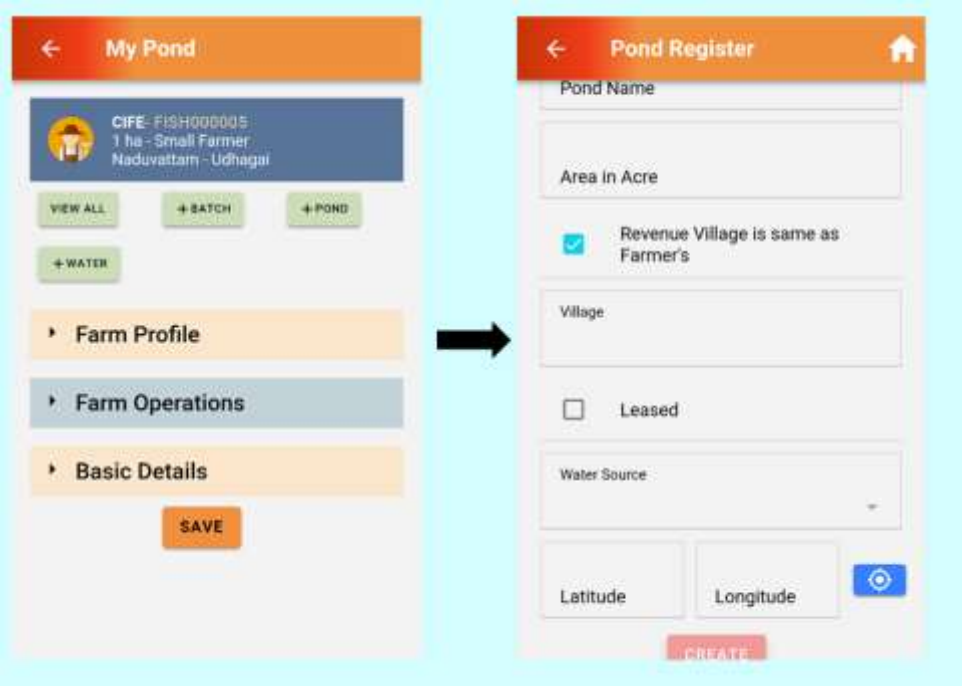
5. Ask the Experts: Aim of this module is that all the registered user can post a query on a specific problem. It has the provision to capture the photos / videos / text / audio / geographical coordinates

6. **Diagnostics:** The most interesting module of this app is the disease diagnostic module. Its aim is to identify the disease based on the symptoms for which pictures have been provided which based on observation farmer can select and accordingly a diagnosis will be shared based on probabilities of having a disease. Solutions or remedies/treatment will be suggested by the experts. Provision has been made for uploading the pictures of diseased animal



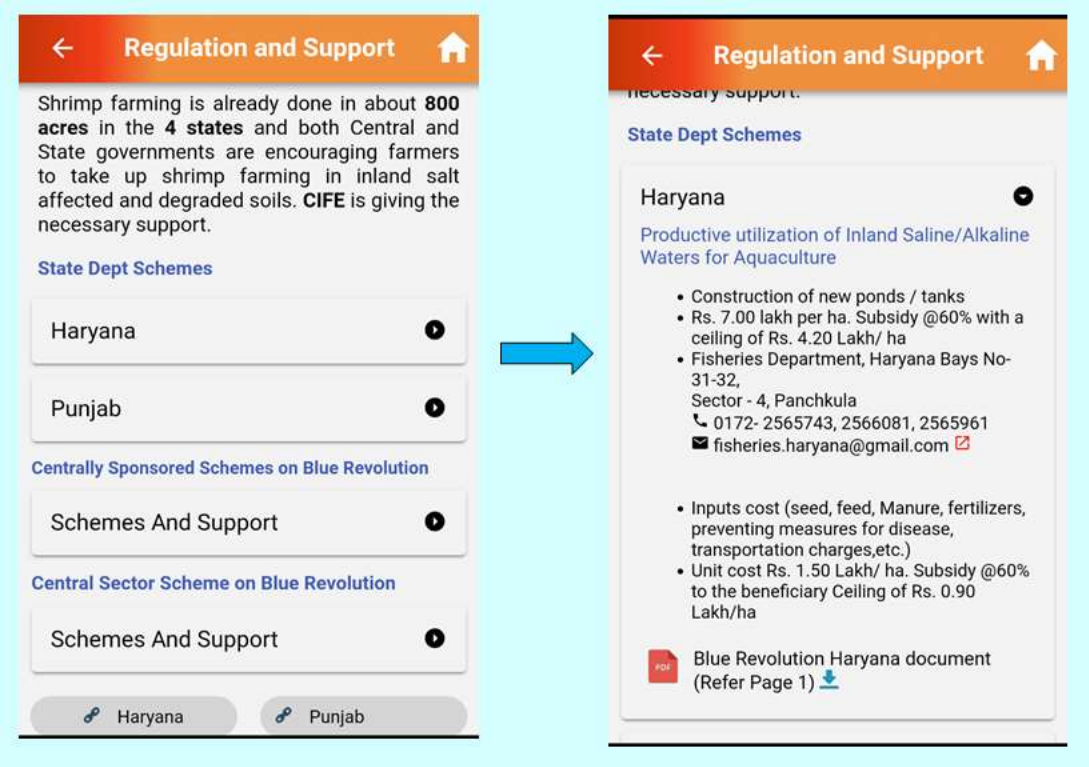
7. **My Pond:** in this module, user has to register with the basic credentials and then Users will be asked to put their basic information. With this the Database for all farmers and their farming

details will be generated parallel. Based on farming system, suggestions on water quality, feed quantity to be fed will be provided to the users

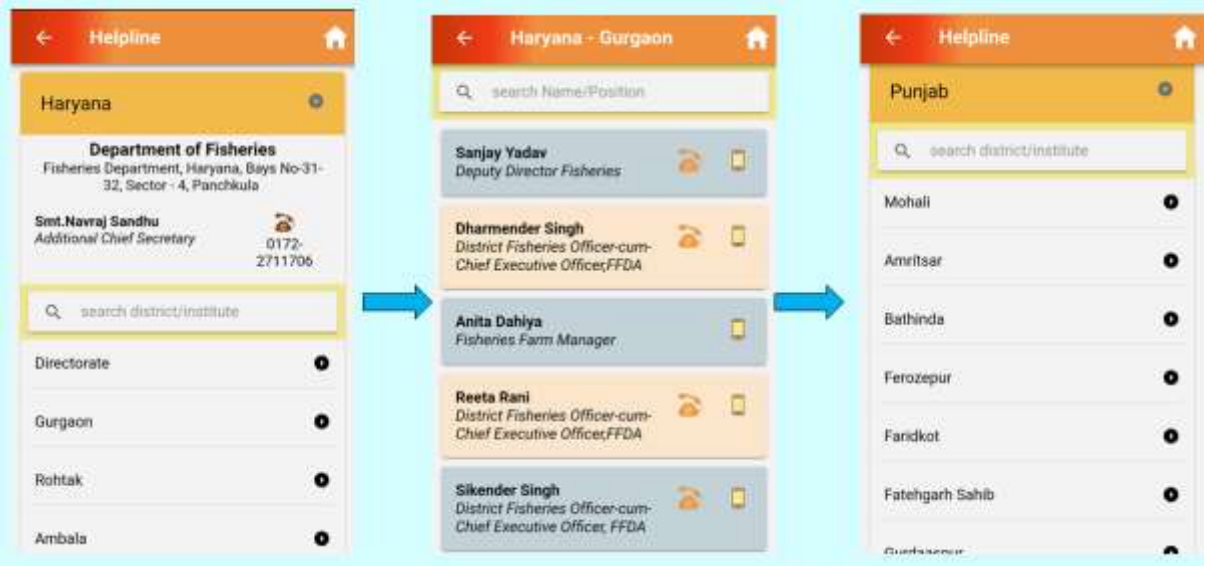


8. Regulation and Support:

Getting right information at right time and right place is the principle of achieving the goal. Regulation and support module provides information on various centrally sponsored schemes and Central sector schemes which can be utilised by farmers for enhancing their productivity.



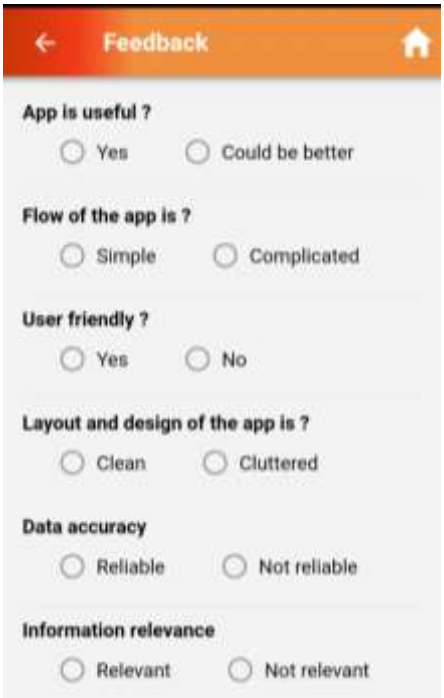
9. Helpline: Provide contact details of experts, Department of Fisheries and Input Dealers



10. **News and Events:** Information of the aquaculture industry will be scouted/ mined from a list of online sources/URLs and will be displayed on the home screen under a specified headline. It will be automated at set intervals

11. **Events:** Recent events, trainings and exhibitions related to fisheries and aquaculture will be taken from public domain and will be displayed under this module. The important news and events will appear as a sliding image on the homepage

12. **Feedback:** Feedback regarding the app design, information relevance, data accuracy will be collected



We have also prepared bilingual videos available on our website (cife.edu.in/NAHEP.html) (under NAHEP module) demonstrating the features of the app

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6. Matsya Setu – Online Course Virtual Learning App for Fish Farmers

Dr I.Sivaraman

Digital Outreach Center

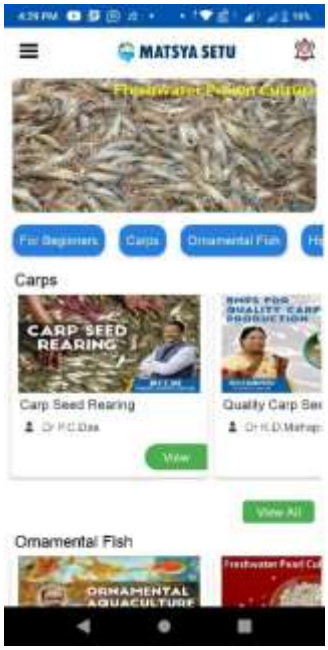
ICAR- Central Institute of Freshwater Aquaculture, Bhubaneswar, Odisha

The Covid-19 pandemic has pushed many of day-to-day activities into a virtual mode. Farmers are no exception too. Here is an interesting mobile application **Matsya Setu** which teaches advanced aquaculture technologies to fish farmers through online classes. Matsya Setu has been developed by ICAR- Central Institute of Freshwater Aquaculture (ICAR-CIFA), Bhubaneswar.

Capacity building is a very vital part of the Technology-led Aquaculture Development, that the country is undergoing now with a lot of Govt initiatives and promotional schemes. Due to the Covid-19 pandemic, our fish farmers could not attend physical training in the research institutes to update their knowledge and skills. To come over this problem, Scientists from ICAR-CIFA have developed this Virtual Learning App.

MATSYA SETU app has species-wise/ subject-wise Self-learning online course modules in video form, where renowned aquaculture experts explain the basic concepts and practical demonstrations on breeding, seed production and grow-out culture of commercially important fishes like carp, catfish, scampi, murrel, ornamental fish, pearl farming etc. Better Management Practices to be followed in maintaining the soil & water quality, feeding and health management in aquaculture operations were also provided in the course platform. The modules are divided into small video chapters for the convenience of the learners along with additional learning materials. In order to motivate the learners and provide a lively learning experience, Quiz/Test options were also provided for self-assessment. Upon successful completion of each course module, an e-Certificate can be auto-generated. Farmers can ask their doubts through the app and get specific advisories from experts. Presently the video modules are available in English and Hindi, Regional language versions are under preparation. The app was launched by the Hon'ble Former Union Minister for Fisheries, Animal Husbandry and Dairying, Shri Giriraj Singh ji on 06.07.21.

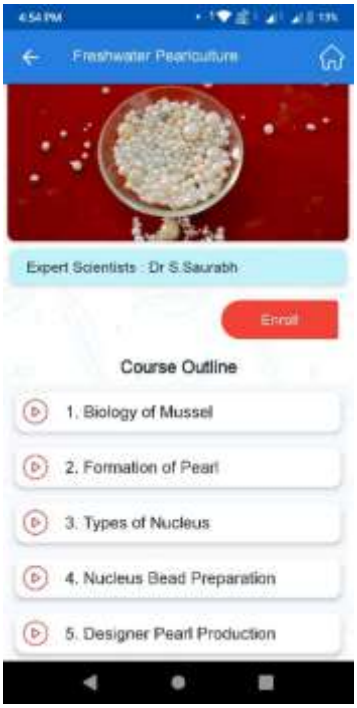

MATSYA SETU
Digital Learning for the Blue Revolution
ICAR- Central Institute of Freshwater Aquaculture
Kausalyaganga, Bhubaneswar, Odisha
&
National Fisheries Development Board, Hyderabad
Department of Fisheries,
Ministry of Fisheries, Animal Husbandry & Dairying
Government of India


MATSYA SETU
For Beginners
Carps
Ornamental Fish
Carps
CARP SEED REARING
Carp Seed Rearing
View
View All
Ornamental Fish
ORNAMENTAL AQUACULTURE

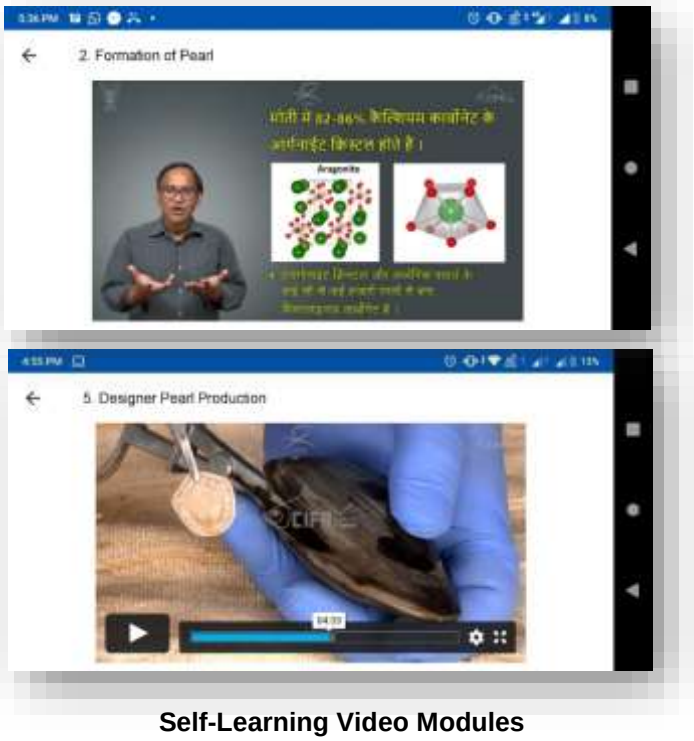
Species-wise/ Domain-wise Learning Modules


Sexual dimorphism not seen !!
Carp Seed Rearing
Nursery Phase
Rearing Phase

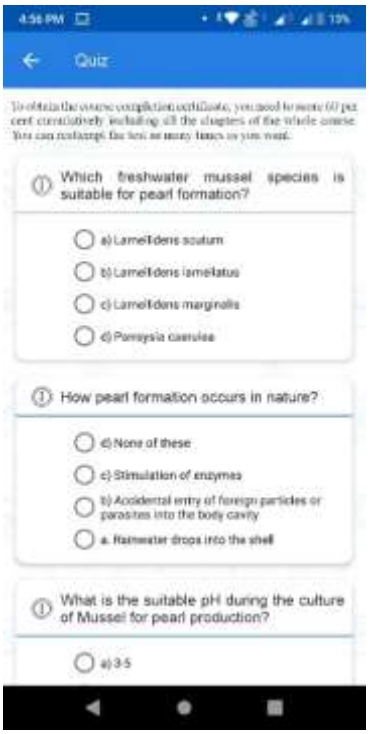

Artificial/Formulated feed:
Grower feed
Nanotechnology in Aquaculture
Importance of Water Quality



Course Page



Self-Learning Video Modules



Quiz / Test for Self-Evaluation

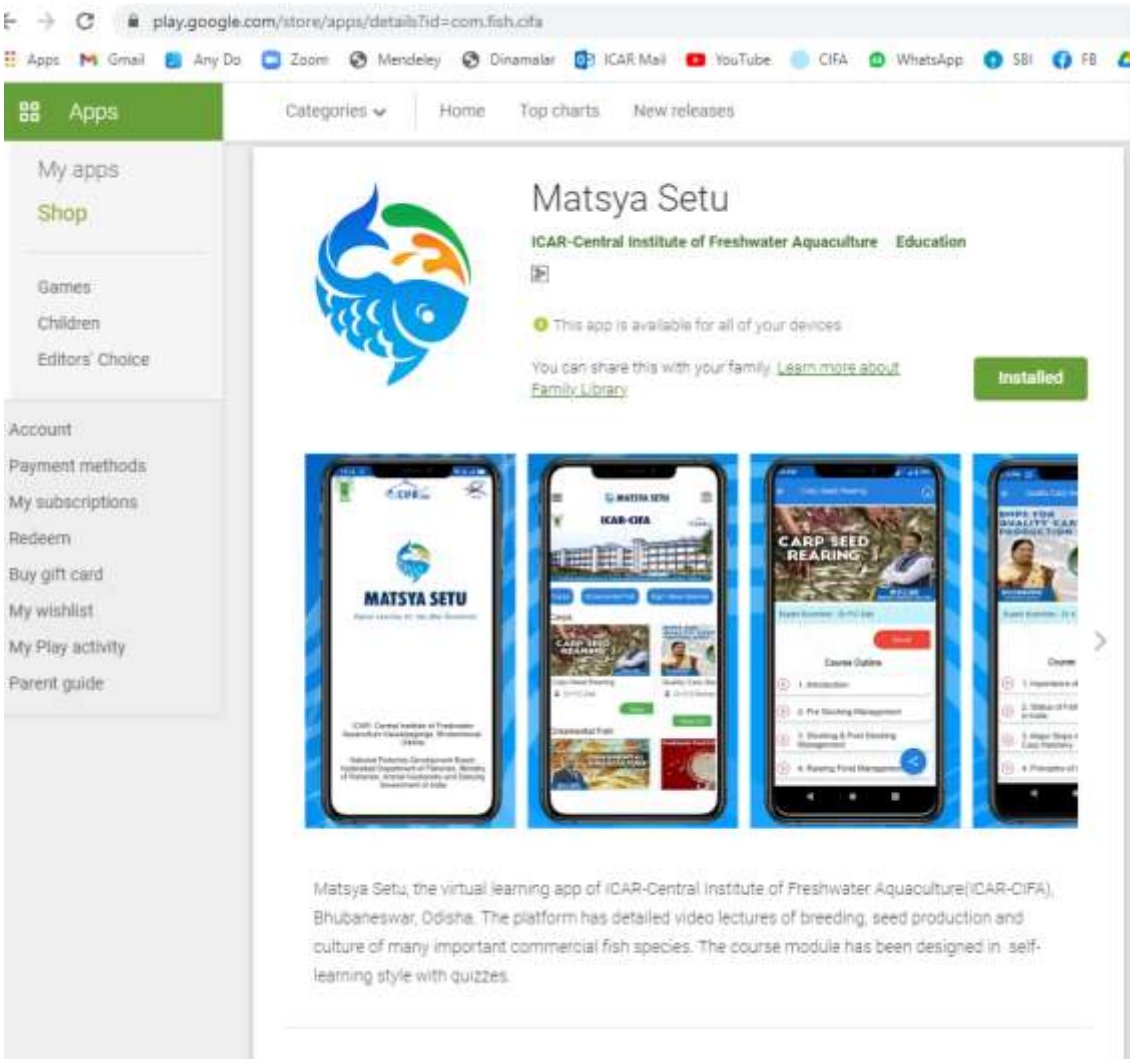
E – Certificate *(auto-generated)*

How to download the app & use the app

The app is deployed in Google Play Store in this link

https://play.google.com/store/apps/details?id=com.fish.cifa

By searching “Matsya Setu” in the playstore anyone can download



7. 'TURBAQUA' A mobile application to monitor water Quality

[1]Grinson George, [1]Manu V.K., [1]Sara Xavier, [2]Robert Brewin, [3]Nandini Menon N, [4]Anas Abdulaziz, [2]Shubha Sathyendranth

[1]ICAR-Central Marine Fisheries Research Institute, Kochi

[2]Plymouth Marine Laboratory, Plymouth, Devon, UK

[3]Nansen Environmental Research Centre (India), Kochi, India,

[4]CSIR-National Institute of Oceanography, Regional centre, Kochi

Email: grinsongeorge@gmail.com

TURBAQUA is a mobile application developed by ICAR-CMFRI to transmit the data generated during the operation of a fabricated Mini Secchi disc designed to measure water clarity and colour. The hand-held, pocket-sized 3D printed Mini Secchi disc was designed and fabricated by Plymouth Marine Laboratory, UK as part of the international project 'REVIVAL'. The Secchi disc is used to measure the clarity of water. It also has a colour scale attached on top of it. This colour scale consists of 21 colours ranging from blue to green to yellow to brown, the colour range of natural waters, and is used by the observer to record the colour of a submerged Secchi disc as viewed by him/her from above. Many Secchi discs are provided with a miniature temperature sensor (i button). After operating the Secchi disc, the operator can submit a photo of the water colour and Secchi depth values onto the app, which will be transmitted to ICAR-CMFRI server with geo-reference co-ordinates of the sampling sites. The application is of immense potential in aquaculture as well as in water quality related studies in inland and inshore waters as it gives almost accurate information based on the colour changes observed in the water body.

How to use Secchi disc

During normal observations taken using the Secchi disc, the white Secchi disc is lowered into the water and the depth at which it disappears and then reappears are recorded. The disc must sink vertically though the water for accurate Secchi depth readings. Initially you need to take the distance from the hand-held device (casing) to the water surface (DO) (In the mobile app, this is the 'Boat level to water surface (m)'). Next you need to take the total distance (TO) from the device to the depth at which the disc disappears and reappears (In mobile app, this is the 'Boat level to

secchi disc visible level (m)'). The colour of the water is determined after cross matching the water colour with that of the colour scale.

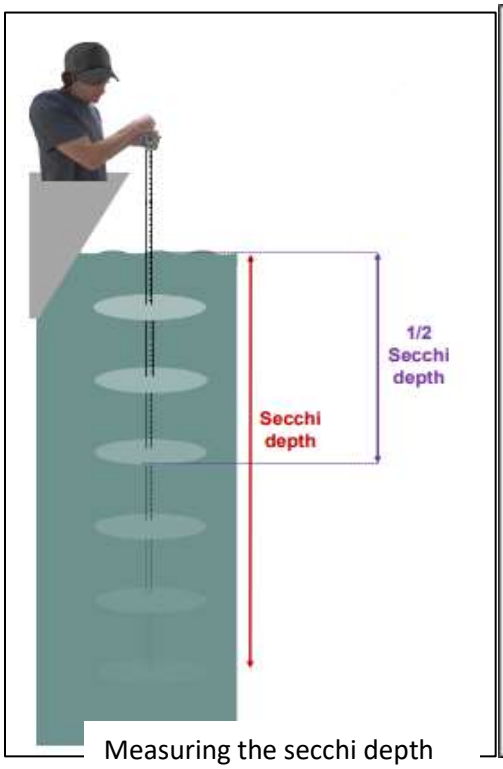
How to operate TurbAqua

- ✓ To begin with the application installation, the mobile App TurbAqua can be easily installed from google play store.
- ✓ To find out the App manually, navigate to the "Google Play store
- ✓ Search the app "TurbAqua". You will now see the results for your search.
- ✓ Click on the icon of the application "TurbAqua" to install.
- ✓ Press the "Install" button to download the application.
- ✓ Please wait while the "TurbAqua" Mobile app is being downloaded and installed.
- ✓ Select "open" to start using "TurbAqua" mobile app
- ✓ Select "done" to proceed for the registration of "TurbAqua" mobile app.
- ✓ Input your name and mobile number and click login
- ✓ A six-digit OTP number will be sent automatically to your registered mobile number. Enter the OTP and click "Verify".
- ✓ There you can fill the DO value, i.e., distance from the hand-held device to the water surface.
- ✓ Then you need to fill the Total distance (TO). In mobile app, this is the 'Boat level to secchi disc visible level (m)'
- ✓ Then you need to fill the colour of the water body by comparing with the colour scale provided in the pocket sized 3D printed Secchi disc
- ✓ Then you need to fill the temperature of the water. A temperature sensor is already inserted in the secchi disc. If you are using normal secchi disc, by manually using a thermometer you can note the temperature, or you can skip this step.
- ✓ Then you can upload images of the water body showing the colour when the Secchi disc is visible,
- ✓ Finally filling all information you can click tsubmit" to upload all data.
- ✓ The entered data will be stored in the server and it will be transferred into excel sheet and used for scientific studies in order to find out the nature and status of the water body.

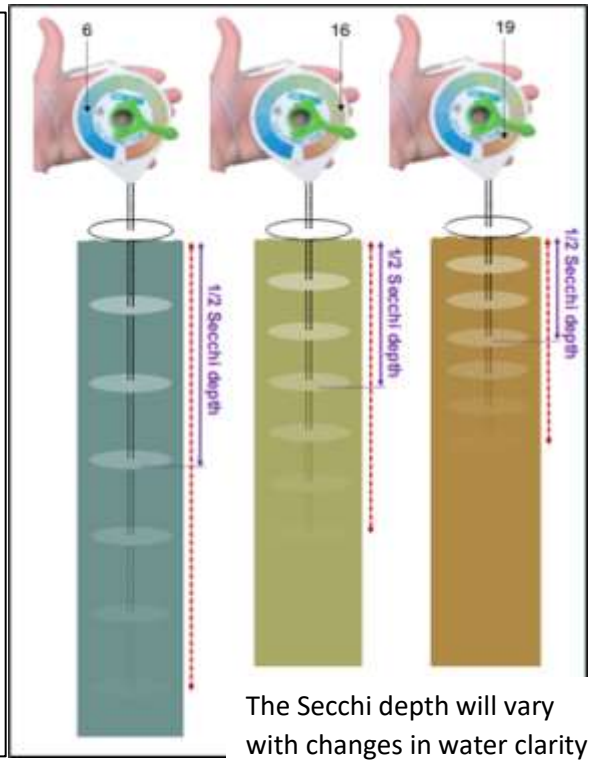
From February 2019 to May 2022, we collected 1566 data from 64 villages/towns of Ernakulam, Alappuzha and Kottayam districts around the Vembanad Lake. More number of data was obtained from Ernakulam district (661 nos.) where population was also found to be high followed by Alappuzha and Kottayam districts. Among the villages/town, more data were collected from Kochi (283 nos.) followed by Maradu (110 nos.). When analyzing the data, it was observed that more observations were obtained from the urban than rural areas, where students acted as citizen scientists. The contribution of stakeholders were more from rural areas as majority of stakeholders participated in citizen science workshop were those who depend on the lake for their livelihood. More data was obtained from Kochi urban areas as more than half of the colleges participated in citizen science workshop were from Kochi.

The Secchi depth data collected by scientists during regular sampling of the Vembanad Lake were compared with that of the data collected by citizen scientists. There was high complementarity of citizen and scientist measurements in the case of Secchi depth whereas the relation was not very good in the case of water colour .Details on the citizen science network are published in George et al. (2021). Citizen science tools were employed to monitor the changes in water quality of Vembanad Lake following the demolition of four high rise buildings on its banks in January 2020 due to violation of Indian Coastal Regulation Zone norms. The findings were published in Remote sensing journal in April, 2021(Menon et al., 2021). The water colour and clarity measurements using the 3D Mini Secchi discs showed that the Vembanad Lake is predominantly 'Greenish brown to brownish green' in colour.

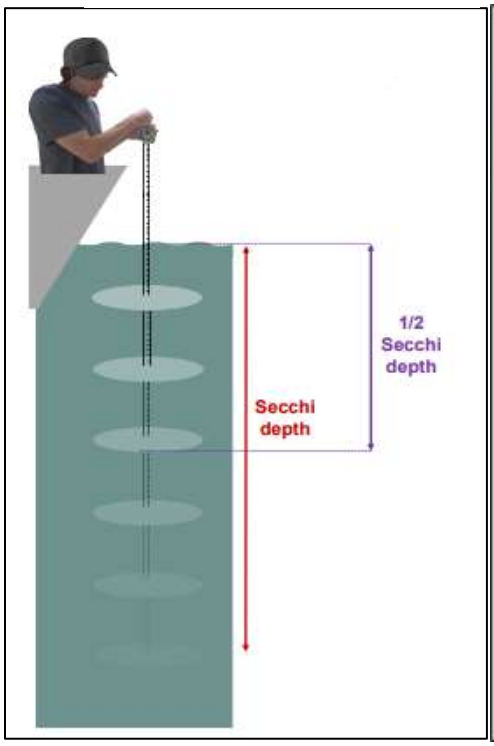
By utilizing artificial intelligence systems, we can analyse the images of water body for measuring water reflectance in the RGB portions of the visible spectrum. We can develop a Decision Support System for monitoring ecosystem health of the Vembanad lake using artificial intelligence and image analysis.



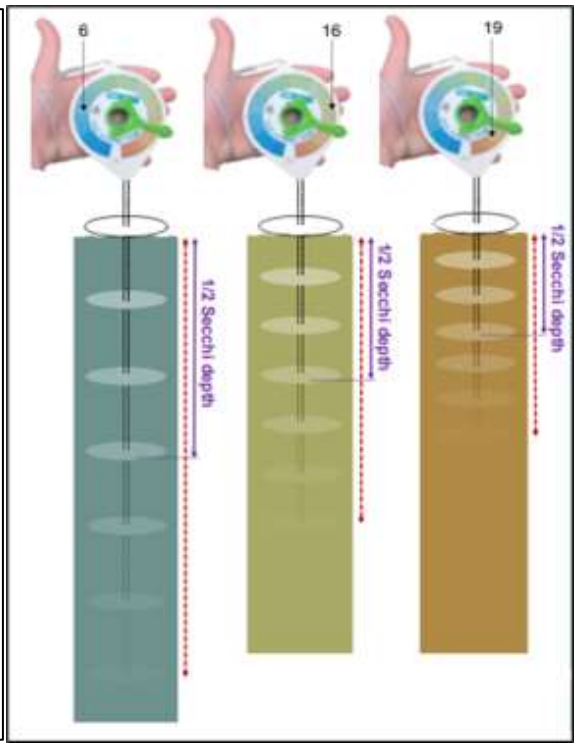
Measuring the secchi depth



The Secchi depth will vary with changes in water clarity

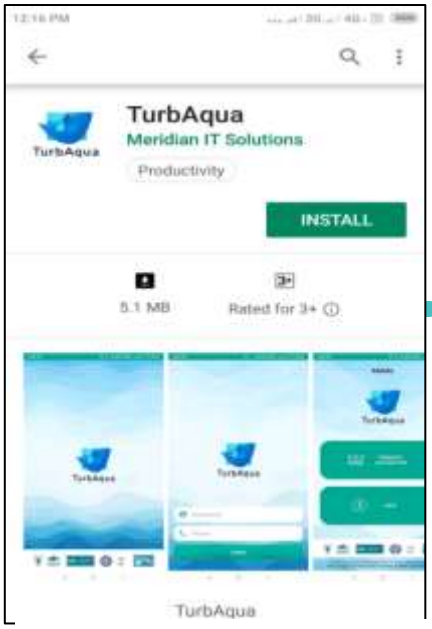


Measuring water colour



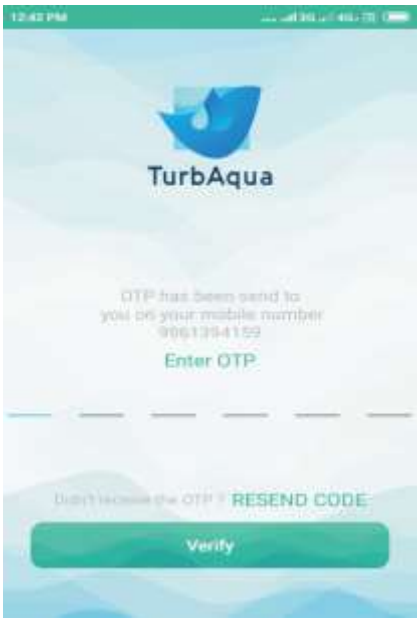
The colour of the water, measured at 1/2 Secchi depth, will vary with changes in substances contained in the water

Manual on TurbAqua mobile application



To download the app, click on the icon of the application "TurbAqua" to install.

Input your name and mobile number and click login



A six digit OTP number will be sent automatically to your registered mobile number. Enter the OTP and click "Verify".

TurbAqua window. Click the Turbidity calculator

Enter the values

REFERENCES

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Brewin, RJW, Brewin, TG, Phillips, J, Rose, S, Abdulaziz, A, Wimmer, W, Sathyendranath, S and Platt, T (2019) A Printable Device for Measuring Clarity and Colour in Lake and Nearshore Waters. Sensors, 19, 936; https://doi.org/10.3390/s19040936.

George, G., Menon, N.N., Abdulaziz, A., Brewin, R.J., Pranav, P., Gopalakrishnan, A., Mini,.G., Kuriakose, S., Sathyendranath, S. and Platt, T., 2021. Citizen scientists contribute to real-time monitoring of lake water quality using 3D printed mini Secchi disks

Menon, N., George, G., Ranith, R., Sajin, V., Murali, S., Abdulaziz, A., Brewin, R.J. and Sathyendranath, S., 2021. Citizen science tools reveal changes in estuarine water quality following demolition of buildings. Remote Sensing, 13(9), p.1683

8. 'Thoondil' – Real time information to fishing communities

L.A.G.Julius Edward,

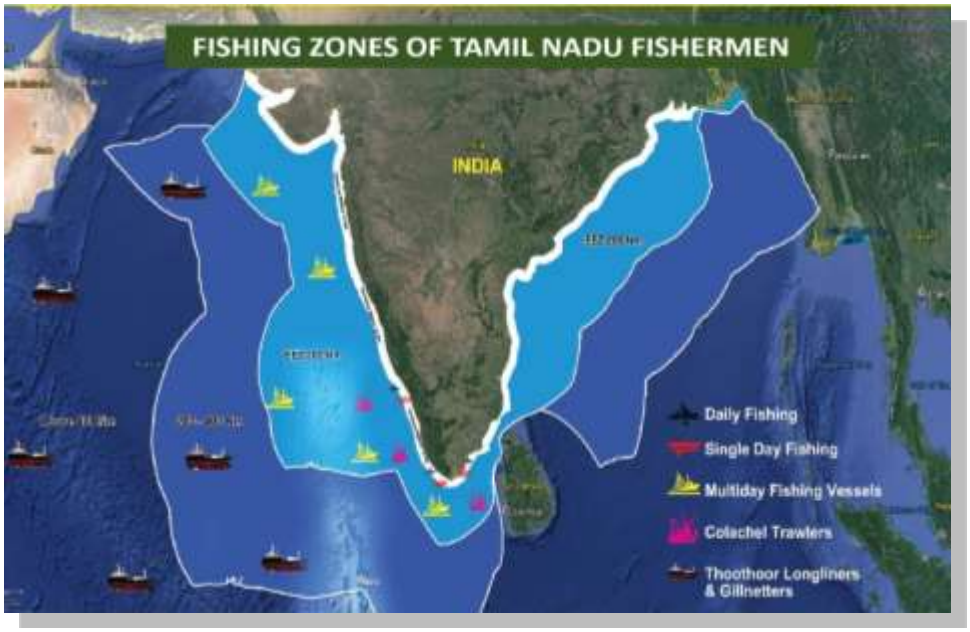
Department of Fisheries, Govt of Tamil Nadu, Chennai

Background

Tamil Nadu is an important maritime state of India and comprises of 13 coastal districts with coastline of 1076 km. There are 608 fishing villages in total with marine fisher folk population around 10 lakh. In Tamil Nadu as on date there are 33,297 motorized country crafts and 5800 Mechanised fishing boats registered under **ReALCraft** (Registration and Licensing of Fishing Craft). Among the mechanized fishing boats, 1500 mechanized fishing boats are deep sea going multiday fishing boats venturing beyond 150 nautical miles and they operate for a period of 15-30 days per voyage. These boats are mostly operated from the fishing bases at Chennai, Nagapattinam, Thoothukudi and Kanyakumari districts.

Fishing being a high risk profession, thousands of fishermen encounter with some or other form of distress at sea which has the potential to cause life loss and severe damage to property. Most of the time, the loss of life is due to the absence of proper communication equipment's, tracking devices and lifesaving equipments.

Until recently, the deep sea fishermen who venture into sea beyond 50 nautical miles were unable to communicate with shore. The severe cyclonic storm "OCKHI" which hit the Kanyakumari coast on 30.11.2017 caused widespread damage and paralyzed the normal life especially in the coastal district of Kanyakumari. The fishermen ventured into sea for multi day deep sea fishing prior to the formation of OCKHI cyclone and were unaware of the adverse weather conditions. They could not be contacted to instruct them to return back to shore immediately. This communication gap has resulted in loss of many fisherman life, major injuries to those who had been rescued apart from damages and loss of fishing crafts and other fishing implements.



Considering the risk involved in fisheries occupation, the agencies such as International Maritime Organisation, International Labour Organisation, Food and Agriculture Organisation, etc. continuously stressed the need for popularizing sea safety measures in fishing boats and to monitor and control the movements of fisherman. The Government of Tamil Nadu plays a pivotal role in ensuring the safety of more than 10 lakh marine fisherman family.

Challenges:

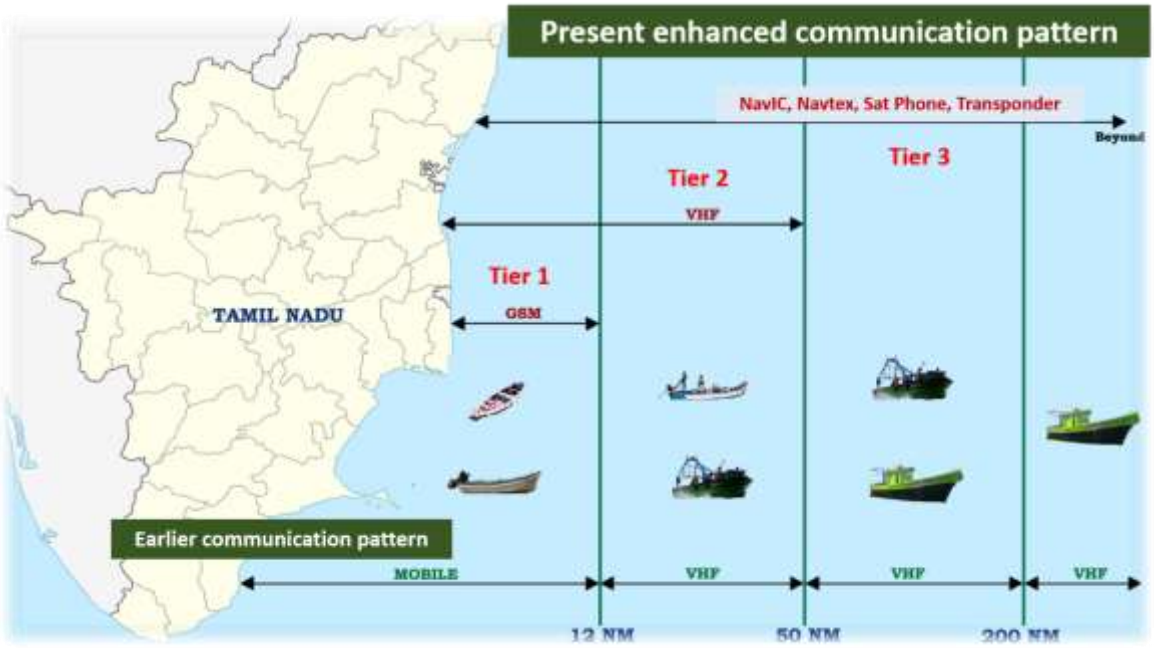
Lack of shore to boat communication connective has created a vacuum in disseminating weather warning and weather updates during crucial emergency period to the boats at sea.

Solution:

In order to provide seamless communication for safety of fishermen at sea, the Government created infrastructures like shore towers, control rooms and procured communication equipments like VHF, Sat phones, NaVIC, Navtex, Transponders by dovetailing various schemes to monitor, control and conduct surveillance of fisherman along its entire coast line of 1076 Km in three Tiers.

The Department of Fisheries has also included certain communication and navigational equipments as mandatory components in the Tamil Nadu Marine Fishing Regulation Amendment Act 2016. Under schedule 4 of the TNMFR amendment Rule, certain basic sea safety equipments, surveillance and communication systems for a registered fishing vessel.

In order to successfully implement the above Monitoring, Control and Surveillance systems (MCS) system across the entire state, Department of Fisheries, Government of Tamil Nadu has made a novel initiative of 3 tier communication system as shown below



Strategies adopted/ mode of transformation with details of role of various stakeholders

The Department has adopted a 3 tier system to address the challenge of gap in communication system. It was done by adopting latest available technology and creating consensus among stake holders.

Tier 1 (0-12NM Monitoring): THOONDIL APP

Tier 1 Monitoring of fisherman involves through fisherman friendly android application which works with Mobile data network that comes with Navigation system, PFZ/Tuna Advisory

Data, Navigational Compass, Weather info, Cyclone/Heavy Rains info etc. and it was developed with assistance from National Centre for Coastal Research (NCCR), Indian National Centre for Ocean Information Services (INCOIS) and ISRO. The details of the App are shown in the below table.

Table 1

S.No	Android App Name	Targeted No of users	Network
1	THOONDIL	30,000+	GSM/CDMA

THOONDIL application Features:

1. Trip Declaration Data
2. PFZ/Tuna Advisory Data
3. Weather Data
4. Message Send/Receive Status
5. Lat long position of boat
6. Past trip data
7. SOS
8. Report Incident

Tier 2 (0-50NM Monitoring): VHF Devices

For the Tier 2 Monitoring, The Government of Tamil Nadu has created 15 towers and control room along the coastline and distributed 17539 marine VHF communication devices (15004 number of 5watt VHF sets to the traditional fishing crafts and 2535 number of 25watt VHF sets to the mechanized fishing crafts) across all the 13 coastal districts under World Bank Funded CDRRP- FIMSUL scheme. The Devices will be monitored from the Department of Fisheries head office at Chennai and also from the base stations located all along the coast of Tamil Nadu. To have a communication networking throughout the coastal Tamil Nadu, 15 places have been identified near shore in which 7 new 100m towers have been established, 7 existing towers of BSNL and one Police towers have been put into use for this seamless networking. In all these places, control rooms have been established and functioning to disseminate two way communication to the fishers and administrators. The fishermen are utilizing these communication equipment effectively for their safety at sea and to communicate to the appropriate authorities and fellow fishers while at distress.

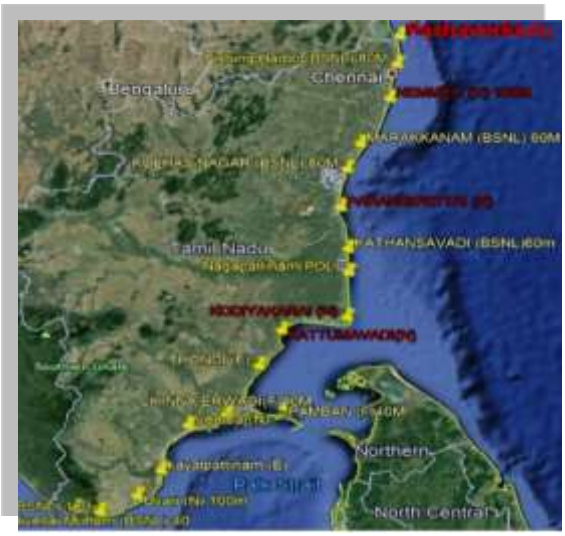


Table 2

S. No	Type of VHF Sets	No of VHF Sets	Range	Recipients

1	5 watt	15004	Up to 25 NM (46KM)	Country Craft Boats
2	25 watt	2535	Up to 50 NM (93KM)	Mechanized Boats
Total		**17539**		

A VHF based Vessel monitoring system uses a dedicated Radio frequency to transmit data. Depending on the height of the Antennas installed on fishing boats and shore towers, transmission is possible up to 50 Nautical miles. There is no transmission cost once the system is set up other than the VHF license cost, but the range of communication is limited. The fishing boat position is recorded using an internal GPS transmitting the positions using VHF technology to a shore based system. The vessel position can be recorded and displayed using an internet based maritime tracking service.

<u>Tier 3 (0 - more than 50NM Monitoring)</u>: Deep Sea Devices

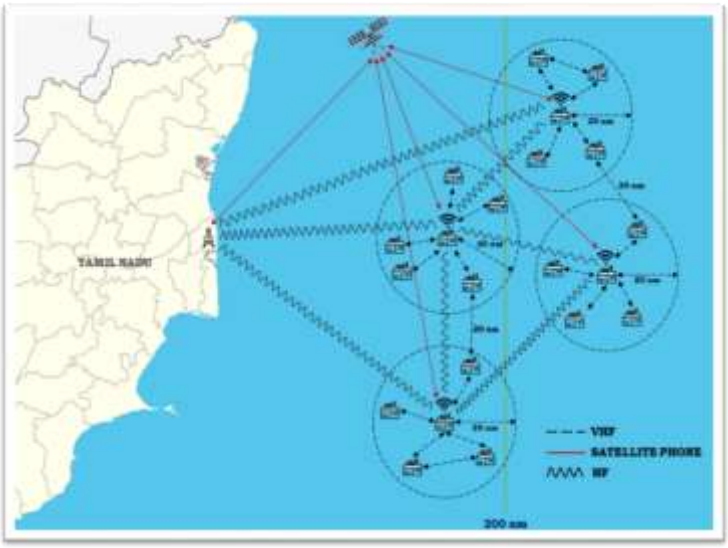
For the Tier 3 Monitoring, The Government of Tamil Nadu has decided to adopt cluster based approach in establishing communication network. Beyond 50 nm in deep sea, mobile and VHF sets are unable to connect with shore for getting updates. Hence Government of Tamil Nadu has decided to issue an array of communication device to deep sea going fishermen clusters as shown in the below table.

<u>Table 3</u>

S.No	Components	Total No of Units	Remarks

1	Satellite phone	160	All these equipment's have been distributed to 80 clusters comprising of 800 Boats under SDRF Fund.
2	NavIC Message Receiver	200	
3	NAVTEX	80	
Total		**440**	

* 1 cluster is a group of 15-20 boats (min of 100 fishermen).



Further by dovetailing scheme from Marine Product Export Development Authority (MPEDA), World Bank funded CDRRP-FIMSUL and beneficiary's contribution 500 satellite phones have been procured from BSNL and being distributed to beneficiaries.

All VMS monitoring data are being monitored in unique Web portal for each Tier separately. In addition to all the above 3 tier communication system, Government of Tamil Nadu in association with Indian Space Research Organisation (ISRO) conducted a pilot trial with 506, 2 way data communication transponders for effective MCS system. Based on the pilot scheme, Government of India has sanctioned a scheme to install 4,993 Transponders in all Mechanised fishing boats for effective MCS operation.

Outcomes

1. Ensuring traceability of the catch, which is a prerequisite condition of Export market.
2. Quick communication to the fishers at sea during emergency from central control room/ shore station
3. Any vital information that should reach the fisherman in times of natural disasters can be done over various tiers.
4. Vessel tracking to identify the commonly exploited fishing grounds for administrative purpose
5. To locate the vessel at Distress and calculate the time for the nearest available craft/ship to reach the site for rescue
6. Safety of fishermen is ensured through continuous monitoring.

Highlights of the initiatives

1. By this special initiative by the Government of Tamil Nadu we have achieved zero loss of life at sea during 2019-20 monsoon period despite subsequent cyclone in Arabian Sea and in Bay of Bengal
2. The project is a scalable one and resource requirements for Nation-wide implementation can be assessed and fine-tuned.

Details of List of Cyclones in India 2018-20

S. No	Cyclone Name	Active Period	Place	Details

1	Daye	19.9.18 -22.9.18	Bay of Bengal	No Marine life loss in TN
2	Luban	6.10.18 - 15.10.18	Arabian Sea	No Marine life loss in TN
3	Titli	8.10.18 - 12.1018	Bay of Bengal	No Marine life loss in TN
4	Gaja	10.11.18- 19.11.18	Bay of Bengal	No Marine life loss in TN
5	Phethai	13.12.18 - 17.12.18	Bay of Bengal	No Marine life loss in TN
6	Fani	26.4.19 – 5.5.19	Bay of Bengal	No Marine life loss in TN
7	Vayu	10.6.19 – 17.6.19	Arabian Sea	No Marine life loss in TN
8	BOB 03	7.8.19 – 8.8.19	Bay of Bengal	No Marine life loss in TN
9	Hikka	22.9.19 – 25.9.19	Arabian Sea	No Marine life loss in TN
10	Kyarr	24.10.19 – 3.11.19	Arabian Sea	No Marine life loss in TN
11	Maha	30.10.19 – 1.11.19	Arabian Sea	No Marine life loss in TN
12	Bulbul	5.11.19 – 11.11.19	Bay of Bengal	No Marine life loss in TN
13	Amphan	16.5.20 – 21.5.20	Arabian Sea	No Marine life loss in TN
14	Nisarga	1.6.20 – 4.6.20	Bay of Bengal	No Marine life loss in TN

9. "MEENGAL" – Online fresh fish marketing by TNFDC

P.Pradeep Kumar,
Sr. Manager (Inland Fisheries), TNFDC, Chennai.

Preface

The Department of Fisheries and Fishermen Welfare, Government of Tamilnadu is implementing various fisheries activities and fishermen welfare schemes for the benefit of Fishermen. The commercial fisheries activities are predominantly carried out by the Tamilnadu Fisheries Development Corporation (TNFDC). The corporation was established in the year 1974 and the corporation is functioning under the guidance of the Board of Directors headed by a Chairman, appointed by the Government. The Commissioner of Fisheries and Fishermen welfare is the Managing Director of the corporation. The annual turnover of the company during 2020-21 is Rs.562 crore and the corporation earned a profit of Rs. 10.80 crore.

The Corporation undertakes the following commercial activities:

- Reservoir Fisheries Management
- Fish Seed production
- Production and Marketing of Ornamental fishes
- Supply of tax free Diesel and subsidized Kerosene to Fishing crafts
- Management of Sport fishing-cum Eco park at Chetpet- Chennai
- Fish Marketing

Marketing of fish and fishery products

TNFDC is pioneer in the field of organized retail fish marketing in Chennai and some parts of Tamilnadu. The corporation carries out retail fish marketing of fresh fishes, ready to eat seafood varieties, value added fishery products through its chain of retail fresh fish outlets and seafood restaurants. The chain of retail stalls and mobile units through which marketing takes place were established in Chennai, Cuddalore, Thiruvannamalai, Thanjavur, Coimbatore,Pollachi,the Nilgiris, Tiruppur, Madurai and Thoothukudi. Mobile seafood courts are being operated at few palaces in Chennai.

The details of retail outlets are given under:

Retail Stalls	40
Mobile Stalls	15
Mobile Food court	03
Franchise stall	11

Fish Marketing In Chennai Marketing

The Corporation during yester years had involved in the marketing of fish caught from its own fishing vessels and fish procured from reservoirs, wholesale marketsetc. At present marine fish are being procured from Kasimedu(Chennai) Fishing harbour, Chintadripet wholesale fish market, private vendors, reservoirs etc and sometimes directly from the fishermen. The procured fish are then transported and stored in Seafood handling center,Santhome, where the corporation is having a cold store facility.

On a particular day, the ice preserved fish is being distributed to the retail fish stalls, mobile stalls in the morning through the corporation's own insulated vehicles.The retail fish stalls and mobile stalls do fish marketing from 7.30 am to 1.30 pm. Quality checking of fish is being exerted randomly at Sea

food handling center and in the stalls.

Online fish marketing

In order to catch up with the trend in marketing of commodities through online marketing platforms, the TNFDC took efforts for marketing of fish by utilizing the internet technology. During May 2018, the corporation introduced www.meengal.com, an internet web based e-commerce platform for marketing fresh fish in Chennai metropolitanarea. A telephone based marketing method was also introduced simultaneously with abrand name "Dial- a-Meen", through a dedicated phone line.

Whenever the customer order fish through the above platforms, the nearest retail fish stall is assigned for packing and delivery of fish. The fish are delivered upon pre book order after advance payment.

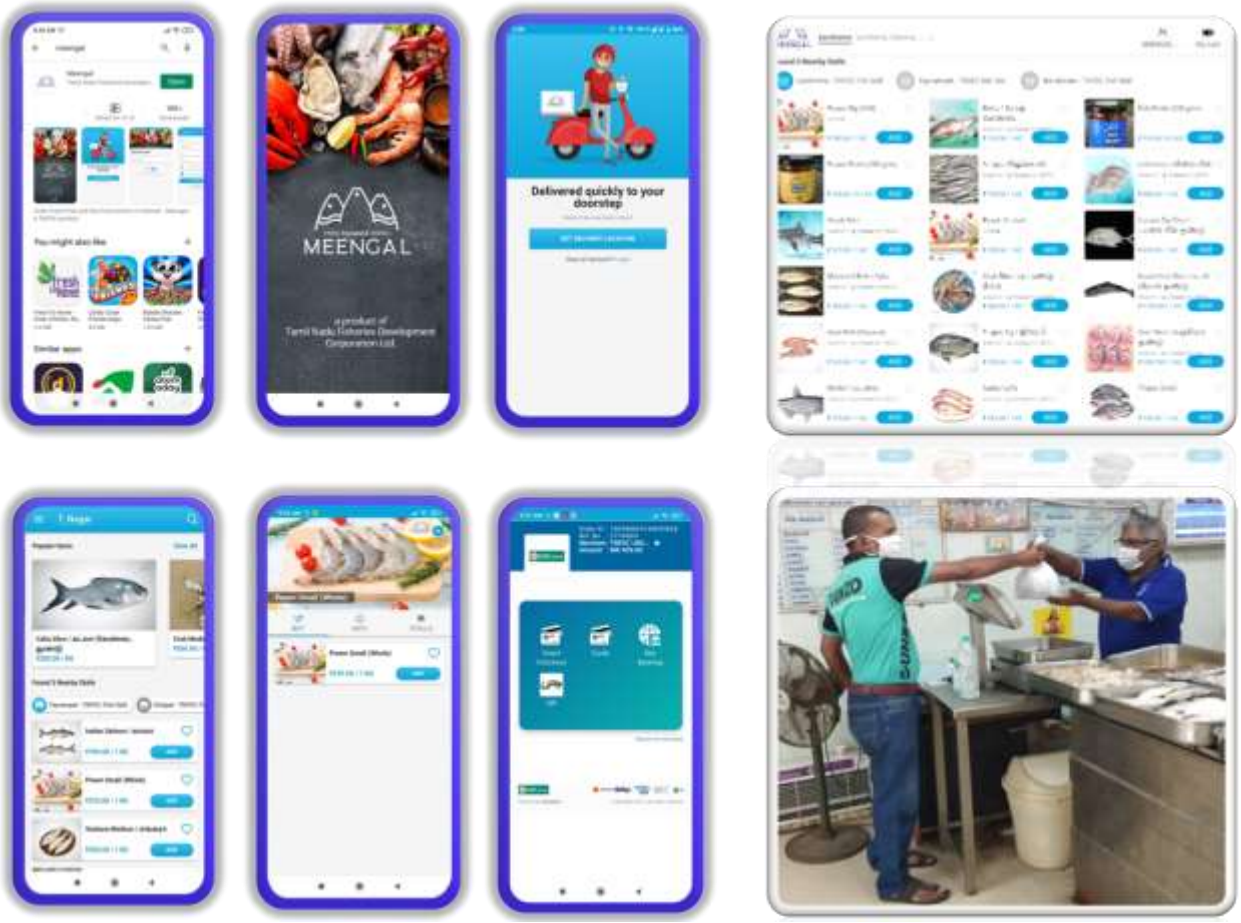
"MEENGAL" – online fish marketing application (App)

With advent of applications (App) in android mobiles for different utilities and its success, TNFDC has conceptualized the "meengal" application during the year April, 2020 for marketing of fresh fish in Chennai city, with technical assistance from M/s Bytize Technology Solutions. The fish were being delivered by M/s DUNZO, our delivery partner and the online payment for supply is being handled by IDBI bank. The application was very helpful in marketing and delivery of fish right at the door steps of the customer especially during first lockdown during COVID-19 pandemic, when total movement was banned, except for essential commodities.

Under this application, the fish procured by the corporation through various sources is pushed into the App inventory,followed by their listing as products in the App. Before purchasing the fish, the customer has to initially download the "meengal"app from Google play store followed by its installation. Once, installed the customer has to register the details regarding the place of residence. While accessing the availability of fish, the app will show allnearest fishretail stalls, from where the customer can procure the fish of his/ her choice. Once selected fish is added to the cart, the payment gateway opens, and the customer has three choices viz. card payment, net banking & through UPI Appsfor making payment. The payment is completed only when the order is accepted

by the nearest dunzo delivery person. The delivery person will go to the retail/mobile shop, pick up the fish and deliver to the customer. The average time consumed in this entire process is just 34 minutes.

Around 27532 customers have registered/ down loaded the “meengal” App, out of which 5566 customers have ordered fish/fish products through this application. TNFDC so far executed 32302 deliveries of online orders since April 2020 to May 2022 and most of them are repeat orders validating its quality. Around 48.90 tons of fish were delivered to the customers at their doorstep and revenue of Rs. 2.62 crore has been realized through online fish marketing.



Meengal Android App *(illustration)*

Infrastructure utilized for undertaking Meengal O nline Fish Marketing:

TNFDC Retail Stall

TNFDC Mobile Stall

Customer Care Centre

SWOT Analysis of Meengal Application

1. Strength

- Government brand name
- Right and transparent pricing
- Customer redressal mechanism with personnel contact

2. Weakness

- Lack of advertisement
- Less number of outlets
- Less area covered

3. Opportunities

- Expansion to areas currently not served
- the process can be utilized for fishery products like dry fish and ready to eat/ cook products

4. Threats

- Competition from private online e-commerce platforms

Meengal- Future roadmap

TNFDC is planning to expand Meengal application to other major cities in Tamilnadu like Coimbatore, Tiruppur, Madurai, Salem, Erode etc. in upcoming months.

The corporation is in the process for revamping the delivery packaging, wrapping papers etc. and will be unveiled in upcoming days.

In order to popularize "meengal" brand name among the public, TNFDC has planned to push fish marketing across various social media platforms like facebook, twitter etc. Targeted marketing will also be carried out to keep the customers aware of the goodness of consuming fish in periodic manner.

Benefits to the customers

"Meengal" played a vital role during Covid-19 lockdown by delivering hygienic fish at the doorsteps of the customer. Good quality fish were delivered at affordable cost to the customer. It helps in ease of fish consumption for the customer.

Benefit to TNFDC

“Meengal” application has helped in understanding the customer consumption behavior. Based on this, fish procurement was done intelligently based on the pattern of consumption. It also increased the trust on TNFDC among the public and finally, it is acting as an additional source of revenue generation for the corporation.

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10. Fisher Friend Mobile Application – A Decision making support tool for small scale fishers in India

Dr.S.Velvizhi, Principal Scientist,

MSSRF, Poompuhar

'Fisher Friend', an Android-based mobile application, has been designed to provide easy access to relevant information and knowledge related to fishing for small-craft fishers. MSSRF, in partnership with Qualcomm, launched 'Fisher Friend' in 2007 as a post-tsunami preparedness and adaptation strategy to help fishers get early warning information. Fisher Friend is a pioneering single-window solution in the regional languages of coastal India, such as Tamil, Malayalam, Telugu, Odiya, Bangla, Kannada, Marathi, and Gujarati, apart from the English version. It addresses the shore-to-shore dynamic information and knowledge needs of small-craft, resource-poor fishers who live in fear of failure, loss, and death every day. In view of providing sustainable knowledge solutions to the fisherfolk and to cater to their knowledge needs instantaneously, the scientific data of INCOIS has been auto-ported into Fisher Friend.

Fisher Friend provides fisherfolk with several scientific inputs. These inputs are

- Ocean State Forecast (OSF) information such as wave height, wind speed and direction, sea surface current, sea surface temperature and tides;
- Disaster alerts such as cyclones, tsunami, and high waves through the instant display of alerts as scrolling messages as well as descriptions in the main menu;
- Potential Fishing Zone (PFZ) and tuna-species-specific forecast;
- No fishing zone alert for indicating turtle congregation zones in Odisha state
- Global Positioning System (GPS)to navigate directly to the PFZ and traditional fishing route/zones;
- Mark danger zones in the sea such as a sunken boat, rock substrata, dead coral reefs, etc.;
- Market prices for various fish varieties;
- International Border Line (IBL) alert with Sri Lanka;
- Compass facility;
- SOS (Save Our Souls) option for rescue during critical situations in sea;

- Navigating harbour locations when in emergency situations;
- Government schemes and daily news;
- My Tracker (tracking fishing route);
- Calling facility along with crucial contact details.

MSSRF has been engaging in a series of consultations with the fishing community to understand their emerging challenges and real-time knowledge requirements to decide on the features of Fisher Friend. All the features, refinements in the user interface, and content architecture of Fisher Friend are based on the feedback received from these consultations with fishers. Several stakeholder consultations were conducted to bring out and prioritize the knowledge needs of fishers. Over 1,026 fishers, including women, from five states, participated in the action research to develop Fisher Friend. As a result, the application went through 51 revisions, evolving from a 'package of six services in three languages in the CDMA platform' to '21 services in nine Indian languages on the Android platform'. Similarly, the technology evolution in the Android versions facilitated easy upgradation of Fisher Friend from time to time to sustain its use and reach. Fisher Friend's journey began with a modest number of 40 users in Tamil Nadu and Puducherry. Over a period, the application has spread across nine coastal states and one Union Territory, benefitting over 89705 users from 66 coastal districts in India. The journey still continues, and it is envisioned to reach every marine fisher in the country.

The participatory approach adopted by MSSRF has been a crucial factor in the success of Fisher Friend. This approach, followed at each stage of the development of Fisher Friend, played a significant role in evolving the features and designing the user interface. A systematic and meticulous implementation process is being used by MSSRF at the ground level to reach Fisher Friend to the target groups. These processes are sequentially as well as simultaneously planned and executed. Engaging a spectrum of partners at the micro, meso, and macro levels, capacity building, and a robust monitoring and evaluation system add value to Fisher Friend's outcome.

The 48-hour detailed information of OSF data including high waves, cyclones, winds, sea current, and sea surface temperature helps fishers in advance to undertake informed decision on whether

to go for fishing or stay, to choose the fishing gear based on wind/water current parameter, and to decide on the fishing route based on wind direction and sea current. Landing-centre-specific information forecasts on PFZ and species-specific advisories enable the fishers to catch high-value fish and thereby increase their income. PFZ information plays a significant role in resource saving; it enables the fishers to get a good catch of economically important fishes. The fishers do not have to wander in the sea in search of fish shoals. This has considerably brought down their mental and physical strain. Also, the reduced search time results in decreased fuel consumption. The reduction in diesel usage leads to a reduction in expenditure, which by itself is a gain for fishers.

There is empirical evidence that Fisher Friend, as a social innovation, though not deliberately designed and targeted to bring out changes in the environment and marine ecosystem, is directly and indirectly contributing to it. One of the environmental benefits is the reduction in energy consumption will lead to reduction in carbon emission. Using Fisher Friend, fishers are saving fuel in two ways. Firstly, by using PFZ, GPS, and My Tracker features, fishers are reaching the point of fishing shoals on time without wandering, thereby reducing diesel consumption. Secondly, the 48-hour ocean state forecast and disaster alerts help fishers to take advanced and informed decisions to cope with current realities and bring down their anxieties. Advance decisions help them plan their fishing trips, which not only avoid potential risks to their lives and livelihoods but also substantially contribute to saving diesel. An interesting example of environmental impact is evident as an outcome of Fisher Friend services is fishers changing their practices from bottom trawling to pelagic fishing. This is an exceedingly valuable outcome and rated very high. The fishers of Gilakaladindi Village in Krishna District have demonstrated how the pelagic fish shoal information had transformed their practices from bottom trawling to pelagic fishing

11. Application of digital intelligent in aquaculture health management

G. K. Sivaraman[1], Delina Evans[2] & Alison Prendivillie[2]

[1]ICAR- CIFT, MFB Division, Cochin-29, Kerala.
[2]School of Design, LCC, University of the Arts London, Elephant and Castle, London.

Introduction

Aquaculture farming in India is a fast-growing sector in the world and plays significant role in the country's economy through nutritional security and income, employment generation and livelihood opportunities to millions of people. India ranks second in aquaculture production, contributing more than 1.00% national GDP and 5.00% agriculture GDP. Recent development of digital intelligent technologies viz., communication on radio, television, internet technologies, mobile phones, 3-D Printing, Artificial Intelligence, Big Data Analytics, Internet of Things (IOTs) could be used in a bethet possible ways to transform, modernize and organizing Indian aquaculture system for the improvement of fish health, monitoring and management of fish diseases, improved lab testing and treatment, formulation of better feed, automated controlled feeding systems and monitoring the feed efficiency, weather forecast, warnings on disease outbreak/ infestation, improved marketing facility, fish waste utilization and its disposal and treatment etc., which could definitely increase the profitability to at least 20-30%.

One of the important factors which significantly affect the aquaculture growth is by the outbreak of different diseases and its control by the indiscriminate use of antibiotics & chemicals could lead to severe public health and environmental problems which account for 10-20% of the operational cost. Highly profitable aquaculture farming could be possible by the use of digital intelligent technologies in disease diagnosis and its management & minimum use of antibiotics and its detection. An appropriate and timely adoption of such technologies can lead to smart and sustainable farming.

In recent times, the Indian aquaculturists are coming with high- tech farming as far with the top competitive aquaculture farm producers like China, Indonesia and Ecuador with the use of sensors, data analytic, and logic controlled systems due to the increase availability of resources and internet

connectivity even in the remote places. Now the aquaculture farming system is becoming industrialized and highly economically viable if properly manage the farming system with these digital intelligent technologies.

With the advent of digital communication, the information dissemination progressed onto radio, television, and is now using mobile App and internet technologies and also could access the information/ knowledge from the remote/ anywhere and can be exchanged with others immediately.

Diagnosis of shrimp diseases and health improvement using ICT: Diagnosis is the identification of an illness or conditions based on the visible symptoms. A disease caused by the pathogens and is influenced by the reaction of the host and some extent by the environment. Most instances, stressful environment plays a significant role in outbreak of diseases and often the presence of pathogen may not cause diseases. Diagnosis of fish diseases are by its clinical signs, symptoms and its diagnostic tests. So the prompt and proper diagnoses of diseases are very important for successful treatment and control of diseases and also restrict the indiscriminate use of antibiotics and therapeutic chemicals. By using the ICT for each economically important disease and its clinical signs, symptoms & diagnosis data are integrated and mobile app could be developed for the aquaculturists.

Ongoing Indo- UK project on "**D**iagnostics for **O**ne-health and user driven **S**olutions for **A**MR" (DOSA) project, we are developing diagnostics that identify the presence of antibiotic residue and disease in shrimp farming. In order to imagine the sociotechnical value of the diagnostics, we need to detatch the technology away from the clinical environment from which it was designed, and situate it into the everyday lives of shrimp farmers and shrimp processing quality control managers. To support this, a systematically designed and collected ethnography fieldwork around antimicrobial resistance (AMR) in Indian aquaculture farming as a foundation for creating an early-stage concept for a mobile application to complement the use of the DOSA diagnostics tests at field level. The aim is to fully develop a working mobile application through a creative process of visualising design concepts through wireframes (how it might be used), through user flows (by target users). The creation of wireframes is to demonstrate, gather feedback and iterate further with number of testing for antibiotic residues and pathogens, and co-designing the concept with end-

users, so that the final design is in functional, user-friendly and valuable to the shrimp farmer and processing plant managers.

Methodology

Through adapting an agile approach from the software development field (O'hEocha and Conboy, 2010), we first created concise statements to demonstrate the needs of shrimp farmers and processing plant managers in relation to the diagnostics tests.

We created 'epics,' which are broad statements of user needs and the rationale for that requirement, written in the form of: *As a <type of user> I need to <action> so that I can <rationale>*. For example, as a <shrimp farmer> I need to <monitor the parameters of my culture, the pond, and the surrounding environments> so that I can <build a strong understanding of the health of my culture and potential contamination hotspots from the environment>.

These broad 'epics' were then dissected into more focused 'user stories,' (Lucassen and Brinkkemper, 2017) which offer manageable functionalities of the platform to be developed in one agile iteration. User stories use the same format as epics, but are more specific and can be directly addressed by a function of an app. For example, the above 'epic' can be broken down into: as a <shrimp farmer> I need to <test and record the results of shrimp, water, and sediment parameters of my pond and the surrounding environments over time> so that I can <monitor my business and have better surveillance of my tanks, ponds and larvae, to take preventative actions if needed sooner>.

Using insights from the design ethnography fieldwork, we created a series of epics and user stories for shrimp farmers and processing plant managers. We were then able to prioritise the statements based on the most pressing needs and the opportunity for addressing the needs through the DOSA project diagnostics tests. Focussing on the prioritised user stories, wireframes and user flows were created using Miro platform, which is a digital and online collaborative tool.

Design outcome

The below table shows the prioritised epics and user stories that were created as a foundation of the wireframes and user flows.

	Epics	User stories
1	*I need to ensure that I receive good quality and antibiotics free products from my suppliers so that I eliminate contamination at my pond or plant.*	As a *shrimp farmer* I need to test larvae for diseases and antibiotic residue at the hatcheries before purchase so that I can procure disease-free and antibiotics-free larvae
2	*I need to monitor the parameters of my culture, the pond, and the surrounding environments so that I can build a strong understanding of the health of my culture and potential contamination hotspots from the environment.*	As a *shrimp farmer* I need to test and record results of shrimp, water and sediment parameters in my pond and the surrounding environments over time, so that I can monitor my business and have better surveillance of my tanks, ponds and larvae, to take preventative actions if needed sooner.
3	*I need to show evidence that I offer good quality, disease-free and antibiotics-free products so that I can have appropriate accreditation and increase my reputation as a trusted business.*	As a *shrimp farmer* I need to test shrimp samples for antibiotics residues before and during harvest ensure my buyers that the consignment is antibiotics free.
4	*I need to make a studied decision on which supplier to procure from so that I can procure based on track record of supplier, ensuring that I buy good quality products.*	As a *processing plant manager*, I need to make a studied decision on which shrimp farms to procure from, so that I can procure based on the track record of the shrimp farm and the knowledge of their suppliers.

Application wireframes and user flows

This section illustrates how the mobile application might look and how it might be used.

Firstly, when the user opens the application, they will enter the Home Page, where they can select the type of user they are and then sign in into their own accounts.

For shrimp farmers who have the intention to test larvae for diseases and antibiotics residue at the hatcheries before purchase (User Story 1), the shrimp farmer can select "Procure larvae", then browse their choice of hatchery in order to view the hatchery information. They can then proceed to 'Test larvae sample', which is when they use the DOSA diagnostics to test the relevant samples and wait for the results. Users can then input and save the record of the results into the application. The input of this data generates an informed recommendation of the level of biosecurity the hatchery practices. With this recommendation, shrimp farmers can make informed decisions when purchasing from hatcheries.

For shrimp farmers who need to test and record the results of shrimp, water and sediment parameters in their pond and the surrounding environments over time (User Story 2), the farmer would select 'Monitor pond. The page then asks the farmer to select the pond or surrounding area they would like to monitor, before displaying the relevant information on the selected area. The user can review this information which has been recorded over time, click 'Test Sample,' and select the type of sample they are testing, whether it will be water, sediments, or shrimp. At this point the farmer would use the diagnostics technology to test the sample and once they have the results, they can input and save the test outcomes onto the platform. The application then generates recommendations based on the input, as well as an opportunity to be in direct contact to an aquaculture advisor for advice. This ongoing monitoring and recording of information allow the shrimp farmers to manage the surveillance of their own farm, enabling them to build a strong understanding of their ponds and also businesses.

For shrimp farmers who need to test shrimp samples for antibiotics residues before and during harvest to ensure buyers that the consignment is antibiotics free (User Story 3), they would select the 'Harvest', after signing in. The farmer then needs to select the pond or the consignment they would like to harvest, which lets the application display data about the selected pond. After the farmer clicks 'Pre-harvest test,' they need to use the DOSA diagnostics to identify any presence of antibiotics or disease, which is included and saved into the application. If the results show that the consignments are free of disease and antibiotic residues, the application generates a PHT results

summary of the consignment and the farm, which the farmer can confirm in order to receive a PHT certification to send to buyers.

For processing plant managers who need to make a studied decision on which shrimp farms to procure from (User Story 4), they would first sign in as a Processing Plant Manager and then on to their account and select 'Browse all suppliers'. This leads them to a page where they can search for shrimp farms or hatcheries who have signed up to the service. The app then allows users to select a specific supplier for further information on the supplier and, if suitable, the processing plant managers can contact the farmer using the application.

Conclusion

The above wireframes are early concepts of a DOSA mobile application that aims to shift the perspective of diagnostics from standalone technologies, towards a diagnostics service that is grounded in the context of shrimp farming in India. Although the wireframes of the application are still at early levels of development and needing further testing and co-designing with end-users, they offer visual aid in imagining the sociotechnical interactions of the diagnostics services through the application. Where monitoring the parameters of a shrimp farm enables farmers to build knowledge around their farms and businesses; making informed decisions around suppliers and ensuring that consignments will be of good quality allows the building of stronger relationships between stakeholders in the industry; and finally the ability to show evidence that products are good quality can strengthen the aquaculture system by building credibility and reputation of individual businesses and the Indian aquaculture as a whole. The next steps would be to use these wireframes as prompts for future testing, prototyping and co-designing with end-users.

12. Mobile alert system for the dryer users

S. Murali
ICAR-CIFT, Kochi.
murali.s@icar.gov.in

The drying of fish and fishery products as a preservation process is followed in many parts of the world from time immemorial. The demand for dried fish and fishery products has been driven by the seasonal unavailability of fresh fish, especially during the monsoon and trawling ban period. Also, the consumer's preference for the characteristic flavor of the dried product and the ready-to-cook nature of the product attracts the attention of the consumers. The open sun drying method is widely adopted by fisherfolks for the drying of fishery products in developing countries.

1. Requirement of IoT system

Drying parameters in the solar drying system were collected manually by opening and closing the dryer at regular intervals which leads to energy loss, in addition to being a laborious task. It has been proposed to automate the acquisition of data collected along the drying process to overcome the issues. At present, developing automatic data acquisition systems are possible due to technological advances and the introduction of low-cost and easily programmable electronic devices into the market. Hence, there is a need for the development of an Internet of Things (IoT) based remote monitoring and alert system for solar dryers, and to collect, process, and alert the user on the drying status of material on a real-time basis. The alert system must be compact, cheap, and easy to operate, and shall save time, energy, and manpower.

2. Mobile alert system for dryer users

The mobile alert system works based on the principle of recording of weight loss of samples on a real-time basis using load sensors and sending the information of weight loss, moisture content, and extent of drying as a short message service (SMS) using the GSM module. A microcontroller "ATmega328P" is coupled with an Arduino UNO board which offers a 16MHz clock cycle speed. The weight-loss and moisture percentage calculation algorithms were written and uploaded to the microcontroller using Arduino software integrated development environment. A GSM module "SIM800" with a valid SIM card is interfaced to the microcontroller through an analog-to-digital converter (HX711 IC) which can amplify the low voltage signals coming from the 1kg load cell.

Weight loss and moisture percentage are frequently calculated by the algorithm and based on the moisture percentage set on the algorithm, the GSM module will receive signals from the microprocessor through the transmission and receiver pins. A unit consisting of a 1kg load cell is placed inside the dryer, upon which 100grams of the material is provided for continuous data acquisition, monitoring, calculating, and transferring information. The components of the mobile alert system were reported in Figure 1.

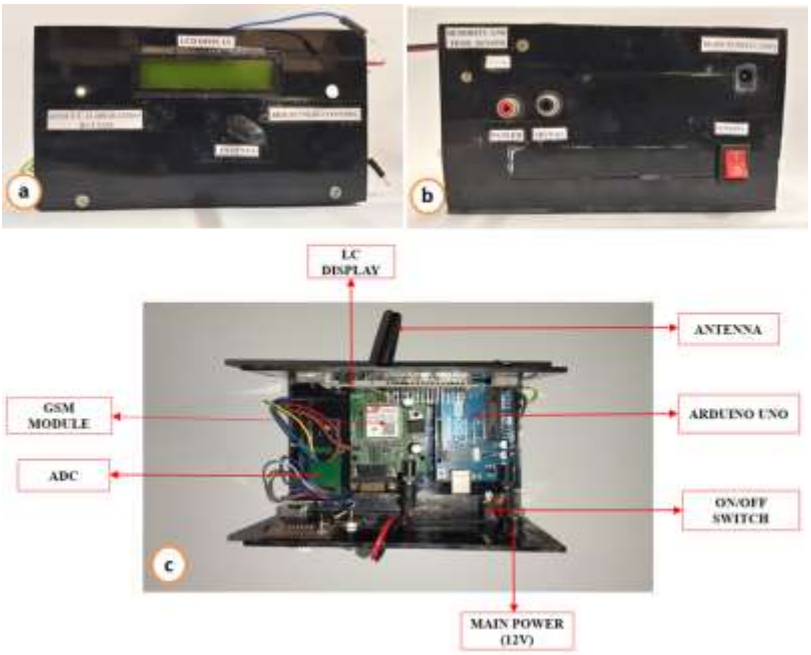


Fig 1. Components of mobile alert system a) Front view b) Back view c) Internal view

3. Automatic data acquisition through the integrated mobile alert system

A mobile alert-based information support system was integrated with the solar tunnel dryer using an aurdino/microcontroller, GSM module, and load sensor, and its usage as an information support system to the dryer users was evaluated in this study. The system was capable of acquiring, processing, and sending information on sample weight loss over time, real-time moisture content (on a wet basis (%)), and the extent of drying of samples *i.e.* Your material is kept for drying, the material is half dried, and or the item is completely dried. The system was programmed with the algorithm for continuous monitoring of the weight of the samples and converting the values into moisture content using equation 1 in microseconds. The final weight of the sample (in equation 1) was taken as the bone-dry weight of a sample. Based on the literature survey and preliminary studies, for a fishery product sample of 100 grams, 20 grams is considered the bone-dry matter

(BDM) as constant for calculations. Similarly, the initial weight in equation 1 is the varying weight of the samples kept for drying on a real-time basis. The system was also programmed in such a way that SMS can be sent to the user's mobile at a predetermined time interval. An SMS "*The material is half dried*" will be sent when the moisture is reduced by 50%, and 30% or below 30%, the sample weight loss value will be cross-checked with the previous value every 15 minutes and as and when both the values are same, one SMS will be sent to the user as "*Item is completely dried*". Otherwise, the same procedure will continue after 15 minutes and until both the values become equal. The reason behind the selection of every 15 minutes value was to ensure that the sample is not over-dried and also to ensure that with the existing drying conditions (when the values are equal) no more moisture removal is possible, thus ensuring completion of the drying process. The photograph of the working mobile alert system is shown in Figure 2.

Fig 2. Mobile alert system for shrimp drying in a solar tunnel dryer

(a) Aurdino UNO display (b) Load cell inside dryer (c) SMS alerts in mobile

The mobile alert system can be very useful to collect relevant drying process information (weight loss of sample, moisture content, and status of drying) to send alerts to the users and plot various graphs to understand the drying characteristics of shrimps. The system can significantly reduce the

manpower requirement and time consumption and also avoid heat loss due to frequent opening and closing of the door and can make data collection easy and effective. Future work may focus on integrating drying parameters (temperature, relative humidity, and air velocity) on the mobile alert arrangement which in turn could control the operation of the fan and heater appropriately to regulate the drying process as an energy-saving measure.

13.TNJFU E-FISH HEALTH APP

Dr.A.Uma

Professor and Head
State Referral Laboratory for Aquatic Animal Health
Tamil Nadu Dr. J Jayalaithaa Fisheries University- Madhavaram Campus
Chennai – 600051
Emaill : uma@tnfu.ac.in

TNJFU-Fish Health App is a mobile app developed by State Referral Laboratory for Aquatic Animal Health in the Madhavaram campus of Tamil Nadu Dr. J.Jayalalithaa Fisheries University to help in easier dissemination of information related to aquatic animal health management to the aquafarmers. This App was developed by Tamil Nadu Innovative Initiative (TANII) scheme – "E – Fish Health Surveillance and Monitoring to Improve Fisheries Production in India " funded by Tamil Nadu State planning commission.

The unique features of this app is that, the users can access variety of informative and customized modules viz., disease information, sample analysis services, Better Management Practices (BPMs) and FAQs through text and imagery. This App is supported by a team which constantly monitors the back-end software linked to the App to get in touch with the farmers for their diagnostic needs and to clarify their queries. This App is also constantly updated periodically based on the feedback from the farmers.

The app was launched by the Honorable Minister of Fisheries for Tamil Nadu on 21.02.2020. TNJFU E-Fish Health App is available in two languages (English and Tamil) which can be readily accessed by Google Playstore. TNJFU-Fish Health App has been translated in its entirety to tamil language which can be separately downloaded from the Google Playstore. The design and interface of the Tamil version of the App is identical to the english version. Meticulous work had been done to ensure that the translated version of the App is easily understandable and easy to navigate without any difficulty by the users.

Tamil version: https://play.google.com/store/apps/details?id=com.efishtamil.health.tnjfufisheries
English version https://play.google.com/store/apps/details?id=com.efish.health.tnjfufisheries

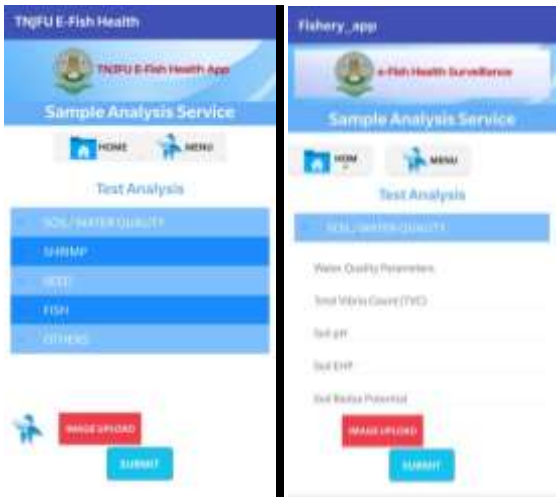
List of App Beneficiaries

The beneficiaries of this app include farmers, students, researchers and fish hobbyists.

a. Information on the disease including photographs with specific symptoms are provided in the App. The farmers can identify the diseases based on the information provided in the disease information section.

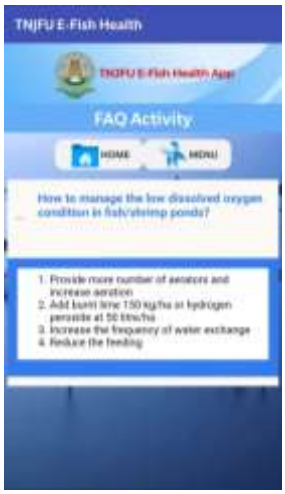
b. Sample analysis service: The farmers can access this option to choose from wide range of tests available in the app to perfom the analysis in respect to their samples of interest.

c. Photo upload provision: The farmers can use the upload option in the app to upload photographs pertaining to diseases and symptoms exhibited in their respective farms



d. BMPs: The app contains information on the Better Management Practices to be followed for prevention and management of diseases for successful aquaculture farming.

e. Frequently asked questions (FAQs): Several questions related to aquaculture farming are answered and the app provides an interface where the users through a simple tap on their required question will reveal the answer.



f. Queries: The app contains a comment box which can be accessed by the users and provide their valuable feedback.

g. Contact details: Location for the state referral laboratory is also provided in the app and by clicking the hyperlink, the app will directly plot the course to the lab's location through google maps.

14. Smart shrimp aquaculture using mobile applications - an innovative approach

M.Kumaran

Principal Scientist,

ICAR-Central Institute of Brackishwater Aquaculture,

75, Santhome High Road, Raja Annamalaipuram, Chennai – 600 028.

Introduction

Shrimp farming is technology intensive and high investment food production system. Shrimp is a high value commodity alone contributed 71% of Indian seafood export earnings worth 5 billion USD. Introduction of Specific Pathogen Free (SPF) Pacific White Shrimp (*Penaeus vannamei*) farming in 2010 has quadrupled the Indian shrimp production from 0.15 MMT in 2008-09 to 0.815 MMT in 2020-21 with an enhanced average productivity of 6.0 tonnes/ha (MPEDA, 2021). Though profit is relatively higher in shrimp farming, it is equally susceptible to diseases and other production risks in the form of pond driven stress factors. Therefore, Farm advisory services are important to enhance the technical capacities of the farmers to adopt appropriate farming practices and facilitate them to access quality farm inputs, diagnostic services and premium market (Joffre *et al*., 2017; Engle, 2017; Kumar *et al*., 2018; Ngugi *et al*., 2018; Obiero *et al*., 2019). Return to investment on farm advisory services is estimated at 58% (Alston et al., 2000; Dercon, et al. 2009) and attributed for increased production and household income of farmers to the tune of 18-30% (Asres *et al*. 2013; Davis *et al*. 2013; Msangi and Batka 2015; Gideon *et al*., 2018). In India fisheries is the provincial subject, hence, the states have the major responsibility in providing extension advisory services. Though fisheries and aquaculture contribute significantly for food production, employment generation, societal development and national economy, it has not been adequately supported with a formal dedicated extension service at states level (Kumaran, 2012; Sadamate *et al*. 2019).

The Departments of Fisheries (DoFs) of states due to their limited reach, welfare-centric functions, lack of manpower, extension service orientation and budgetary constraints, could not perform this role efficiently (Kumaran *et al*., 2012). Many ICT aided projects were undertaken to provide the extension support, but due to their narrow focus and limited geographical attention they could not

make an impact (Walsham, 2013; Evans, 2018a; Alagappan and Kumaran, 2016; Vimala *et al*. 2017, Monica *et al* 2019). Nevertheless, development of mobile networks that support greater data speeds and connectivity even in remote geographies and affordable prices of mobile handsets across the globe facilitated the exponential rise of mobile applications to bridge this communication gap in a required mode to the end users and facilitate research, extension, farmers, input and market integration (World Bank, 2012). Studies have asserted that mobile phone based information pathway could ameliorate the major impediment, the access to farm advisory, for raising agricultural productivity among smallholders (Aker and Ksoll, 2016; Karanasios and Slavova, 2018; Sontakki and Subash, 2017). Further, mobile applications were found to have ensured bidirectional information flow (Anand and Kumaran, 2017; Sontakki and Subash, 2017), customised advisories to the farmers, broken information asymmetry and enhanced knowledge level among the farmer segments (Aker, 2008; Kumar and Padmaiah, 2012; Lee and Bellemare, 2013; Ganesan *et al*., 2013; Katengeza *et al.,* 2014; Mahedi Hasan, 2015; Reddy *et al*., 2017; Thokozani and Fredy Kilima, 2018; Vimala et al., 2019). Elfeky and Masadeh (2016) and Brize-Ponce (2016) confirmed that the use of mobile learning (e.g., apps) was more effective on end-user's knowledge than the use of traditional teaching approaches, due to the availability of the device without the restrictions of time and place. Shrimp farmers are constant information seekers from online sources and positively receptive towards accessing technology information through mobile applications (Anand and Kumaran, 2017).

Development of Mobile Applications for Smart Shrimp Farming

In the present case, smart shrimp farming refers to facilitating shrimp farmers with specific mobile based applications inclusive of digital technology advisories, input optimizing calculations, bio-mass/stock assessment, on-farm disease diagnosis, farm risk assessment, pond-wise digital record keeping of all the farming operations, graphical display of pond parameters in the dash board, recommendations based on the data given by the farmer/end user for the efficient management of farms. In this context ICAR-CIBA has developed two android mobile applications viz., *CIBA ShrimpApp* and *CIBA ShrimpKrishi* both are available in the Google play store for free of coast. The applications developed adopting the Software Development Life Cycle (SLDC) approach which is comprised of eight phases and relevant methodologies as given in Table-1.

CIBA ShrimpApp: This app has eight information modules *viz.*, better management practices of shrimp farming, quantification of inputs, on-farm disease diagnosis, on-farm risk assessment, Frequently Asked Questions (FAQs) in shrimp farming, regulations, advisories and updates and posting queries were integrated in the mobile application. The internal consistency and validity of the modules were evaluated with appropriate reliability tests and judgement validation by domain subject matter specialists. The contents of the modules were translated in to programming language wherein the programme specifications were converted in to software instructions. Android Studio version 3.4.2 Integrated Development Environment was adopted for the development of mobile application with Java language as front end and the data bases were created as back end through Structured Query Language (MySQL). The framework for knowledge representation the mobile application along with the modules is given in Fig. 1.

Table-1: Software Development Life Cycle (SLDC) approach and methodology

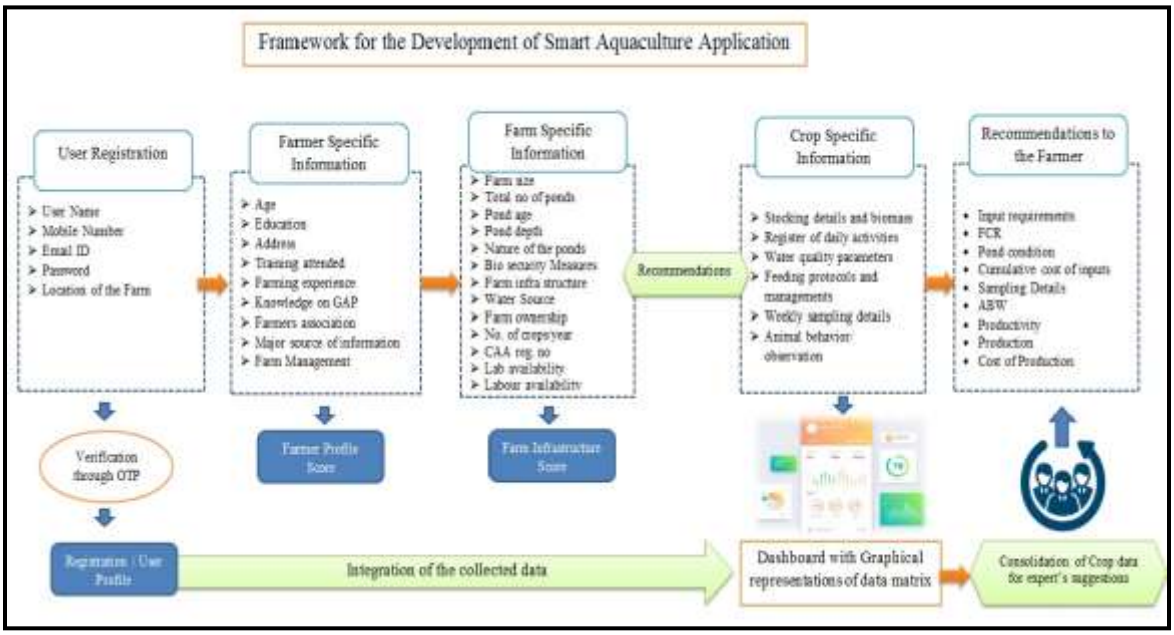
Sl.No	SDLC Phase	Subject matter	Methodology
1.	System Analysis	Shrimp aquaculture sector, production systems, exiting information flow, mobile application for bidirectional flow of information, shrimp farmers profile analysis, information need assessment, formats, receptivity and sustainability.	Farm survey, focus group discussions.
2.	Feasibility Analysis	Availability of technical content, subject matter specialists, operational resources, time and budget requirement.	subject matter specialists
3.	Requirement analysis	Availability of mobile networks, connectivity, access to smart phone by end users, technical information requirements, modules, format of delivery, preferred platform and language.	Farm surveys using structured questionnaire and focus group discussions.
4.	System design	Modules and content: static/dynamic; end user access to app, login details, dashboard details,	Flow chart analysis

		navigation details, module choosing, accessing the content and interacting with modules.	
5.	Coding	Translation of module content in to programming language and software instructions. Operating system - Android Studio Integrated Development Environment with Java language as back end score and the data bases were created through MySQL.	Data base creation and linking, Android application file formatting and computer programmes.
6.	Testing	Testing to recognize the gaps, errors and missing necessities *vis-à-vis* the actual requirements. Unit/module wise testing for its functionality, integration testing for connectivity of modules, programme testing for coding and the whole app testing to ensure the user requirements. Each module interface of the app was tested to ensure its proper functioning.	Content validation by domain subject matter specialists. Internal consistencies and validity of the modules evaluation with appropriate reliability tests.
7.	Implementation	Naming the mobile app "CIBA ShrimpApp" and display in the Google play store publisher for publication. Tutorial for end users.	Awareness / sensitization workshops; social media and online communication.
8.	Maintenance	Review of module contents for updation and modification, design and visual improvements.	Content review and updation analysis.

Fig.1. Framework for knowledge representation of CIBA ShrimpApp

CIBA Shrimp KrishiApp: The farmer end-users preferred that a mobile application in which the farmer or the farm operator could enter his/her data on water quality parameters, feed requirements, feed rationing, feeding behavior and feed management, biomass estimation, animal behavior, pond conditions, average growth, body weight and economics of inputs. The application could include blocks of farmer specific details, farm specific information, crop specific information and day-to-day data entry register. The application should integrate the data from these components, process them and show inferences in the form of graphs or data matrices using that the farmer can visualize the status of his farming and might take decisions appropriately. It is intended that by using this application the farmer can forecast his inputs requirements and productivity. Such that we can pool the data from several farms and forecast the requirements and identify the shortfalls in every aspect monitored and alert the farmer to rectify the issue and take an appropriate decision. Therefore the second application CIBA Shrimp Krishi was developed. A frame work for the mobile application is developed for implementing a mobile application for shrimp farm management (Fig-2). The screen shots of the mobile application are presented as figures below.

Fig-2. Framework for Mobile application for shrimp farm management



"CIBA Shrimp KrishiApp" was developed for handholding the farmers to make real-time based informed decisions at the farmer level. Front end was developed on Android platform SDK using Java programming language. This technology was used because it is portable to all android devices. Linux, Apache, MySQL and PHP tools were used for designing back-end. These tools are selected as they are open source, robust, and institute has the entire necessary infrastructure to store, manage and update the back-end content. The app size is 8 MB and it will work in Android version 5.0 and above. The app is made available in English, Hindi, Tamil and Telugu languages. Using this interactive mobile application, the farmer can input his farm data on day-to-day farming operations/observations from stocking to harvest. Based on the inputs provided and inbuilt decision-making system, the app will display pond-wise status on shrimp survival, biomass, feed conversion ratio, pond water quality, and the expenditure incurred.

Fig-2. **CIBA ShrimpKrishi Mobile Application**

Three expert systems viz., Shrimp feed management, water quality management and shrimp disease management are inbuilt in to the app. Based on the data fed in to the app, it Shrimp Krishi alerts the end-user farmer with technical advisories whenever any deviations are noted in the pond operational and critical day-to-day parameters such as water quality, feeding and shrimp health. The app can store the entire crop data in it, and the farmer can retrieve the data for their own long-term decision-making purposes or share it with their resource person for technical advice. Moreover, it paves the way for accessing real-time bulk data from the remotely located shrimp farms to monitor and extend customized technical advisories.

Fig-3. Graphical recommendations of shrimp pond parameters in the App

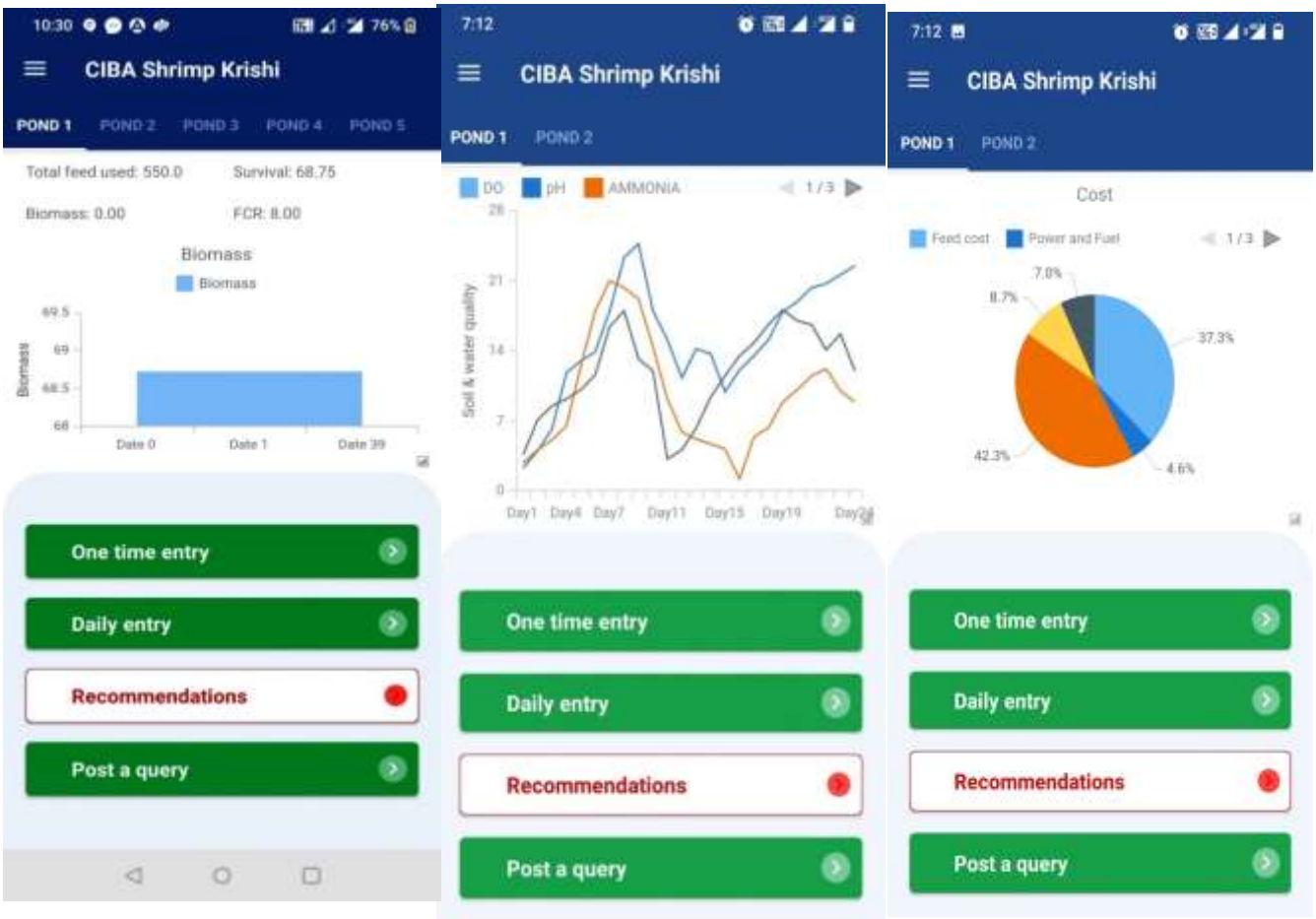
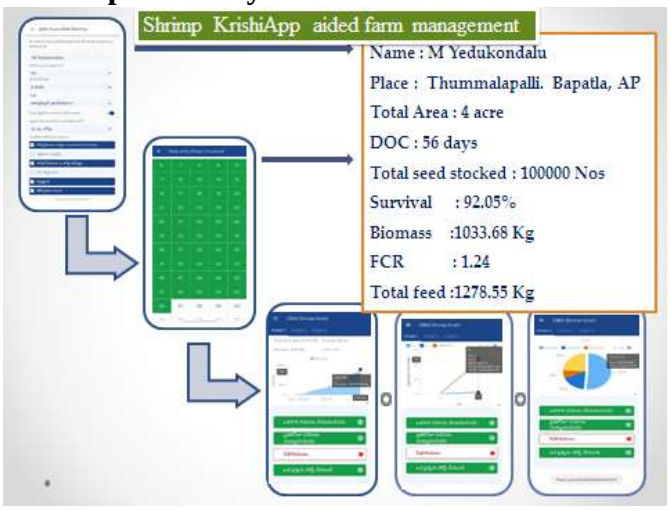
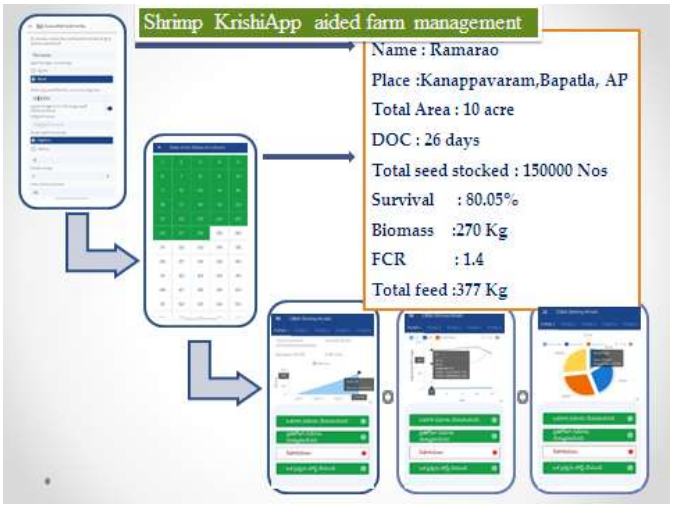
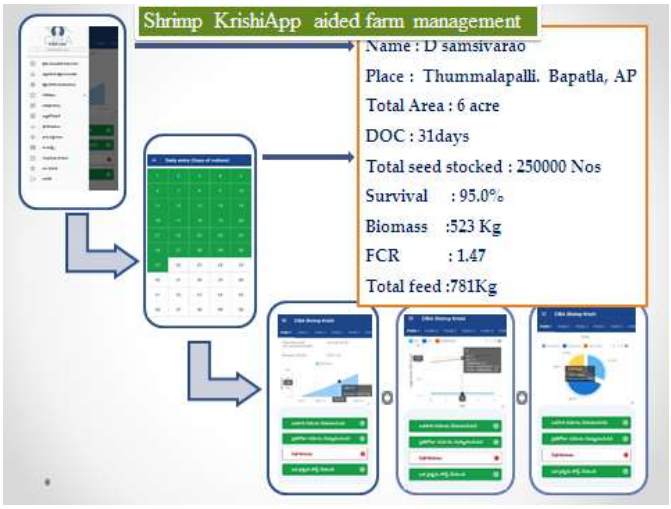


Fig-4. Successful adoption of CIBA Shrimp Krishi by the farmers



Impact of the mobile applications

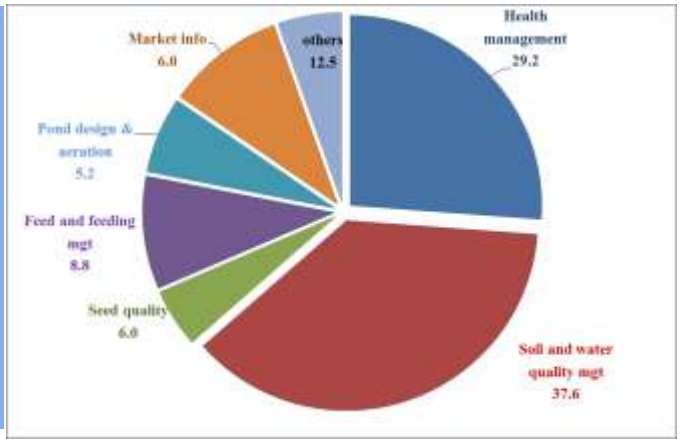




The CIBA ShrimpApp has more than 27500 cumulative downloads across the world (Fig-5) and rated as 4.5 out of 5.0. The application was found to have improved the knowledge level of end users to the tune of 20-37%. The Google firebase application data showed that 98.4% of users of CIBA ShrimpApp were free from errors and crashes. Through post your Query option more than 5000 queries received and advisories were given the end-users (Fig-6). An evaluation study conducted among sample regular users indicated that the app aided in farm decision making and its design functionality and extension service function were perceived to be efficient. Considering pervading mobile connectivity and affordability of mobile phones, smart phone based mobile applications and data analytics would play a significant role in shrimp farm advisory services and its sustainability.

Fig -5. CIBA ShrimpApp users across countries received and

Fig-6. Subject matter wise queries answered through the app



Likewise the initial feedback from the end-user farmers on Shrimp Krishi indicated that the app is highly useful for efficient shrimp farm management by acquiring, storing and sharing the data, helped in inputs optimization, tool for farm traceability & certification, very handy as the app is in regional languages, facilitated the farmer in crop planning and helped efficient decision making based on real-time data. There are suggestions like convert the app in windows platform, wider sensitization and training to the end users for effective use of the tool by the farming community. An evaluation study conducted among sample regular users indicated that the app aided in farm

decision making and its design functionality and extension service function were perceived to be efficient.

Conclusion

Evaluations and field feedback have shown that CIBA mobile applications are an important contribution to the shrimp farming sector and found effective in disseminating the technology information to the end users. The farmers and extension workers perceived mobile application as a potential tool for knowledge improvement and real-time data based shrimp farm management. Apps enabled the bidirectional flow of information between the research institution and end users in getting field feedback through receiving and answering queries. Considering the all-pervading mobile connectivity, mobile application based technology advisories play a major role in minimizing the information communication gap in shrimp aquaculture and it may speed up and enhance the quality of the farm extension services. However, the efficiency of mobile application for extension services would depend on constant updating of the modules based on field requirements and translation of the modules in vernacular languages.

15. ERP software for fish business

V. Geethalakhsmi and V. Chandrasekar

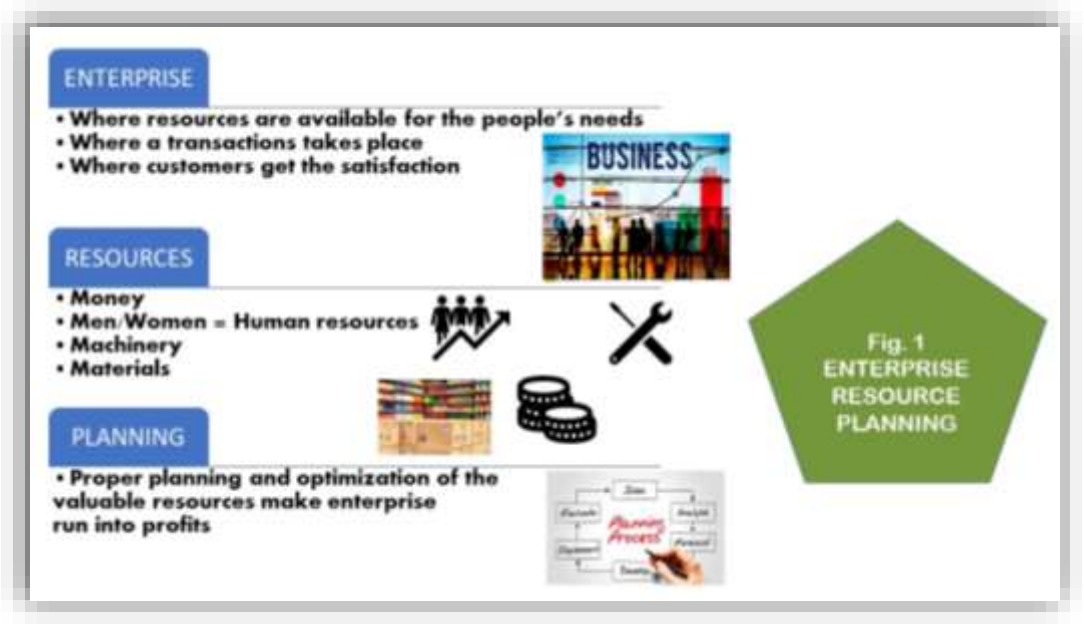
ICAR-Central Institute of Fisheries Technology, Cochin

Introduction

ERP stands for Enterprise Resource Planning. It can be defined as a "system of integrated software applications that standardizes, streamlines, and integrates business processes across finance, human resources, procurement, distribution, and other departments." ERP systems were introduced around 1990 mainly for use by manufacturing companies. The concept emanated from such systems as the material requirements planning II (MRP II) developed in 1983, MRP in 1964, and Economic Order Quantity (EOQ), which came into existence in 1913.

From an enterprise point of view, ERP is a software system that addresses the ENTERPRISE NEEDS taking the PROCESS VIEW of an organization to meet the ORGANISATIONAL GOALS tightly INTEGRATING all functions of an enterprise**.** The benefits of ERP system are

- Reduce overhead costs by combining a number of business tools and applications into one system
- Cause individual operations/departments (warehouse, accounting, HR, etc.) to work faster.
- Automate specific processes that would otherwise require manpower to complete
- Improve business data analytics for better, more accurate and actionable insights
- Positively impact customer relationships by being an overall faster, more efficient company to work with
- Be customized to focus on the aspects of your business that are most aligned with your current goals and needs



Components of Enterprise Resource Planning

Enterprise Resource Planning (ERP) software systems are used by companies to oversee, customize and automate time-consuming daily activities. This includes business needs such as:

- Financial management
- Human resources
- Project management
- Sales orders
- Warehouse management
- Supply chains
- Sales volume
- Risk management
- Inventory management

Fig.2 Enterprise resource planning Components

The automation that ERP systems utilize saves time and money, and their business intelligence saves the difficulties management faces in maintaining multiple systems. ERPs use a **common database to streamline company needs** instead of multiple standalone systems to organize business processes. This means that *all users*—from administrative staff to the CEO—can create, store, and use the same data derived through common processes.

Main characteristics of ERP system

The primary characteristics of ERP system are modular design, flexible, open and centralized database, and automatic generation of information. The software system operates real-time from a general database that supports all component softwares. Basically, an ERP system works on a shared database it supports all applications. This means that workers in different units can depend on the same information from the database for their day-to-day activities. For instance, when a shipment order is initiated for the last item in stock, the inventory management modules must record this information and inform relevant departments so that the inventory can be replenished. The sales team will also be informed so that it doesn't make promises that it can't deliver.

Type of ERP systems

There are basically three different ERP systems: on-premises software, cloud-based software, and hybrid software. The specific type of any organization needs depends primarily on the enterprise's size, available computing gadgets, and the system's ability to meet the enterprise's needs.

On Premise ERP software

As the name suggests this software is installed and operated on site itself. Prior to installation of "on premise ERP software" the enterprise has to ensure that dedicated IT resources are available to handle the applications and server maintenance. After installation of this type of software, the software can be controlled by the enterprise.

Advantages of on premise software are

- The confidentiality of the data is maintained as no third party doesnot have access
- According the needs of the business the modules of software can be customised
- Provides strong integration options with other systems

Cloud based ERP system

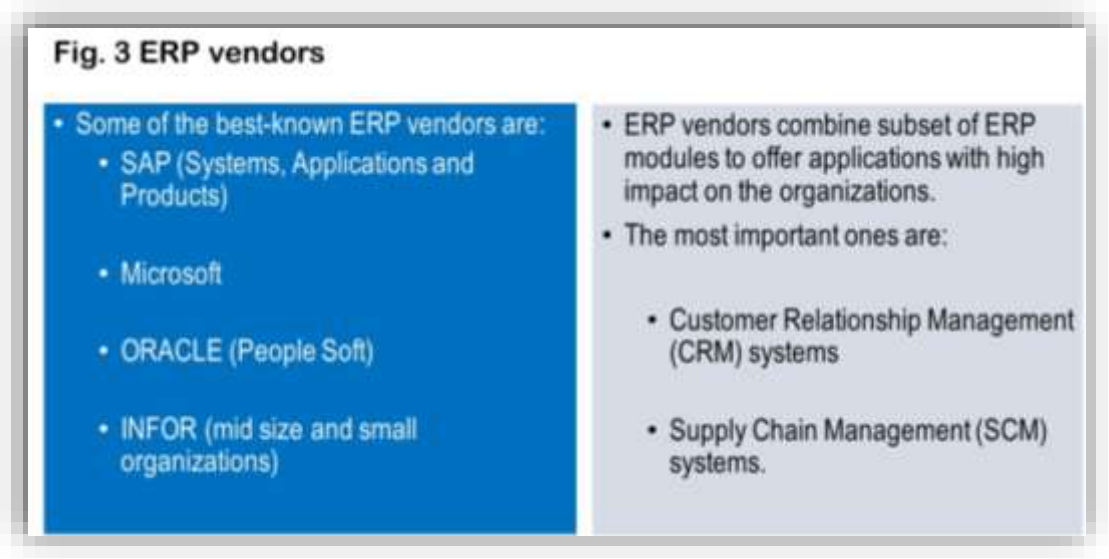
When enterprise wishes to cut the cost on aspects like storage space, equipments and maintenance, this type of ERP system can be opted. A third party manages the service and a more flexible design allows the users to store and surf through data via any gadgets with an internet connection. The only disadvantage of this system is that the enterprise has to trust and ERP vendor to handle sensitive data.

Hybrid ERP system

Hybrid ERP system combines the advantage of both cloud based and on-premise ERP system. It is also called a two-tier ERP system where ERP vendors' expertise will be used to implement and maintain the ERP software without the need to allow them to access all the information.

Enterprise Resource Planning vendors

Companies need to purchase modules for an ERP that represent different functions within the organization from an ERP vendor. When an ERP vendor designs a module, it must implement the rules for the associated business processes. These rules reflect the best practices for that process within a giving industry. The implementation of an ERP system is an excellent opportunity to improve their business practices. An ERP system's functionality allows for streamlined workflow and easier business processes no matter what industry you work in.



Here are some examples of industries that use ERPs:

- Healthcare
- Manufacturing companies
- Small businesses
- E-commerce
- Non-profit organizations

SAP – Systems, Applications and Products

SAP is the largest ERP vendor which has covered more than 2,500,000 users in over 50 countries. An additional aspect of the software integration capability is real time, so that the business can react to immediate information and changes. This type of updating reduces the overhead of manual processing and communication and enables companies to react quickly in the nonstop and complex business world, which makes SAP software systems a very valuable tool. SAP adopts 3-tiers structure –

- GUI – Graphical User Interface or Web Interface
- Application server (one or many)
- Database server (one single location)

Popular enterprises who use ERP

Amazon uses an ERP software called *Systems Analysis and Program Development* (SAP). SAP was created in Germany in 1972 by five former IBM employees **who envisioned a software integration of all business and data processing in *real-time.*** SAP has continued to grow and transform from a small startup company to a *global leader* in business software, so **it's no surprise Amazon chose this system to run its business processes.** Now SAP business customers can manage their…

- Finances
- Logistical business needs
- Human resources
- Order management
- Sale and more through just one database**.**

SAP S/4Hana Cloud is the most modern version of SAP ERP with built-in AI, machine learning, and advanced analytics.

Well-known Enterprises / Companies which use ERP.

Starbucks uses Oracle ERP – a cloud-based **software solution used to automate back-office processes and day-to-day business activities.** It's a business management software suite that includes financial management, supply chain management, project management, accounting, and procurement.

Oracle E-Business Suite provides users applications for customer relationship management (CRM), enterprise resource planning (ERP) and supply chain management (SCM) processes. The Oracle ERP above shows revenue analyses and includes information you need to know at-a-glance including:

- Revenue
- Expenses
- Sales data
- Inventory management
- Operations updates

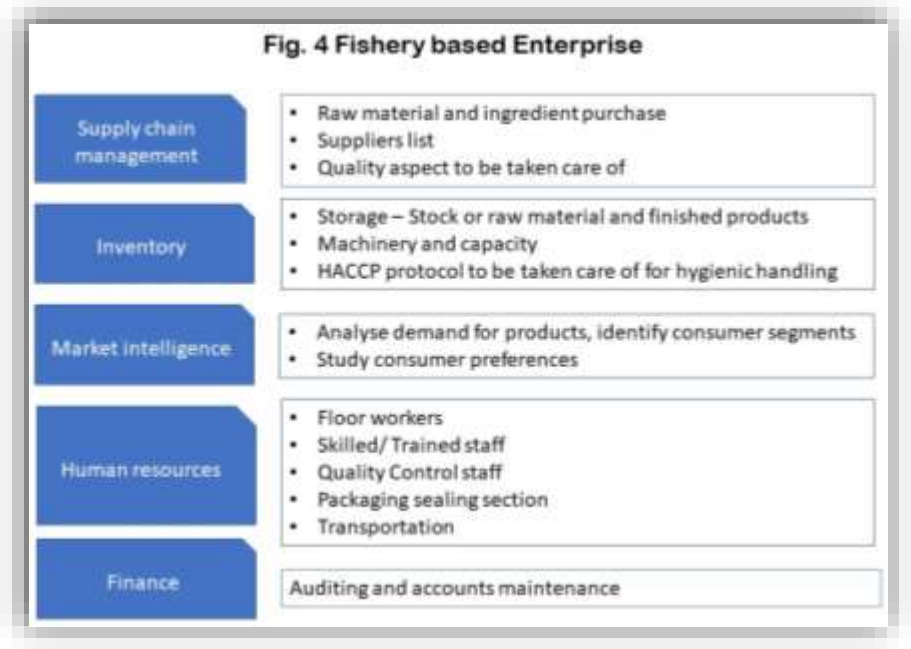
Fishery based enterprise.

Fisheries sector has witnessed an impressive growth from a subsistence traditional activity to a well-developed commercial and diversified enterprise. It has been playing a pivotal role in the economic development by virtue of its potential contribution to employment generation. For example, hundreds of fisherwomen are engaged all along the coastal districts of our country in fish drying either as a household activity or as small-scale enterprise. Several enterprises based on fish value addition are coming up which have been initiated with technology backing of R & D institutions like CIFT. Cage culture of fish is being practiced in the backwaters in Ernakulam district by fishers by availing subsidy schemes from Fisheries department and other developmental agencies.

Fish being a highly perishable commodity travel along the fishery value chain through multiple channels before it reaches the consumers' plate. When fish-based business is planned, there are several aspects which must be planned in advance and streamlined for smooth management and

sustainability. Starting from raw material and ingredient purchase, supplier database, through storage and manpower, planning and management is involved. For example, in the case of manufacture of fish value added products the following stages are identified:

- Supply chain management – Purchase of fish, ingredients, list of suppliers who supply at competitive rates, quality and safety assurance, transportation of fish and finished products.
- Inventory – Storage of stock, machinery, capacity of plants, equipments
- Production protocol – implementation of hygienic handling practices
- Market intelligence – consumer preferences, demand for products
- Human resources management – floor workers, skilled/ technical staff, labour, drivers, managerial staff, supervisors
- Finance management – accounts maintenance and auditing



Implementation of ERP to manage a fishery-based enterprise will enable smooth functioning of the various activities/ operations. Customer relations can be better maintained, the consumer preferences can be better understood and better focus on profits, analysis of financial loss is possible.

16. A Product of Tamil Nadu Forest Department from KMTR Invention by the Village Forest Committees Surabi Mobile App and Wep portal

M G. Ganesan

Deputy Director, Aanamalai Tiger Reserve, Pollachi, T.N**,**

Introduction:

In Kalakad Mundanthurai Tiger Reserve, 263 Village Forest Committees (VFC) were successfully running under Eco development Division. In the 263 VFCs there are 289 Sub village Forest Committees and 696 Micro Village Forest Committees which Contains 16904 Committees Members. From 1996 there are 1,31,761 revolving Members were benefited under FREEP, Eco Development, ABR, BCRLIP in ALS and SADP Schemes. Upto May 2022 Rs.109.97 Crore of revolving Micro Credit had Been Issued in 9.7 Crore of Scheme Fund to the VFC Members and in it 93% Recovered. Thus online Management of the Village Forest Committees through Web portal and Surabi Tamil Mobile app had been introduced in 2018-2019.

Eco Development Division :

The Eco Development Division Controls Four Eco Ranges. Papanasam Eco Range, Ambasamudram Eco Range, Kalakad Eco Range and Tirukurungudy Eco Range. The Objective of the Eco Development Division is Biodiversity conservation and Rural Livelihood Improvement through Alternative Income Generation Activites. Thus the 260 Village Forest Committees were formed in the Buffer Zone villages and Three Eco development Committee were formed in tribal Hamlet of the Reserve forest of Kalakad Mundanthurai Tiger Reserve under Five Schemes.

Village Forest Committees/Eco Development Committees:

The Village Forest committees / Eco Development Committees is the registered institution under Tamil Nadu Societies act 1975. Those who paid Subscription in the village to VFC will be a General Body Member. From the General Body Members elected seven Executive Committee Members and among seven EC member one elected as Chairman. Tamilnadu Forest Department – Eco Development Division, Relevant Eco Range Forester will be the Member Secretary of the Village Forest Committees (VFCs). The Member Secretary/ Forester Holds the Cheque Power in the VFCs and Monitored by the Relevant Eco Range Assistant Wildlife Wardens(AWLW). AWLWs moniterd by the ECO DEVELOPMENT OFFICER.

Web Portal and Surabi Mobile App:

The Web Portal (https://www.bcrlip.org/BCRLIP/) designed with the Technology of HTML, JAvascript, Jquery, Bootstrap, PHP, Mysql and the Surabi Mobile app designed with IONIC, Angula, Mysql by THRAYAM Tech Solutions with the agreement to Village Forest Committees. TAMIL language is used in the Surabi Mobile app and the app will be installed in all Android Mobile Phones. The Surabi app is linked with the web portal where the Primary data were already linked.

Initialization:

The updated Mobile App Software can receive only from the agreed company of 'THRAYAM Tech Solutions' by the Forester/Member Secretary of the VFC. and installed it in the Mobiles of the Volunteers who done field level Loan recovery works in VFCs, Range level management staffs and Staffs of the Eco development Division.

Method of Using:

The Unique ID and Password for the mobile app had been issued to the Cluster wise VFC Volunteers to feed their Data. The Volunteers feed the daily Data of Micro Credit issued and recovery Details through their ID. The Data updated in through the mobile app effects auto update in the web portal. Tamil Language in tha mobile app is useful to easy understand to feed the data by the Field staffs.

Monitoring:

The Data fed by the field staffs checked by the range level data entry Operators and scrutinized by the range FORESTER/MEMBER SECRETARY weekly and monthly by the Assistant Wildlife Wardens.

Correction/Changes and Update in the App and webportal:

The Manual error correction, Changes, Addition, Deletion needs will be requested by the Forester/Member Secretary by sending the request report to the agreed Company. With the request report the Software engineer of the agreed company make needed changes and reported to the

Forester/Member Secretary. After the changes done the Forester/Member Secretary reported to the management and Staffs for necessary action and Follow-up.

Monthy PDLs:

The data feed in the Web portal and Mobile app effects the Auto generated Monthly PDL of range wise and Division wise PROFILE.

Maintenance Charges:

In 263 VFCs, Interest amount created through Micro Credit from 250 VFCs -RS 600/- each had been paying as app and web portal annual Maintenance charges. thus 250 VFCs * Rs 600/- = Rs. 1,50,000/- had been paying from the VFC as annual Maintenance charges.

Conclusion:

Thus online Management of Eco Development Committees is the successful invention in Eco Development Division of Kalakad Mundanthurai Tiger Reserve.

17. Extent of utilization of information communication technologies by the fishermen of coastal districts of Tamil Nadu - A comparative study

Dr.G.ARUL OLI

Assistant Professor
Department of Fisheries Extension, Economics and Statistics
Fisheries College and Research Institute
Tamil Nadu Dr.J.Jayalalithaa Fisheries University, Thoothukudi – 628 008

INTRODUCTION

Fisheries industry has been accepted not only as a powerful income and employment generator but also modern information communication technologies and their tools and equipments has made a significant contribution in changing the status of marine fisheries sector in our economy into a vibrant one. Latest technological externalities like information communication technologies in the marine fisheries have brought about a great transformation of fisherfolk population both in their personal life styles as well as livelihood activities. The expansion and development of marine fisheries sector through information and communication technological tools like GPS navigation, satellite communication and wireless connectivity etc. are quite significant. It is interesting to note the significant change brought about by the high profile of information communication technologies in the field of marine fisheries sector throughout the world.

The most preferable information communication technological tools which provide wide range of adoption by the marine fishing industry in general are : community radio, satellite sensing, GPS, electronic sensors, satellite imaging, SONAR, echo sounders, mobile phones, E-log books, information centres, print publications, web based applications, etc. Some are specialised applications like sonar for finding the vicinity of fish, GPS for navigation and finding location, mobiles phones for trading, exchanging information and emergencies and radio programming with fishing communities etc.(FAO, 2007).

The ongoing ICT revolution has asserted the belief that through the facilitation of information and knowledge, growing economies like in India has unprecedented opportunities to make changes in production sectors. The positive externalities of information communication technologies in marine fisheries sector definitely enhance livelihood activities of marine fisher folk which are purely economic oriented. Realizing the importance of information communication technologies for fishing industry and to understand the driving factors behind for the development of the sector, the comparative study were undertaken to analyse the extent of utilization of information communication technologies for fishing by the fishermen in various costal districts of Tamil Nadu. A comparative research study was undertaken between two sectors such as ICT – Non impact area as control and ICT impact area as study area. Nagapattinam District and Kanyakumari District were selected for ICT impact study area and Pudukkottai and Thoothukudi Districts were selected for ICT Non-impact area under control category. This region was purposively selected for the study based on the Governmental and Non-governmental agencies located and its exposure with specific reference to ICTs for fishermen.

The socio- economic characteristics of respondents namely age, educational status, experience in fisheries, type of fishing crafts used, boat ownership, type of fishing gears used, active fishermen, fishing distance, fishing depth, duration of fishing, daily average fish catch, annual income, annual expenditure, social participation status, extension agency contact, service centre contact, mass media exposure, decision making behavior, innovativeness, economic motivation, market orientation, information needs, information source exposure, information source utilization, were considered to find the relationship with the extent of utilization of fisheries information communication technologies by the fishermen.

The ten different information communication technological tools usage for fishing by the fishermen such as GPS, Remote sensing satellite – PFZ, Android Mobiles and its software applications, Television and Radio, Other Electronic gadgets, SONAR/Echo sounder, RADAR, On board data integrators, ICT displays, Internet linkages, E-Fishing were taken to analyze the extent of utilization for fishing.

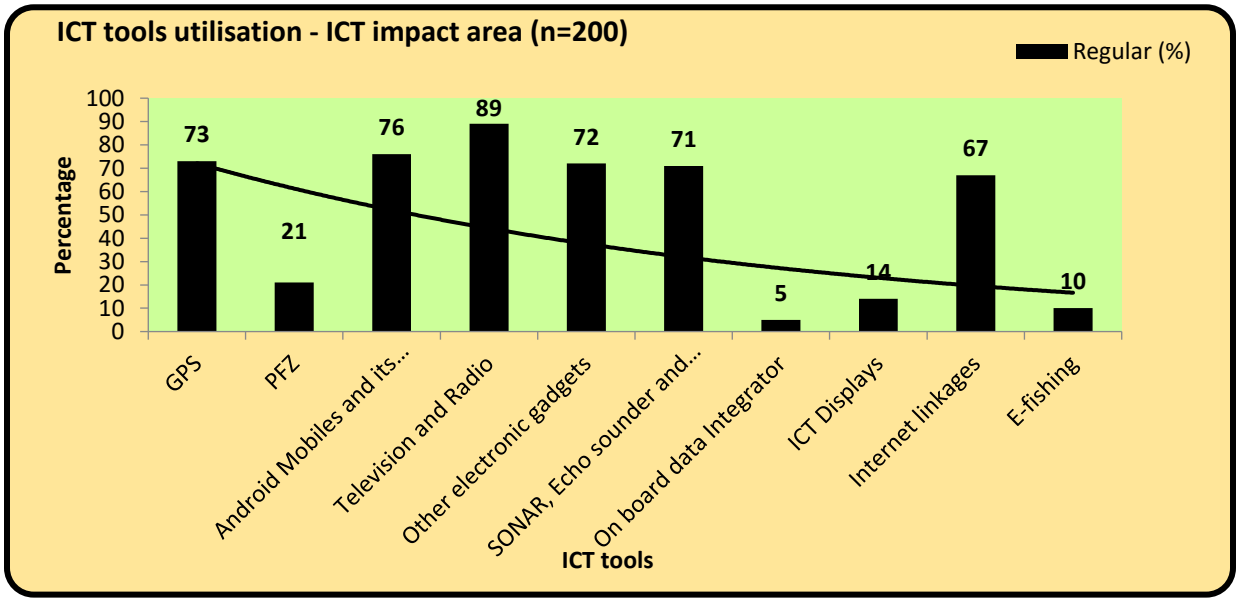
Extent of utilization of information communication technologies by the fishermen

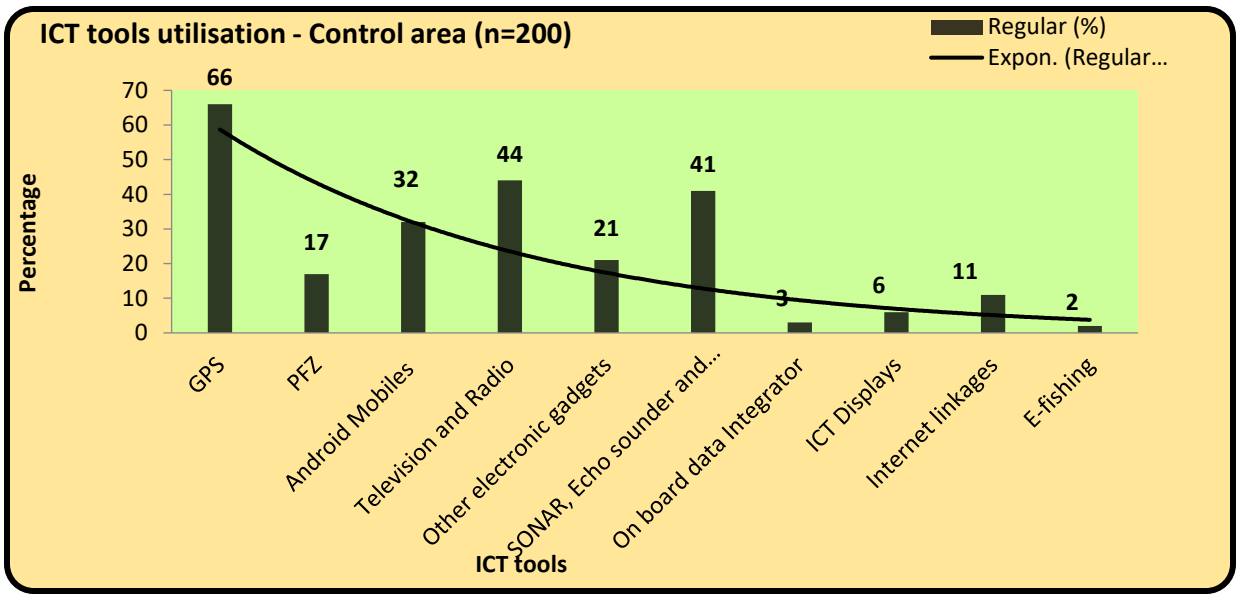
Sl. No.	ICT tools	Control (n=200)			ICT impact area (n=200)		
		Regular (%)	Occasional (%)	Never (%)	Regular (%)	Occasional (%)	Never (%)
1	GPS	66	18	16	73	15	12
2	PFZ	17	21	62	21	14	65
3	Android Mobiles and its software applications	32	19	49	76	13	11
4	Television and Radio	44	36	20	89	11	0
5	Other electronic gadgets	21	27	52	72	11	17
6	SONAR, Echo sounder and RADAR	41	33	26	71	17	12
7	On board data Integrator	3	5	92	5	27	68
8	ICT Displays	6	5	89	14	15	71
9	Internet linkages	11	9	80	67	17	16
10	E-fishing	2	6	92	10	28	62

It is evident that the majority (66%.00) of the respondents of control area used the GPS for finding the fishing locations. In ICT impact area, nearly three fourth (73%.00) of the respondents used the GPS for finding the fishing locations. In the control area, only 17.00 percent of the respondents used PFZ data to find the location for fish shoals whereas in ICT impact area the lesser portion of the respondents only (21.00%) used PFZ data. Around 32.00 percent of the respondents had android mobile phones with required software applications in control area. Almost three fourth (76.00) of the respondents had android mobile phones for accessing the information in ICT impact area.

Nearly (44.00%) half of the respondents in the control area used radio and television to access the information for fishing whereas in the ICT impact area, radio and television were the most accessed ICT tools by the majority (89.00%) of the respondents. Less than one fourth of the

respondents (21.00%) in the control area used other electronic gadgets such as personnel computer with data cord, lap top, tabs, etc. Majority of the (72.00%) respondents used other electronic gadgets such as personnel computer with data cord, lap top, tabs, etc. in ICT impact area. Echo sounder, SONAR and Radar were used regularly by 41.00 percent of the respondents for fishing in control area whereas in ICT impact area Echo sounder, SONAR and Radar were used regularly by nearly (71.00%) three fourth of the respondents for fishing. A meagre portion of the respondents in control area used of Onboard data integrator (3.00%), ICT displays (6.00%), Internet linkages (11.00%) and e-fishing (2.00%) for fishing whereas in the ICT impact area, a meagre portion of the respondents used of Onboard data integrator (5.00%), ICT displays (14.00%), and e-fishing (10.00%).

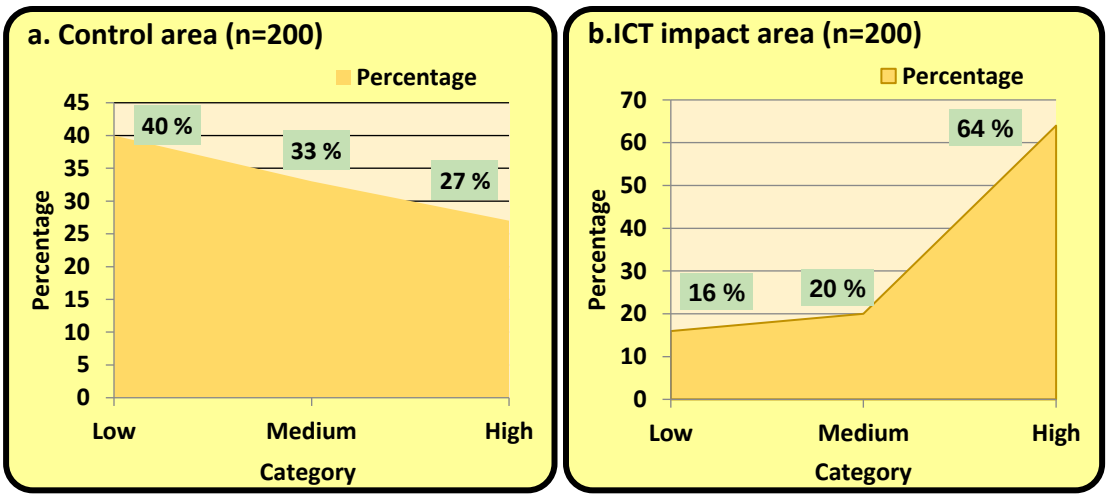




The Figure represented the comparison between the control area and ICT impact area with relative ranking of the percentage of extent of utilization of ICT tools for fishing by the fishermen regularly. The exponential line revealed that all the ICT tools usage by the ICT impact area fishermen was in high level than that of control area fishermen.

Distribution of respondents according to extent of utilization of ICT tools by fishermen

The comparison between the control area and ICT impact area with relative rating of the percentages of extent of utilization of ICT tools for fishing by the fishermen. The importance of ICT tools for fishing by the fishermen in the control was observed as lower level than that of the ICT impact area where in the exposure and usage level of ICT tools for fishing by the fishermen was higher in level. The respondents in control area had low level of extent of utilization of ICT tools for fishing followed by medium (33%) and high (27%) level. In the ICT impact area, majority (64%) of the respondents had high level of extent of utilization of ICT tools for fishing followed by medium (20%) and low (16%) level.



Relationship between the socio – economic characteristics of fishermen with their extent of utilization of communication technologies

Among total 26 independent variables thirteen had positive relationship with the dependent variable (extent of utilization of information communication technologies by the fishermen) and the remaining fourteen variables exhibited negative relationship in control area.

Relationship	Significant relationship with dependant variable at 5 per cent level
Positive relationship	Type of fishing crafts used, Social participation status – Frequency of contact, Mass media exposure, Economic motivation, market motivation, Information source exposure and Knowledge level of fisherfolk on communication technologies
Negative relationship	Educational status, Type of fishing gears, boat ownership, Decision making behaviour, Information needs
Non Significance (Positive)	Age, Active fishermen, Fishing depth, Fishing duration, Daily average fish catch, Service centre contact, Information source utilization

Non - Significance (Negative)	Experience in fisheries, Fishing distance, Annual income, Extension agency contact, Innovativeness, Scientific orientation

While looking the relationship between the independent and dependent variables for ICT impact study area, among total 26 independent variables, 21 had positive relationship with the dependent variable and the remaining six variables exhibited negative relationship.

Relationship	**Significant relationship with dependant variable at 5 per cent level**
Positive relationship	Experience in fisheries, Fishing distance, Daily average fish, Annual income, Annual Expenditure, Social participation status – Frequency of contact, Extension agency contact, Service centre contact, Decision making behaviour, Innovativeness, Economic motivation, market motivation, Scientific orientation, and Knowledge level of fisherfolk on communication technologies
Negative relationship	Information needs and Information source utilization
Non - Significance (Positive)	Age, Educational status, Type of fishing craft used, Mass media exposure and information source exposure
Non - Significance (Negative)	Boat ownership, active fishermen, Duration of fishing and Social participation status

The respondents were pointed out the difficulties that they face while in fishing specifically with regard to ICT tools for fishing. The main problems revealed by them are listed below:

Constraints faced by fishermen in extent of utilization of ICT tools for fishing in control area

No.	Constraints	Number	Percentage	Rank
1.	Financial constraints for the purchase of costly ICT tools	149	74.50	IV
2.	Lack of knowledge of information sources	147	73.50	V
3.	Lack of skill in using ICTs tools	158	79.00	III
4.	Lack of training for proper using of ICT tools for fishing	164	82 .00	I
5.	Poor electronic communication ability	160	80.00	II
6.	Low pursuance of TV/Radio programmes	127	63.50	VI
7.	High charges for accessing Internet through mobile	124	62.00	VII

Constraints faced by fishermen in extent of utilization of ICT tools for fishing in ICT impact area

Sl.No.	Constraints	Number	Percentage	Rank
1	Less accuracy and reality of the information on PFZ and OSF while using it in fishing	186	93.00	II
2	Difficult to find and understandable the area specific information and are not easier also since plentiful information is available	180	90.00	III
3	Improper network connectivity to get information at sea continuously	188	94.00	I
4	Higher cost of hardware and software of ICT tools for fishing	170	85.00	IV
5	Lack of Private service centres for repairing of ICT gadgets	142	71.00	V

CONCLUSION

The R^2 value showed in this comparative study that the difference were found in control and ICT impact study area with the predict value 79% and 89% accuracy respectively. The tools with specific reference to ICTs, the Global Positioning System (GPS), SONAR, wireless set, computer, internet and android mobile phones were the most vitally used communication tools for fishing by the fishermen in the ICTs impact study area. It was found that based on the usage of mobile phones and GPS, the fish workers were able to exchange their information on shore and off shore to achieve the effective fishing. By utilizing the major communication tools such as community radio, electronic equipments such as echo sounders, SONAR, the greater level of catch and income had obtained in the ICTs impact study area.

The GPS is one of the most preferred ICT tools among the fishermen. The information source utitlization levels were high in the ICT impact study area since the contact level was high with the extension agencies and information service centres by the fishermen. The impact on the major information sources such as radio, television and news paper were higher for utilization of information for fishing. Based on the analyses done, it can be concluded that ICT offers a lot of benefits such as increased socio-economic characteristics of fishermen, knowledge and skills on utilization of ICTs for effective fishing.

18. "Enmeen" - A smart data aggregating interface for fish landing repository

J. Jayasankar, D. Pugazhendhi and P. Laxmilatha

ICAR- Central Marine Fisheries Research Institute, Cochin

Introduction

As is well recorded, marine fish landings along coastal India, especially, Tamil Nadu, is an incessant activity in the strictest of senses. Though the type and even number of crafts could be anticipated at any given day, the time and type of landings may not follow a strict pattern. The greatest support in this scenario of seminal uncertainty is the well identified and approved list of locations where the crafts with catch are regularly landed. These landing centres (LC) or Fishing Harbours (FH) have their infrastructure well documented by the state officials and other stakeholders. Such an exhaustive list happens to be the fountainhead of marine fish landings pertaining to any geographical confinement *viz*. state, district etc.

Estimation of marine fish landings

When it comes to measuring the landings (craft landed catch) there are only two ways possible despite knowing the landing points. The first one is to have a mechanism in place by which each and every landing point could be monitored 24x7 throughout the year, which would tantamount to collating the data based on complete enumeration.

This is a near impossible proposition taking into account the vast multitude of fishing crafts reaching every day at various centres at almost all the parts of the day and even when planned would be an unviable proposition in economic terms. So, the second option, which is based on selection of samples out of survey forays to the landing centres at a genuinely non-prejudiced random pattern, is the most plausible one. But as it can be understood even for one state like Tamil Nadu the diversity of craft-gear combinations, targeted fisheries and the expanse of by-catches and the variegated timings make it extremely challenging to put in place a solid plan. However as per the mandate of the component-III of FIMSUL-II project (A project undertaken by ICAR-CMFRI during 2017-19) a modified version of the methodology was followed estimation of statewise monthwise marine fish landings. The core modification suggested was to consider the 38 centres

listed by the Tamil Nadu Fisheries Department (TNFD),which provided in Table 1, as single centres and for each one of them per month sampling strategy would be prepared for estimating the craft-gearwise resource wise marine fish landings. While the landings get estimated simultaneously the efforts as unit craft-gear or in hours too get estimated.

Table 1. List of landing centres covered

No	District	Name of FH/LC
1	Chennai	Chennai FH (MFH)
2	Kancheepuram	Cuddalore Periathalai kuppam (KPK)
3	Villupuram	Ekkiyar kuppam (EGK)
4	Cuddalore	Cuddalore FH (CUD)
		Mudasal Odai (MUD)
		Annankoil (PGP) MGR Thittu (MGT) Samiyarpettai (SAM)
5	Nagapattinam	Nagapattinam (NFH) Nagoor (NAG) Siruthur (SER) Arcottuthurai (ARC) Pazhayar (PAZ)
6	Thanjavur	Sethubabachathram (SBC) Mallipatnam (MAL)
7	Pudukottai	R. Pudupattinam (RPU) Muthukuda (MUT) Jagathapatinam (JAG) Kottaipattinam (KOT)
8	Ramanathapuram	Rameswaram (RM1) Thanuskodi (DAN) Thangachimadam (TAM)

		Mukuntharayar Chathiram (MIC) Pamban (PM1) Vethalai (VED) Mandapam MDP) Kilakarai (KEL) Rocemanagar (ROC) Devipattinam (DVP) Soliakudi (MVP)
9	Thoothukudi	Thoothukudi (TFH) Tharuvaikulam (TKM) Theraspuram (TES) Punnakayal (PUN) Periathalai (PER)
10	Kanyakuamari	Inayamputhenthurai (EPU) Simon Colony (COL) Chinnamuttom (CHI)

Estimated landings of a resource by a gear in a FIMSUL centre for a given month

$$Y_{ijk\ldots} = \frac{d_{ij}}{c_{ij}}\left(\sum_{l=1}^{c_{ij}}\sum_{m=1}^{3} a_{ijl}\left(\sum_{n=1}^{b_{ijlm}} Y_{ijklmn}\Big/ b_{ijlm}\right)\right)$$

where

i month

j gear

k resource

l landing centre day

m session

n boat observed

$Y_{ijk..}$ Estimated landings

a_{ijl} # boats landed

b_{ijlm} # boats observed

c_{ij} #landing centre days in the month

From this it can be derived that the total of the selected landing centre day can be given as

$$Y_{i..l..} = \sum_{m=1}^{3} a_{ijl} \left(\sum_{n=1}^{b_{ijlm}} Y_{ijklmn} / b_{ijlm} \right) \dots\dots$$

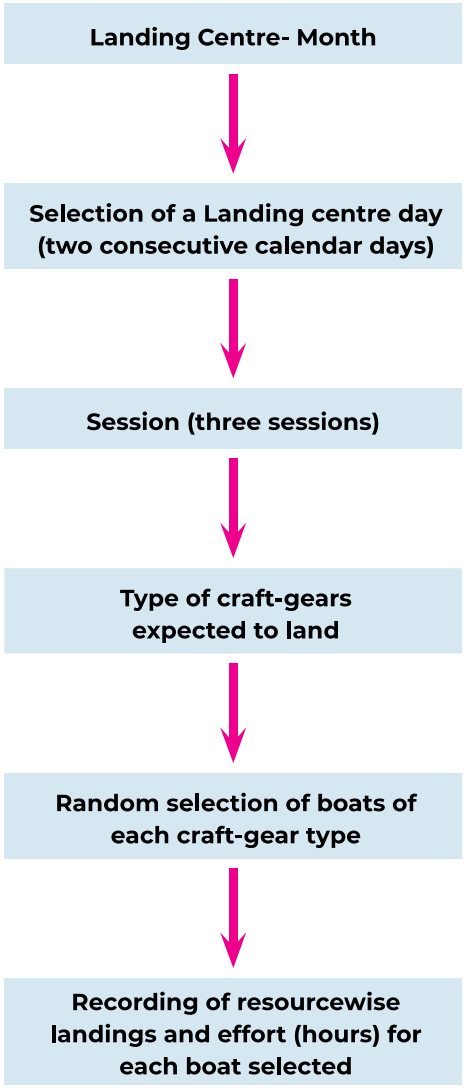


Fig. 1 Sample survey flow

App and software development – 'Enmeen'

The ASCII format based analysis and storage was in vogue in CMFRI till 2017. The reasons are basically two fold, ease of use and storage and amenability to computational rigours without taxing on the machines' memory, which are narrated subsequently. ASCII (American Standard Code for Information Interchange) is the most common format for text files in computers and is the traditional name for the encoding system. The fishery data were collected by FRAD CMFRI survey staff based on their work programme and the survey staff used submitted their data in data sheet manually filled as per various gear/ craft templates.

The traditional method of data entry and analysis work have many disadvantages. The data sheets has to be sent by post and are prone to delay. After coding and verification of data, a data validation is done manually. To overcome the tardy and arduous process of data entry and data analysis, ICAR-CMFRI found new modern trending method i.e. data entry app, data stored in data base format in the dedicated server and data analysis using user friendly interface. Digital forms are electronic versions of paper forms that can be filled out on a electronic tablet have advantages over traditional paper forms because it allows businesses to collect data and obtain results in a swift and accurate manner. For data entry App 'Enmeen" has been developed and released in April 2018. The EnMeen - *எண்மீன்* app, has been developed for data entry through electronic tab and collected data will be sent to the server immediately for further analysis and the app has the following features. The App has dual advantages of data collection and data digitalization with single effort. The names of landing centre, craft and gear are selected by drop-down menu which will minimize the data entry typographical vagaries. Duration of absence will be calculated automatically by giving departure and arrival time. The input data is already validated when it is entered. The App has efficiency of real time data entry validation and increased process efficiency and speed.

A Dashboard provides central location for users to access, interact and analyse up-to-date information so they can make smarter, data-driven decisions. Dashboard enables to monitor and measure performance and metrics in real-time and on the go in a single glimpse.

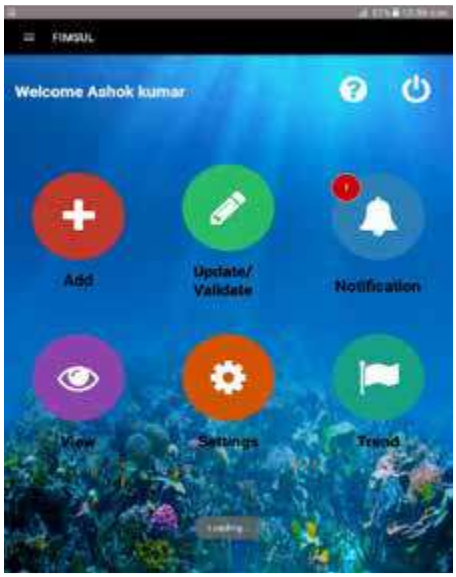


Fig. 2 EnMeen Dashboard

Data base and Server

The data stored in the server by My-SQL format and MySQL is an Oracle-backed open source relational database management system (RDBMS) based on Structured Query Language (SQL). Although it can be used in a wide range of applications, MySQL is most often associated with web applications and online publishing. In MySQL, schema is synonymous with database... Logical structure can be used by the schema to store data while memory component can be used by the database to store data. Also, a schema is collection of tables while a database is a collection of schema.

WAMP Report Interface

Data analysis and reports task are performed by WAMP middleware. WampServer is a Web development platform on Windows that allows one to create dynamic Web applications with Apache2, PHP and MySQL. Wamp Server automatically installs everything you need to intuitively develop Web applications. One would be able to tune your server without even touching its setting files.

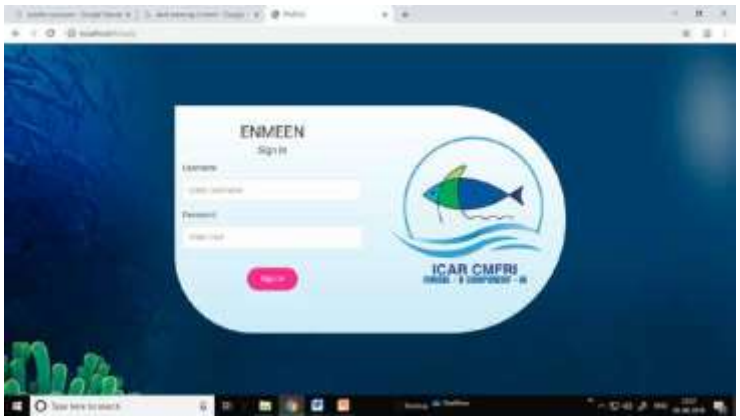


Fig. 3 EnMeen login page

The View option provides information on following sub titles as

a) Basic view gives information the datewise, centrewise of latest received data

b) Centre option gives centres names with code

c) Staff option gives particular survey staff submitted data

d) Message option list out received messages to the serv

Bumper Catch option used in rare occasion and used when unusual catch landed. Estimation is one of the prime process of data analysis. By selecting Month and Centre name a list of available data will be displayed. Here data analyst can estimate the catch for a particular month of a landing centre. Total number of days in the month and no of observation have to be give as input for estimation. The process of estimation needs for all the centres for a month total estimation.
Reports will be displayed on three types such as

i) Month-wise reports will be generated based on selected month

ii) Gear wise report will be generated by giving centre, Gear and Month names

iii) Monthwise, gearwise, centrewise and species report. In addition to that trend of fishery, delete and setting features too included.

Overall, the EnMeen app is user friendly and handy for data collection, entry, and report generation which saves time and is cost-effective for the organisation.

18. Digital Advisory Services in Agriculture

G. Bhaskar

Assistant Director (Selection Grade) (IT), MANAGE, Hyderabad

1 Introduction:

India is an agriculture based country, where more than 52% of population is dependent on Agriculture and Allied sector activities. The commitment of agribusiness in the national income in India is all the more, subsequently, it is said that Agriculture in India is a backbone for Indian Economy. In the changing globalization scenario farmers are shifting their focus from routine agricultural activities to high value commodities like fruits, vegetables, livestock, poultry and fisheries products. High value commodities account for a larger share of the total value of agricultural production in the market.

This situation demands for a strong extension delivery mechanism at field level. Over the years, man power and shortage of funds have adversely affected the performance of agricultural extension services in Government. The requirement of field level extension functionary is estimated to be about 6 lakhs, against which the present availability is only two lakh. Presently no state government provides required number of field level workers, as it is cost prohibitive. Extension is now becoming more diversified, technology intensive, knowledge oriented and more demand driven. This requires the extension functionary at the cutting edge level to be master of so many trades, which is neither predictable nor possible. In these situations use of Information Communication Technologies (ICT) in extension is the only way to enables the extension functionary to be more effective in meeting the information needs of the farmers and to speed up the extension process.

ICTs are playing a vital role in dissemination of the content generated by the experts to the farmers. The awareness and use of ICTs has increased in the farming community. The Central and State Governments have initiated a good number of ICT projects to provide the services to the farmers. NeGP-A has provided an ICT platform in terms of building hardware infrastructure, connectivity and content development to all the stake holders in the States. However, the lack of quality content and out-dated farmer's database, the reach of advisory services is not reaching to the targeted farmers. The advisory services are generic in nature. This kind of system makes less

involvement of Extension functionary to disseminate relevant local messages to the farmers.

Report on Evaluation & Impact Assessment Study of State Sector Scheme NeGP conducted by MANAGE indicated that all the Agro advisories given were useful to them as expressed by 47.2 per cent of the farmers. But the other respondents opined that half (26.2 percent) /few (15.7 percent) /very few (11 percent) messages sent were useful to them. 74 per cent of the agro advisories were given by extension officers and the Scientists from KVK and the university is 10.3 per cent and 0.3 per cent. For improving the quality of the messages involvement of the Scientists is crucial. 80 per cent of the advisories through SMS were focusing on Agriculture. The advisories covered in Horticulture (17.3 per cent), Animal Husbandry (1.8%), Fisheries (0.4 per cent), Marketing (0 per cent) and weather (0.4 per cent) were limited. This situation demands to develop the agro advisory messages on Animal Husbandry, Fisheries, Horticulture, marketing and weather etc

2.0 ICT Pilot Project

2.1 CCKN-IA Project

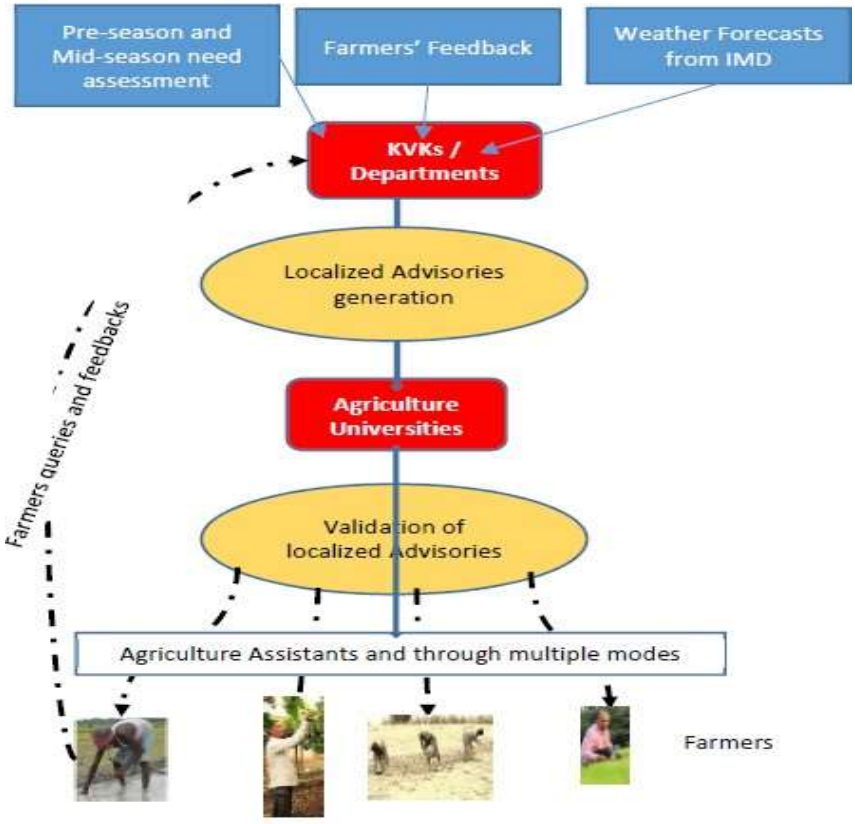
The National Institute of Agricultural Extension Management (MANAGE) was implemented an innovative project in selected villages of Odisha, Jharkahand and Maharashtra states, in technical collaboration with the German Development Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH) – called Climate Change Knowledge Network in Indian Agriculture (CCKN-IA). The CCKN-IA project supports farmers to better adapt to the vagaries of climate change through an innovative ICT enabled solution providing timely and quality advisories to farmers. The ICT system also enables a two-way communication wherein feedback, local needs and queries of farmers help in an iterative process of refining and localizing the advisories. This approach provides effective and efficient processes for both - better and timely adaptation to climate variations as well as preparedness and risk reduction during contingency situations. This knowledge network is supported by national and state institutions and is led by MANAGE as a national partner for managing the network. The CCKN-IA project has been operational since September, 2013. Based on the findings the project developed an innovative ICT based platform for exchange of knowledge around climate change adaptation in agriculture. This was followed by establishing institutions and processes for effective knowledge networking

between stakeholders through optimal use of ICT approaches.

The project interventions are built on four pillars:

1. Capacity building of knowledge providers: improving the knowledge integration and development processes
2. Strengthening the capacities of extension systems
3. Establishing facilitating institutions and processes
4. Enhancing adaptive capacities of farmers

The process of agro advisories given in CCKN-IA has created a considerable impact on the income of the farmers in the project implemented area with the following Knowledge Management Process.



Knowledge Management process under CCKN-IA

2.2 Pro-SOIL Project

In India, the "Soil Protection and Rehabilitation for Food Security in India (Pro SOIL)" is integrated into the Natural Resource Management Portfolio of GIZ. The project is being

covered in the five districts of Maharashtra (Ahmednagar, Amravati, Dhule, Jalna and Yavatmal) and two districts of Madhya Pradesh (Balaghat and Mandla). Three NGOs, BAIF Research Development Foundation, Watershed Organization Trust (WOTR) and Foundation for Ecological Security (FES) are building the capacities of smallholder farmers to protect and rehabilitate their soils and to invest in soil fertility management. The advisory services provided directly to farmers. These advisory services will include recommendations regarding the selection of crops and fertilizer recommendations, among others.

As the National Consortium Facilitating Agency (NCFA), MANAGE facilitates the network approach envisaged under the pro-SOIL collaboration through capacity building support, technical guidance and overall network management at national as well as state levels (through the network of state level Consortium Facilitating Agencies - CFA). The objective is to generate regular advisory service to the farmers by the lT-platform "**Network for information on Climate (EX) change (NICE)".**

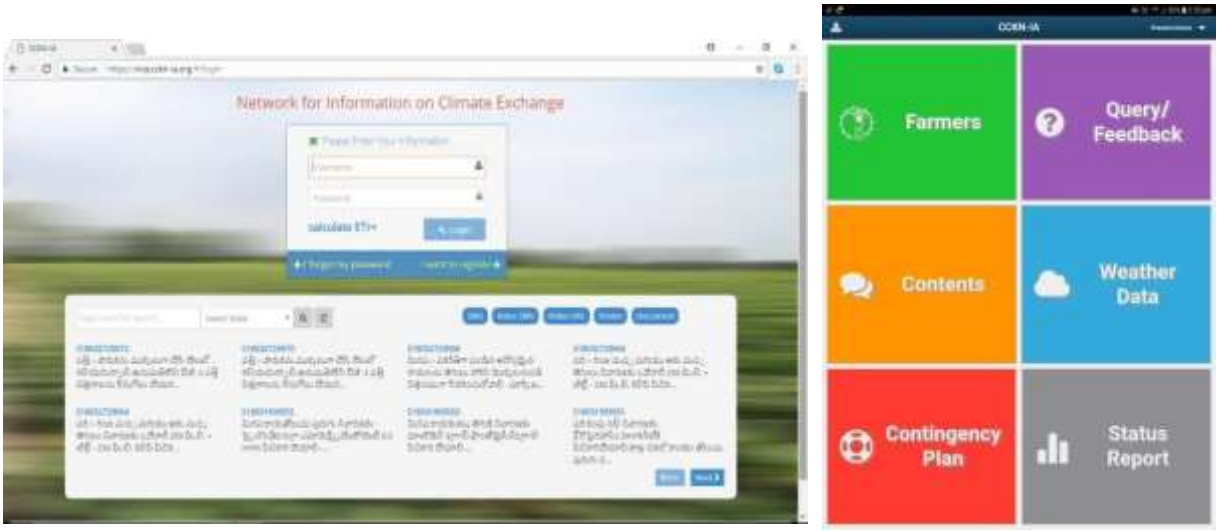
3.0 NICE SOFTWARE:

The Network for information on Climate (EX) change (NICE) is a web-based open source platform, allows multimodal approach and enables a two-way communication to link farmers' needs to knowledge experts on a real time basis. The farmers receive the advisories through SMS, field agents also use tablets to disseminate advisories to farmers thereby creating a more personal link. NICE has some remarkable features for successful collation, validation and dissemination of advisory information. The modular structure of NICE allows a peer-review mechanism from content aggregation, expert validation and subsequent translation and dissemination of the content. Finally the content created on NICE will be disseminated to the farmers. The NICE system has facility to capture the farmer's basic and socio-economic details including, land details, crops grown for the season etc.

Using NICE system, the expert can send advisory to the farmers in multi-model approach i.e. not only in the form SMS and also Posters, Video URL, documents etc. The content other than SMS will be delivered to the Tablet of Field Agents. This content is further disseminated to the farmers by the Field Agents in the village. The farmer will get timely, authentic advisory messages and the content is generated based on their local needs i.e. fully localized content will

be generated by the experts. Thus helps the farmers to adopt the advisories sent by the experts. The field agents also play an important role in disseminating the advisories to the farmers using mobile app on TAB. The posters, video URL, and documents will help the farmers to know more details of the advisory.

The key players involved in content generation, validation and dissemination process are State University Scientists, KVK scientists, and field functionary. The feedback on field level functionary will be assessed and based on the need and requirement, the content will generated by the KVK subject matter experts. The generated content will be validated by the university scientists of the same knowledge domain division and approves the content. The validated content will be disseminated to the farmers and field agents in the form of SMS service. The farmer queries, which are received from the field agents for specific farmer or entire village, will be taken up the subject expert and resolve the query. The resolved query advises will be sent to farmer and also to the field agents.

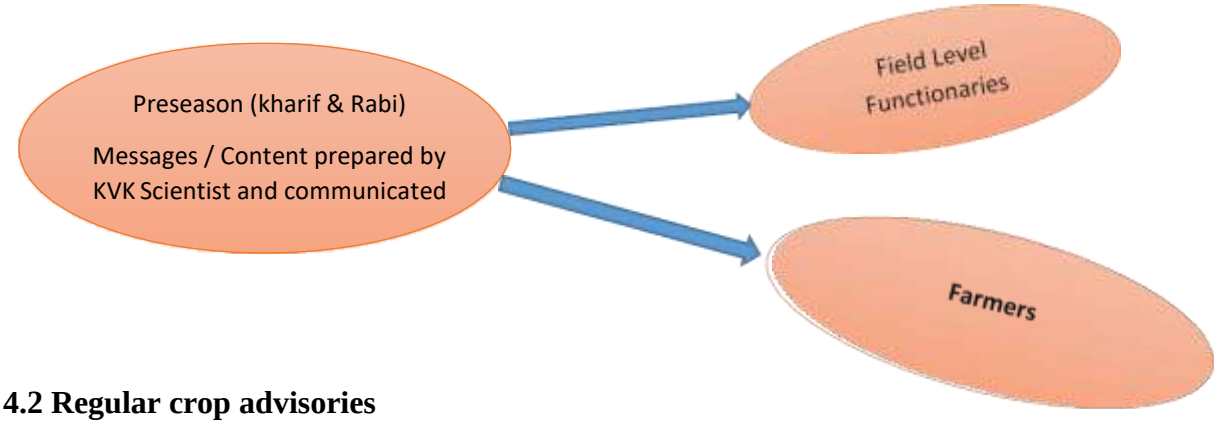


NICE Software and Mobile App.

4.0 Strengthening of present extension system with NICE System.

4.1 Pre-Seasonal Advisories

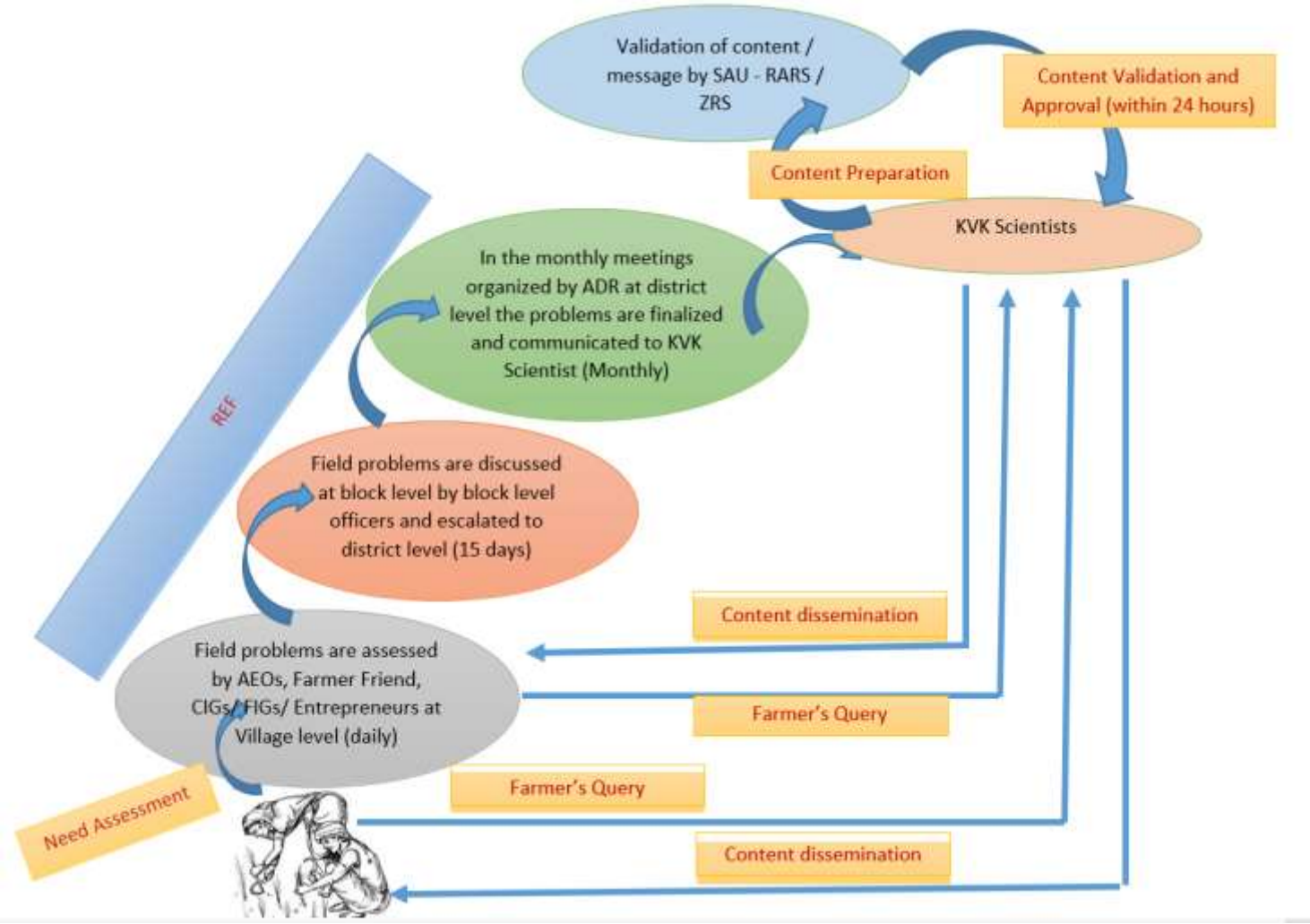
In the existing Research- Extension - Farmers (REF) linkages, the pre-seasonal work-shops are held at district level and State level wherein the University scientists, ICAR and other institutions and officers of the State Department of Agriculture participate to thoroughly discuss the production program for the districts. Based on the recommendations of the REAC and ZREAC meetings the content messages are decided and communicated to the farmers through the district extension mechanism. This manual system consumes more time and cost and less effective in reaching to the farmers. To overcome these limitations NICE can be utilised for more effective and faster dissemination through short message services (SMS), Video URL and posters. The designated KVK scientists will prepare the content and disseminate to the field level extension functionaries and also the farmers directly.



4.2 Regular crop advisories

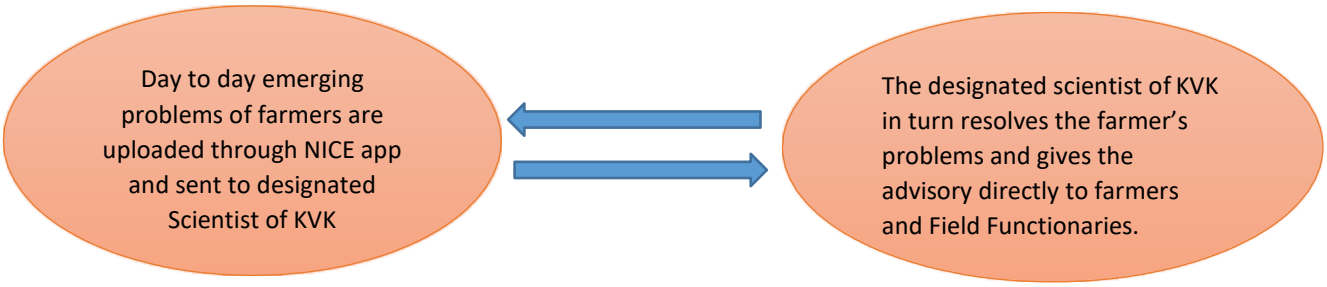
In the existing system, the village level extension functionaries (AEOs) have a fair understanding and knowledge about the local situations and problems of the farmers. Based on their understanding and requirements of farmers, the field level functionaries identifies the problems of farmers. These identified problems/ queries are communicated to Block level officers. The problems/queries are discussed in the **fortnightly meetings (15 days)** of the block level officers at the block level. The problems/ queries are then escalated and discussed in the monthly meetings at District level, organized at RARS or ARS or KVK by Associate Director of Research (ADR) of State Agricultural University. The outcomes are directed to the KVK designated scientists to prepare the content / messages. KVK scientists in turn prepares the content / message advisory through SMSs, Video URLs, Posters, etc) and sends to SAU scientist for validation with the help of NICE system. This validated advisory content by SAU scientists will be disseminated to the field level functionary and farmers

Process flow of Need Assessment, Content Generation, Validation and Quality Advisory Dissemination to Farmers



4.3 Day-to-day Emerging Farmer's queries

The NICE system has a facility to address the day-to-day emerging problems of farmers immediately. The farmers or field level functionary, can upload the field problems using NICE mobile app, directly to KVK designated scientist. The designated scientists of KVK or University will resolve farmers' problem and directly sends advisory to the farmers or field level extension functionaries. The advisory can be viewed on the mobile app by farmers and /field level extension functionary at village.



The above process has been pilot tested in the project areas of CCKN-IA and also at present in ProSoil project selected villages of Maharashtra and Madhya Pradesh. The scientists were involved from SAUs and KVKs of Maharashtra – MPKV, Rahuri, MAU, Parbhani and PDKV, Akola region and JNKVV from Madhya Pradesh region. The results are encouraging in disseminating quality, validated advisories to the farmers. This model can be extended to the all the district of both states.

5.0 Integrating NICE system with ATMA Extension System

The Ministry of Agriculture, Government of India piloted initially the Agricultural Technology Management Agency (ATMA) extension model in the few states. The ATMA extension model is a parallel structure to the department of agriculture established in all the district for specially strengthen the extension services in the district, below and village level. In this model the ATMA staff works in collaboration with Krishi Vigyan Kendra"s (KVKs) and State Agriculture Universities (SAUs) for providing quality advisory services by addressing location specific problems of block and village level farmers. The ATMA extension model has been part of a scheme called Scheme "Support to State Extension Programmes for Extension Reforms". The main objective is that disseminating technology to farmers through new institutional arrangements. Later this scheme has been opoerationalised in 639 districts under NMAET in 2014.

Under NMAET ATMA will function as an autonomous institution set up at district level with a Governing Board is the apex body, which provides overall policy direction.to ensure delivery of extension services to farmers. ATMA Management Committee is the executive body looking after implementation of the scheme with various committees at district and block level.

5.1 District level

Each district in the state, ATMA offices are placed for better coordination of extension services at district and below district level. Under ATMA system, District Farmers Advisory Committee (DAC) is also available to work on strategic planning and implementation of extension services in the district. ATMA is headed by a senior level officer from the department on regular or deputation basis and supported by the staff working in the ATMA. The chairman of the ATMA, is the district collector, who monitors the all the activities of ATMA. The ATMA body will be responsible for taking feedback of the DAC and officials from all the line departments for preparing and implementing Strategic Research and Extension Plan (SREP) of the district.

5.2 Block Level

Under ATMA system, a Block Farmers‟ Advisory Committee (BFAC) are placed at each block. The BFAC is a group of selected farmers from the same block, who will prepare the Block level Action Plan (BAP) in consultation with Block Technology Team (BTT). The BTT is a extension structure formed under ATMA system with a team comprising officers of agriculture and other allied departments within the block. The Block level Action Plan will provide necessary extension support to farmers of the block.

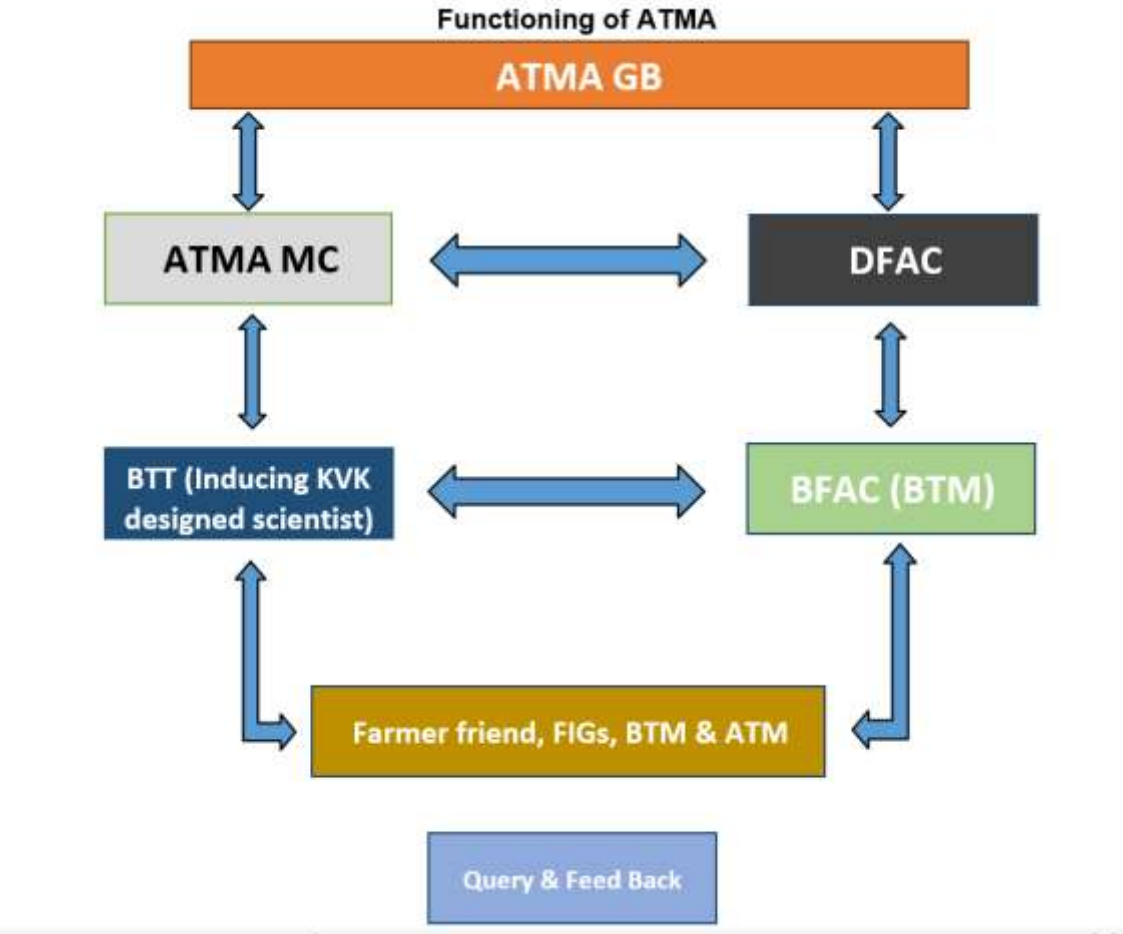
The BTM as a Member Secretary in BFAC will brief all the issues discussed in BFAC meeting to BTT at the time of monthly meeting. The designated Scientist from KVK in BTT will provide the technical guidance in preparation of the content with the support of BTT members. DFAC chairman, PD ATMA will coordinate with PC, KVK with regard to the crop advisories and brief the Management committee ATMA. ZRS will validate the messages given by the KVKs because of their research background and as a member in ATMA management committee.

5.3 Village Level

1. The **Farmer Friend (FF)** will serve as a vital link between extension system and farmers at village level (one FF for every two villages).
2. **Agri-entrepreneurs, Diploma holders in Agricultural Extension Services for Input Dealers (DAESI), Input Dealers and extension workers in non- governmental sector**

will supplement the efforts of extension functionaries.

3. **Commodity Interest Groups (CIGs), Farmer Interest Groups (FIGs) and Food Security Groups (FSGs)** will serve as a nodal point for information & technology dissemination among its members.



The key success factors of NICE software implementation in Pro-SOIL is as follows:

1. Convergence between all the stake holders such as SAU scientists, KVK scientists, field functionary and farmers.
2. The quality advisory services, localized and timely content in local language sent to the farmers and field agents.
3. Multi-model content delivery SMS, Posters, Video URLs and documents etc.
4. Farmers feedback and query resolving by Subject Expert at SAU / KVKs (two- way

communication with farmer and Subject Expert for problem solving)

5. The NICE system has facility to capture the farmer's basic and socio-economic details including, land details, crops grown for the season

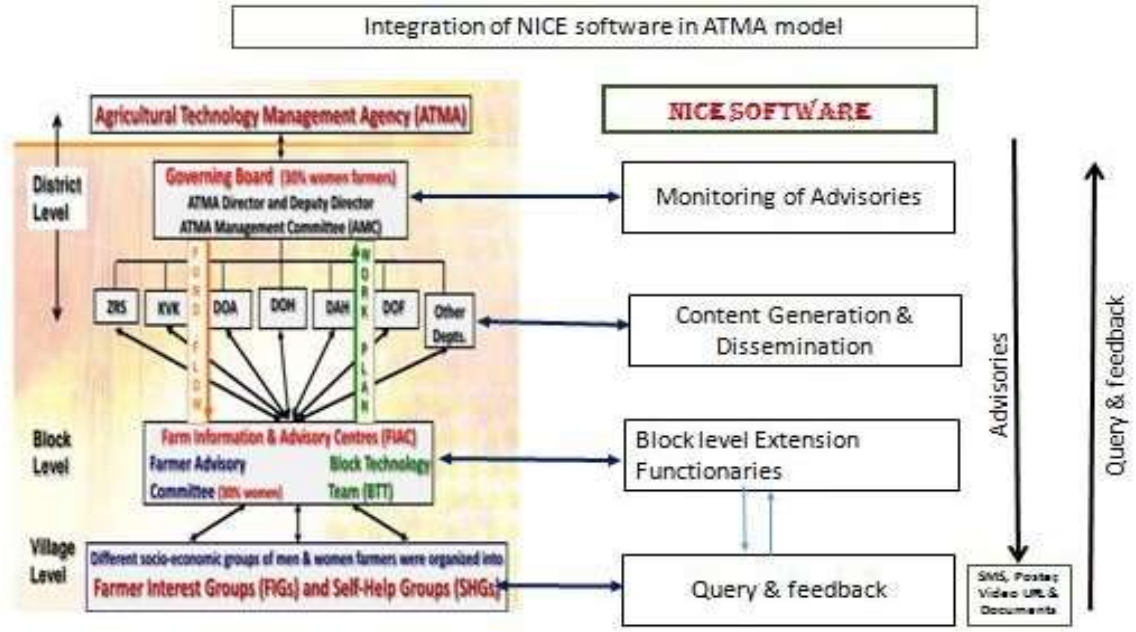
The above success factors, NICE system can be streamlined to fit in to the present Agricultural Extension System in the district. The present extension functionary working at Block level and below Block level have a detailed knowledge about the local situation problems of farmers. The Block level extension functionary of Agriculture and line departments can assess the local problems and submit to the scientists of KVK for SMS content preparation for farmers. The scientists working at KVK district level, can generate the content in the form of SMS, posters, Video URLs etc and further communicates to the domain experts / scientists of Agriculture University (RARS/ZRS etc). The domain experts / scientists working in Agriculture University validates the content generated by KVK scientists, approves the content and send back to the KVK scientists. The KVK scientists will disseminate the content (SMS, Posters and Video URLs) to the block level extension functionary and also to farmers.

At district level, the Joint Director / District Agriculture Officer will acts as nodal officer to coordinate with extension functionary, KVK scientists and domain experts of Agriculture University and convene a fortnight meeting to assess the local problems of farmers, advisory generation, validation, approval and dissemination of advisory to the farmers. As such the convergence between all the stake holders such as field functionary of agriculture and line departments, KVK scientists, SAU scientists, and farmers is achieved.

The above success factors of NICE can be integrated with ATMA model for effective delivery of advisory services to the farmers. The existing Farmer Advisory Committee (FAC) and the Block Technology Team at Block level can access the field level situation and prepare the content required for the local farmers. The Block Technology Team (Technical officers at block level) along with KVKs (Scientists) can formulate messages required for that season and get validated from the domain expert from the University / ZRS and finally sent to the relevant

farmers in time and in local language. For the purpose, a Coordination Committee at district level to see the quality of the content is required which will be taken care by the ATMA Management Committee (AMC) i.e., "Content Coordination Committee", since AMC is a core committee of the district heads of agriculture and line departments. Further, the ATMA Governing Board (GB) consisting of District Collector/ Magistrate as chairman, heads of Agriculture and line department, P.C KVK, Scientists representing the Agricultural Research Stations and District Farmers Advisory committee (DFAC) as members will act as the decision making body to supervise and monitor the advisory services to the farmers. As such the convergence between all the stake holders such as SAU scientists, KVK scientists, field functionary and farmers is achieved.

The diagrammatic representation of integration of NICE system with ATMA model at the district level is as follows:



On integration of NICE system with ATMA at the district level will not only reduce the dependency on strength of grass root extension workers but also disseminates situation specific, validated relevant technical messages in local language is delivered to the farmers.

6.0 Conclusions

The quality, timely and location specific advisory services are very important to farmers for better cultivation of their crops. The inadequate services of present extension services should be supported by ICT platform like NICE System, which has been piloted in selected villages in two states with local SAUs and KVKs. The extension functionary with NICE System and scientists of SAUs and KVKs of local area definitely fulfill the huge gap exists in traditional advisory services to farmers.

7.0 References

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National Institute of Agricultural Extension Management (MANAGE)
Hyderabad

ICAR - Central Institute of Fisheries Technology
Cochin