11. ICT interventions in fisheries value chain

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Information has played an important role by adding value to all section of society since the dawn of civilization. For communicating information requires various digital technology and tools to reach the ultimate beneficiaries of the respective field. In the initial years use of ICT was limited to academic and research institutes along with costly to access. However, over time its reach has touched every stratum of society as it has become the most popular and cost-effective way of sharing knowledge and information. Information technology is also playing a significant role in the modernization and growth of the fishing industry. The world is undergoing an Information Communication Technology (ICT) revolution, a revolution that has enormous socio-economic implications for developed and developing countries. ICTs play a vital role by adding value to the entire Indian fisheries at each stage of fisheries supply chain starting from fish catching to reach the ultimate consumer. The latest ICT application will transform the fishermen's lifestyle as well as their livelihood activities mainly profit motive by reducing the labour and also reduce the vulnerability by timely getting of information which paving the way for social equity and ultimately uplifting fishermen to the mainstream.

It is vividly believed that ICT as a basic resource for development, several ICT tools used in fishing such as mobile phone, television, radio, GPS, fish finder, wireless communication at very high frequency (VHF), etc can bring significant changes in the fishermen livelihood and reduction in the level of poverty of different fishing communities (Kularatne, 1997). ICT plays an important role to linking the knowledge among all stakeholders such as researchers, fisheries officials, etc by improving the linkages between the researcher and clients. This will mainly save the cost, time, and energy of the fishermen especially through mobile used by the fishermen will provide the best price for their catch before being brought into the landing center. With the help of this technology, fishermen were moving farther into the deep sea getting better catch high-value fish. This will be highly helpful for the fishermen to decide the various constraints such as higher operational cost, more investment, the decline in the fish catch rate, fewer infrastructure facilities, and low profitability. All these factors are affecting the overall performance or fishing efficiency. Using ICT application in fisheries will be an advantage for the fishermen to reduce their operational cost as well as increase their quantity of catch. But the rural communities in developing countries like India still lack basic communication infrastructure was seen. Different initiatives in ICTs have been taken up which would also help in expanding and developing the fisheries technologies to the fisher communities.

Definition:

Information technology (IT) is the use of any computers, storage, networking and other physical devices, infrastructure, and processes to create, process, store, secure and exchange all forms of electronic data. Eg letter, Photograph, Digital sensor, GPS, satellite.

Communication: it acts as a medium to transfer information from one to another eg: the internet, mobile network, local and wide area network.

Information communication technologies (ICT). As per the definition of UNESCO "Diverse set of technological tools and resources used to transmit, store, create, share or exchange information". ICT are set of tools that assist to capturing, storage, processing, transmission and display of information by electronic mean of technologies. ICT play important role in sustainable development of fisheries sector by timely collection of essential information, processing them and distributing among various organizations.

ICT Technologies applied in the fisheries sector

There are various ICT tools were used by the marine fishermen to communicate and increase the fish catch such as What's up, Television, Radio, Mobile, Global Positioning System (GPS), GPRS, Echo sounder, Sound Navigation and Ranging (SONAR), Search and Rescue Transponder (SART), Automatic Identification System (AIS), Distress Alert Transponder (DAT), Internet-enabled PC, Radio Deduction and Ranging (RADAR), Community Radio, portal, Very High-frequency wireless sets (VHF).

Identity technologies used in the fisheries value chain:

- **Barcoding:** A barcode is a method of representing data in a visual, machine-readable form. Initially, barcodes represented data by varying the widths and spacings of parallel lines. These barcodes were used in the seafood products to ensure the authenticity and the origin of fish and other information such as price, product packed date etc.

- **Vessel tracking devices** - Vessel tracking devices such as the Pelagic Data Systems (PDS) tracker can be used to establish locations in which fish are caught and landed. These data can serve as part of a digital record of seafood provenance.

- **Supply chain tracking software** - Several software systems are now available for tracking fish through the supply chain to reduce fish fraud and reliably transmit information about the seafood to buyers. First, the fish must be labelled with a unique identifier. For high-value products, a QR code, barcode or NFC-enabled labels (small passive electronic disks that encode information and are activated by the magnetic fields produced by smartphones) might be required to ensure sufficient security. For other products, text messages or app input fields that include information on where the fish was caught, how it was caught, how it was handled, where it was landed and other information can be validated by trusted entities.

- **Sensors:** It is highly used in many equipment along the fisheries value chain and it is majorly used in the aquaculture farm and fish processing industries. Monitoring the

various water quality parameters and weather parameters of aquaculture farm using both wired as well as wireless sensor technology, embedded computing technology, MEMS technology (Micro-Electro-Mechanical Systems), distributing information processing technology and wireless communication technology to build the wireless network sensor network system. This system is a digital, networked, intelligent real-time dynamic for monitoring the aquaculture water quality. The system not only can deal with the normal detection of the aquaculture environment indicators (temperature, PH, dissolved oxygen, turbidity, ammonia, etc.) monitor in real-time.

- **Image processing:** Image processing-based technique used to find the freshness of the fish by capture segmentation of gill tissues from fish images. The segmented image of gills tissue is used for assessment of fish freshness, which is the most required property from the consumers because of its strong relationship to the taste and health. A number of sensorial inspection procedures have been introduced to point the state of freshness. These procedures involve the use of sight (to evaluate the skin appearance and the color and the global aspect of eyes).

- **Data management:** Web-based Seafood export management software system that simplifies and helps you in a smarter way to increase your business productivity and profitability for data storing and easy access at anywhere and any point of time. Along the fisheries supply chain, inventory could operate in multiple warehouse locations. It calculates the true yield and margin on everything you cut and meeting the unique challenges of weight, products where yields, collection hub, product accounting, settlement processing, catch weight, multiple freezer/warehouse and Shipment.

- **Server Side:** Web server, Search Engines

- **Clients side:** Browsers, Apps

- **Cloud:** Google Drive, iCloud, Dropbox, Skydrive

- **Access Devices:** Desktop, Laptop, Tablet, smartphone.

Identity management:

AIS (Automatic Identification System)

The Shipborne Automatic Identification System (AIS) is a vessel tracking system capable of communicating navigation information automatically between AIS-equipped vessels and coastal authorities. It is a collision-avoidance system that gives information on all the ships in your area, their speed and courses and how to contact them (name, callsign, MMSI). This information is publicly broadcast on VHF radio which can be picked up either by other ships or by shore-based receivers. The main purpose is to improve the safety of navigation by assisting in the efficient navigation of the ship, protection of the environment, and operation of Vessel Traffic Services (VTS), by satisfying the following functional requirements:

- in a ship-to-ship mode for collision avoidance,

- as a means for littoral States to obtain information about a ship and its cargo and

- as a VTS tool, i.e. ship-to-shore (traffic management).

Location recognition:

    a. **GPS (Global Positioning System)**

A network of satellites that continuously transmit coded information, which makes it possible to precisely identify locations on earth by measuring the distance from the satellites. As stated in the definition above, the satellites transmit very low power radio signals allowing anyone with a GPS receiver to determine their location on Earth. The advantage is that the global positioning system (GPS) enables the fishermen to plot a course to the potential fishing area. A fisherman can plot his course from any location by using stand-alone GPS, which can work without a mobile network.

    b. **Fish Finder:**

It provides valuable information to help you locate rich fishing grounds and boost your catch the Bottom Discrimination Function - Analyze bottom structure Configurable Alarm function (depth, fish echoes, etc.) Post-processing Gain Control applied to all echoes displayed on the screen Share and display information on a chart plotter.

    c. **Very High-frequency wireless sets (VHF)**

VHF has been retained for short-distance communications but the range is limited under normal circumstances to less than 20 nm. VHF channels at sea especially the distress, safety and calling Channels 16 (156.8 MHz) and 70 (156.525 MHz).

Application of ICT solutions in the fisheries value chain:
Advisories:

    a. **Indian Marine Fishery Advisory System: Dissemination of PFZ Advisories:**

SMS, IVRS, Helplines, Voice Messages, Information Kiosks, etc. through Location-Based, New Generation E.D. Boards, Doordarshan, E.D. Boards, News Papers, Emails, Website with Web GIS Facility, Phones & Faxes.

    b. **Web-based Dissemination**

Unique website for multi-lingual advisories. Provides information in eight local languages (Gujarati, Marathi, Kannada, Malayalam, Tamil, Telugu, Oriya, Bengali) as well as in Hindi and English. Web GIS Facility without any commercial package installation. Retrieve PFZ information about any area in the Indian EEZ of their interest by doing simple GIS operations.

    c. **Mobile phone**

Using mobile phones, fishermen can keep themselves up to date about prices and quality of fish in surrounding markets which ultimately enhance their income (Jensen, 2007). In addition, mobile phones have provided easy access to the fishermen to search for the best prices for their catches in different markets (Evoh, 2009). Mobile phone penetration in rural India has revolutionized information access as also connectivity between people, the mobile phones not only have provided information concerning market information to the fishermen but also have facilitated weather. Mobile phones allow fishermen to avoid potential losses to boats and nets as well as risks to personal safety. Emergency and safety benefits were consistently described

as the most important impacts on their life (Mittal, & Tripathi, 2009). It has been also observed that coastal fishermen used to get information weather condition through SMS about the before entering into the sea.

**PFZ Advisory mobile application:**
Potential Fishing Zone (PFZ) advisories useful to fishermen along the coastal areas. It also provides daily advisories to fisherfolk about the presence of chlorophyll, sea temperature, water clarity and helps them easily locate areas of abundant fish in the ocean while saving on both fuel and time used to search for the same.

mKRISHI mobile application:
mKRISHI® Fisheries is a mobile app developed by Tata Consultancy Services (TCS) Innovation Lab – Mumbai, in collaboration with ICAR- Central Marine Fisheries Research Institute and Indian National Centre for Ocean Information Services (INCOIS) Hyderabad. This app is a result of multi-dimensional research and fieldwork involving the best of the expertise of all the partner organizations. INCOIS generates Potential Fishing Zone (PFZ), a fish shoals prediction information based on the remote sensing data received from NOAA satellites, sea surface temperature and the presence of phytoplankton which form the food of several fish species. mKRISHI® Fisheries app consolidates this information and presents advisories in a local language.

CIFT Lab Test mobile application
ICAR- Central Institute of Fisheries Technology, Cochin, an ISO 9001: 2008 certified organization has been recognized as a National Referral Laboratory for Fish and Fishery Products by Food Safety and Standards Authority of India (FSSAI) under the Ministry of Health and Family Welfare, Government of India.
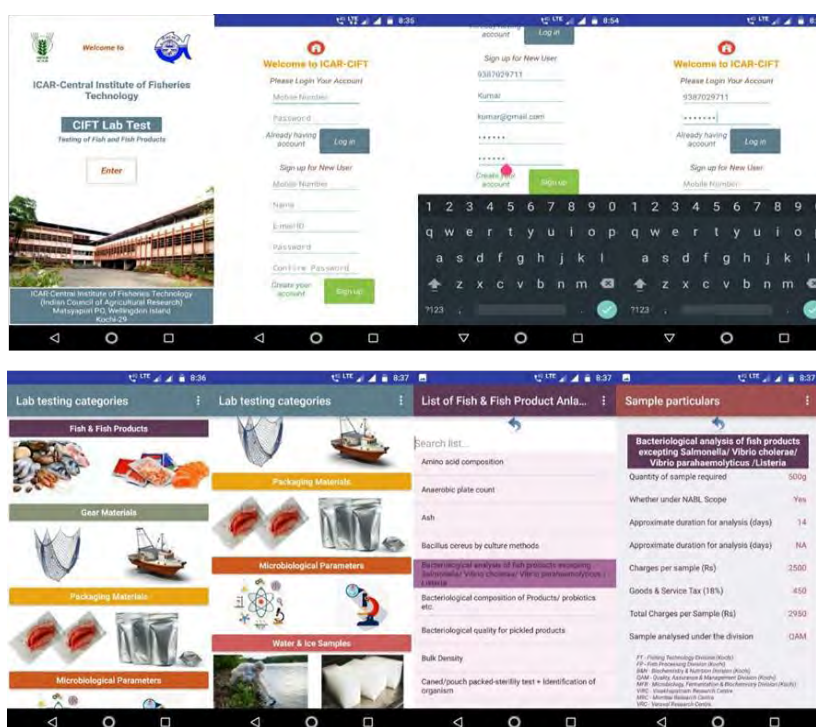
ICAR-CIFT has developed an innovative Mobile Application christened as "CIFT Lab Test" intended for providing information related to different types of sample testing and analysis of various fish and fish-based products, fishing gear materials, packaging materials, microbiological parameters, quality parameters of ice and water samples etc. This Mobile App may be useful for the aquaculture farmers, processing industries and other stakeholders in the sector to access the contents of different lab tests as per their interest online and get the desired information on the quantity of sample required, the time required for test report and cost particulars etc. available at 24X7 times.

CIFTraining mobile application

ICAR-Central Institute of Fisheries Technology, Cochin has developed an innovative Mobile Application christened as "CIFTraining" that provides a complete package of information on ICAR-CIFT Training programs. This App is highly useful for the fisheries students, researchers, industry personnel, state extension personnel, fisheries-based entrepreneurs, fishers and other stakeholders in the sector to access the 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 Extension & Economics.
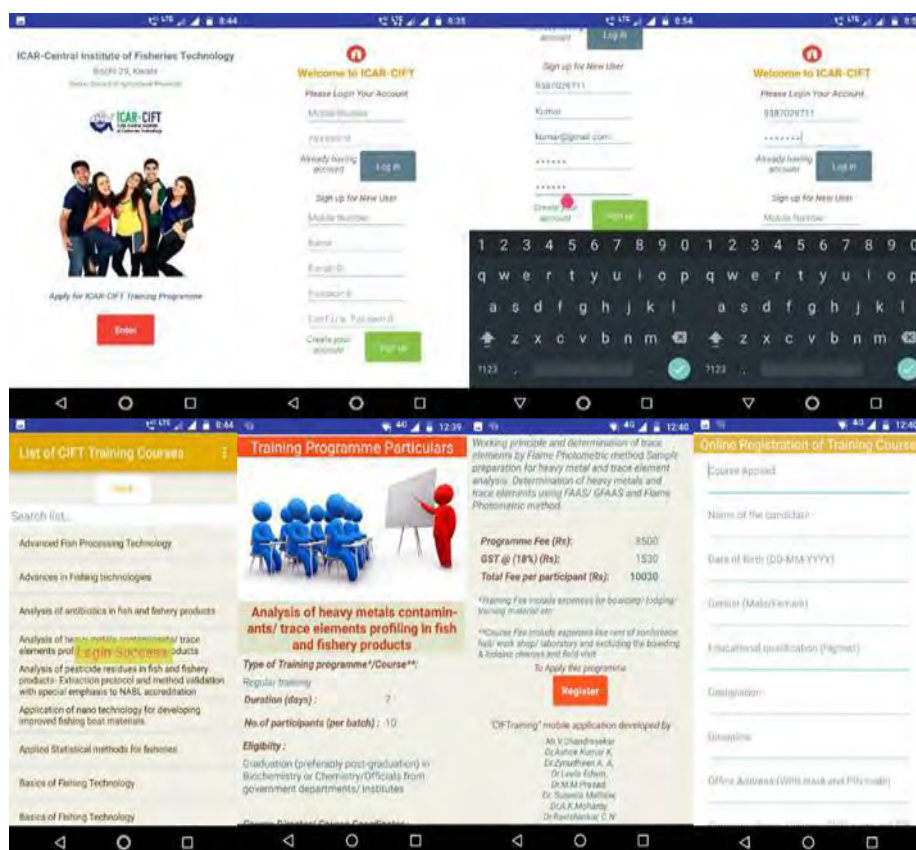
The "CIFTraining" Mobile App has embedded with a total list of 68 types of clientele-based training programs available in ICAR-CIFT, which contain 60 regular training courses along with 2 comprehensives, 3 specialized and 3 certified courses covering the themes of seven

divisions. The "CIFTraining" mobile app will help the stakeholders to search the training of their interest and see the training program details like course contents, course fee, duration, eligibility and other facilities at their fingertips so that the right stakeholder can opt for the right training program for improving the technical knowledge and skill in the concerned field. Finally applying for the training program through online registration mode.

Fisher Friend Mobile Application
Developed on Android mobile platform which supports English, Tamil, Telugu, Odia and Malayalam languages

FFMA provides following facilities to fisher folks:
- Potential Fishing Zone
- GPS facility
- International Border Line Alert
- Ocean State Forecast
- Disaster Alert
- Weather Forecast
- Government Schemes
- Market Information
- News
- Important Contacts

E-Commerce in fishery
www.marinefishsales.com is developed under the NICRA project of ICAR-CMFRI as innovative multi-vendor e-commerce. The platform is made available as an android application for mobile phones to facilitate direct sales between fisherfolk and the customers. The app envisions reasonable prices as a direct sale between fishermen/farmer to consumer is facilitated.

Daily fish: The voyage of your 'Daily Fish' from 'catch' to 'kitchen' has never been so world-class. Daily Fish, the online seafood store serves you ready-to-cook seafood that is 'As good as Live' with all the goodness of nutrients stored in it. This is in step with the vision of Baby Marine; promoters of Daily Fish and one of the leading exporters of marine products from India to Europe, the US, South America, Japan, South East Asia, Gulf, South Africa and Australia for over four decades.

Decision support system:
A decision support system (DSS) is a computer-based application that collects, organizes and analyses business data to facilitate quality business decision-making for management, operations and planning along the fisheries value chain. A well-designed DSS aids decision-makers in compiling a variety of data from many sources: raw data, documents, personal knowledge from employees, management, executives and business models. DSS analysis helps companies to identify and solve problems and farm level make decisions.

Types of Decision Support Systems (DSS)
These can be categorized into five types: Communication-driven, data-driven DSS, document-driven DSS, knowledge-driven DSS and model-driven DSS. For example, Aqua manager is a comprehensive, integrated software solution for improved efficiency in aquaculture industries.

It is a complete fish farming software that supports all stages of fish production, from hatchery to harvest.

Expert Systems

Expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise. Development of Expert System for Shrimp Aquaculture (ESSHA) involved five steps viz., problem selection, knowledge acquisition, knowledge representation, system design and development as well as system validation (Zetian et al., 2005).

Expert Systems in Fisheries Sector:

Expert systems are rapidly becoming an integral part of applications in several domains ranging from traditional manufacturing processes to applications in outer space. Expert systems have been shown to improve traditional approaches by as much as an order of magnitude. There are several areas, including fisheries and aquaculture, in which the return on investment in an expert system can be tremendous.

Social networking:

The penetration of the internet and subsequent usage of social media, especially among the youth is increasing day by day. In this context, a study was conducted to identify the internet and social media usage by students as well as their mode of accessing professional (fisheries) information through social media. social media has been classified into two types, namely social networking sites, and Instant messaging applications based on both form and content of the media.

Social Networking Sites	Instant Messaging Applications
Instagram	WhatsApp
Twitter	FB Messenger
Pinterest	Yahoo Messenger
Google plus	Skype
Google groups	Google Hangouts
Research Gate	IMO
Google Scholar	Snap Chat
Wikipedia	Viber
Facebook	Hike
YouTube	Telegram
LinkedIn	We Chat
Bharat Student	

The Department of Fisheries through the following agencies serves fisheries sector:
Information source exposure: Seminar, workshop, Training programme, scientific books/ Literature, Fisheries related magazine and other publications, radio programme, Television programme, Exhibition, Newsletter, Mobile help line communication, Newspaper, NGOs and others,

Fisheries related government organisation:
    a. Fisheries Department
- Kerala State Cooperative Federation for Fisheries development Ltd (Matsyafed), http://www.matsyafed.in/
- Agency for Development of Aquaculture, Kerala (ADAK),
- Kerala Fishermen's Welfare Fund (KFWEB),
- State Fisheries Resource Management Society (FIRMA),
- Fish Farmers Development Agency (FFDA),
- Kerala State Coastal Area Development Corporation (KSCADC),
- National Institute of Fisheries Administration and Management (NIFAM),
- Society for Assistance to fisherwomen (SAF)
- Kerala Aqua ventures international limited (KAVIL)

    b. MPEDA, Fisheries Colleges, Research institutes
    c. KVK, ATIC, AFCA, CIFNET, CIFT, NGO

Mass media:
Newspaper, Magazine, Newsletter, Farm Journals, Periodicals, Exhibitions, TV, Radio, Internet, Video lessons.

Social organization:
Village panchayat, Co-operative credit, Co-operative group, Fisheries co-operative society, Fishermen Association, Community organization, Harbour mechanized boat association.

Initiatives in Fisheries Sector and aquaculture in India (CIBA, 2012)
Aquaculture is a technology-driven farming enterprise and aqua farmers are looking for quality information in time at an affordable cost. ICT aided tools like e-learning courses, publications, compact discs, short films, mobile telephony, Phone in a program, information kiosks, expert systems and decision support systems have been developed and implemented on a limited scale as projects or programs. Some of the initiatives are mentioned below.
- E-learning courses on aquaculture
- The 'Phone- in' Programme (PiP)
- Technology dissemination through mobile phones
- Village/ Rural knowledge Centre
- Kisan Call Centre
- e-Sagu Aqua
- Aqua-Choupal
- e-TSA

➢ Decision Support Systems
➢ Farmer-friendly touch screen information kiosk on BMPs in shrimp culture
➢ One stop aqua shop
➢ Helpline

Latest technology used in the fisheries value chain
Blockchain technology in fisheries value chain
It is mainly used to addressing the traceability issue in seafood industries by integrate fish farmers and all stakeholders with blockchain solutions and gathering specific data on the environmental impact, feed, growth and fish health as these contribute as key factors when raising fish sustainably this traceability technology monitors the fish catch from water to plate.

• Transparent resourcing for marine conservation,
• Reducing pollution from plastics,
• Reducing slavery at sea
• Sustainable fisheries management.

Traceability:
Traceability is linked to the validity of seafood labels that boast about a product's sustainability, authenticity, location and other factors important to consumers. Providing a socially responsible product can translate to higher profit margins, enhanced customer loyalty, and improved brand reputation. Suppliers are under increased pressure from consumers and retailers to provide traceability for their products. Traceability is seen as a way to soothe such worries. Traceability technology can mitigate risks and limit the impact of public health incidents. A unique ID code for fisheries and its application in traceability and data-sharing. The unique codes for fisheries maintained as part of the Global Record for Stocks and Fisheries (GRSF) will save time and money for the seafood supply chain, traceability/technology companies, governments, and non-governmental organizations (NGOs).

**IoT: Smart aquaculture farming enhance the value chain.**
IoT make a tremendous change in both monitoring and automation of highly helpful to aquaculture sector to operate remotely anywhere in the world. It is useful to know the real-time water parameter of pond such as dissolved oxygen (DO), Temperature, pH, and water level. micro controller development kit such as Arduino, Raspberry Pi, ESP etc. It will generate big data consciously in a frequent interval which will be send to the cloud storage, which will be processed and accessed through web portal or mobile application.
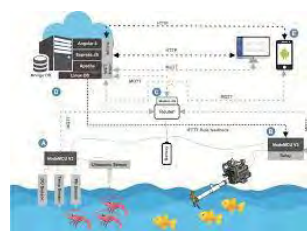
Artificial Intelligence in Fisheries
Artificial Intelligence (AI) by definition means 'the future made from the pieces of past'. These are programs that learn new solutions through experience. AI has been implemented in a variety of fields starting from agriculture to complete automation in industries. Through AI, fisheries sector can develop rapidly and production can be quadrupled within a short period as it makes aquaculture a less labour-intensive field. It can take form of any labourers at work for example

feeders, water quality control, harvesting, processing etc. In aquaculture feed costs itself nearly 60% of the total operation expenditure so reduce feed wastage increase profitability and also maintain water quality. AI programmed drones equipped with sensors can collect and analyze water quality data such as turbidity, temperature, dissolved oxygen.
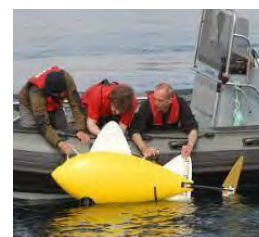
AI in Fish Processing industries: Cutting, filleting or cleaning the products can be done through programmed AI robots with much accuracy towards size, shape and hygiene. Quality control and grading can be done through AI programs equipped with visual image sensors and cameras. After grading, the processed foods can even be packed and transported through AI robots. This makes zero labour cost and needs no human supervision.

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