APPLICATION OF ICT TOOLS IN FISHERIES

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Throughout history, information has played a pivotal role in enhancing the value of every facet of human society. To disseminate information effectively, various digital technologies and tools have become indispensable, reaching diverse segments of society. Initially, the adoption of Information and Communication Technology (ICT) was confined to academic and research institutions due to its high costs. However, over time, ICT has permeated all levels of society, emerging as the most accessible and cost-efficient means of sharing knowledge and information. At first glance, the connection between fishery and the realms of computers, the internet, and communication technology may seem tenuous. However, the fishing industry has witnessed a remarkable transformation driven by information technology, responding to economic, environmental, and regulatory pressures. These pressures have prompted substantial investments in ICT within the fishing sector, fostering sustainability, operational efficiency, and adaptability. In today's world, the Information Communication Technology (ICT) revolution has far-reaching socioeconomic consequences for both developed and developing nations. ICTs play a pivotal role in elevating the Indian fisheries industry at every stage of the supply chain, from catch to consumer. The application of the latest ICT tools promises to revolutionize the lives and livelihoods of fishermen, offering improved profitability, reduced labor, and timely access to critical information, thereby promoting social equity and mainstream integration. The fisheries sector is experiencing rapid expansion and evolution through ICTs. Technologies such as GPS, navigation devices, sonar, fish finders, and high-frequency wireless communication (VHF) have made significant contributions to marine fisheries. Numerous ICT initiatives have been launched to further expand and enhance fisheries technologies for fishing communities. ICT is widely recognized as a fundamental resource for development. Various ICT tools, including mobile phones, television, radio, GPS, and fish finders, have the potential to substantially improve the livelihoods of fishing communities and reduce poverty levels (Kularatne, 1997). ICT also plays a pivotal role in bridging knowledge gaps among stakeholders, fostering better collaboration between researchers, fisheries officials, and other relevant parties. This not only saves time and energy but also helps fishermen secure the best prices for their catches before reaching the landing center. With the aid of ICT, fishermen can venture farther into the deep sea to target high-

value fish, addressing challenges such as rising operational costs, increased investments, declining catch rates, limited infrastructure, and reduced profitability. By integrating ICT applications into fisheries, fishermen can cut operational expenses while boosting their catch quantities. However, it is important to note that rural communities in developing countries, like India, still face challenges related to basic communication infrastructure. In summary, this overview underscores the transformative potential of ICT in the fisheries industry. It highlights how ICT tools can enhance the lives of fishermen, improve profitability, and contribute to the sustainable development of fisheries, while acknowledging the existing communication infrastructure gaps in rural areas.

Definitions:

Information technology (IT) encompasses the utilization of various computing resources, storage systems, networking infrastructure, and physical devices to generate, process, store, safeguard, and exchange electronic data in multiple formats, including letters, photographs, digital sensors, GPS data, and satellite imagery.

Communication, a core function of IT, serves as a conduit for transmitting information from one entity to another, facilitated by technologies such as the internet, mobile networks, and both local and wide area networks.

Information communication technologies (ICT), as defined by UNESCO, encompass a diverse set of technological tools and resources employed to transmit, store, generate, share, or exchange information. ICT comprises a suite of tools that aid in capturing, storing, processing, transmitting, and displaying information through electronic technology means. In the context of the fisheries sector, ICT plays a pivotal role in supporting sustainability by enabling the timely collection, processing, and distribution of crucial information among various organizations.

ICT Technologies Applied in the Fisheries Sector:

In the marine fishing industry, various ICT tools have been adopted to enhance communication and increase fish catch. These tools include messaging applications like WhatsApp, television, radio, mobile phones, Global Positioning System (GPS), General Packet Radio Service (GPRS), echo sounders, Sound Navigation and Ranging (SONAR), Search and Rescue Transponders (SART), Automatic Identification Systems (AIS), Distress Alert Transponders (DAT), internet-enabled personal computers, radar systems, community radio, online portals, and Very High-Frequency (VHF) wireless communication sets.

Identity Technologies Used in the Fisheries Value Chain:

Barcoding: Barcodes, initially represented by varying line widths and spacings, have evolved into 2D barcodes, which can be scanned by mobile devices equipped with cameras. These

barcodes are employed in seafood products to verify authenticity, origin, and additional information like pricing and packing dates.

Vessel Tracking Devices: Devices such as the Pelagic Data Systems (PDS) tracker are employed to determine fishing locations, contributing to a digital record of seafood provenance.

Supply Chain Tracking Software: Various software systems now exist for tracking fish through the supply chain, reducing fraud and ensuring reliable transmission of seafood information to buyers. This may involve labeling fish with unique identifiers, including QR codes, barcodes, or Near-Field Communication (NFC) labels.

Sensors: Sensors are extensively used along the fisheries value chain, particularly in aquaculture farms and fish processing. They monitor water quality parameters and weather conditions in real-time, aiding in the maintenance of aquaculture environments.

Image Processing: Image processing techniques are employed to assess the freshness of fish by analyzing gill tissue segmentation in fish images. Applications like FishAPP use this technology to determine fish freshness through smartphone photos.

Data Management: Web-based seafood export management software simplifies data storage and access, optimizing business productivity and profitability. This system addresses inventory management, yield calculation, product accounting, and various logistical challenges along the supply chain.

Server-Side and Client-Side Components: Web servers, search engines, browsers, and mobile applications comprise the server-side and client-side elements of the IT ecosystem.

Cloud Storage: Cloud services such as Google Drive, iCloud, Dropbox, and SkyDrive provide secure data storage and accessibility from various devices, including desktops, laptops, tablets, and smartphones.

Rephrased:

Fisheries Data Management:

a. *Fish Base*

Fish Base serves as a global biodiversity information system specializing in finfish. Initially designed to furnish critical population dynamics data for 200 major commercial fish species, Fish Base has since expanded its scope to encompass comprehensive information on all known fish species worldwide. This encompassing dataset includes taxonomy, biology, trophic ecology, life history, and utilization aspects, along with historical records spanning 250 years. At present, Fish Base compiles data on over 33,000 fish species from more than 52,000 references, cultivated through collaboration with over 2,000 contributors. The repository also features a wealth of over 300,000 common names and boasts a collection of over 55,000 images. [Link to Fish Base](https://www.fishbase.de/home.htm)

Identity Management:

a. AIS (Automatic Identification System)

The Automatic Identification System (AIS), deployed aboard vessels, operates as a tracking system that autonomously exchanges navigational information among AIS-equipped vessels and coastal authorities. Functioning as a collision-avoidance system, AIS provides details on all nearby ships, including their speed, courses, and contact information (name, callsign, MMSI). This information is publicly broadcast over VHF radio frequencies, accessible to other vessels and shore-based receivers. AIS primarily aims to enhance navigation safety by facilitating efficient ship navigation, environmental protection, and the operation of Vessel Traffic Services (VTS). It accomplishes this by satisfying several functional requirements, including ship-to-ship collision avoidance, providing information to littoral states about a ship and its cargo, and serving as a VTS tool for ship-to-shore traffic management.

Location Recognition:

a. GPS (Global Positioning System)

GPS is a constellation of satellites continuously transmitting encoded data, enabling precise Earth location determination by measuring distances from these satellites. The low-power radio signals transmitted by these satellites allow anyone with a GPS receiver to ascertain their Earth-based location. GPS is particularly advantageous for fishermen, enabling them to chart courses to potential fishing areas from any location, even without mobile network coverage.

Fish Finder:

Fish Finders offer valuable information to help locate abundant fishing areas, with features including bottom structure analysis, configurable alarms for depth and fish echoes, and post-processing gain control for all displayed echoes on the screen. Additionally, they allow information sharing and display on chart plotters.

Very High-Frequency Wireless Sets (VHF):

VHF remains a vital communication tool for short-distance marine communications, with a typical range of less than 20 nautical miles. Essential VHF channels include distress, safety, and calling channels, such as Channels 16 (156.8 MHz) and 70 (156.525 MHz).

Application of ICT Solutions in the Fisheries Sector:

Advisories:

Indian Marine Fishery Advisory System (IMFAS) disseminates Potential Fishing Zone (PFZ) advisories using various mediums, including SMS, Interactive Voice Response Systems (IVRS), helplines, voice messages, information kiosks, and electronic display boards. These advisories are made available through location-based electronic display boards, Doordarshan broadcasts, newspapers, emails, websites equipped with Web GIS features, phones, and faxes.

Web-Based Dissemination:

A dedicated website offers multilingual advisories, providing information in eight local languages (Gujarati, Marathi, Kannada, Malayalam, Tamil, Telugu, Oriya, Bengali), as well as Hindi and English. This web platform includes Web GIS functionality for users to retrieve PFZ information for their areas of interest within the Indian Exclusive Economic Zone (EEZ) through simple GIS operations.

Mobile Phones:

Mobile phones empower fishermen with real-time access to market prices and fish quality information, ultimately boosting their income. Additionally, mobile phones facilitate price comparison across different markets. They are particularly transformative in rural India, providing fishermen with weather updates and enhancing safety by helping avoid potential losses to boats and nets. Fishermen also receive weather condition information via SMS before venturing into the sea.

Mobile Applications:

Mobile applications play a crucial role in fisheries, with fishermen using them to receive alerts when crossing borders. Fisheries inspectors utilize mobile apps for reporting cases of illegal, unregulated, or unreported (IUU) fishing. While freely available, customizable fisheries apps were initially scarce, collaborations with service providers enabled the dissemination of PFZ, OSF, and Tsunami warnings through their mobile networks.

PFZ Advisory Mobile Application:

Potential Fishing Zone (PFZ) advisories are essential for coastal fishermen, providing daily insights into chlorophyll presence, sea temperature, and water clarity. These advisories help fishermen locate areas teeming with fish, leading to fuel and time savings.

mKRISHI Mobile Application:

Developed by Tata Consultancy Services (TCS) Innovation Lab, mKRISHI Fisheries is a mobile app created in collaboration with ICAR- Central Marine Fisheries Research Institute and Indian National Centre for Ocean Information Services (INCOIS). This app consolidates Potential Fishing Zone (PFZ) advisories based on remote sensing data from NOAA satellites, sea surface temperature, and phytoplankton presence. It presents advisories in local languages, aiding fishermen in optimizing their fishing activities.
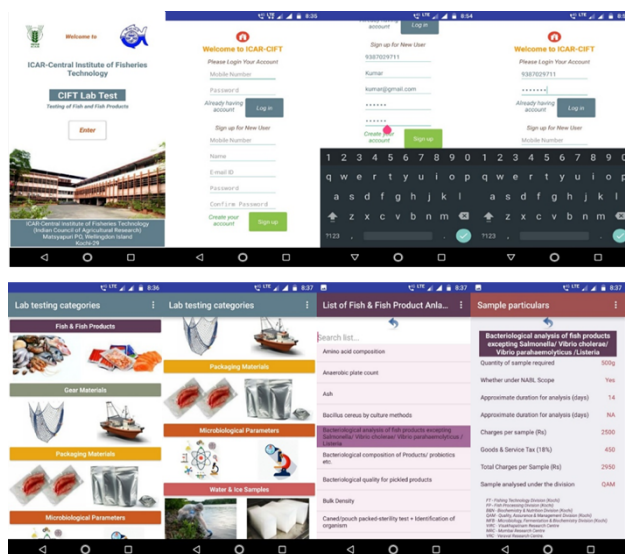
CIFT Lab Test mobile application

The ICAR-Central Institute of Fisheries Technology in Cochin, which holds ISO 9001:2008 certification, has earned recognition as a National Referral Laboratory for Fish and Fishery Products from the Food Safety and Standards Authority of India (FSSAI), operating under the Ministry of Health and Family Welfare within the Government of India.

To enhance accessibility to information pertaining to diverse sample testing and analysis services encompassing fish and fish-derived products, fishing equipment materials, packaging materials, microbiological metrics, as well as quality benchmarks for ice and water samples,

ICAR-CIFT has introduced an innovative mobile application known as "CIFT Lab Test." This mobile app is designed to benefit aquaculture farmers, processing industries, and other stakeholders within the sector. It grants users online access to a comprehensive repository of various lab tests, offering details such as the requisite number of samples, the estimated time for test report generation, associated costs, and more. This information is available round the clock, ensuring convenience and accessibility.

CIFT Lab Test

CIFTraining mobile application

The ICAR-Central Institute of Fisheries Technology (ICAR-CIFT) in Cochin has developed an innovative mobile application called "CIFTraining," which serves as a comprehensive information resource for ICAR-CIFT's training programs. This app is a valuable tool for fisheries students, researchers, industry professionals, state extension personnel, fisheries-based entrepreneurs, fishermen, and other stakeholders in the sector. It offers 24/7 access to online information about a wide range of training programs in fields such as Fishing Technology, Fish Processing, Biochemistry & Nutrition, Microbiology, Quality Control, Engineering, Extension & Economics.

The "CIFTraining" mobile app includes a complete list of 68 training programs available at ICAR-CIFT. These programs comprise 60 regular training courses, two comprehensive courses, three specialized courses, and three certified courses, covering various themes across seven divisions. With the "CIFTraining" app, stakeholders can easily search for training programs that align with their interests. They can view detailed information about each

program, including course content, fees, duration, eligibility criteria, and available facilities. This empowers stakeholders to select the most suitable training program to enhance their technical knowledge and skills in their respective fields. Furthermore, the app facilitates online registration for these training programs, streamlining the application process.

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	Weather Forecast
GPS facility	Government Schemes
International Border Line Alert	Market Information
Ocean State Forecast	News
Disaster Alert	Important Contacts

E-Commerce in the Fisheries Industry:

www.marinefishsales.com is an innovative multi-vendor e-commerce platform developed under the NICRA project of ICAR-CMFRI. This platform is available as an Android application for mobile phones, facilitating direct sales between fisherfolk and customers. The aim of the app is to ensure fair pricing through direct sales between fishermen/farmers and consumers.

Daily Fish:

Your journey from 'catch' to 'kitchen' has never been more top-notch than with 'Daily Fish.' This online seafood store offers ready-to-cook seafood that is 'As good as Live,' preserving all the essential nutrients. This aligns with the vision of Baby Marine, the promoters of Daily Fish and a leading marine product exporter from India to various global regions, including Europe, the US, South America, Japan, South East Asia, the Gulf, South Africa, and Australia, spanning over four decades.

Decision Support System (DSS):

A Decision Support System (DSS) is a computer-based application that gathers, organizes, and analyzes business data to facilitate informed decision-making across the fisheries value chain. A well-designed DSS assists decision-makers in consolidating various data sources, including raw data, documents, employee knowledge, and business models. DSS analysis helps companies identify and resolve issues and make decisions, particularly at the farm level.

Types of Decision Support Systems (DSS):

These systems can be categorized into five types: Communication-driven DSS, data-driven DSS, document-driven DSS, knowledge-driven DSS, and model-driven DSS. For instance, Aqua Manager is a comprehensive software solution designed to enhance efficiency in aquaculture industries, supporting all stages of fish production from hatchery to harvest.

Supply Chain Integration:

Integrating technology into the supply chain can be complex, even in the seafood industry, with the introduction of traceability technology that monitors the entire journey of seafood products from water to plate. As consumers increasingly seek information about the origin of their fish, companies are developing advanced solutions to capture, transmit, and receive data across all components of the seafood supply chain, including fishermen, processors, transporters, distributors, and retailers.

Traceability:

Traceability is closely linked to the accuracy of seafood labels that highlight a product's sustainability, origin, authenticity, and other factors significant to consumers. Offering socially responsible products can lead to higher profits, enhanced customer loyalty, and an improved brand reputation. Suppliers are under growing pressure from consumers and retailers to provide traceability for their products. Traceability technology can mitigate risks and minimize the impact of public health incidents. The use of unique ID codes for fisheries and their incorporation into traceability and data-sharing systems, such as the Global Record for Stocks and Fisheries (GRSF), can streamline operations, save time and reduce costs for the seafood supply chain, traceability technology companies, governments, and non-governmental organizations (NGOs).

The Global Record for Stocks and Fisheries (GRSF):

GRSF integrates data from three authoritative sources: FIRMS (Fisheries and Resources Monitoring System), RAM (RAM Legacy Stock Assessment Database), and Fish Source (Program of the Sustainable Fisheries Partnership).

Expert Systems:

Expert systems are computer applications specifically designed to address intricate problems within a particular domain, leveraging an extraordinary level of intelligence and expertise. The development of the Expert System for Shrimp Aquaculture (ESSHA) followed a structured process encompassing five key steps: problem selection, knowledge acquisition, knowledge representation, system design, and development, culminating in system validation (Zetian et al., 2005).

Expert Systems in the Fisheries Sector:

Expert systems have rapidly gained prominence as integral components of applications across various domains, spanning from conventional manufacturing processes to applications in outer space. In multiple fields, including fisheries and aquaculture, expert systems have demonstrated the potential to significantly enhance traditional approaches, often yielding improvements on the order of magnitude. The return on investment in expert systems can be remarkably high in such domains.

Social Networking:

The internet's widespread penetration and the increasing adoption of social media, particularly among the younger generation, are notable trends. In this context, a study was conducted to assess students' internet and social media usage patterns, as well as their means of accessing professional (fisheries) information through social media platforms. Social media has been categorized into two main types: social networking sites and instant messaging applications, considering both their form and content.

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 this 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)
- MPEDA, Fisheries College, Research institute, CMFRI,
- 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 detailed 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

Blockchain technology in fisheries

It is mainly used to addressing the traceability issue in seafood industries by integrate fish farmers 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.

IoT: Smart aquaculture farming enhance the value chain.

IoT make a tremendous change in both monitoring and automation of highly helpful to the aquaculture sector to operate remotely anywhere in the world. useful to know the real-time water parameter of the pond such as dissolved oxygen (DO), Temperature, pH, and water level. microcontroller development kits such as Arduino, Raspberry Pi, ESP etc. It will generate big data consciously in frequent intervals which will be sent to the cloud storage, which will be processed and accessed through the web portal or mobile application.
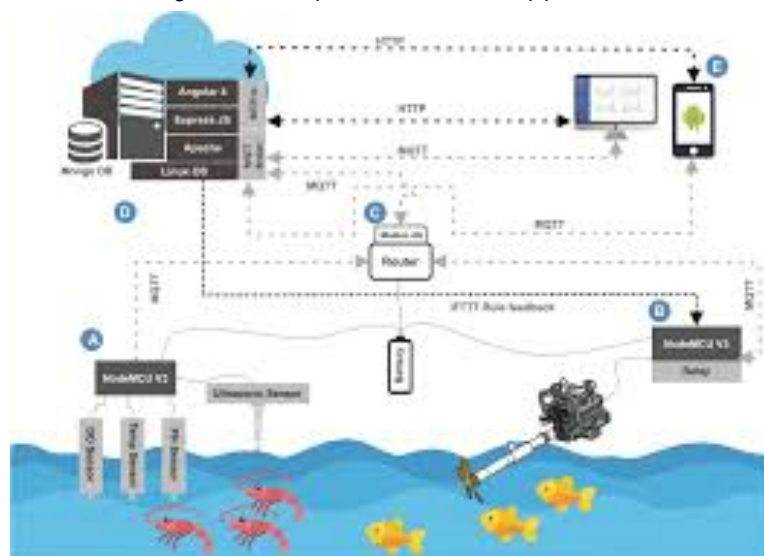
Artificial Intelligence in Fisheries

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 labor-intensive field. It can take the 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, hence AI feed dispenser releases right amount of feed at the right time, which will be remote control. Further AI read the fishes through vibration-based sensor and acoustic signals. Reduce cost of feed by about 21% measures and tracks the feeding pattern of stocks. AI programmed drones equipped with sensors can collect and analyze water quality data such as turbidity, temperature, dissolved oxygen,

Aquaculture Automation: Automation in aquaculture involves the use of sensors to monitor water quality parameters like temperature, pH, and oxygen levels. These systems can also automate feeding processes and control environmental conditions in fish farms, ensuring optimal growth and health for the fish.

Remote Sensing: Remote sensing technologies, such as satellites and aerial drones, provide real-time data on ocean conditions and fish populations. This data helps fisheries management make informed decisions about sustainable fishing practices.

Drones (Unmanned Aerial Vehicles - UAVs): Drones equipped with cameras and sensors are used for aerial surveillance of fishing areas. They can monitor fishing activities, detect illegal practices, and collect data on fish stock distribution.

Fish Health Monitoring: Underwater robots equipped with cameras and sensors can inspect fish health and behavior. They help fish farmers detect diseases early, reducing the need for antibiotics and improving overall fish welfare.

Genetic Technologies: Advanced genetic techniques, including selective breeding and genetic modification, are used to develop fish breeds with desirable traits, such as disease resistance, rapid growth, and better feed conversion rates.

Artificial Intelligence (AI) and Machine Learning: AI and machine learning algorithms analyze vast datasets to predict fish stock levels, optimize fishing routes, and improve aquaculture management. They can also identify patterns related to fish health and environmental conditions.

Smart Fishing Gear: Innovations in fishing gear include devices like smart buoys that use GPS and sonar technology to reduce bycatch and minimize environmental impact. These technologies promote sustainable fishing practices.

Aquaponics and Recirculating Aquaculture Systems (RAS): Aquaponics combines fish farming with plant cultivation in a closed-loop system. RAS systems recycle water and nutrients, reducing waste and conserving resources.

Biotechnology: Biotechnology is used for fish health management, including the development of vaccines and treatments for fish diseases. It also plays a role in producing pharmaceuticals and other value-added products from fish.

3D Printing: 3D printing allows for the customization of aquaculture equipment, making it more efficient and cost-effective. It is also used for rapid prototyping of new aquaculture technologies.

Virtual Reality (VR) and Augmented Reality (AR): VR and AR technologies provide immersive training experiences for fisheries personnel and aquaculture workers. They simulate real-life scenarios and enhance learning.

Sustainable Feed Formulation: Software tools use algorithms to formulate fish feeds that meet nutritional requirements while minimizing the environmental impact. This helps reduce overfeeding and waste in aquaculture.

Underwater Robotics: Remotely operated vehicles (ROVs) and autonomous underwater vehicles (AUVs) are used to explore underwater environments, collect data on fish habitats, and conduct maintenance tasks in fish farms and fisheries.

These technologies collectively contribute to the sustainability, efficiency, and innovation of the fisheries and aquaculture sectors, addressing challenges related to environmental conservation, disease management, and responsible fishing practices.

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