

Smart Fishing: How Technology is Empowering Fishers

Rajan Dinesh

Ph.D. Scholar, ICAR - Central Institute of Fisheries Education, Mumbai – 400061

Corresponding Author Email: *dineshcife1210@gmail.com*

Abstract

Smart fishing integrates digital tools like GPS, sonar, AI, and data platforms to enhance efficiency, sustainability, and safety in fisheries. It empowers small-scale and commercial fishers through better catch prediction, reduced costs, and improved resource management. While adoption faces challenges such as cost and infrastructure gaps, emerging innovations and policy support offer strong potential for global transformation.

Keywords: *Smart Fishing, Sustainability, Digital Tools, Fishers, Technology Adoption.*

Received Date: 13/10/2025

Revised Date: 18/10/2025

Accepted Date: 28/10/2025

1. Introduction

The evolution of fishing

Fishing has transitioned significantly from subsistence-level, manual practices to more sophisticated and technology-driven operations. Modern fisheries now integrate tools such as sonar, GPS, mobile apps, and satellite imaging. According to the Food and Agriculture Organization (FAO), global fish production reached 179 million metric tons in 2020, up from 148 million metric tons in 2010. This increase highlights both the growing global demand and the push for more efficient fishing practices. As nearly 30% of fish stocks worldwide are overexploited, the need for smarter fishing methods has become urgent. Technological adoption in fisheries accelerated after 2015, largely in response to declining catch per unit effort (CPUE) and operational inefficiencies in traditional methods.

The challenges faced by traditional fishers (climate, overfishing, fuel costs, etc.)

Traditional fishers face a range of challenges that threaten both livelihoods and marine ecosystems. Climate variability has altered fish migration patterns, with species moving poleward or into deeper waters some by up to 10 kilometers per decade, according to the Intergovernmental Panel on Climate Change (IPCC). Overfishing remains a pressing issue, with the FAO reporting that 35% of marine fish stocks are being harvested at biologically unsustainable levels. Rising fuel prices also weigh heavily on small-scale fishers, who often spend 20–30% of their daily income on fuel due to inefficient route planning and guesswork-based fishing. In the absence of real-time data, they may spend over 10 hours at sea with minimal catch returns. Safety is another critical concern, with more than 24,000 fisher deaths reported annually worldwide, often due to limited access to weather alerts and emergency communication systems.



2. The Rise of Smart Fishing Technologies

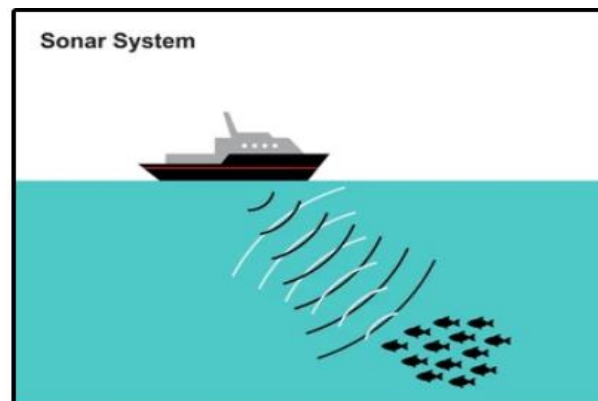
Smart fishing

Smart fishing refers to the application of digital tools, real-time data, and automation to improve the efficiency, safety, and sustainability of fishing operations. This approach enables fishers to make informed decisions using environmental, navigational, and market data. The World Bank reports that digital tools can boost incomes for small-scale fishers by up to 30% and reduce fuel consumption by as much as 40%. The scope of smart fishing extends from locating fish and planning routes to monitoring catch volumes and complying with marine regulations. (Table: 1

Types of technologies involved

GPS and sonar systems

GPS technology allows fishers to map routes, mark successful fishing spots, and avoid hazards, significantly reducing time and fuel spent at sea. Sonar systems send sound waves underwater to detect fish and obstacles, enabling more precise targeting. According to the National Oceanic and Atmospheric Administration (NOAA), vessels equipped with sonar can achieve up to 25% higher catch rates per trip compared to those relying on traditional methods.



Fish finders and depth sensors

Fish finders use sonar to detect the presence, location, and size of fish beneath the boat, helping to focus efforts on specific species. Depth sensors measure water column levels, providing data on where fish are likely to be found based on their habitat preferences. Research indicates that using fish finders can reduce bycatch by 15–20%, as fishers can avoid non-target species and protect marine biodiversity.



Mobile apps and data analytics tools

Mobile applications offer fishers real-time access to weather forecasts, sea conditions, market prices, and digital logbooks. Advanced data analytics platforms compile and interpret information such as fish migration patterns, ocean temperatures, and historical catch data. The FAO notes that digital reporting and analytics tools have

improved compliance with fisheries regulations by over 50% in selected pilot

regions, contributing to better resource management and traceability.

Table 1: Smart Fishing Technologies

Technology	Function	Impact / Data
GPS and Sonar Systems	Navigation, route planning, locating fish-rich zones	Increases catch efficiency by up to 25%; reduces search time significantly (NOAA)
Fish Finders and Depth Sensors	Detect fish presence and depth-specific species	Reduces bycatch by 15–20%; improves species targeting
Mobile Apps	Provide weather updates, market prices, digital logbooks	Enables better planning; boosts income by 15–35% through direct market access
Data Analytics Tools	Analyze sea temperatures, migration patterns, catch history	Improves decision-making; enhances sustainability through data-driven actions
Satellite Imaging & Tracking	Monitor fish movements, detect illegal fishing, support conservation efforts	Enhances enforcement; helps reduce overfishing in protected zones by 40%
AI (Artificial Intelligence)	Predict fish behavior, automate processes	Increases operational efficiency by up to 40% (FAO)
Blockchain Technology	Ensures traceability of seafood from catch to consumer	Improves verification accuracy by 50%; builds consumer trust (WEF)

3. Empowering Small-Scale and Commercial Fishers

Improved efficiency and catch prediction

Smart fishing technologies significantly improve operational efficiency and predictability for both small-scale and commercial fishers. Real-time fish location tracking through satellite imaging and acoustic sensors helps identify fish-rich zones, reducing search time by over 40%. According to the World Bank, vessels using such tracking systems report up to 35% higher catch efficiency than those using traditional methods. Weather forecasting and route optimization tools provide access to live meteorological data and ocean

conditions. These systems help fishers avoid storms and high-risk areas while optimizing fuel use. Data from NOAA shows that such tools can reduce unnecessary trips by 20%, contributing to more productive and safer fishing operations.

Cost savings and resource management

Fuel-efficient navigation is a major advantage of digital integration in fisheries. Smart GPS and route planning tools lower fuel consumption by 25–40%, directly benefiting operational costs. The FAO estimates that fuel can account for up to 60% of a small fisher's total expenses, making efficiency critical to financial

sustainability. Technologies that reduce bycatch and prevent illegal fishing are also making a difference. AI-based monitoring systems, smart nets, and electronic catch logs enable fishers to avoid non-target and protected species. Trials reported by WWF have shown bycatch reductions of up to 30%, supporting both environmental and economic goals. These tools also strengthen transparency and legal compliance in seafood supply chains.

Safety improvements at sea

Emergency alert systems and remote communication tools are enhancing the safety of fishers at sea. Satellite-enabled distress signals allow vessels to send SOS alerts and real-time locations to coast guards and rescue teams. Data from the International Maritime Organization (IMO) shows that these technologies have reduced response times by up to 60% in coastal regions. Communication tools such as satellite phones, VHF radios, and mobile safety apps ensure constant connectivity, enabling fishers to receive live weather updates and emergency support. These advancements contribute to a safer working environment, especially during severe weather or equipment failure.

4. Environmental and Economic Impacts

Sustainable fishing practices through data

Smart fishing technologies enable more sustainable practices by providing accurate, real-time data on fish stocks, seasons, and legal catch limits. Tools such as digital logbooks, smart sensors, and e-monitoring systems help prevent overfishing by tracking the quantity and type of fish harvested. According to the FAO, regions using data-driven catch monitoring systems have seen overfishing rates decline by 20–25%. These systems also help protect

juvenile and endangered species, ensuring long-term viability of marine ecosystems.

Supporting marine conservation efforts

Digital technologies play a critical role in advancing marine conservation. AI-powered surveillance and satellite tracking systems are effective in detecting illegal fishing in restricted zones, increasing enforcement efficiency by more than 40%. Real-time ocean monitoring tools measure water temperature, coral reef health, and pollution levels, providing early warnings and guiding conservation actions. WWF data shows that marine protected areas using digital surveillance have experienced fish biomass recovery rates up to 30% faster than areas without such technologies.

Boosting incomes and livelihoods of local communities

Digital platforms improve the economic resilience of fishing communities by connecting fishers directly to markets through mobile apps. This reduces dependence on intermediaries and raises profit margins by 15–35%. Tech-based cooperatives help stabilize pricing and expand market reach. According to the World Bank, communities adopting smart fishing technologies have experienced up to 26% growth in average income along with better preparedness against economic and climate-related disruptions.

5. Challenges and Barriers to Adoption

Cost and accessibility for small fishers

One of the main obstacles to adopting smart fishing technologies is cost. High upfront investment for devices such as GPS units, sonar systems, and electronic logbooks places them out of reach for many small-scale fishers. According to FAO data, fewer than 10% of small vessels globally are equipped with advanced digital fishing

tools. Recurring expenses like software subscriptions and equipment maintenance add to the burden, making long-term adoption difficult for low-income fishing operators.

Digital literacy and training needs

Lack of digital literacy presents another major barrier. Many fishers have limited or no experience using mobile applications or data platforms related to fishing. A 2021 report by the OECD found that over 60% of small-scale fishers in coastal areas had never used mobile-based fishing apps. Without accessible training programs and intuitive, local-language interfaces, even subsidized technologies often go unused or misused, reducing their intended benefits.

Infrastructure gaps in remote areas

Infrastructure challenges further restrict the spread of smart fishing. Weak internet access and unreliable mobile network coverage prevent fishers from using real-time data services or uploading catch information. In many coastal zones, electricity supply is either inconsistent or unavailable, making it difficult to charge essential devices. World Bank research highlights infrastructure as a top barrier in more than 40% of surveyed fishing communities, limiting the reach and effectiveness of digital innovations.

6. Future

Emerging innovations (AI, drones, blockchain in traceability)

Emerging technologies are reshaping the future of fisheries through advanced solutions like artificial intelligence, drones, and blockchain. AI systems are now used to predict fish movement, automate vessel operations, and optimize catch timing, improving efficiency by up to 40% according to FAO reports. Drones provide

aerial monitoring of fishing zones, helping detect illegal fishing and track habitat conditions in real time. Blockchain technology is being applied to seafood traceability, allowing each stage of the supply chain to be verified securely. Pilot programs using blockchain have achieved up to 50% improvement in traceability accuracy, reducing fraud and strengthening consumer trust in sustainably sourced seafood.



Role of governments and NGOs in supporting tech adoption

Support from governments and non-governmental organizations plays a key role in expanding access to smart fishing tools. Public funding, subsidies, and partnerships with private tech firms are making equipment like digital logbooks and satellite communication systems more affordable. NGO-led training programs have enhanced digital skills for over 30,000 fishers across coastal regions of Southeast Asia and Africa, according to WWF. These efforts are critical in ensuring that technology reaches marginalized communities and is used effectively to support both livelihoods and sustainability goals.

Potential for global transformation in fisheries

Wider adoption of smart fishing technologies holds major potential for global food security and ocean

conservation. More than 1 billion people rely on fish as a primary source of protein, and improving the sustainability of fisheries is essential to meeting this demand. The FAO projects that tech-driven sustainable practices could lead to a 15% increase in global fish stocks by 2030. With seafood demand expected to grow by 30% by 2035, scaling digital innovation will be vital to balance production needs with ecosystem preservation.

Conclusion

Smart fishing technologies are transforming global fisheries by improving efficiency, sustainability, and livelihoods. Wider access, training, and infrastructure are key to ensuring inclusive, long-term impact for fishers and ecosystems.

References

- Amuthakkannan, R., Vijayalakshmi, K., Al Arai, S., & Ali Saud Al Tobi, M. (2023).** A review to do fishermen boat automation with artificial intelligence for sustainable fishing experience ensuring safety, security, navigation and sharing information for Omani fishermen. *Journal of Marine Science and Engineering*, 11(3), 630.
- Bradley, D., Merrifield, M., Miller, K. M., Lomonico, S., Wilson, J. R., & Gleason, M. G. (2019).** Opportunities to improve fisheries management through innovative technology and advanced data systems. *Fish and fisheries*, 20(3), 564-583.
- Chandrasekhar, A., Vivekananthan, V., Khandelwal, G., & Kim, S. J. (2020).** A sustainable blue energy scavenging smart buoy toward self-powered smart fishing net tracker. *ACS Sustainable Chemistry & Engineering*, 8(10), 4120-4127.
- Honarmand Ebrahimi, S., Ossewaarde, M., & Need, A. (2021).** Smart fishery: a systematic review and research agenda for sustainable fisheries in the age of AI. *Sustainability*, 13(11), 6037.
- Hungevu, R., Lawal, A., Yinusa, S., Titiloye, T. A., Lasisi, R., & Okunola, M. (2025).** The impact of low-cost technological innovations on sustainable fisheries for economic development in developing countries. *World Journal of Advanced Research and Reviews*, 25(02), 1170-1184.
- Hungevu, R., Lawal, A., Yinusa, S., Titiloye, T. A., Lasisi, R., & Okunola, M. (2025).** The impact of low-cost technological innovations on sustainable fisheries for economic development in developing countries. *World Journal of Advanced Research and Reviews*, 25(02), 1170-1184.
- Landge, A. T., Mano, A., Akansha, Nikhil, K., & Abuthagir Iburahim, S. (2025).** IoT and AI Applications in Fishing: Smart Fishing for Sustainable Practices. In *Information Technology in Fisheries and Aquaculture* (pp. 59-70). Singapore: Springer Nature Singapore.
- Li, Y., & Ji, J. (2024).** The digitalization of Chinese fisheries and its configuration path to empower fishery sustainable development. *Journal of Cleaner Production*, 466, 142807.
- Velliangiri, A. (2025).** Empowering Coastal Communities through Smart Fisheries Innovation and Circular Blue Economy Models. *National Journal of Smart Fisheries and Aquaculture Innovation*, 3(1), 10-17.