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New Approaches In The Fishing Industry Through The Technological Advancements

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Abstract

The global fishing industry is undergoing rapid transformation through advanced technologies that boost efficiency, sustainability, and economic performance. GPS navigation, sonar systems, and satellite remote sensing have improved fish location accuracy, safety, and fuel efficiency while reducing by catch. Automation in gear handling, processing, and storage has streamlined operations and maintained catch quality. Data analytics, AI, and IoT enable real-time monitoring of vessel activity, environmental conditions, and fish stocks, supporting sustainable management. In aquaculture, innovations such as recirculating systems, selective breeding, and precision feeding are enhancing yields and resource efficiency. Together, these developments are shaping a more sustainable and resilient fishing sector.

Introduction

In recent years, the fishing industry has witnessed significant technological progress, reshaping how aquatic resources are harvested, managed, and conserved. With the global appetite for seafood steadily increasing, the adoption of innovative tools and methods has become essential for safeguarding fish stocks, reducing ecological footprints, and boosting operational efficiency. These advancements are not only improving productivity but also playing a vital role in promoting sustainable practices within the sector. While traditional fishing methods continue to thrive in many small-scale and artisanal fisheries, modern systems have brought about unprecedented gains in efficiency, safety, and profitability. However, the increased capacity to exploit marine resources also raises pressing concerns about sustainability, biodiversity conservation, and ecosystem balance. Understanding how technology is reshaping the fishing industry allows us to appreciate both the opportunities it offers and the responsibility it places on stakeholders to ensure the long-term health of global fisheries. The present study examines key breakthroughs in fishery technology and their role in shaping a more sustainable, productive, and resilient fishing sector.

Methods

A comprehensive review of academic literature was conducted, drawing from peer-reviewed journals, conference proceedings, and scholarly publications on advancements in fishery technology. The literature encompassed diverse themes, including sustainable fishing methods, aquaculture automation, precision fishing gear, aquatic robotics, and AI-based fisheries management tools. Studies from high-impact marine science and fisheries management journals were prioritized, with attention given to both developed and developing country perspectives. Research addressing environmental impacts, policy frameworks, and socio-economic considerations was critically examined to capture the multi-dimensional effects of technological adoption. Regional variations in technological focus were noted, with industrialized nations emphasizing automation and

developing regions prioritizing cost-effective, low-impact solutions. Ethical implications, sustainability challenges, and identified gaps in the existing research provided a strong foundation for guiding the study's analysis and case selection.

Traditional Fishing Methods

Fishing, one of humanity's oldest subsistence activities, has evolved over millennia, yet many traditional techniques continue to be practiced in India alongside modern innovations. Rooted in local ecological knowledge, these methods are often low-cost, eco-friendly, and community-oriented, making them essential for small-scale and artisanal fisheries. Common practices include the use of cast nets in rivers, ponds, and coastal waters particularly in Kerala, West Bengal, and Assam which allow fishers to harvest modest quantities without significant habitat disturbance. Hand line fishing, prevalent in coastal Maharashtra and Tamil Nadu, employs baited hooks to selectively target species such as groupers and snappers, with minimal bycatch. In inland areas, bamboo traps and woven baskets, crafted in states like Assam, Manipur, and Odisha, capture fish and crabs while enabling smaller species to escape, thus supporting stock sustainability. Spear fishing and bow fishing, though now rare, remain part of the cultural heritage in certain indigenous communities, requiring both skill and an intimate understanding of aquatic ecosystems. Collectively, these methods illustrate a harmonious balance between livelihood needs, cultural traditions, and environmental stewardship.

Modern Fishing Gear

Modern fishing techniques have greatly expanded the efficiency and scale of marine harvests in India, particularly along the coasts of Gujarat, Tamil Nadu, and Kerala. Key industrial methods include trawling, where large nets are dragged through the water either in midwater (pelagic) or along the seabed (bottom trawling). While highly productive, bottom trawling is criticized for damaging seafloor habitats, including coral reefs. Purse seining, another widely used method, encircles and traps schooling species such as sardines, mackerel, and tuna, offering high yields but risking overfishing of ecologically important small pelagic fish. Longlining, with thousands of baited hooks, efficiently targets large species like tuna and swordfish, though it can unintentionally catch non-target species such as sharks, turtles, and seabirds; by catch-reduction tools like circle hooks are increasingly adopted to mitigate this.

Other prevalent practices include Gill netting, which can be adapted to target specific fish sizes but may still cause unintended catch if poorly managed, and the use of fish aggregating devices (FADs) to attract tuna and other species raising concerns about excessive fishing pressure. Mechanized vessels, equipped with powerful engines, refrigeration, and navigation systems, enable longer trips into deeper waters, increasing catch volumes but also intensifying competition with small-scale traditional fishers. Technological tools such as GPS navigation, sonar-based fish finders, and satellite communication systems enhance fishing efficiency, safety, and fuel optimization. Onboard processing units, cold storage facilities, and improved logistics have strengthened the seafood supply chain, reducing post-harvest losses. Smart nets embedded with sensors can identify the size and species of captured fish in real time, enabling the selective release of undersized or non-target species. While modern methods have increased productivity and profitability, they also raise concerns over overfishing, habitat degradation underscoring the need for responsible fishing regulations and sustainable management strategies.Recent innovations in fishing gear have prioritized both efficiency and sustainability.This technology significantly reduces bycatch, helps maintain healthy fish populations, enhances the long-term profitability of fishing operations to balance economic gains with ecosystem health.

AI and Robotics in Modern Fishing

Artificial Intelligence (AI) and robotics are driving a transformative shift in global fisheries, redefining how fish are harvested, processed, and managed. Traditionally reliant on manual skill and labor, the sector is now integrating advanced technologies to address critical challenges such as overexploitation of fish stocks, illegal and unreported fishing, and high levels of bycatch. AI powered systems can analyze vast datasets from satellite imagery to sonar readings to optimize fishing locations, predict stock movements, and enhance

regulatory compliance. Robotics, including automated sorting machines and unmanned surface or underwater vehicles, improves operational efficiency, reduce human labor requirements, and preserve catch quality.

One of the most impactful applications of AI in fisheries is predictive analytics for locating fish stocks. Instead of depending solely on traditional knowledge, intuition, or past experience, fishers can now use AI-powered platforms that integrate and analyze multiple data sources such as satellite imagery, sea surface temperature, chlorophyll concentration, salinity, ocean currents, and historical catch records to forecast fish distribution patterns with high accuracy. For example, Japan's Fisheries Research and Education Agency employs AI models that combine oceanographic data with sonar readings to predict sardine school locations, achieving accuracy rates above 80% and greatly reducing search times. In Norway, salmon farms use AI driven monitoring systems to process underwater video and environmental sensor data, optimizing feeding schedules and tracking fish movement to improve yields. In India, pilot projects led by the Central Marine Fisheries Research Institute (CMFRI) have tested mobile applications that deliver Potential Fishing Zone (PFZ) advisories based on satellite data from the Indian National Centre for Ocean Information Services (INCOIS) to small-scale fishers. These tools enable fishers to plan trips more effectively, conserve fuel, reduce operational costs, and lower ecological impacts by targeting areas with higher catch potential and minimal bycatch risk. Collectively, the integration of AI and robotics in modern fishing is enabling fishers, processors, and regulatory bodies to achieve greater productivity while advancing sustainable and responsible fisheries management.

IoT and Automation in Fishing

The Internet of Things (IoT) and automation technologies are rapidly transforming fishing operations by enabling real time monitoring, data-driven decision making, and improved operational efficiency. IoT enabled sensors installed on vessels, gear, and aquaculture systems collect continuous data on location, water temperature, salinity, oxygen levels, and catch composition. This information is transmitted to centralized platforms where it can be analyzed for optimizing fishing routes, reducing fuel consumption, and ensuring compliance with fisheries regulations.

Automation has further streamlined processes onboard and in aquaculture facilities. Hydraulic net haulers, automated sorting and grading machines, and onboard freezing systems reduce manual labor while maintaining product quality. In aquaculture, automated feeders and water quality control systems, integrated with IoT sensors, allow for precise feed delivery and early detection of stress or disease in fish stocks. For example, tuna vessels in the Pacific are increasingly equipped with IoT enabled monitoring buoys and automated winch systems that reduce hauling time and labor costs. Similarly, shrimp farms in Southeast Asia employ cloud connected water sensors and automated aerators to maintain optimal growth conditions, leading to higher yields and lower mortality rates. By linking physical fishing equipment with digital analytics platforms, IoT and automation help fishers and aquaculture operators operate more efficiently, reduce waste, and minimize environmental impacts. These technologies also facilitate traceability and transparency in the seafood supply chain, supporting both sustainability certification and consumer trust.

Aquaculture Automation

Automation in aquaculture has emerged as a key driver of efficiency, sustainability, and scalability in fish and shellfish farming. By integrating mechanical systems, robotics, and digital monitoring technologies, aquaculture operations can optimize feeding, environmental management, and harvesting with minimal human intervention. Automated feeding systems, for example, deliver precise quantities of feed at scheduled intervals, reducing waste, lowering operational costs, and improving feed conversion ratios. These systems often incorporate underwater cameras and sensors to monitor fish behavior, allowing for real-time adjustments in feeding rates. Water quality management is another critical area where automation is making an impact. IoT enabled sensors continuously measure parameters such as dissolved oxygen, pH, salinity, and temperature, with automated aerators, pumps, and filtration units activated to maintain optimal conditions. In re circulating aquaculture systems (RAS), automated control of water flow, bio filtration, and waste removal ensures stable and bio secure environments, reducing the risk of disease outbreaks. Harvesting and processing are also benefiting from automation. Robotic graders and sorters classify fish by size and weight with high precision, while automated conveyors and packaging systems streamline post-harvest handling, preserving product

quality and extending shelf life. For example, salmon farms in Norway employ fully automated feeding barges and remote-operated net cleaning robots, while Indian shrimp farms have adopted cloud-based water-quality monitoring combined with automated aeration systems.

By reducing labor demands, minimizing resource waste, and enabling consistent production, aquaculture automation is not only enhancing profitability but also supporting environmental sustainability. When combined with AI and IoT, these systems provide integrated farm management solutions, empowering operators to make data-driven decisions that improve yield, animal welfare, and ecological performance.

Mobile Fishing Apps

The proliferation of mobile technology has transformed the accessibility of real-time information for fishing communities, enabling more informed and sustainable fishing practices. Sustainable fishing apps provide fishers with instant updates on weather forecasts, tide and current predictions, and oceanographic data, helping them plan safe and efficient trips. These applications also integrate geo location features to display marine protected areas, seasonal closures, and no fishing zones, ensuring compliance with fisheries regulations.

Many APPs include species identification tools and guidelines on legal size limits, bag limits, and protected species, promoting selective harvesting and reducing the risk of overfishing. Some platforms, such as Fish verify in the United States and Abalobi in South Africa, combine these functions with digital logbooks, allowing fishers to record catch data, which contributes to national and regional stock assessments. In India, emerging apps like Matsyasetu and Fisher Friend Mobile Application (FFMA) provide localized advisories in multiple languages, along with market price updates to help fishers make better economic decisions. Additionally, community reporting features enable users to share catch records, sightings of endangered species, or illegal fishing activities, thereby enhancing collaborative fisheries monitoring. By bridging the gap between traditional fishing knowledge and modern data-driven management, these apps are helping small-scale and commercial fishers adopt practices that balance productivity with long-term sustainability of marine resources.

Results and Discussion

Findings show that modern fishery technologies have greatly improved monitoring, management, and sustainability in both capture fisheries and aquaculture. Tools such as satellite-based tracking, real-time monitoring systems, and precision fishing gear have strengthened regulation enforcement, reduced overfishing, and minimized bycatch. Automated aquaculture systems particularly smart feeding technologies have boosted production efficiency while lowering waste and environmental impact. Enhanced traceability methods, including RFID tagging and DNA barcoding, have increased transparency in seafood supply chains, enabling consumers to make informed and ethical choices while deterring illegal, unreported, and unregulated (IUU) fishing. Aquatic robotics, drones, and unmanned underwater vehicles have advanced data collection on marine species, habitats, and environmental conditions, improving scientific understanding and conservation planning. Mobile applications providing weather updates, regulatory guidelines, and species identification have empowered fishers to adopt more responsible practices. Overall, these innovations are driving a transition toward a more sustainable, efficient, and transparent aquatic industry, safeguarding marine ecosystems while supporting the long-term viability of fisheries-dependent communities.

Conclusion

The integration of advanced technologies in the fishing and aquaculture sectors has marked a significant shift toward sustainability, efficiency, and responsible resource management. From precision fishing gear and real-time tracking systems to aquaculture automation and AI-driven analytics, these innovations have strengthened our ability to meet However, to fully realize these benefits, continuous investment in research, cross-sector collaboration, and robust regulatory frameworks is essential. Such measures will ensure that technological progress not only addresses current challenges such as overfishing and climate change impacts but also secures a resilient and prosperous future for global fisheries and the communities that depend on them.

References

1. FAO. (2024). *The State of World Fisheries and Aquaculture 2024 (SOFIA): Blue Transformation in action.* Rome: FAO.

2. Chen, A., Lv , Z., Zhang, J., Yu, G., & Wan, R. (2024). Review of the accuracy of satellite remote sensing techniques in identifying coastal aquaculturefacilities. *Fishes, 9* (2), 52. https://doi.org/10.3390/fishes9020052

3.Fisheries Innovation & Sustainability / Space Intelligence. (2023).Updated Report of Satellite Technologies and Opportunities for Fisheries.

4 An integrated IoT , AI, and block chain framework for sustainable growth in aquaculture (2025). *Computers & Electronics in Agriculture.*

5. Nguyen, T. T., et al. (2024). Artificial intelligence in the aquaculture industry: A critical review. *Aquaculture.*

6. Zhang, X., et al. (202 5). Integrating AI oT technologies in aquaculture: A systematic review. *Future Internet, 17* (5), 199. https://doi.org/10.3390/fi17050199

7. Processes Review Team. (2025). Artificial Intelligence of Things (AIoT) advances in aquaculture.*Processes, 13* (1), 73. https://doi.org/10.3390/pr13010073

8. Aquaculture Research Editors. (2024). Recent developments in recirculating aquaculture systems: A review. *Aquaculture Research.*

9. Radhakrishnan , B., et al. (2024). Recent advances in RAS and the role of microalgae for circularity. *Bioresource Technology Reports.*

10. Davidson, J., et al. (2023). The economics of recirculating aquaculture systems. *Journal of the World Aquaculture Society, 54* (S1), 3–24.