layer of constraint. Smaller fishing vessels often have to work with low-power devices, while deep-sea observation platforms, despite stronger computing capacity, still struggle with the sheer volume of video data that needs to be processed.n terms of wider application, AI video monitoring appears easier to adapt than many other digital technologies. Approaches first tested in Australia are now being discussed for use in other offshore fisheries, and in some cases have also been applied to recreational fishing. At the same time, core detection modules are becoming more standardized, which makes it possible to use similar systems across aquaculture facilities, nearshore fisheries, and mixed-catch monitoring settings (Khiem et al., 2025; Baker et al., 2025; Al-Abri et al., 2025). Even so, technical readiness alone rarely leads to smooth adoption. Questions around privacy, access to data, and coordination among different stakeholders tend to emerge during implementation. In practice, setting clear goals for how systems are meant to be used, building open and comparable benchmark datasets, and involving fishers directly in system design often prove more helpful for real-world uptake than continuing to focus only on improving algorithm performance (Afrifa-Yamoah, 2025).

6 Intelligent Technologies and Sustainable Fisheries Development

6.1 How intelligent monitoring supports resource conservation and ecological restoration

In fisheries management, recent changes are driven less by specific devices than by continuous data collection and use. Previously, data were scattered and infrequent, and problems were often identified only after damage occurred. With the gradual adoption of intelligent monitoring, sensors deployed at sea, on vessels, and around aquaculture sites now regularly record key indicators such as temperature, salinity, dissolved oxygen, and fish distribution. While individual measurements may seem ordinary, together they provide managers with a clearer picture of fishing pressure and help identify areas requiring protection (Li et al., 2025; Lu, 2025). When combined with satellite data and automated analysis, these systems also make illegal fishing harder to conceal, while selective fishing gear has further helped reduce pressure on certain fish stocks (Wang et al., 2025). Although not immediate solutions to overfishing, these tools allow earlier and better-informed management responses.

Marine protected areas follow a different approach, where limiting disturbance is often more important than increasing monitoring frequency. Technologies such as underwater robots, biological tagging, and automated stations enable long-term observation of species behavior and habitat recovery with minimal human interference, providing more stable references for restoration decisions (Masmitja et al., 2025). Management has gradually shifted from reacting to damage toward earlier risk identification, as AI and large-scale data analysis can detect early signs of stock decline (Wang et al., 2025). At the same time, cleaner farming practices and blockchain-based traceability are beginning to influence production choices, placing greater emphasis on long-term sustainability (Li et al., 2025).

6.2 Improving efficiency without focusing on output alone

Innovation in fisheries has never been only about producing more. As resource limits become increasingly clear, attention has shifted toward how efficiency can be improved without adding further pressure on ecosystems. In aquaculture, cloud platforms, Internet of Things technologies, and artificial intelligence are gradually finding their way into everyday management. Feeding and aeration decisions are no longer guided solely by experience. Instead, systems adjust settings in response to real-time data, which helps reduce feed waste and lower mortality under typical operating conditions (Briones et al., 2025). AI-supported biofloc systems provide a practical example of this trend. By automatically fine-tuning culture conditions, these systems help maintain fish health even at relatively high stocking densities, while keeping costs within a manageable range (Alghamdi and Haraz, 2025). They are not suitable for every situation, but they illustrate that improvements in efficiency do not necessarily have to come at the expense of environmental performance.

Changes can also be seen in capture fishing, although they are often less visible. With IoT-based monitoring tools, fishers are increasingly able to plan routes based on real-time sea conditions and market information, reducing unnecessary travel and fuel consumption caused by limited or outdated data (Li et al., 2025). In several developing regions, relatively simple technologies-such as solar-powered equipment and mobile information