management routines. When projects move from the planning stage into everyday operation, practical difficulties tend to appear quickly. High initial costs, uncertainty over data ownership, and reluctance to change long-standing management habits often turn out to be more disruptive than expected, slowing implementation or, in some cases, causing projects to stall altogether (Barreiro et al., 2025).

Regional differences add another layer of difficulty to this process. In some areas, relatively advanced and integrated applications are already being tested in practice, while in others progress is still constrained by basic infrastructure limitations. This uneven development has gradually exposed gaps in access to digital tools and has prompted ongoing discussion about who is able to use new technologies and who ultimately benefits from them (Wang et al., 2025). In this context, focusing only on technological advancement is unlikely to bring about stable outcomes. What matters more in practice is whether these tools can be adjusted to fit local ecological needs, governance arrangements, and social conditions, allowing them to become part of routine work rather than remaining symbolic additions with limited real impact.

This study will explore the resource, environmental and governance challenges faced by global fisheries, and analyze the reasons why intelligence and data-driven approaches have become the key to sustainable development. At the same time, it will review the current intelligent technologies related to fisheries, analyze their application value and the path of integrating them into an eco-oriented management system, and combine cross-border cases to provide theoretical and practical references for building an intelligent sustainable fishery.

2 Common Intelligent Technologies in the Fishing Industry and Their Operating Modes

2.1 Internet of things and sensing technology

In day-to-day work, many fish farmers still rely on fairly familiar routines to judge what is happening in their ponds. They walk along the edges, watch the color of the water, pay attention to any strange smells, and now and then pull up a few fish to check their condition. This way of working has been passed down for a long time and is not completely unreliable, but its limitations are obvious. It requires time and constant presence, and much depends on whether someone happens to be on site. Changes that take place late at night are especially easy to overlook. When water temperature drops suddenly or dissolved oxygen falls quickly, the signs are often noticed only after the fish have already been affected, leaving little chance to react early. Precisely because of this, the Internet of Things and sensing technologies have gradually been introduced to the livestock farming sites. In simple terms, some devices are installed in fish ponds or near-sea farming areas to enable them to "keep an eye" on the water conditions. Data such as water temperature, pH value, and dissolved oxygen, which previously required manual monitoring, can now be continuously recorded. Even minor fluctuations are not easily overlooked (Huang and Khabush, 2025). After preliminary processing of the data, it will be transmitted to the platform. Farmers do not necessarily have to go to the pond; they can roughly grasp the situation from their offices or mobile phones (Huang and Han, 2025).

In real settings, this type of system is rarely tied to just one kind of farming environment. How it is used often depends on where it is deployed. Along coastal waters, it tends to function mainly as an early warning tool. Events such as red tides can be picked up earlier than before, giving managers at least some time to respond instead of reacting after the fact (Adnan et al., 2025). In inland ponds, however, the focus is more on everyday control. When water quality starts to shift, equipment like aerators or water exchange systems can be activated in time, helping fish and shrimp remain in relatively stable conditions. There are also cases where monitoring does not stay in one fixed location. With the use of mobile devices, for example unmanned boats, areas that were previously difficult to cover can now be checked more easily, and the overall monitoring range becomes wider. Of course, there will also be problems in actual use. Sensors may be blocked by mud or algae, and power supply instability occurs from time to time. These are not the "ideal conditions" mentioned in the technical promotion, but some targeted improvement methods have emerged now, such as self-cleaning probes and solar power supply. In the end, it is precisely because these data come more promptly and in greater detail that fishery management can gradually shift from "based on experience" to a more precise approach.