Fisheries Management and Digital Governance: Opportunities and Challenges for Sustainable Fisheries

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Abstract
Digital technologies are increasingly influencing fisheries management and the delivery of fisheries-related public services. Digital systems can support vessel registration, licensing, catch and landing data collection, vessel monitoring, traceability, welfare delivery and communication with fishing communities. Their effective use can improve the availability of timely information and strengthen coordination among fisheries institutions. However, the benefits of digital governance are not equally accessible to all sections of the fisheries sector. Small-scale fishers may face challenges related to digital literacy, connectivity, affordability, language, data protection and limited access to technical support. This paper examines the role of digital governance in fisheries management; its major applications and the challenges associated with its implementation. It emphasises the need for practical, inclusive and participatory digital systems that consider the working conditions and requirements of fishing communities. The paper also highlights the role of fishing cooperatives and fisher organisations in supporting digital inclusion and strengthening sustainable fisheries management.

Keywords: Digital Governance; Fisheries Management; Digital Inclusion; Fishing Cooperatives; Sustainable Fisheries

1. Introduction

Fisheries management depends on the availability of reliable information and the ability of institutions to use that information for planning, regulation, monitoring and service delivery. Information relating to fishing vessels, fishers, fishing effort, catches, landing centres, markets and fisheries resources is essential for informed decision-making. Governments also require efficient systems for vessel registration, licensing, welfare delivery, safety, insurance and communication with fishing communities.

For many years, fisheries administration has depended largely on paper records, manual reporting and direct interaction between fishers and government offices. These systems continue to be relevant, particularly where digital access remains limited. At the same time, the growing use of digital technologies has created opportunities to improve the collection, storage, transmission and analysis of fisheries-related information.

Digital governance refers to the use of digital technologies and information systems to improve public administration, decision-making, and service delivery. In fisheries, it can support vessel registration, licensing, catch reporting, electronic logbooks, vessel monitoring, traceability, communication, and access to government programmes. Electronic reporting and monitoring can improve the timeliness, quality, and accessibility of fisheries-dependent data, particularly when the technologies and data-collection systems are designed to meet the specific management and monitoring requirements of the fishery concerned (National Oceanic and Atmospheric Administration [NOAA] Fisheries, n.d.).

India is increasingly incorporating digital systems into fisheries administration and service delivery. Under the Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana (PM-MKSSY), one of the key initiatives is the formalization of the fisheries sector through the creation of work-based digital identities for fishers and other stakeholders on the National Fisheries Digital Platform (NFDP). The initiative is intended to strengthen access to services while contributing to broader institutional and technological reforms within the sector (Department of Fisheries, Government of India, n.d.). However, technology alone cannot ensure better fisheries management. The usefulness of digital systems depends on accurate data, suitable infrastructure, affordability, institutional capacity and the ability of fishers to access and use the systems. Digital governance must therefore be developed in a manner that improves fisheries administration without excluding small-scale and traditional fishing communities.

2. Fisheries Management and the Need for Timely Information

Fisheries management involves decisions concerning access to fisheries resources, fishing effort, conservation, regulation, monitoring and development. These decisions require reliable information about the fisheries and the people who depend upon them.

Important information may include:

- Number and type of fishing vessels;
- Registration and licence status;
- Fishing areas and fishing effort;

- Catch and species composition;
- Landing patterns;
- Seasonal variations in fishing;
- Market and price information;
- Safety and welfare requirements; and
- Information required for fisheries research and management.

Delays in receiving and processing fisheries information can limit the speed at which management agencies respond to changing fishing conditions. Digital tools can shorten the time between recording information and making it available for monitoring and management. Electronic reporting and monitoring systems, vessel monitoring systems (VMS), and electronic logbooks are increasingly being incorporated into fisheries data collection and management processes to improve the availability and timeliness of information (Food and Agriculture Organization of the United Nations [FAO], 2022; National Oceanic and Atmospheric Administration [NOAA] Fisheries, 2025).

The quality of the information remains equally important. A digital database containing incomplete or inaccurate information cannot automatically produce better management decisions. Therefore, digitalisation must be accompanied by proper procedures for data collection, verification, updating and responsible use.

3. Meaning and Scope of Digital Governance in Fisheries

Digital governance in fisheries includes the use of digital systems by fisheries departments, government agencies and authorised institutions for administration, information management, monitoring and service delivery.

Its scope may include:

- Digital registration of fishers and fishing vessels;
- Online licence applications and renewals;
- Electronic catch and landing records;
- Electronic logbooks and digital fishing diaries;
- Vessel Monitoring Systems;
- Automatic Identification Systems;
- Digital traceability;
- Digital communication and advisories;
- Online access to welfare and other government services; and
- Digital market and supply-chain information.

The purpose of digital governance should not be limited to converting paper documents into electronic records. A useful digital system should simplify procedures, improve access to information, reduce unnecessary duplication and support better coordination among institutions.

Where fisheries departments, harbour authorities, research institutions and other agencies require similar information, appropriate interoperability can reduce the need for fishers to repeatedly provide the same information to different authorities. Such systems, however, must operate within clear institutional and legal arrangements.

4. Major Applications of Digital Technology in Fisheries Management

4.1 Digital Registration and Licensing

Digital databases can assist fisheries authorities in maintaining updated records of fishing vessels, owners, crew and licence details. Online facilities may also simplify applications, renewals and document processing.

An organised digital record can make verification easier and reduce duplication. However, online systems should not create difficulties for fishers who have limited digital knowledge, poor connectivity or inadequate access to devices. Physical assistance and alternative service arrangements should remain available where necessary.

4.2 Electronic Catch and Landing Records

Catch and landing information is central to fisheries management. Digital systems can be used to record information relating to species, quantity, fishing effort, fishing areas and landing locations.

Electronic reporting can improve the speed with which fisheries-dependent information becomes available for analysis and management. NOAA Fisheries notes that electronic reporting can be used for landings, discard information and other fisheries data, while electronic technologies can improve the timeliness and efficiency of data collection (NOAA Fisheries, n.d.).

Electronic logbooks and digital diaries may be useful, particularly where manual recording creates delays or difficulties in processing information. However, the reporting system should be practical for the type of vessel and fishing operation concerned.

4.3 Vessel Monitoring, AIS and Safety

Vessel Monitoring Systems (VMS) can provide information on vessel position and movement and support monitoring, control and surveillance. Such systems may assist fisheries authorities in monitoring fishing activities and supporting compliance with applicable management measures (FAO, n.d.; FAO, 2022).

Automatic Identification Systems (AIS) and other location-based technologies also provide opportunities for monitoring vessel movement. In appropriate circumstances, digital location systems can support search and rescue, emergency response and fleet management.

The adoption of these technologies should take into account the diversity of India's fishing fleet. A system suitable for a large industrial vessel may not be suitable or affordable for every small-scale fishing operation. Training, maintenance and user support are therefore important considerations.

4.4 Digital Traceability

Traceability has become increasingly important in fisheries supply chains. Digital systems can record information at different stages, including landing, handling, processing, transportation and marketing.

A properly designed traceability system can support:

- Product identification;
- Food safety;
- Quality control;
- Market compliance;
- Supply-chain transparency; and
- Access to markets with specific traceability requirements.

Digital traceability should not become an additional barrier for small-scale fishers. Small producers, fishing cooperatives and small enterprises may require institutional and technical support to participate effectively in such systems. The wider experience of fisheries digitalisation shows that technological benefits can be unevenly distributed if access, cost and governance are not properly addressed (FAO, 2022).

4.5 Digital Delivery of Government Services

Digital governance can improve communication between fisheries departments and fishing communities. Information relating to licences, registration, welfare programmes, insurance and official notices can be made available through digital platforms.

Mobile-based communication may be particularly useful for providing timely information. Nevertheless, digital communication should supplement rather than completely replace other methods. Language, literacy, connectivity and access to devices must be considered.

Under the Pradhan Mantri Matsya Kisan Samridhi Sah-Yojana (PM-MKSSY), the Government of India seeks to bring more fisheries stakeholders into the formal system by creating digital identities linked to their work. The National Fisheries Digital Platform is intended to support this process and facilitate better access to fisheries-related services (Department of Fisheries, Government of India, n.d.)

4.6 Digital Platforms and Fisheries Marketing

Digital platforms can provide information about markets, prices and potential buyers. They can also support direct interaction between producers, consumers and institutional buyers.

For fishing cooperatives, digital marketing can create opportunities to:

- Share market information;
- Communicate with buyers;
- Promote fish products;
- Develop direct marketing channels; and
- Maintain customer and transaction records.

However, digital marketing alone cannot solve the marketing problems of the fisheries sector. Product quality, cold chain, transportation, packaging, market access and the capacity to meet buyer requirements remain important.

Digital platforms are most useful when they are combined with practical improvements in the fisheries supply chain.

5. Digital Governance and the Role of Fishing Communities

Fishing communities should not be considered merely as recipients or users of technologies designed elsewhere. Their knowledge and practical experience should contribute to the design and implementation of digital fisheries systems.

Fishers can help identify:

- Information that is genuinely required;
- Practical difficulties in data collection;
- Suitable reporting procedures;
- Local language requirements;
- Connectivity problems; and
- The actual conditions under which digital devices are used at sea and in landing centres.

Participation during the design stage can help prevent the introduction of systems that are technologically advanced but impractical for daily use.

Fishing cooperatives and fisher organisations can play an important role in this process. They can serve as local support points for members who require assistance with registration, digital applications, documentation and communication with government departments.

A cooperative-based approach may be particularly relevant where individual fishers have limited access to digital devices, internet connectivity or technical support. Cooperatives can help bridge the gap between government digital systems and fishing communities.

The expansion of digital governance in fisheries also presents several challenges.

6.1 Digital Literacy and Access

Digital literacy is not uniform among fishers and fisheries workers. Some individuals may use smartphones regularly, while others may have limited experience with digital applications.

The ability to read and use an application can also vary according to language and educational background. Systems designed without considering these differences may unintentionally exclude some users.

6.2 Connectivity and Infrastructure

Reliable mobile and internet connectivity cannot be assumed in all fishing areas. Offshore operations, remote landing centres and coastal settlements may experience communication difficulties.

Digital systems should therefore consider options for offline data collection, delayed transmission and local support arrangements where continuous connectivity is not available.

6.3 Cost and Affordability

The cost of devices, communication services, software, installation and maintenance may affect the adoption of digital technologies.

Where technologies are introduced as mandatory requirements, particular attention should be given to the financial capacity of small-scale fishers. A digital system intended to improve management should not impose a disproportionate burden on economically weaker sections of the fishing community.

6.4 Data Quality

Digital technology does not automatically guarantee reliable data. Incorrect entries, incomplete reporting and outdated records can reduce the value of the system.

Training, simple reporting formats and appropriate verification procedures are necessary. Data systems should also avoid collecting unnecessary information that does not have a clear administrative or management purpose.

6.5 Data Protection and Privacy

Digital fisheries systems may contain personal, financial and operational information. Clear arrangements are therefore necessary regarding data collection, access, storage, sharing and use.

In India, the Digital Personal Data Protection Act, 2023 establishes the legal framework for the processing and protection of digital personal data. As fisheries organisations increasingly adopt digital platforms and collect personal information, issues relating to data governance, privacy, and the responsible handling of such information need to be taken into account (Government of India, 2023).

6.6 Exclusion of Small-Scale Fishers

Perhaps the most important concern is digital exclusion. If licences, registrations, reporting or welfare services become entirely dependent on digital systems without adequate assistance, some fishers may face new barriers.

The objective of digital governance should be inclusion. Technology should make fisheries services easier to access, not more difficult.

7. Towards an Inclusive Digital Fisheries Governance Framework

The future development of digital governance in fisheries should be guided by practical requirements rather than technology alone.

7.1 User-Centred Design

Digital applications should be simple and suitable for actual fishing conditions. Language, literacy levels, type of fishing operation and availability of connectivity should be considered from the beginning.

7.2 Participation of Fishers

Fishers, cooperatives and fisher organisations should be consulted during the development and testing of new systems. Pilot testing can identify difficulties before a system is introduced on a larger scale.

7.3 Training and Local Support

Digital systems require continued support, not only initial training. Fisheries extension personnel, cooperatives, producer organisations and other local institutions can assist fishers in using digital services.

7.4 Interoperability

Where possible, different government systems should be capable of exchanging authorised information. Fishers should not be required to repeatedly submit the same information to different departments.

Interoperability must, however, be supported by clear rules concerning data access and responsibility.

7.5 Data Governance

Every digital fisheries system should have clear arrangements concerning:

- What data are collected;
- Why the data are required;
- Who is responsible for maintaining them;
- Who can access them;
- How long they are retained; and
- How privacy and security are protected.

7.6 Gradual Introduction

Digital transformation should be introduced in stages. Pilot projects, user feedback and periodic review can help identify practical problems before large-scale implementation.

This approach is particularly important in the diverse fisheries sector, where a single digital solution may not be equally suitable for all categories of fishing.

8. Opportunities for India

India has an opportunity to connect digital fisheries governance with broader fisheries development and institutional reforms. PM-MKSSY provides for technological intervention and the development of digital identities through the National Fisheries Digital Platform, while PMMSY has supported sustainable and responsible fisheries development through a broad programme framework (Department of Fisheries, Government of India, n.d.; Government of India,

2020).
The next stage should focus on making digital systems useful for the fisher. A practical digital fisheries framework could link, where appropriate:

Fishers → Fishing Vessels → Licences → Fishing Operations → Catch and Landing → Traceability → Markets → Welfare and Financial Services

Such a framework should not necessarily mean that every agency has unrestricted access to all information. Instead, it should be based on authorised access, clear institutional responsibilities and protection of personal data.
Fishing cooperatives can play an important role in supporting this process. They can assist members in accessing digital services, maintaining records, providing feedback and developing collective capacity to participate in the digital transformation of the fisheries sector.

9. Key Policy Considerations
The following considerations may be useful for developing digital fisheries governance:
1. Digitalisation should solve identified fisheries management problems. Technology should not be introduced merely because it is available.
2. Systems should be designed with fishers. Consultation and field testing are essential.
3. Small-scale fishers should receive special support. Digital requirements should not create exclusion.
4. Local languages should be used wherever possible.
5. Digital and non-digital support systems should operate together during the transition period.
6. Fishing cooperatives and fisher organisations should be recognised as important institutions for digital inclusion.
7. Data protection and responsible data governance should be incorporated from the beginning.
8. Different digital systems should avoid unnecessary duplication of information.
9. Training should be continuous and practical.
10. Digital systems should be regularly evaluated based on their usefulness to fisheries management and fishing communities.

10. Conclusion
Digital governance offers significant opportunities for improving fisheries management and administration. Digital registration, licensing, electronic catch reporting, vessel monitoring, traceability and digital communication can improve the availability and use of fisheries-related information.
At the same time, digital technology is not a substitute for sound fisheries institutions, reliable data or the participation of fishing communities. Poorly designed systems may increase costs, create reporting burdens and exclude fishers who have limited digital access.
The central issue is therefore not whether fisheries should become digital, but how digital systems should be developed and governed. The technology must be practical, affordable, inclusive and suited to the conditions of different fisheries. Fishing cooperatives and fisher organisations can play an important role in this transition by helping members access digital services, providing local support and ensuring that the experience of fishers is reflected in the development of new systems.

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