

Harnessing Digital Technologies to Revolutionise Malaysia's Fishery Sector

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1. Fishery Sector in Malaysia

The fishery sector in Malaysia is a cornerstone of the agrifood system, generating income, employment, foreign exchange, and a critical source of protein, particularly for rural and coastal populations. With a value-added of more than US\$3 billion, it contributes approximately 0.8% of the total GDP (8.9%), reflecting a notable increase from US\$726 million and 1.2% of GDP (9%) two decades ago. For decades, the sector has played a vital role in alleviating poverty and ensuring national food security.

The Department of Fisheries Malaysia (DOFM) has implemented several digital systems to enhance the management and sustainability of the fisheries sector. These systems include the Vessel Monitoring System (VMS), which uses satellite technology for the monitoring of deep-sea vessels, and the e-Logbook for accurate reporting of fish catches by location, species, and quantity. Additionally, the Malaysian Fishing Vessel Record (MFVR) streamlines vessel profiling for easier licensing and enforcement management. The e-Sampan system enables traditional fishers to renew their licenses through self-declaration, while the Fishing Site Identification (FSI) system has helped fishermen reduce fuel consumption by up to 30%, increasing their net returns. These digital advancements are critical in ensuring traceability, enhancing operational efficiency, and supporting sustainable practices within the fisheries industry.

Similarly, Lembaga Kemajuan Ikan Malaysia (LKIM) has launched digital solutions such as the FSI System, which predicts potential fishing zones using advanced applications and remote sensing technologies. The e-Nelayan system regulates subsidized fuel sales for fishermen, ensuring proper fuel use for fishing activities. The e-Dana platform facilitates loan applications for fishermen, while the e-Pengisytiharan system ensures accurate fish landing declarations, crucial for fuel subsidy management. LKIM's Sistem Pengurusan dan Kawalan Kompleks (SPKK) monitors fish landing sites, strengthening traceability and sustainability in the supply chain, while the Web Integrated Computerized Control System (W-ICCS) tracks fish imports and exports, ensuring transparency across the industry.

KEY POINTS

Economic Importance and Challenges

Malaysia's fishery sector, contributing over US\$3 billion to GDP and supplying essential protein to rural populations, faces challenges like climate change, low productivity from traditional methods, and limited market access, hindering its economic and food security potential.

Role of Digital Technologies

Digital systems such as VMS, e-Logbook, and FSI enhance efficiency, reduce costs (e.g., 30% fuel savings via FSI), and improve traceability, offering opportunities to scale innovation across the sector.

Barriers to Adoption

Digitisation benefits are hampered by an ageing workforce, poor internet in coastal areas, high digital tool costs, and fragmented data systems, limiting widespread adoption and transformation.

Policy Recommendations for Modernisation

Investments in digital infrastructure, targeted incentives, and interoperable systems, alongside public-private collaboration and capacity-building, are key to fostering a resilient, sustainable, and globally competitive fishery sector.

These digital systems are pivotal in modernizing Malaysia's fisheries sector, and they align with the broader goals of Digital Agricultural Technologies (DATs), which present a transformative opportunity to enhance productivity, ensure sustainability, and improve market accessibility. By scaling up digital initiatives like these, fostering innovation ecosystems, and establishing supportive regulatory frameworks, Malaysia can unlock the full potential of its fisheries, addressing challenges while promoting growth and sustainability. However, this vital sector faces mounting pressures from environmental change, resource inefficiencies, and evolving consumer demands. These challenges threaten its sustainability and the livelihoods of millions who depend on it.

BOX 1: Digital Systems under Department of Fisheries Malaysia (DOFM)

1. Vessel Monitoring System (VMS) - the monitoring system for C2 vessels (deep-sea) uses satellite systems as one of the vessel licensing and equipment renewal methods.
2. e-Logbook - Reporting of fish catches by location, quantity, and species.
3. Malaysian Fishing Vessel Record (MFVR) (vessels profiling) - Allowing vessel profile display for easier licensing and enforcement management.
4. e-Rekreasi - Registration and licensing of recreational fishermen and fishing competition organization.
5. e-Lesen (vessel license application) - the Malaysian fishery vessel licensing management system.
6. e-Sampan - allowing traditional boat fishers to renew their licenses through the self-declaration concept.
7. e-SMPP - collects and reports data on marine fish landings, aquaculture and inland, efforts, and price.
8. Fishing Site Identification (FSI) - use of tracking for small pelagic fish has been adopted by some Malaysian fishermen, especially on the Peninsula, since 2010. Research findings indicate that fishermen can save up to 30% in fuel consumption, resulting in a net return of nearly 20% above the usual.
9. Electronic ASEAN Catch Documentation Scheme (eACDS) - system developed with SEAFDEC at regional level which the purpose is for commodity export to EU. ASEAN Catch Documentation Scheme (or ACDS) is one of fisheries management tools to improve traceability for marine capture fisheries and enhance intra-regional and international trade of the ASEAN Member States (AMSs). The development of ACDS formed part of the ASEAN Guidelines for Preventing the Entry of Fish and Fishery Products from IUU Fishing Activities into the supply chain.
10. Fisheries Mobile Information Package (FISHMiP) - The Malaysian Fisheries Zone Mapping System for digital mapping of fishery capture zones and the designation of molluscs lots on the coast.
11. MyFirst - Fisheries management information system that integrates information from Marine Parks and Resource Management into a single digital system with integrated data and spatial data displays that will assist the Department in viewing the perspective of fisheries resource management and Marine Parks in a holistic manner.

BOX 2: Digital Systems Under Lembaga Kemajuan Ikan Malaysia (LKIM)

1. FSI System - This system can predict and determine the potential fishing zone over time by using effective applications and devices. This programme was developed through collaboration between LKIM, NEKMAT, DOFM and the Malaysian Remote Sensing Agency (ARSM).
2. e-Nelayan - A control mechanism for subsidized fuel sales ie. diesel and petrol, and monitors the implementation of the schemes, for fishermen in Malaysia. All vessel information and transactions are recorded through this system.
3. e-Dana - An online loan application for fishermen and Fisherman's Association. This system aims to facilitate loan application matters, loan monitoring and loan performance reports.
4. e-Pengisytiharan - was developed to record all vessel owners' fish landing information to determine the catch incentive payment eligibility and at the same time ensure that the fuel subsidy is used only for fishing activities, by requiring the declaration of landings before the purchase of fuel subsidy.
5. Sistem Pengurusan dan Kawalan Kompleks (SPKK) - LKIM carries out a fish landing site monitoring programme at 25 fisheries complexes out of 48 in Malaysia. From a domestic perspective, this programme is aimed at strengthening the existing management system and adding control elements for stakeholders at fish landing sites, including fishing boats/vessels, users, and vehicles. This programme would be an ideal to support the traceability in the fisheries sector in Malaysia with the ability to track seafood products from their source of origin to the consumers, ensuring transparency, accountability, and sustainability throughout the supply chain.
6. Web - Integrated Computerized and Control System (W-ICCS) - monitoring import and export of fish and gathering all relevant information related to registered importers and exporters with LKIM in Sabah and Sarawak.

2. Challenges in the Fishery Sector



2.1 Environmental Pressures

The impacts of climate change are increasingly evident in Malaysia's marine ecosystems, profoundly affecting the fishery sector. Rising sea surface temperatures and ocean acidification are altering marine habitats, leading to shifts in fish migration patterns and spawning grounds. For instance, certain fish species are moving to cooler waters, making traditional fishing zones less productive. Additionally, the increasing frequency and intensity of extreme weather events, such as monsoons and typhoons, disrupt fishing activities and damage critical infrastructure like boats, nets, and storage facilities. These environmental challenges not only reduce fish stock availability but also jeopardise the livelihoods of small-scale fishers, who often lack the resources to adapt to such changes. The cumulative effect is a decline in income stability and food security for communities dependent on fisheries.

2.2 Low Productivity

Fishers especially the small-scale fishers in Malaysia face persistent productivity challenges due to limited access to modern tools and digital technologies. Traditional fishing methods often rely on guesswork and manual techniques, resulting in suboptimal yields and higher operational costs. Furthermore, the lack of integration of technologies such as GPS-enabled tracking, automated sorting systems, or smart aquaculture practices hampers efficiency across the value chain, from capture to processing and distribution.

Labour productivity in the fishery sector lags significantly behind other industries, reflecting the sector's slow digital transformation. This stagnation not only affects individual fishers' profitability but also limits the sector's contribution to national economic growth. Without targeted interventions to modernise fishing practices, productivity gaps will likely widen, further marginalising small-scale operators.

2.3 Market Barriers

Access to markets remains a significant challenge for fishers in Malaysia, largely due to a lack of timely and reliable market information. Many fishers operate without adequate data on consumer demand, pricing trends, or buyer requirements, leading to inefficiencies in selling their catch. The absence of robust traceability mechanisms further exacerbates their challenges, particularly in meeting the stringent quality and sustainability standards demanded by export markets. For example, international buyers often require verified information on the origin and handling of fish products, which small-scale fishers find difficult to provide. Price volatility adds another layer of complexity, as fishers lack the tools to predict and respond to market fluctuations effectively. These barriers not only limit the competitiveness of small-scale fishers but also create an uneven playing field that favours larger, better-equipped operators, widening inequalities within the sector.

These issues necessitate urgent action to modernise the fishery sector through the adoption of DATs, which can address these challenges holistically.

3. Analysis of Digital Technologies in the Fishery Sector

3.1 Potential Benefits

Digital technologies can transform Malaysia's fisheries in several ways. Real-time monitoring through IoT sensors and satellite imagery enables fishers to identify optimal fishing zones while reducing overfishing and bycatch. Blockchain technology enhances supply chain traceability, allowing fish products to meet international eco-certification standards. Additionally, digital platforms can connect small-scale fishers to markets, improving their ability to secure fair prices and access financial services.

Case Study:

Super-intensive shrimp farming in Malaysia has shown how DAT integration can yield significant results. This innovative approach, which uses automated feeding systems, water quality sensors, and AI-driven disease monitoring, has boosted productivity by 26% per hectare. The success of this pilot programme demonstrates the scalability of similar technologies across other fishery segments.

BOX 3: Pilot Project of Digital Solutions for Super-Intensive White Shrimp Farming

Super-intensive shrimp farming is a technology developed based on high-density shrimp farming research conducted by Fisheries Research Institute under Department of Fisheries Malaysia (DOFM) in Gelang Patah (2016-2019). Typically, each hectare of farming area only yields between 10.0 to 15.0 tonnes of white shrimp, while the super-intensive technology produces up to 40.0 tonnes in the same area.

PILOT DESIGN MARINE AQUACULTURE

FARM PROFILE

Land area: 1.2 acres of private ownership

Facilities:

- a) Tanks 1,000 m² @ 0.1 ha: 4 units (1 unit under construction)
- b) Tanks 500 m² @ 0.05 ha: 2 units (1 unit under construction)
- c) Tanks 300 m² @ 0.03 ha: 2 units
- d) Treatment pond 2,000 m² @ 0.2 ha: 1 unit

Tank structure:

BRC A10 steel frame, 4 x 4 concrete pillars, 1.0 mm HDPE lining
 Stocking density: 300 - 400 super PL per m²
 Rearing period: 2 - 3 months
 Survival rate: 70 - 80%
 Size: 50 - 60 shrimps per kg or 16.7 - 20.0 grams per shrimp

Tank size, release rate, and yield:

- a) 1,000 m² @ 0.1 ha: 300,000 - 400,000 super PL: 3.0 - 4.0 MT
- b) 300 m² @ 0.03 ha: 100,000 - 120,000 super PL: 1.0 - 1.8 MT

Production: 15 MT (April - September 2021)
 Production targets (per cycle): 4 MT (0.05 ha tanks), 8 MT (0.1 ha tanks)
 Number of employees: 14 people
 Technology: IOT system (trial phase)

THE BASELINE SITUATION

IoT System that managed the shrimp farm and adhere to the MyGAP Certification Scheme (MS 1998:2007 - Good Aquaculture Practice (GAQP) - Aquaculture Farm General Guidelines) under DOFM.

- Cost per IOT system = Estimated RM30,000
- Return of investment = 1 year
- Production increase = 10-20%
- Reduction in labor = 1 worker for night supervision. Reduction in labor cost around RM30,000 per year.
- Farmer can control their equipment remotely (on and off) & have a real time update

THE IMPROVED SITUATION

KEY FEATURES

- Data Analytics**
Interpret and use real-time data to drive informed decision making across your business.
- Scheduled Reports**
Deliver PDF or Excel data clearly, concisely, and Regularly
- Mobile Operation**
Allows freedom to work remotely with laptop and smartphones
- Notifications**
Add conditional business logic to your hardware with triggered alerts to keep operators informed

*Note: This technology is a component of the Smart Aquaculture System, provided to selected industries by the Malaysia Digital Economy Corporation (MDEC) in collaboration with DOFM.

4. Challenges of Digitization in the Malaysian Fish Industry

There are five key challenges facing Malaysia's fishing industry:

- The fishing community is aging, posing another challenge. LKIM statistics from 2017 show that out of 51,608 fishers in Malaysia, 14.7 percent were aged 65 years or over. Meanwhile, the highest percentage of fishers is those between 41-64 years old (59.4 percent). Younger people aged between 15-40 accounted for 24.9 percent of fishers and were more interested in the technology and tourism industries than fishing (Omar & Chhachhar 2012; Shaffril et al. 2011; Ramli et al. 2013; Bolong et al. 2013). Cultural, social, and behavioural factors also can influence acceptance and willingness to go digital. Efforts to raise awareness, demonstrate benefits, and address concerns are essential to overcoming resistance and fostering digital thinking.
- Reliable internet connectivity and digital infrastructure can be challenging to access, especially in remote coastal areas, where fishing communities are based. Poor connectivity hinders the implementation and use of digital technologies and can limit the scope and effectiveness of digitization efforts.
- Digital technology requires a certain level of technical knowledge and skills. Fishers and industry players can face challenges in adapting to new technologies, understanding how to use digital tools, and leveraging data-driven solutions. Appropriate training and capacity-building efforts are essential to closing the skills gap and accelerating technology adoption.
- Digitization has up-front costs associated with acquiring and implementing digital systems such as sensors, surveillance devices, and software solutions. These costs can be a barrier, especially for small-scale fishers and those with limited financial resources (i.e., VMS equipment). Ensuring affordable and accessible digital solutions is key to widespread adoption.
- Multiple actors - including fishers, government agencies, processors, and traders - are involved in fisheries. Ensuring compatibility and interoperability of digital systems and data formats across different entities and platforms can be a challenge. Achieving seamless data sharing (transparency), collaboration, and interoperability requires a standardization effort.

5. A Framework to Promote Digital Solutions to Improve the Fisheries Sub-Sector

Implementing a digital platform for fisheries in Malaysia requires a well-thought-out strategy that addresses the specific needs and challenges of the domestic fisheries sector.

Digital solutions can greatly improve fisheries governance by enhancing transparency, sustainability, and efficiency in the management of fisheries resources. Below are several digital initiatives that can be employed to enhance fisheries governance:

CHALLENGES	INITIATIVES	OUTCOMES	TARGETS
Data Infrastructure & Collaborative Data Sharing Platforms	Government should foster a robust data infrastructure to support data collection, storage, sharing, and analysis as to ensure data interoperability and compatibility between different systems and stakeholders	Integration data system platform within an organization	<ul style="list-style-type: none"> One digital system under DOFM One digital system under LKIM i.e Fisheries Management Information Systems (FMIS)
Scalable & Flexible Systems/ Programmes	Any systems/programmes created should be scalable and flexible, allowing for future expansion as the fisheries sector grows and evolves (changes in regulations, technology advancements, and stakeholder needs)	Modular System Architecture (MSA) which allows for easy integration of new features, technologies, and data sources as they become available or necessary	<ul style="list-style-type: none"> Fishing Site Identification System (FSI) which could be expanded by including more features like weather forecast, zoning alarm, etc. Integration of e-Lesen and MFVR (a collaboration between DOFM and LKIM)
Monitoring & Evaluation System	Implement a system for continuous M&E of the platform's performance and impact on fisheries management, using data-driven insights to make informed decisions for improvements and adjustments	A comprehensive framework to measure the effectiveness of the systems/ programmes developed by an organization (as suggested in Box 3)	<ul style="list-style-type: none"> Regularly assess the cost-effectiveness and benefits of programme components (every three to five years) to determine whether adjustments or reallocations of resources are needed i.e Cost Benefit Analysis (CBA)
e-Extension	Essential for the Malaysian fisheries sector as it addresses various challenges, supports sustainable practices, enhances productivity, and contributes to the overall development of the industry	Helps fishers adapt to changing conditions and align with the country's goals or sustainable fisheries management and economic growth	Engage local fishing communities in monitoring and data collection through digital tools and extensive training programmes, fostering a sense of ownership and responsibility for sustainable fisheries

6. Policy Recommendations

6.1 Infrastructure Investments

Addressing the digital divide is critical to unlocking the potential of DATs in fisheries. The government should prioritise expanding internet connectivity in coastal and remote fishing areas, enabling real-time access to market data, weather forecasts, and stock management tools. Additionally, investing in marine monitoring systems integrated with DATs can support sustainable fish stock assessments and enhance compliance with regulations.

6.1 Innovation Ecosystem Development

The government must foster a robust ecosystem that supports fishery-specific technological innovations. Initiatives such as accelerators and incubators should focus on developing digital solutions for market linkages, traceability systems, and predictive analytics. Partnerships between private technology firms and fishing cooperatives can drive innovation and ensure that solutions are tailored to the needs of fishers.

6.3 Creating an Enabling Environment

Policy reforms are needed to incentivise the adoption of DATs. These could include subsidies for purchasing digital tools, tax incentives for adopting eco-friendly technologies, and grants for capacity-building programmes. Furthermore, implementing blockchain systems to ensure traceability will help Malaysian fish products comply with international standards, such as the EU's Deforestation-Free Products regulation, thereby boosting export opportunities.

7. Conclusion: Advancing Malaysia's Fisheries Through Digital Innovation

The adoption of Digital Aquaculture Technologies (DATs) promises significant advancements for Malaysia's fishery sector. In the immediate term, these technologies are anticipated to enhance operational efficiency, minimise post-harvest losses, and boost profitability for fishers. Over time, DATs will bolster the resilience of Malaysia's fisheries against environmental disruptions, expand export potential, and position the nation as a global leader in sustainable fishery practices.

To realise these outcomes, policymakers, industry leaders, and stakeholders must actively prioritise the sector's digital transformation. By addressing existing barriers to technology adoption and implementing strategic recommendations, Malaysia can fully leverage digital innovation. This concerted effort will not only ensure a resilient and productive fishery sector but also enable the country to meet the evolving demands of domestic and international markets.

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