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Sustainable Small-Scale Marine Fishing Resources and Communities in Kerala, India

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Context for the research project

Approximately 3.3 billion people rely on fish for ~20% of their protein intake; nearly 60 million people are employed in the primary sector of fisheries and aquaculture, associated value chains support over 100 million full and part-time jobs; and one in two fishworkers are women (FAO 2022). Yet globally wild fish stocks are in decline. The oceans and viability of marine fisheries are under threat from rapid declines in biodiversity and intensifying human impacts (IPBES 2022), and increasingly unsustainable and unequitable fisheries (FAO 2022). The vital importance of improving ocean health for people and nature is well-recognised in the United Nations Sustainable Development Goals 5, 10, 12 and 14, Convention on Biological Diversity, and in the current Decades of Ocean Science and Ecosystem Restoration.

In Kerala, fishing is a significant economic activity providing livelihoods to thousands of fisher men and women and supporting the state's economy. While the mechanized sector dominated by trawlers contributes significantly to fish catches, small-scale fisheries contribute to the bulk of catches of sardine, mackerel and anchovies (Abdussamad et al. 2015). However, the livelihoods of small-scale fishers have been affected by decline of Indian oil sardine landings in Kerala from 3,22,103 t in 2011 to a meagre 13,154 t in 2020, though there has been a subsequent increase in sardine landings.

The rich and unique coastal ecosystem of Kerala is impacted by: increasing frequency of extreme climatic events; and human factors such as increased presence of plastics and other litter (Damaris et.al., 2019; Lekshmi, 2023), overfishing and fishcatch of juveniles due to increased demand in local and international markets, and habitat degradation resulting from coastal development activities. Declining marine fishing livelihoods is resulting in fishers seeking alternative occupations and migration to urban centres.

The Kerala government has implemented various marine fisheries regulations since the 1980's with the aim of improving the condition of fisheries resources in the state, to promote sustainable fishing practices, and to promote alternative livelihoods for fishermen. Some of these regulations include:

- Stipulating the mesh sizes and the total dimension of the fishing gear used, including restrictions on the size and number of fishing vessels and the engine power
- Seasonal ban for certain class of vessels coinciding with the breeding season of fishes
- Zone wise demarcation for different classes of vessels
- Minimum legal sizes for fish that can be harvested

Also noteworthy in Kerala is the formation of State Fisheries Management Committees (SFMCs) at three different tiers, beginning at the village level up to the state level. This structure provides a vehicle to integrate needs from the grassroots level that can be considered through a regional focus at the state-level SFMCs, which meet every six months. This is the first initiative of its kind in the nation, and it has enormous potential for citizen involvement in fisheries management decision-making.

Despite these efforts, the fishing ecological system in Kerala continues to face significant challenges resulting from increasing demand for fish, the lack of effective enforcement of fishing regulations, and the degradation of marine habitats. Understanding local socio-economic, cultural and political contexts small-scale fisheries operate within, is vital to understanding opportunities and barriers to potential interventions to facilitate adaptation and build resilience among marine fishing communities in Kerala.

About the study

Research findings and key recommendations are based on the project 'Food, Gender, Enterprise: leveraging interdisciplinarity for sustainable small-scale fisheries'. The project leveraged engineering and social science methodologies to create understanding of the social and technological solutions needed to enhance capacities for adaptation, develop resilience and sustainably manage small-scale fisheries resources.

Acknowledgments

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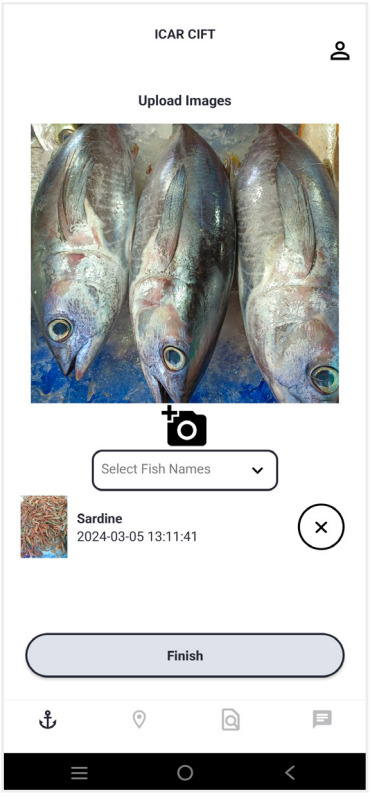

Image: The Fishing App

Key findings

Trends in the fishing ecological system in Kerala:

Historical fish stock data, from the ICAR-Central Marine Research Fisheries Institute (ICAR-CMFRI), on Indian oil Sardine and Indian Mackerel for the major fishing harbours of Ernakulum District, Kerala for the period 2002-2021 indicate substantial drop in certain years (Figures 1 and 2). Such variations can be explained by natural climate events (see Figure 3: infographic time- line). After any extreme climate event there is a sharp decline in fish catch, which take time for recovery.

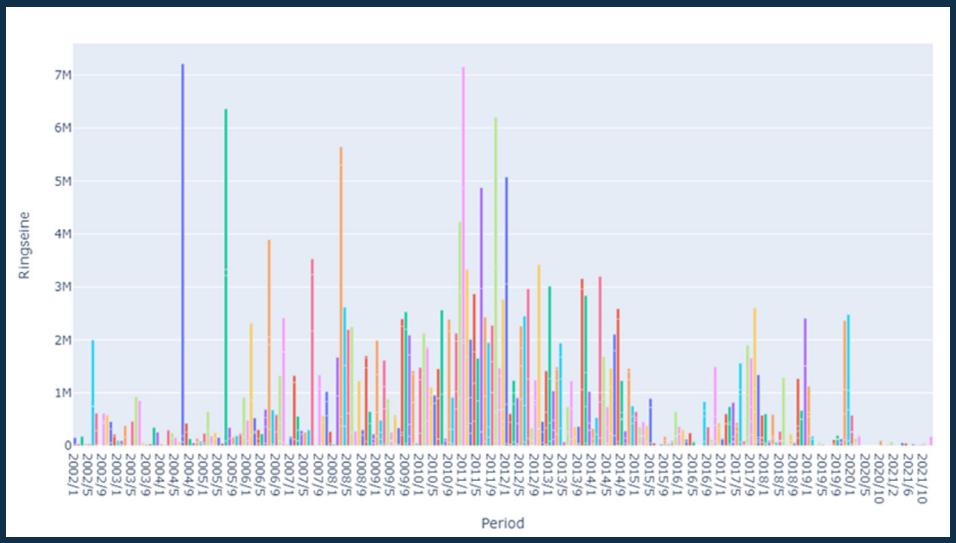

Figure 1: Oil sardine catch (kg) from Ringseiners in Ernakulam, between 2002-2021 (data source: CMFRI).

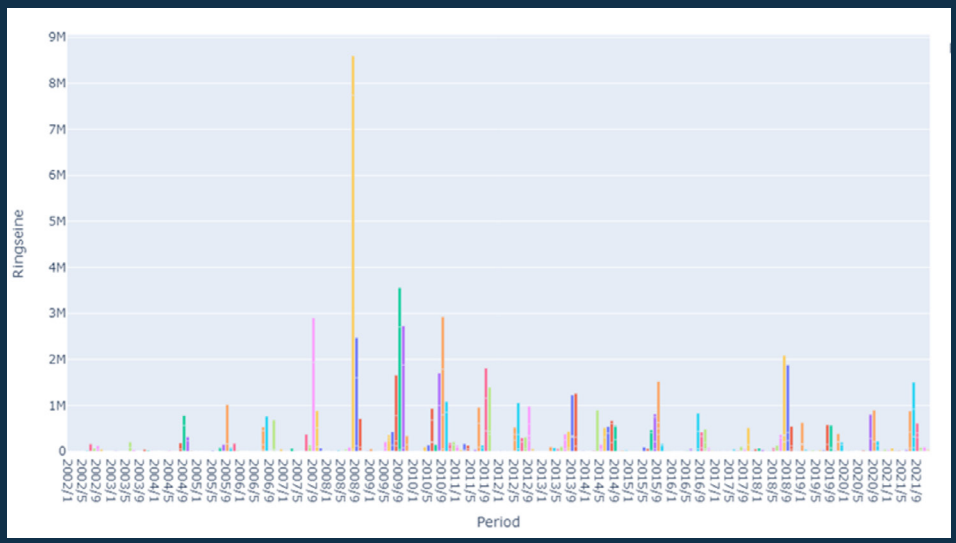

Figure 2: Mackerel catch from Ringseiners in Ernakulam, between 2002-2021 (data source: CMFRI).

Figure 3: Infographic time-line indicating key extreme weather events.

Figures 1 and 2 also indicate a gradual decline in sardine and mackerel fish stocks after 2015. Despite measures introduced since the 1980s by Kerala state to improve fisheries resources and promote sustainable fishing, the decline of fisheries resources in Kerala suggests the influence of other environmental factors, such as changes in water temperature, salinity, ocean currents, and pollution, which can lead to drastic changes in the catches of Indian sardine and its population dynamics.

Our findings suggest that longer term studies including collection of real time data on water parameter from fishing grounds would help in understanding correlation between variability in fish catches and ocean environmental factors in determining fish abundance and longer-term sustainability.

Trends in socio-economic and cultural changes in small-scale fishing in Kerala:

We employed qualitative research methods to understand the socio-economic and cultural changes that small-scale fishing community of Chellanam, on the coast of Kerala, has experienced. Chellanam is a major small-scale fish landing centre of Kerala with about 150 motorized ring seine fishing boats, followed by fishers using gill netting and cast netting. Fishermen are mainly dependent on marine fisheries for their livelihood, but during the lean period they also depend on the brackish water resources.

Convergence of the challenges highlighted below has led to a decrease in incomes for small-scale fishers (Natarajan et al. 2023) and has prompted a shift of local labour away from the fishing sector to other occupations in urban areas in recent years.

CHALLENGES: FISHERMEN

Ring seine fishing

- Increasing incidence of dolphins damage fishing gear, which results in reduction of number of fishing days due to time needed for repairs of the gear.
- High incidence of plastics, including Abandoned, Lost or otherwise Discarded Fishing Gear (ALDFG), and from terrigenous sources, and increased prevalence of jellyfish in the grounds clog fishing nets that affect the efficiency of fishing operations.

Climate change

- Frequency of cyclones has increased, resulting in significantly reducing the total number of effective fishing days. This is leading to loss of income from fishing.
- Increased frequency of extreme weather events requires improvement in the accuracy of the prediction system for adverse weather conditions.

Anthropogenic

- Extensive destruction of mangrove forests due to siltation and activities associated with shrimp farming and other anthropogenic activity like building construction. This has contributed to declining fish catches as mangrove forests which are crucial habitats for the juveniles of fish and shrimp growth.

CHALLENGES: FISHERWOMEN

Climate change

- Increasing unpredictability of weather in recent years, notably irregular rainfall patterns and inconsistent sunlight availability, presents significant work challenges for fisherwomen. Inadequate sunlight during drying leads to reduced shelf life for fish with high fat content. Drying fish now needs regular monitoring to prevent fish spoilage due to unexpected rainfall.
- Challenges associated with climate change coupled with fluctuating availability of fish, impact income and undermine any attempts at economic planning.

Maintaining quality in fish drying

- Insect and microbial infestations and contamination caused by animals also lead to fish spoilage and resultant loss of income.

Infrastructure facilities

- Fisherwomen do not have access to adequate facilities that will enable them to use solar fish driers.
- Driers need to be constructed of materials that can withstand damage due to the highly corrosive coastal environment and must be easy to handle and store after use.
- Access to secure storage facilities, potable water, and transport for carrying fish are limited.
- Bulk fish drying is a challenge due to space limitations that do not allow fisherwomen to implement adequate waste management procedures.

Key recommendations for future research

Our overall recommendation is to enhance research funding for developing appropriate technologies to combat multiple challenges in fishing operations:

- Development and popularisation of appropriate dolphin-safe technologies and bycatch reduction devices.
- Explore possibilities for development of bioactive compounds of high value from bycatch in general, and jellyfish in particular.
- Research funding for development of accurate system of weather forecasting.
- Research funding for:
  - development of small scale IoT/AI based sensors as an effective technique for measuring real-time ocean parameters to correlate variability in fish catches with such parameters will help with data validation.
  - encouraging fishers to use mobile phone apps, such as that featured at **https://www.youtube.com/watch?v=mxgI6IcfofU&ab_channel=PublicPolicySouthampton**, as an easy method to collect valuable real-time data on fish catch, location and ocean parameters.
  - analysing longitudinal data on quantity, quality and location of fisheries resources generated from fishers' use of mobile phone app.
  - development of smart and convenient technologies for women in fish processing
  - impact of dredging activities on fishing grounds
  - development of location specific small-scale drying and storage equipment/technologies.

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