



## ICT, Labour, and Livelihoods in Kerala's twin fishing harbours

Manju J Manoj<sup>1</sup>, Anupam Sankar M S<sup>2</sup>

<sup>1</sup> Research scholar, Department of Anthropology, University of Hyderabad, Telangana, India

<sup>2</sup> Research scholar, Department of Sociology, University of Hyderabad, Telangana, India

### Abstract

The study examines the impact of technological adoption on fishing practices and livelihood patterns in the Latin Catholic fishing communities of Shakthikulangara and Neendakara, Kerala, India. This research investigates how tools such as GPS, echo-sounders, wireless communication devices, and mobile phones reshape occupational choices and social dynamics. Quantitative correlations between tool usage and duration of fishing operations reveal significant trends. The study finds that while tools like GPS and wireless have achieved wide adoption due to affordability, usability, and efficiency, others, such as radar and BRDs, remain underutilised due to cost and lack of institutional support. ANT allows for the analysis of how fishermen, technologies, and market actors co-constitute each other, forming dynamic livelihood assemblages. Findings suggest that the integration of new technologies not only improves operational efficiency but also transforms social relationships, access to resources, and alters attitudes towards fishing operations due to capital-intensive technology. The study concludes with a call for participatory, policy-driven technological support to ensure inclusive and sustainable growth in these coastal communities.

**Keywords:** Actor-Network Theory, Fishing Technology, Kerala, Twin Harbour, Livelihoods, ICT Tools, Coastal Communities, Modern Fishing Gears

### Introduction

Implementation of the Indo-Norwegian Project (INP) marked an important milestone in the transformation of the villages of Neendakara and Shakthikulangara in Kollam district of Kerala, drawing from the fishing economy, setting a series of technological and structural changes. ICT (Information and Communication Technologies) supports and enhances various stages of the fisheries value chain, from locating fish and navigating through water to market access and communication, contributing to the increase of productivity, safety, and income of fishing communities. ICT tools are used in every stage of fisheries, from resource assessment, capture or culture, to processing and commercialisation. Those technologies facilitate communication, processing and transmission of information by electronic means (FAO, 2007). It was since the 1990s that the ICT revolution has swept the world. In accordance with the NSO report of 2010, ICT tools have repercussions on socio-economic, political, cultural, environmental, ethical and behavioural divisions of an economy. The progression of technology, especially ICT, has brought about systematic change since the new economic policy of 1991, including in primary sectors like agriculture and fisheries.

The ICT integration into fisheries, though started in the early 2000s, it found momentum after 2010. Early ICT breakthroughs included fish finders, early weather warning systems, GPS navigation, and mobile phones for market price updates. A frequently cited instance (Jensen, 2007<sup>[7]</sup>; Abraham, 2006)<sup>[1]</sup> of ICT influence in India comes from Kerala is about how the use of mobile phones in the early years of the 21st century reduced price volatility and increased market efficiency significantly. By using these techniques, fishermen were able to determine markets with high demand before landing, reducing post-harvest losses and transportation time. At first, adoption was irregular and

mostly restricted to owners of mechanised boats. Economic limitations, a lack of digital literacy, doubts about dependability, and a generational divide in technology receptivity were some of the reasons for the resistance.

Mobile apps, e-auction systems, SMS-based advisories (e.g., by INCOIS), and WhatsApp groups for crew coordination have become increasingly common in study villages in particular and Kerala in general. But the adoption remains largely uneven. Studies from Vietnam, Indonesia, and various locations of West Africa reveal that the initial resistance gradually shifts to large-scale acceptance as the benefits are yielded, such as efficient weather forecasting, price negotiations, bringing better association among suppliers and traders, etc. However, the access is affected by social stratifications of gender, class and technological infrastructure. Women's engagement in ICT-enabled decision-making is low, especially in environments where fishing is still male-dominated. The digital gap remains a challenge, especially for small-scale and artisanal fishermen in distant coastal settlements. Thus, while ICT technologies have increased efficiency and empowered many fishermen, their adoption is heavily controlled by local social, economic, and gendered dynamics.

### Significance of the study

This paper adds to the existing literature in the field of anthropology, engaging in a critical analysis of the role of technology in transforming or maintaining social relations and livelihood. This paper particularly focuses on the fisheries economy of Kerala, drawing from the author's ethnographic study, hence the context-specific exploration of ICT integration in the Twin harbours of Neendakara and Shakthikulangara. Despite the policy focus on "smart fisheries" and digital empowerment, the study finds that social inequalities continue to exist, often reproducing in the uneven adoption and access of technology. In consideration

of social control and access to ICT, this paper argues for an inclusive and sustainable adoption of technological modernisation in the fisheries sector.

### Research Problem

The research problem it addresses is twofold: the first, how ICT tools (such as GPS, wireless, and echo-sounders) are transforming the technological landscape of fishing. Moreover, the second is how this technological shift reconfigures access to resources, labour hierarchies, and gendered patterns of inclusion and exclusion.

### Review of literature

The interplay between technology, social organisation, and economic development in the fisheries sector has long been a subject of anthropological, economic, and development studies. The literature reviewed here discusses the historical trajectories of technological transformations and the integration of ICT in the fishing economies concerning particulars of Kerala and India.

Foundational ethnographic work such as *The Lobster Gangs of Maine* by Acheson (1988) [2] illustrates how fishing communities form complex, non-market social organisations to manage resources, emphasising that economic activity in fisheries is embedded in cultural and social relations. Similarly, Mathur's (1977, 2008) [10, 11] studies on the Mappila fisherfolk of Kerala detail how ecology, technology, and social organisation have co-evolved, showing both continuity and change in response to environmental pressures and policy interventions. These ethnographies underscore the importance of understanding technological change not just as innovation adoption, but as reconfiguration of labour, knowledge systems, and community structures, a perspective echoed in more recent works such as Tsing's (2005) [17] *Friction*, which frames global technological connections as negotiated and contingent.

The modernisation and mechanisation of fisheries in India raise critical questions on their sustainability and social equity. Findings of Bindu and Rajasenan (2011) [3] suggest that modernisation has disproportionately benefited the capital-intensive fishers, whereas the traditional and small-scale fishers are increasingly marginalised. Gopal, Hapke and Edwin (2023) [6] raised similar concerns on the effect of mechanisation, reinforcing the gender relations and community control over the marine commons. At a broader level, Fabinyi *et al.* (2020) [5] argue that human-ocean relationships must be understood through lenses of governance, culture, and justice, rather than narrow techno-ecological perspectives. Menon, Sowman, and Bavinck (2018) [12] further critique the capitalist restructuring of fisheries in India and South Africa, showing how privatisation and commodification have deepened exclusion and vulnerability.

The introduction of ICT tools such as mobile phones, GPS, echo-sounders, and mobile applications is celebrated for increasing market access and reducing uncertainty in the fishing economy. The use of mobile phones itself, Jensen (2007) [7] argues, has reduced the price dispersion and resulted in improved welfare among the South Indian fishermen. And Abraham (2006) [1] highlights the role of mobile phones in improving economic decision-making, particularly in volatile market environments. However, later studies complicate this narrative. Srinivasan and Burrell

(2013) [16] argue that such gains are often overstated and that the social structures of fishing labour, like boat-owner hierarchies, mediate the benefits of ICTs. Sabu and Saijumon (2017) [13] extended a practical critique, sharing empirical data on how the utility of GPS and mobile phones varies across the crafts with the varying degree of mechanisation shaped by the affordability, skill levels, and crew roles. Using the Analytic Hierarchy Process (AHP) model, Sabu, Saijumon, and Rajesh (2018) [15] demonstrate that GPS that the rates were higher as the perceived reliability and risk reduction capacity. A later study by the same authors (Sabu and Saijumon, 2019) reinforced these findings, raising concerns about the sustainable dependency on the technological infrastructure.

Through a case study of the Malappuram district of Kerala, CP, Rao, and Nirmala (2022) demonstrate that even with advanced technology, deteriorating living conditions persist due to inadequate institutional support and unfair benefit distribution. From a political economy perspective, Gopal *et al.* (2023) [6] argue that technological change in fact has intensified labour exploitation and weakened traditional community governance mechanisms, accounting for unequal distribution of access, risk and profit.

On a different regional setup Williams and Staples (2010) [18] discuss how overcapitalisation, overfishing and inequitable access challenge the sustainable fisheries sector in Southeast Asia, echoing similar concerns to those of Kerala. Mathew and Verghese (2019) [9] provide a trend analysis of fish production in Kerala, showing how catch fluctuations are increasingly tied to both ecological pressure and technological saturation.

The existing studies overlooked the everyday social negotiations that shape how such technologies are accessed and utilised within fishing communities. While the impacts of tools like GPS and mobile phones have been measured in economic terms, there is limited ethnographic attention to how they reconfigure labour, authority, and inclusion, especially in this context. This research addresses that gap by examining how ICT tools are embedded in local livelihood strategies and socio-technical hierarchies, analysing uneven adoption and implications of such tools.

### Methodology

This study adopts a qualitative, ethnographic methodology grounded in long-term fieldwork conducted in the Latin Catholic fishing communities of Neendakara and Shaktikulangara in Kerala's Kollam district. Both harbours have witnessed early and intensive technological transitions, particularly due to the Indo-Norwegian Project. These harbours are spatially adjacent and functionally integrated to work as a single fishing complex. This paper locates ICT use within a broader context of everyday life experience, recognising that technological adoption is a social process rather than simply a technical reformulation.

A mixed-method approach, combining participant observation, semi-structured interviews, focus group discussions (FGDs), and time-use surveys, was employed for data collection. To ensure representation across the occupational roles, age, and gender purposive sampling strategy was used. Particular emphasis was placed on intergenerational narratives, comparing the experiences of fishermen tracing transformations in labour, mobility, and access to ICT tools over time.

Fishermen in both mechanised boats and artisanal boats were asked about the ICT tools they deploy in fishing on a day-to-day basis. Sixty fishermen from motorised boats and sixty fishermen from mechanised boats were asked questions about which ICT tools they were using and asked to scale their preference for particular ICT tools. Respondents were asked to scale each ICT tool on a scale between 1 and 10 according to their preference for daily usage among both motorised and mechanised boats. GPS was preferred the most among the mechanised boats. Meanwhile, artisanal fishermen primarily preferred mobile phones. Special attention was given to tools such as GPS, echo-sounders, wireless radios, and mobile phones, including their adoption trajectories, usage patterns, and social meanings.

This methodological design was guided by Actor-Network Theory (ANT) in a loose conceptual sense, acknowledging that technologies are not passive tools but active mediators that reconfigure social relations, access to labour, and mobility. The secondary data collected from the Department of Fisheries, CMFRI, and Matsyafed contextualise the historical trajectory of ICT adoption in the fisheries sector. These sources helped frame individual and community-level responses within broader policy and economic shifts.

By centring ethnographic depth and lived experience, the methodology moves beyond techno-optimist narratives to critically assess who benefits from ICT adoption, who is excluded, and how technology reshapes not just tools or efficiency, but relationships, rhythms, and rights within coastal fishing communities.

### ICT integration in the fishing sector

Numerous studies have been conducted on the Information and Communication Technology (ICT) tools used by the fisher community in Kerala. Nevertheless, all these are in terms of technicality. Even when we look at ICT tools, we should analyse what benefits which groups. There are four main ICT tools employed in the fishing sector on a day-to-day basis—Global Positioning System, wireless, mobile phone, and echosounder. Sabu (2018)<sup>[15]</sup> demonstrates that among the various ICT tools, Global Positioning System (GPS) and mobile phones are widely considered the most cost-effective and widely preferred by fishermen.

On the other hand, the use of echo-sounders remains limited and least preferred. According to Abraham (2007), the introduction of mobile phones has significantly reduced market risks, uncertainties, and price fluctuations while simultaneously enhancing productivity. Several studies emphasise that ICT tools contribute to increased fish productivity, improved market efficiency, and reduced time spent at sea.

GPS and echo-sounders are used to identify productive fishing grounds and provide real-time data on fish availability, while Wireless communication tools enable smooth communication between vessels during emergencies. Widely used mobile phones now, while helping optimal pricing decisions, also ensure that fishermen remain connected with their families during fishing trips. The adoption of technology in fisheries is organic in the sense that it was driven by factors like user friendliness, income generation potential, life-saving capacity, energy and time efficiency, and its ability to support marketing efforts (Sabu, 2018)<sup>[15]</sup>.

In addition to ICT tools, innovations like the Bycatch Reduction Device (BRD) have been introduced to address ecological concerns. The BRD is designed with a mesh panel anterior to the codend, allowing juvenile fish to escape and thus minimising unintended catch. While bycatch presents a significant threat to the marine ecosystem, demand for juvenile fish stock along Indian shores is increasing. Though not in wide usage, enforcing the adoption of BRD and ensuring regular monitoring could promote a sustainable fishing practice and marine conservation in the future in India.

This study tries to understand the popular opinion on dissemination and access to these ICT tools in day-to-day fishing operations and how they have made a difference in the working hours in fishing. It looks beyond the fishing efforts and catch usually seen in studies. Further, it tries to explore how fishermen thought and made decisions about which tools to use. Hence, this paper examines the adoption, usage patterns, and socio-economic implications of ICT tools in the fisheries sector of Kerala's twin harbours, focusing on how these technologies influence livelihoods, operational strategies, and community dynamics. Once grounded in artisanal knowledge and communal rhythms, the fisheries economy in these harbours now operates through a technologically mediated environment where GPS devices, echo-sounders, wireless radios, and mobile phones structure work routines, market participation, and mobility patterns.

The data presented in Table 1.1 is based on interviews conducted with 120 boat crew members, 60 each from Neendakara and Shaktikulangara. It focuses on the use of four major ICT tools in the fishing sector, such as GPS, echo-sounder, wireless communication systems, and mobile phones. Respondents were asked about their awareness of these tools, ease of use, methods of learning, perceived effectiveness, and to rank their preferences.

GPS emerged as the most widely used and preferred among the ICT tools because of its utility in navigating through seaways and identifying fishing grounds. The use of GPS is not limited there but to marking estuaries, underwater rocks, and other hazardous zones to avoid gear damage and optimise time at sea. Echo-sounders assist in identifying underwater features and the presence of fish based on group structure and shapes, although their use remains secondary to GPS.

Wireless communication systems are employed between vessels to share information about potential fishing grounds and to send emergency messages. However, some boat owners admitted to turning off their wireless systems to prevent sharing strategic information with competing crews, except those under the same ownership. Mobile phones, though limited in utility during deep-sea fishing due to a lack of coverage, are commonly used nearshore to gather real-time market information. This enables fishers to adjust their landing sites or timing based on prevailing prices and also to stay in contact with auctioneers or family members.

While fleets from Shaktikulangara appear to be more technologically advanced, this may not fully reflect the actual differences in technological utilisation. Both Shaktikulangara and Neendakara vessels frequently land at the same harbour and operate under fixed auction arrangements, though landings are not always restricted to a single site. In addition to the commonly used tools, a few

boat owners also reported the use of Radar and Beacon systems, although these were less prevalent. Further, the researcher analysed preference for each ICT tool depending on a scaling method. People were asked to scale their preference for each ICT tool on a scale between 1 and 5, 1 being the tool they prefer the most and 5 being the ICT tool they prefer the least. It was found that the most preferred ICT tool among the 120 respondents was GPS. From this analysis and the previous table on the percentage of people who are using particular ICT technology, it is observed that people widely accept GPS. Technology like beacons, radar, or BRD is preferred by fishermen the least. When the research probed into why they had a particular liking for an ICT tool, it was noted that the money required for installation is less, and it aids them in fishing more efficiently. GPS help them situate the place where the fish school was spotted. Likewise, places where big rocks were underneath. Avoiding such places helps them keep their nets intact with fewer repairs. The repair of nets has reduced significantly after GPS was installed. It was also easier for

them to navigate after the use of GPS. Echo-sounder was the next most preferred ICT tool as it made it easier to spot the fish which was under the gear. With their experience, they could easily understand which fish it was and the kind of net that would be required for their body type and the speed at which they swim. Wireless came as the third option, for which the maximum response came. This is because they could communicate with the people while they were at sea. According to them mobile phone was only useful when they were near the shore to see in which harbour they should land or what the price fluctuation was. Due to signal problems, this was not an option for most of them while at sea. A preference and usage of a particular tool indicate if the dissemination of that particular tool was successful in that community. Mobile phone was used by all as they came at a cheaper rate. Likewise, people used it for entertainment while they waited for the catch. They download videos or movies and watch them while waiting at the sea. That was why most of them thought it was not a major tool aiding them in fishing. Whereas it is a tool that they do not want to avoid.

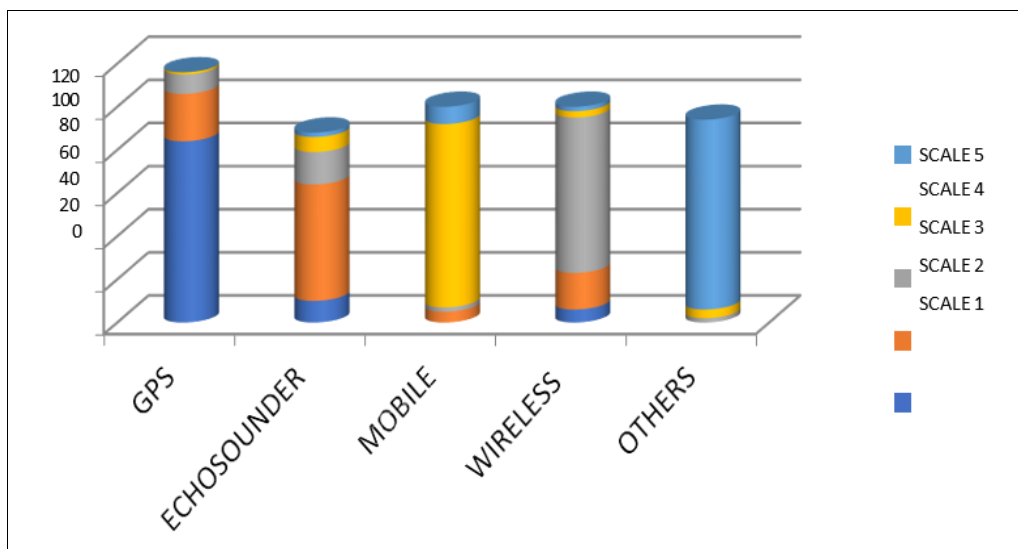


Fig 1.1: Preference of usage of ICT tools among fishermen

To understand whether the usage of advanced technology has led to an increase in income, a correlation coefficient test was carried out. The number of increases in working hours was associated to adaption to new technology. It was tested with this if there was increase in income. In a daily wage work, depending upon the increase in number of working hours indicate an increase in income. However, with technological use the working hours are supposed to decrease making work easier and less risky. Here, the usage of ICT tools facilitates fishermen to go for more fishing days than they usually do. The study also probed into whether this means an increase in income, too. This analysis shows that the number of working days remained more or less the same. But even when the number of days spent on the sea remained the same, there has been a noticeable increase in income levels owing to the increased efficiency. Traditionally, the community preferred working for six days and spending the seventh day in church engagement and other religious observances. However, there has been a gradual shift in this attitude, reflecting broader socio-cultural changes influenced by economic

pressures and technological advancements. Sometimes, when people go fishing for more than a week, it becomes the work of women to go to church and take care of their religious duty. Also with more migrant workers being in the crew it is easier to stay in sea for more than a week because they are anyway staying away from their families. Despite the increase in income, their expenditure has likewise increased. This aspect does not come under the purview of the current examination. The gross income of a boat owner depends on several factors. Therefore, the boat owner's response was not taken into consideration. This is not the case with the crew members. This economic dynamic is one of the reasons cited by respondents for the view that owning a fishing vessel is not necessarily profitable unless the owner possesses multiple boats. The ability to absorb the financial loss from one boat is seen as feasible only when profits from other boats can offset it. The increasing participation of individuals from outside the traditional fishing communities will be examined in the final section of this study, where the broader

implications of technological advancement in the fisheries sector will be analysed in detail.

For the present evaluation, a comparison was made between the increase in income and the number of working days. The analysis considered data from 120 mechanised fishing fleets operating out of Shaktikulangara and Neendakara. Only those fleets equipped with all major ICT tools and regularly landing at either of the two harbours were included in the study. The formula for the correlation coefficient is,

$$R = \frac{\sum((x-\bar{x})(y-\bar{y}))}{\sqrt{\sum(x-\bar{x})^2 \sum(y-\bar{y})^2}}$$

where value of r is  $-1 \leq r \leq +1$

$$\sum(x-\bar{x})^2 \sum(y-\bar{y})^2$$

In order to evaluate the impact of ICT tools on fishing activity and income generation, the study examined the change in the number of working days before and after the adoption of such technologies in fishing fleets.

To analyse whether the use of ICT tools such as GPS, echo sounders, wireless communication, and mobile phone were associated with increased fishing activity and consequently higher income levels, a correlation coefficient test was conducted.

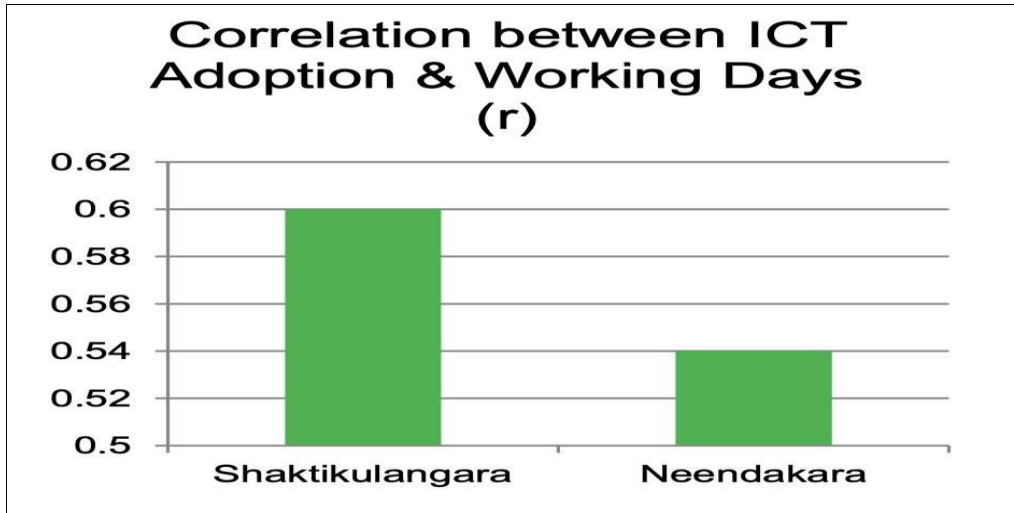


Fig 1.2: Correlation between ICT adoption and working days

The positive correlation with a coefficient of 0.6 for Shaktikulangara and 0.54 for Neendakara suggests that as the usage of ICT tools increased, the number of days spent at sea also rose correspondingly. The findings imply that ICT tools, by enhancing navigation accuracy, improving safety, increasing cold storage capacity, facilitating communication, and providing real-time market information, enabled fishermen to extend their fishing operations more efficiently and consistently.

Significantly, the increase in working days indicates not just higher operational engagement but also a greater rise in income. Traditionally, increased working hours would suggest greater physical labour, but the technological intervention has enabled a thorough strategic and productive use of time at sea. The data thus supports the argument that technological advancements, particularly the use of ICT tools, have contributed to both an expansion of fishing effort and improved economic returns for the mechanised fleets in both regions.

**Conclusion**

By analysing two adjacent villages in Kollam district, the study demonstrates how the integration of ICT tools into the fisheries sector in Kerala has reshaped and reorganised the fishing practices, operations, decision-making, and socio-economic structures within coastal communities. Tools such as GPS, echo-sounders, wireless radios, and mobile phones have significantly improved locating fish, navigating through water, income opportunities and reduced market uncertainties. However, due to the uneven adoption of the technology, owing to capital access, occupational roles, and perceived utility, it produces a paradox. As it facilitates

modernisation and market integration on one hand, it also exacerbates exclusions, especially for those without capital, training, or formal recognition, on the other hand, resulting in reproducing social inequalities. While technology adoption improves the fishing duration and strategic decision-making, it also sets a socio-cultural shift in motion by altering traditional work cycles, increasing dependency on migrant labour, and restructuring household responsibilities. Crucially, the study highlights that the benefits of ICT are mediated by existing hierarchies within the fisheries economy, and that certain innovations, like BRDs, remain underutilised due to a lack of training, differences of interest in sustainability and policy support. The findings underscore the need to move beyond techno-centric development narratives to a more socially embedded understanding of how technologies are used, who benefits, and under what conditions.

Using Actor-Network Theory, this study demonstrates that the ICT tools are not innocent or passive instruments but play an active role in reconfiguring relations between fishers, tools, market, and social institutions and stratification too. This perspective highlights the capacity of technology and society to mutually structure, that the interaction between human and non-human actors paves the path to decision, outcomes, and exclusion. Addressing these disparities needs an active attempt to create policies that are inclusive, localised, and informed by empirical data on the practices and constraints. By viewing ICT not as an isolated innovation but as part of a larger assemblage of livelihood, gender, and environmental politics, this study urges for a more holistic and justice-oriented approach to coastal

modernisation; one that centres not just profit or efficiency, but also equity, care, and ecological concern.

### Limitations and Feasibility of Future Research

The adoption of technology, like the integration of ICT tools into fisheries as discussed here, reproduces existing socio-economic hierarchies and gendered exclusions. An inclusive and sustainable development is possible only through policies considering not just the availability of technology but the accessibility of the technology, cutting across all social stratification. Addressing the digital divide, especially among women and small operators, is a challenge which needs immediate policy attention.

This paper opens several avenues for further inquiry. First, while this study has focused on male-dominated operational patterns, later papers could explore how women's informal roles and labour practices are being reshaped by digital transformations in fisheries, which is explored in the ethnographic study conducted by the first author. Second, explore the feasibility of community-based training programs for BRD use, wireless systems and mobile apps, especially among small-scale and artisanal fishers, by assessing their impact. Third, a comparative study between harbours or coastal states in India could offer insights into how infrastructural and policy differences shape ICT outcomes across regions. And finally, studies focusing on participatory digital mapping and longitudinal tracking of adoption trends for a better analysis of the evolution of ICT use in response to the ecological changes, fuel efficiency and market pressures. A mixed-methods framework that combines ethnographic observation with data analytics would provide a fuller picture of both the material and symbolic roles of technology in shaping the future of coastal livelihoods.

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