

Exploring the prospects, challenges and need assessment of live fish marketing from aquaculture farms in Kerala

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Abstract

The current study investigated the potential and challenges of live fish marketing in the aquaculture farms of Kerala, India. Surveys were conducted among farmers from six major aquaculture producing districts of Kerala to gather information regarding aquaculture practices, harvesting methods and marketing strategies followed. Freshwater aquaculture systems, particularly tilapia farming was dominant among the farmers. The respondents primarily sold their products to domestic market through dealers. The study revealed that approximately 20% of the farmers adopted live fish transportation methods, preferring tank systems and open-type transportation. The study emphasised the importance of addressing challenges related to culture, harvest as well as post-harvest operations and providing know-how on effective marketing and distribution channels to promote the adoption of live fish marketing.

Introduction

Kerala is considered as the land of fish consumers with annual *per capita* fish consumption of 17.93 kg (DoF GoI, 2022). The fisheries sector contributes significantly to the development of Kerala's economy, accounting for 1.180% of total GDP, with marine product exports valuing ₹6014.7 crores in 2020-21 (DoF GoK, 2021). The importance of this sector can be easily reasoned from the fact that it offers employment and revenue opportunities, both directly and indirectly to more than one million people. In addition to this, it satisfies the increased demand for protein among the marginalised population and generates substantial revenue for the state, particularly in the form of foreign exchange. Kerala's 590 km long coastline, 3600 sq. km Exclusive Economic Zone and 5.43 lakh ha of expansive inland waters provide an abundance of fisheries resources. The state's total fish production for 2021-22 was 6.16 lakh t, with the marine sector accounting for 3.916 lakh t and the inland sector for 2.244 lakh t (DoF GoK, 2020).

The aquatic ecosystems of Kerala are highly productive, contributing significantly to food and nutritional security as well as economic and social development through capture and culture fisheries. The state's aquaculture industry has grown substantially in recent years, on account of increased productivity in culture systems by novel farming technologies and the introduction of new species. Aquaculture production has experienced growth from 24,198 t during 2017-18 to 34,987 t in 2020-21, despite facing challenges caused by climate change, including flooding, as well as the disruptions caused by the COVID-19 pandemic (KSPB, 2022). On the other hand, farmers face enormous marketing challenges when it comes to aquaculture produce. The primary reason of obstacles in marketing aquaculture produces in India is the country's historically disorganised and unregulated fish marketing system. The marketing system, however, is undergoing swift changes due to innovations in the fields of handling and transportation technologies.

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Marketing live fish is a value-added process because it offers better price realisation than does marketing fresh, chilled, or frozen fish. Improvements in logistics have enabled live fish to carve out a niche in both the domestic and global markets. The South-East Asian and Southern Pacific regions are the global epicentres of live fish trade. The domestic market for transporting live fish in India was once limited to the North-Eastern states, but the increasing demand for this category has opened the door to a promising market across the country. Salim *et al.* (2018) analysed online fish purchases in Kochi, Kerala and found that consumers preferred live, cleaned and skinless items.

With the given background, the primary objective of this study was to examine the aquaculture practices and viability of live fish marketing within the aquaculture sector of Kerala. Documentation of the potential aquaculture species, various methods of live fish transportation, analysing the influence of live fish marketing on fish prices and investigating the live fish marketing needs of aquaculture farmers were carried out during the study. Additionally, an evaluation of factors such as harvesting type, daily harvesting patterns and the gears employed for harvesting aquatic resources, which play crucial roles in determining the effectiveness of live fish transportation was also done.

Materials and methods

This study was selected purposively in six districts of Kerala viz., Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam and Ernakulam, being the major aquaculture productive areas in Kerala. The respondents were the fish farmers of each district and snow ball sampling technique (Idiku *et al.*, 2020) was used to select the farmers. Snow ball sampling technique was adopted on account of the difficulty to track the fish farmers involved in live fish transportation. Participants were identified through peer referrals, leveraging existing networks within the aquafarming community and ensuring diverse perspectives, including those practicing live fish transportation. Accordingly, thirty respondents were selected from each district, making a total sample size of 180. However, it is important to note that all aquafarmers may not be engaged in live fish transportation and therefore, the sample size for this specific category may be relatively small compared to other marketing approaches. Personal interviews were conducted with selected respondents with the help of a semi-structured interview schedule. The data was analysed using SPSS Statistics 26 (IBM, 2019). The data covered aspects such as type of culture, species, harvesting method, harvesting quantity, market location, consumer demand for live fishes and methods of live fish transportation. Live fish transportation needs of farmers were analysed using weighted score method and the preferences were ranked from low to high (Dona *et al.*, 2016). The farmer's responses were collected in a three-point scale namely 'very much needed', 'needed' and 'not needed' which were assigned scores of 3, 2 and 1, respectively. The needs of the respondents were ranked in terms of weighted score using the formula:

$$\text{Weighted score (WS)} = \frac{(\text{No. of VMN} \times 3) + (\text{No. of N} \times 2) + (\text{No. of NN} \times 1)}{6}$$

VMN: Very Much Needed; N: Needed; NN: Not Needed

Weighted scores were ranked and the first three rankings were identified as most important needs of the respondents.

In order to investigate price realisation, the study area was surveyed to identify the average prices of each species in the chilled and live fish categories. Influence of live fish marketing on fish prices was assessed by determining the price premium acquired for live fish, calculated as follows:

$$\text{Price premium obtained for live fish} = \frac{\text{Price of live fish} - \text{Price of chilled fish}}{\text{Price of chilled fish}} \times 100$$

Results and discussion

The present study focused on exploring the aquaculture production landscape in the southern districts of Kerala, namely Thiruvananthapuram, Kollam, Pathanamthitta, Alappuzha, Kottayam and Ernakulam. These districts have been identified as key contributors to the aquaculture sector in Kerala, based on data provided by Department of Fisheries, Government of Kerala (DoF GoK, 2021).

Aquaculture profile

Aquaculture practices in Kerala are versatile in nature. The study revealed the diversity in aquaculture practices, documenting various types of aquaculture systems operated by respondents in different districts along with their preferred marketing strategies (Table 1). The farmers were open towards adoption of innovative techniques developed in the field. Exposure to extension activities on innovative technologies in aquaculture were found to be advantageous for improving adoption rate of different aquaculture practices among farmers (Kappen *et al.*, 2013). The aquaculture profile of respondents shows that the majority (38%) of the farmers were practicing fish farming in freshwater ponds, while 20% were practicing biofloc technology. Out of the 180 respondents, only three farmers were found to be practicing freshwater cage culture. This may be due to the fact that the profitability of cage farming largely depends on the culture area, technical knowhow of the stakeholders and the existing protocols. A study by Kappen *et al.* (2018) revealed that constraints like non-availability of quality fish seed and high cost of feed affected the development of sustainable cage farming.

Candidate species for culture

Majority of the respondents (70%) were practicing aquaculture in freshwater systems which included freshwater cage, ponds, aquaponics and biofloc with tilapia (GIFT) as the major culture species. The extensive culture of tilapia can be attributed to several key factors such as ease of seed production, enhanced growth rates, adaptability to various aquaculture systems and cost-effectiveness of production (Arumugam *et al.*, 2023). In brackishwater cages, species such as pearlspot *Etroplus suratensis*, Asian seabass *Lates calcarifer*, giant trevally *Caranx ignobilis* and mangrove red snapper *Lutjanus argentimaculatus* were considered in polyculture. In the light of economic feasibility, farmers in the coastal waters of Kerala consider these species as the major candidate species for cage fish farming (Aswathy and Joseph, 2019). Pacific white shrimp

Table 1. Aquaculture systems of respondents and corresponding marketing strategies in different districts (N=180)

Aquaculture system	Districts												Total
	TVM		KLM		PT		ALP		KTM		EKM		
	LM	CM	LM	CM	LM	CM	LM	CM	LM	CM	LM	CM	
Freshwater cage culture	0	0	0	0	0	1	0	0	0	2	0	0	3
Brackishwater cage farming	0	6	0	3	0	0	0	6	0	0	3	6	24
Freshwater pond culture	2	10	1	11	3	13	1	5	3	13	3	4	69
Brackishwater pond farming	0	0	0	6	0	0	0	6	0	0	1	5	18
Aquaponics	2	4	1	2	2	5	1	5	1	5	2	0	30
Biofloc	1	5	2	4	2	4	1	5	1	5	3	3	36
Total	5	25	4	26	7	23	3	27	5	25	12	18	180

TVM (Thiruvananthapuram), KLM (Kollam), PT (Pathanamthitta), ALP (Alappuzha), KTM (Kottayam), EKM (Ernakulam), LM (Live fish marketing, CM (Conventional marketing)

Penaeus vannamei is extensively farmed in brackishwater pond systems, while one of the farmers was practicing mud crab *Scylla serrata* fattening. Consistent supply of water crabs and unpredictability in market might be the reason of lower adoption rate for crab fattening as compared to shrimp culture (Joseph and Sathiadhas, 2006).

Harvesting methods and pattern

As far as fish harvesting is concerned, daily harvesting frequency plays a crucial role in determining both the market availability and pricing of the product. The quantity of fish harvested varies depending on the harvest method. Complete harvest yields a large quantity of fish as it involves harvesting the entire stock at once. On the other hand, partial harvest yields lower quantities and involves selectively harvesting a portion of the fish stock from an aquaculture pond or tank, while leaving the remaining fish to continue growing (Brummett, 2002). Respondents were surveyed to understand their preferred mode of harvest, including partial, full and a combination of both methods according to market demand. Full harvesting was adopted by 55% of respondents, while partial harvesting was adopted by 27% and the remaining 18% used a combination of both harvesting methods, depending on market needs. The relationship between quantity of fish harvested and its marketing in aquaculture is complex and influenced by multiple factors, such as market demand, availability of marketing channels, consumer preferences, pricing and market competition. The daily harvesting quantities of respondents were classified into five groups and depicted in Fig. 1. According to the data, majority of farmers (56%) reported harvesting more than 20 kg of fish per day. These respondents, includes two farmers engaged in brackishwater cage culture who have adopted partial harvesting. These farmers have streamlined their operations by incorporating a daily harvesting routine, employing scoop nets for selective harvesting. Based on the opinions expressed by the respondents, adopting a bulk selling approach to wholesalers helped mitigate several risks and cost-related challenges associated with marketing and distribution. This strategy also enabled farmers to obtain better price realisation compared to directly selling to consumers or small retailers. By engaging in direct transactions with wholesalers, farmers were able to concentrate on their core fish cultivation activities, while leaving the marketing and distribution aspects to the expertise of wholesalers. Farmers practicing partial harvesting primarily aimed to maximise their earnings. Selling smaller quantities directly to retailers resulted in an additional income boost of up to 20%. Bassey *et al.* (2015) highlights that retailers have a competitive edge over

wholesalers by catering to specific demands of consumers, leading to increased profitability. The success of a retail sales business in the aquaculture relies on several factors, including demand for specific species, maintaining product quality, incorporating value addition and a diverse product range, setting competitive pricing, implementing effective marketing and promotion strategies. Further, ensuring hygienic handling practices, providing excellent customer service and actively seeking feedback for continuous improvement are essential (Olawunmi and Clarke, 2022). Farmers who employ live fish transportation as a marketing strategy commonly practice partial harvesting, typically harvesting around 15-20 kg of fish daily. This approach allows them to transport live fish more efficiently, helping to enhance product appeal and promote sales.

Harvesting gears

Less stressful harvesting methods such as line fishing, trapping, or the use of knotless meshed nets, are recommended, especially when fish are intended for live fish transportation and marketing (Parvathy *et al.*, 2019). An analysis on harvesting methods adopted by farmers revealed that scoop netting was the most widely used method, accounting for 50% of the total fishing gear used. Cast netting was the second most popular method, used by 29% of the respondents, followed by drag netting, used by 21%. The time of fish harvest also significantly impacts fish quality. Harvesting in the early morning or at night, when temperatures are cooler, helps to reduce stress and maintain better fish quality. In the context of live fish transportation, farmers predominantly rely on scoop nets, owing to the ease of operation and the minimal stress it imposes on the fish. These findings highlights the importance of selecting appropriate harvesting method to reduce stress, ultimately enhancing survival rates during live fish transportation.

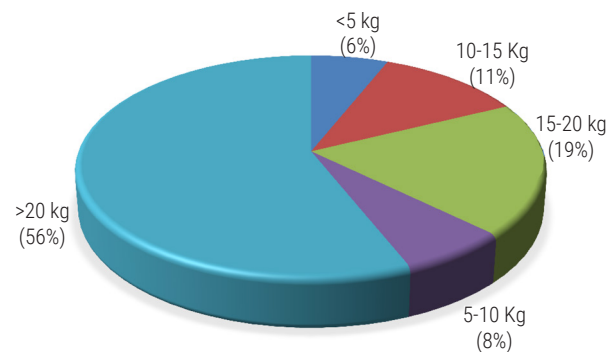


Fig. 1. Daily harvesting pattern of respondents (N=180)

Marketing and market location

The relationship between the quantity of fish and live fish transportation is crucial, as the quantity of fish being transported can directly affect the conditions needed to maintain the health and survival of the fish during transportation. Similarly, the duration of transportation and the distance to be covered can also impact the quantity of fish that can be safely transported (Nair *et al.*, 2023). Market demand, driven by factors such as consumer demographics and geographical location of market, also play key roles in determining the quantity of fish harvested. Onoja *et al.* (2013) revealed an interesting trend; as the distance to the market increases, the probability successfully selling fish decreases. An analysis of the market locations where respondents sold their farmed fish showed that 50% sold to markets outside their district through dealers. In contrast, farmers engaged in partial harvest and selling smaller quantities, mostly sold their fish in local retail (27%) and domestic markets (23%) within the district. This pattern emphasises the influence of quantity of the product and proximity to markets, on sale strategies.

Consumer demand and live fish transportation practices

In recent years, the Indian fish marketing industry has undergone a significant transformation, driven by remarkable advancements in transportation and handling technologies, as well as a growing consumer preference for fresh produce. One notable trend is the rising popularity of live fish trade, as consumers increasingly demand fresh, high-quality seafood. An assessment of consumer demand for live fish was conducted by asking farmers whether their customers specifically requested live fish. The results indicated that 94 farmers (52.6%) acknowledged that their consumers demanded live fish, underscoring the growing importance of live fish trade. According to farmers, the perception that chilled products to be of inferior quality, tends to drive consumers towards purchasing live fish. Among the 180 participants, 36 farmers (20%) opted for live fish transportation as their marketing approach, with the vast majority of 32 farmers operating freshwater-based aquaculture systems (Table 1). The quantity of fish transported for live fish marketing ranged between 15 to 20 kg. Further, the relationship between quantity of fish and live fish transportation is crucial, as the quantity of fish being transported can directly affect the conditions needed to maintain the health and survival of the fish during transportation. Similarly, the duration and distance of transportation also impact the quantity of fish that can be safely transported (Nair *et al.*, 2023). Tilapia (GIFT) emerged as the prominent species for live fish transportation on account of their compatibility to live transportation systems, strong consumer demand for live tilapia and better price realisation. A comprehensive analysis of the data and farmers' opinions, highlights the growing potential and importance of live fish transportation in the aquaculture sector, especially for species like tilapia that are well suited to these systems. It is apparent that this particular marketing method is primarily limited to local markets, with the maximum reach being confined within the district, requiring a transportation duration of approximately 2-3 h. The lack of a convenient live fish transportation system for long-distance marketing and an established live fish marketing chain restricts farmers from expanding their operations and

meeting consumer demands beyond district boundaries. They were using their own transportation methods and strategies to market live fish, with majority opting for the tank method or open-type live transportation systems with fish to water ratio of 1:14 to 1:20 (w/v). However, these methods which are not standardised, do not guarantee satisfactory survival rates for the species transported, thus restricting their widespread adoption.

In general, the live fish trade commonly employs three main transportation systems viz., the closed system, the open or tank method and the modified waterless system (Rimmer and Franklin, 1997). In a closed system, the transportation unit is completely sealed and equipped with all the necessary conditions to support the survival of live fish during transit. On the other hand, an open system uses water-filled containers that require external facilities to maintain proper transportation conditions (Omeji *et al.*, 2017). The modified waterless system, utilises materials such as sawdust and cotton, operating without water but maintaining a cool and moist environment by dampening and pre-chilling the transportation medium (Parvathy *et al.*, 2021).

Influence of live fish marketing on price realisation and profitability

The value of live fish can be affected by several factors such as demand for a particular species, transportation costs, market competition and cultural preferences. According to Moon *et al.* (2017), the concept of price premium for a specific product relates to consumers' willingness to pay a higher price. A comparative evaluation of the price realisation for commonly marketed live commodities in comparison to their chilled form were carried out to understand the significance of live trade in the domestic market (Table 2). The study revealed that a notable price premium in the range of about 26-33% was achieved when fishes were marketed in their live form. This price premium can be attributed to the heightened demand for live commodities among customers, which is driven by the perceived freshness and superior quality associated with live fish compared to their chilled counterparts. Olesen *et al.* (2010) investigated consumer willingness to pay for organic and welfare-labelled salmon, revealing that consumers demonstrated a readiness to incur a price premium for these products due to their enhanced quality attributes. Furthermore, FAO (2020) highlighted that live, fresh and chilled fish are highly valued and preferred by consumers for direct human consumption, constituting the largest market share at 44%. This category of fish is considered to have superior sensory quality attributes such as flavour, texture and appearance compared to processed forms, which may suffer from quality degradation during storage and transportation. In line with this, India has exported a significant amount of live fish, totalling 7287 t and worth ₹324.26 crores during 2019-20, demonstrating the high price realisation potential of these premium products (MPEDA, 2021).

Need assessment for live fish transportation

Despite the high price realisation for live fish as compared to its counterpart, the adoption rate of this strategy among the farmers is comparatively low. This study sheds light on the transportation needs of live fish for farmers in Kerala. Need represents an imbalance, lack of adjustment or gap between present situation

Table 2. Price Comparison between live and chilled fish (N=180)

Species	Average Price Realisation (₹ per kg)		Price premium (%)
	Chilled fish	Live fish	
Tilapia (GIFT)	153.81	193.52	25.82
Pearlspot (<i>E. suratensis</i>)	306.46	406.23	32.56
Asian seabass (<i>L. calcarifer</i>)	412.55	531.71	28.88
Giant trevally (<i>C. ignobilis</i>)	416.78	541.38	29.90
Mangrove red snapper (<i>L. argentimaculatus</i>)	409.63	534.15	30.40

and a new or changed set of conditions assumed to be more desirable (Leagans, 1961). According to Rothwell and Kazanas (2004), need assessment is the process for identifying and prioritising performance needs. Weighted score was computed for every individual need and subsequently, ranks were assigned in descending order from the highest to the lowest (Fig. 2). The convenience of the system emerged as the foremost priority among the identified needs, as farmers consistently expressed a preference for a live fish transportation system that is compact and lightweight. Such a system would facilitate easier and cost-effective handling and transportation, while also reducing labour requirements. Although the development of standard operating procedures was ranked second, a minor difference in the obtained scores was observed compared to the top-ranked need. The predominant rationale behind farmers assigning priority to the standard operating procedures is the excessive mortality rates encountered during live transportation, leading to a consequent decline in market prices. Improving the survival and quality of fishes during transportation necessitates a critical assessment of various internal and external factors. Key determinants include the density of fish being transported and water quality parameters such as water temperature, pH, dissolved oxygen, carbon dioxide, and ammonia levels (Hong *et al.*, 2019). Physiological changes occur as a consequence of variations in these factors, resulting in the accumulation of stressors that significantly impact the quality of fish during transportation. This, in turn, leads to a decrease in market value, as the ultimate goal of the market strategy is to offer healthy fish that can endure until they are sold, processed, or restocked (Wynne and Wurts, 2011). Hence, the stakeholders take meticulous measures to not only reduce product loss due to

mortality but also minimise the deterioration of product quality resulting from the stress during live transportation (Christophersen *et al.*, 2008). Furthermore, it is important to note that the optimal micro-environmental conditions for live transportation vary for each species and may even differ based on harvest size and maturity stage. Therefore, species-specific standardisation is imperative to ensure successful live transportation (Nair *et al.*, 2023). Least ranks were given for market chain establishment and live fish market outlets. The establishment of market chains and live fish market outlets received the lowest ranks, indicating their relatively minimal influence. This observation can be attributed to the existing market demand for live commodities, suggesting that these factors have a lesser impact on the overall decision-making process. However, the potential to enhance their importance lies in the extensive popularisation of live fish transportation and its associated benefits among consumers. As a result, the need for popularisation and awareness ranks third, reflecting its potential to elevate the significance of market chain establishment and live fish market outlets in the future.

Further, the common concern of fish farmers was the cost and complexity of setting up a live fish marketing operation. To address this, educational programs and resources could be made available to assist farmers in understanding the necessary equipment and infrastructure requirements, as well as best practices for managing and maintaining live fish systems and its associated trade. Additionally, partnerships with research organisations, industry experts and suppliers could help farmers' access affordable and reliable technology. ICAR-Central Institute of Fisheries Technology (ICAR-CIFT), Kochi, has been a pioneer in this research field and has developed prototype for live fish transportation (Parvathy *et al.*, 2020). Another technology is from the ICAR-Central Institute on Post-harvest Engineering and Technology (ICAR-CIPHET), Ludhiana which has introduced the "Live Fish Carrier System (LFCS)", for the live transportation of cultured food fishes.

Another potential barrier in popularisation of the marketing strategy is the lack of knowledge about marketing and distribution channels for live fish. Farmers have meagre awareness on the linkages that they require with potential buyers or how to effectively market their product. Providing training and resources on marketing and distribution strategies could help farmers overcome this challenge and increase their success in the field. By addressing these common

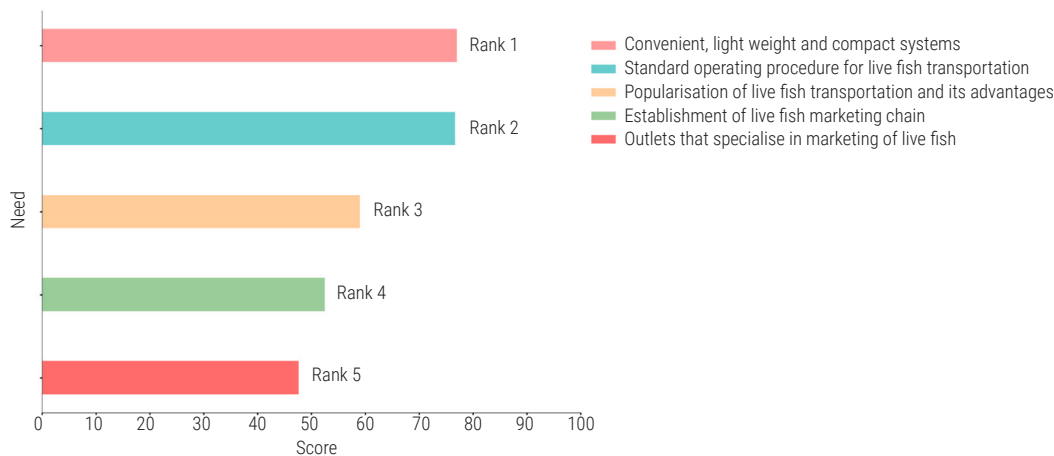


Fig. 2. Ranking of live fish transportation needs of farmers (N=180)

challenges and concerns and providing farmers with the necessary resources and support, more farmers could be encouraged to enter the live fish marketing sector. This would enhance the profitability and viability of their aquaculture ventures.

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