

3.1 Value chain considerations of culture-based fisheries in Sri Lankan reservoirs

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Abstract

Sri Lanka's culture-based fisheries (CBF) provide significant livelihoods and food security for villagers in proximity to the country's dense network of reservoirs. In this paper, we summarise the value chain findings of ACIAR project FIS/2018/157, comparing these findings to that of other countries and fisheries, and identifying how these project findings can be applied for the enhancement of Sri Lankan CBF.

We describe 3 types of finfish and giant freshwater prawn (GFP) domestic value chains, depending on whether products are consumed locally or in urban areas, and the number of agents in the chain. We also describe 2 types of GFP export value chains – one where export companies are not involved in activities along the value chain, and the second where export companies partner with reservoir fishery organisations to stock, cultivate, harvest and market their products. We show that CBF are profitable, with low risk to fishers. Price received by GFP fishers are lower when export companies are involved in all aspects of the marketing chain than when they are not, but these companies bear a significant burden of the costs such that the profitability of fishers is similar for both types of value chains. However, where export companies are involved throughout the chain, they bear most of the risk.

The division of labour within the value chains of CBF is traditional, with men performing physically intense and skill-requiring activities, females assisting in less demanding tasks and children providing occasional support. Providing training for various members of the value chains, especially to convert informal activities into commercial economic activities, is likely to enhance economic and social benefits within fishing households, as well as within the fisheries sector.

We present a SWOT analysis of Sri Lankan CBF, considering all aspects of the value chain. Many of the weaknesses and threats are common across similar fisheries in other countries, such as poor availability and supply of seed stock, poor harvesting technologies, lack of common GFP grading methods at landing sites, poor storage and transportation facilities, asymmetries in price transmission along the chain, poor access to bank loans and governance issues. However, Sri Lanka has advantages that are not experienced in other countries, such as the profitability of the fishing enterprise due to low costs and low risks, and the established export market for GFP.

There are significant opportunities for improving the efficiency of production, institutions and markets of GFP and finfish CBF value chains in Sri Lanka. To exploit opportunities and transform activities throughout the value chain, we recommend Sri Lanka develops a comprehensive sector-wide strategy, with extensive consultation and buy-in from all stakeholders, that includes a vision, strategic objectives, implementation plan, resourcing strategy, and monitoring and evaluation plan.

Introduction

Sri Lanka is home to a dense network of reservoirs constructed for the purpose of irrigation, hydroelectric generation and drinking. These reservoirs provide year-round food supply for local communities as well as livelihoods that include small-scale irrigation of agricultural crops (predominantly paddy rice), fishing, and associated agribusiness services such as marketing and transportation services. Many of these reservoirs are very large. Irrigation authorities in Sri Lanka classify them by size as major (>800 ha), medium (200–800 ha) and minor (<200 ha).

These reservoirs support a wide range of native and exotic fish species as well as GFP. Although indigenous cyprinid species are abundant, they are largely unexploited due to poor consumer preference. Fish production is dominated by 2 exotic cichlid species: *Oreochromis mossambicus* and *O. niloticus* (commonly known as Mozambique tilapia and Nile tilapia, respectively).

The productivity of reservoir fisheries has been enhanced through the stocking of post larvae (PL) seed. This type of fishery enhancement is called ‘culture-based fisheries’ (CBF) and is practiced in many inland water bodies across the world. Sri Lanka’s National Aquaculture Development Authority (NAQDA) produces PLs in hatcheries and partners with local fishing communities to stock the PLs into the reservoirs. There are some private hatcheries run largely by export companies.

Fish production from CBF is largely sold into local, regional or urban markets. On the other hand, GFP is largely sold to high-end restaurants or hotels in Sri Lankan cities, or exported. GFP is a high-value species, with the average harvest price being about double that of finfish, and consumer prices can be 20 times or more higher in foreign markets.

Value chain analysis in fisheries refers to a systematic examination of all the steps involved in producing and delivering a fish product from the initial input stage (such as PL stocking) to the final consumer, identifying areas where value can be added or inefficiencies minimised at each stage to optimise the overall profitability of the fish product. Stages in the value chain include input supply, production (fish harvesting), processing, marketing and distribution. Key actors in the chain include input suppliers, fishers, processors, traders, exporters, wholesalers, retailers and consumers.

Value chain analysis is a key objective of ACIAR project ‘Improved productivity, efficiency and sustainability of the CBF for finfish and GFP in Sri Lankan reservoirs’ (FIS/2018/157). Specifically, the aim of the project’s value chain analysis is to ensure post-harvest and supply practices meet market requirements and that both male and female actors in the supply chain gain maximum benefits. The purpose of this paper is to summarise the project’s value chain findings, comparing these findings to that of other countries and fisheries,

and identifying how these project findings can be applied for the enhancement of Sri Lankan CBF. The summary of project findings is taken from Paranamana (2025), Paranamana et al. (2024) and Paranamana et al. (2025).

Project findings

Understanding the value chain

There is significant variation across GFP and finfish value chains in Sri Lanka. Value chain analysis was conducted for case studies of 5 reservoirs of different sizes and locations across Sri Lanka in late 2023. Three different types of value chains were identified for finfish and GFP sold into local markets, as shown in simplified schematics in Figure 3.1.1. Type 1 value chains describe marketing channels where Reservoir Fishery Organisations (RFOs) sell product direct to local retailers who sell to local consumers. Types 2 and 3 value chains describe marketing channels where the product is sold to consumers in urban markets. Type 2 value chains include urban wholesalers and retailers. Type 3 value chains exclude urban wholesalers; RFOs sell direct to urban retailers.

Very little finfish but most GFP is exported. Two different types of value chains were identified for exports of GFP – Case 1 and Case 2 – plus variations within these types. Figure 3.1.2 provides a simplified schematic for these different cases.

In Case 1, the export company is not involved in activities further down the chain. Production and collection are conducted independently and RFOs, primary collectors and secondary collectors have the freedom to sell their products to any collectors and exporters. In Case 2, a private export company is involved in all nodes of the value chain. The export company is involved in input supply by

breeding PLs and providing this seed stock to RFOs so they can stock their reservoirs. The RFOs must then sell to primary and secondary collectors that are engaged by the export company. Generally, farm-gate prices are higher in Case 1 value chains than Case 2 (Table 3.1.1).

Table 3.1.1: Average farm-gate price of GFP for Case 1 and Case 2 export value chains (LKR/kg)

	Case 1	Case 2
Quality 1	1,700 – 2,000	900 – 1,500
Quality 2	1,000 – 2,000	900 – 1,000

Case 2 value chains are generally less complex than those of Case 1. We identify 3 types of variations in Case 1 value chains (Case 1A, 1B and 1C). Case 1A is a linear value chain, with one primary collector, one secondary collector selling to one export company. Case 1B involves several primary collectors who sell straight to the exporter. Fishers have the freedom to sell to any primary collector, although they often negotiate long-term agreements with single buyers. Case 1C involves several primary collectors, one secondary collector and one exporter. Negotiated prices in Case 1B are generally higher than those received from Case 1A and Case 1C as they avoid the need of a secondary collector (Table 3.1.2).

Table 3.1.2: Average farm-gate price of GFP for Cases 1A, 1B and 1C export value chains (LKR/kg)

	Case 1A	Case 1B	Case 1C
Ungraded	2,000	1,700	
Quality 1		2,000	2,000
Quality 2		1,500	1,000

If grading is conducted at the landing site, it is generally based on whether the GFP are damaged. In some rare cases, the prawns are graded on weight as to whether they are higher or lower than 250 g/individual.

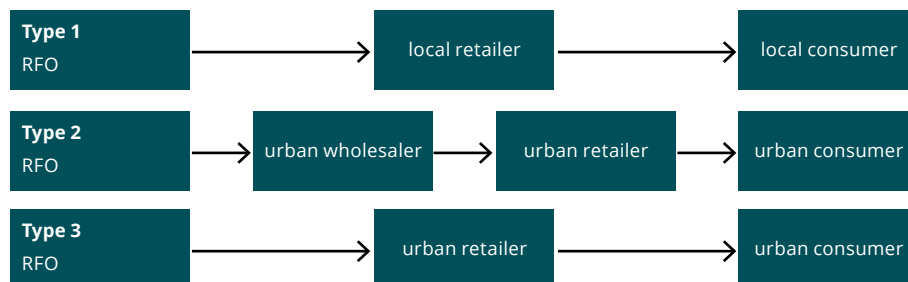


Figure 3.1.1: Simplified schematic of 3 different types of finfish and GFP value chains for local markets of CBF in Sri Lanka

Note: RFO = Reservoir Fishing Organisation

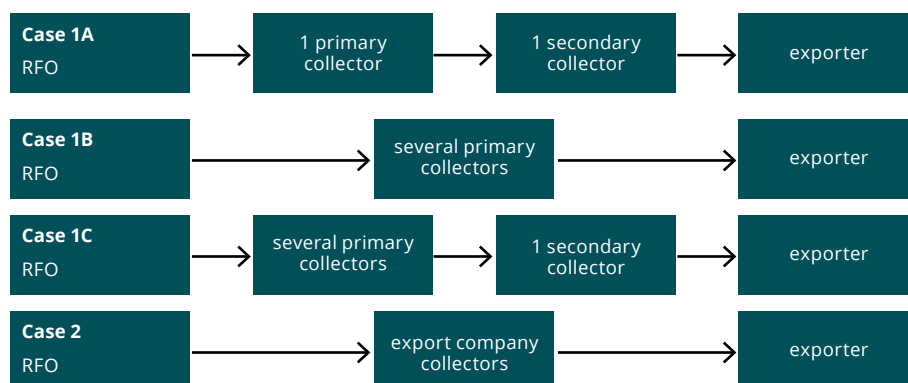


Figure 3.1.2: Simplified schematic of 2 different types of GFP export value chains (Case 1 and Case 2), showing variations within Case 1

Note: RFO = Reservoir Fishing Organisation

Table 3.1.3: Consumer prices of cooked GFP (LKR/individual)

Size	Price in foreign markets	Price in local markets	
		5-star hotels	Other hotel retailers
150 – 200 g	5,900	4,500	1,900
200 – 250 g	6,200	5,400	2,200
250 – 300 g	8,100	6,000	2,400
300 – 400 g	10,000	7,600	3,000
400 – 500 g	12,000	9,100	
>500 g	14,800	10,600	

However, significant grading occurs along the value chain, generally by the exporter, providing significant value adding.

If GFP are rejected due to damage or other quality issues, they are sold into local markets. Those GFP of a standard that satisfies international consumers are graded by weight and exported. Consumer prices differ for different sized prawns, with larger prawns receiving higher prices, as shown in Table 3.1.3.

We focus on the Sri Lankan segments of the value chain. Price build-up along the chain between the RFO and the exporter for Case 1 and Case 2 value chains is shown in Figure 3.1.3. Fishers and secondary collectors get a higher proportion of the price in Case 2 where exporters are involved throughout the chain, compared with Case 1 where exporters are not involved throughout the chain. However, the overall price is lower for Case 2 than Case 1 (see Table 3.1.1).

The total revenue (price multiplied by production) in Case 1 is higher for RFOs and primary collectors compared with Case 2 (Figure 3.1.4 A). However, their variable

costs¹ are also higher, as export companies are paying most of the RFO and primary collector costs in Case 2 (Figure 3.1.4 B). Gross margins are almost the same for both cases (Figure 3.1.4 C): slightly lower when the export company is involved in the chain (Case 2) than when they are not (Case 1). However, as export companies are paying a larger proportion of the costs in Case 2, they are bearing significant risks, more than offsetting the small difference in gross margin. This risk borne by exporters is reflected in gross margin per unit costs shown in Figure 3.1.4 D.

Fisher costs are dominated by fish net replacement, boat repairs and maintenance, and labour. Primary and secondary collector costs are dominated by GFP purchases, with some fuel, and vehicle repair and maintenance costs.

1 We focus on the collection of variable costs (such as labour, nets and fuel) rather than total costs (variable costs plus fixed costs (such as buildings and vehicles)) for practical reasons, and also because fixed cost items are often used for purposes other than fishing. As variable costs fluctuate with production volume, they provide an accurate picture of how much profit is generated per unit sold.

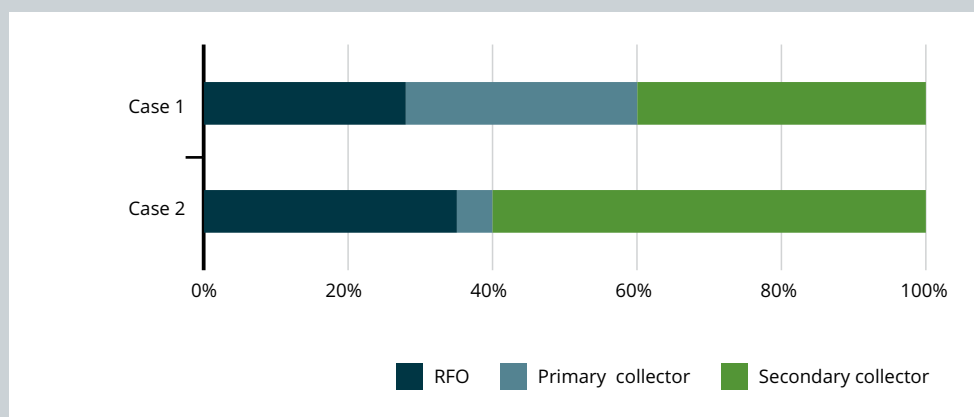


Figure 3.1.3: Price build-up between RFO and exporter for Case 1 (no exporter involvement in the chain) compared with Case 2 (exporter involvement along the chain) value chains

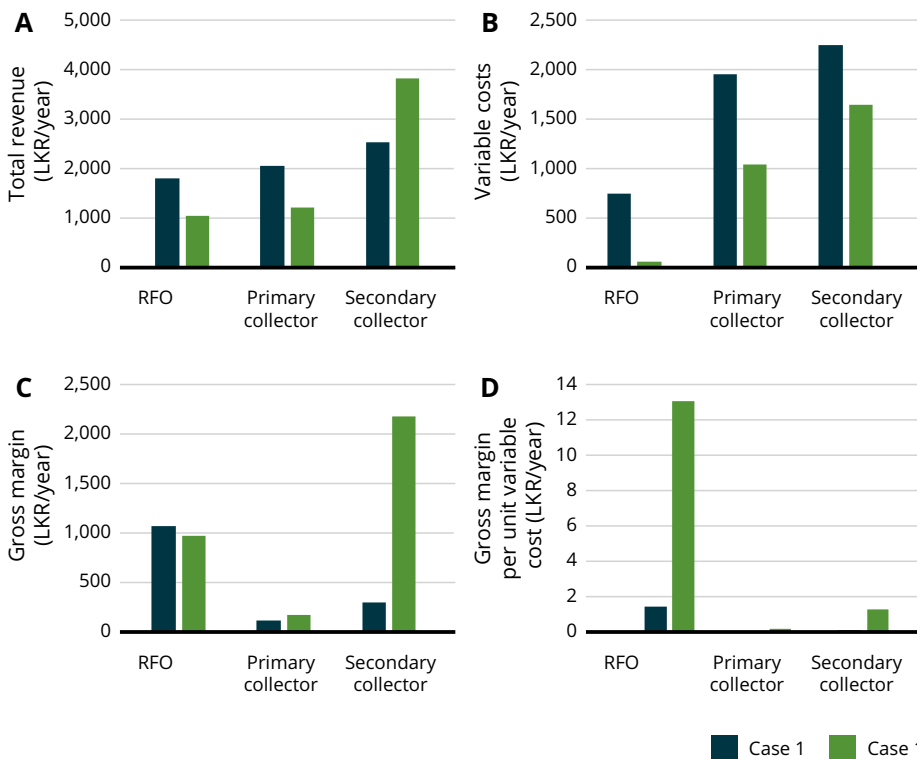


Figure 3.1.4: Total revenue (A), variable costs (B), gross margin (C) and gross margin per unit variable cost (D) for RFOs, primary collectors and secondary collectors for Case 1 (export companies are not involved in the value chain) and Case 2 (the export company is involved in the value chain)

Inclusivity of value chains

There is both female and male participation in all nodes of value chains, with the exception of finfish wholesaling, which is exclusively a male activity (Figure 3.1.5 and Figure 3.1.6). Male participation dominates female participation in all value-chain activities with the exception of finfish processing (largely fish drying). RFO, fisher and collector activities conducted by men, women, boys and girls are listed

in Table 3.1.4. The division of labour is traditional, with men performing physically intense and skill-requiring activities, females assisting in less demanding tasks and children provide occasional support. Providing training for various members of the GFP and finfish value chains, especially to convert informal activities into commercial economic activities, will enhance economic and social benefits within fishing households, as well as within the fisheries sector.

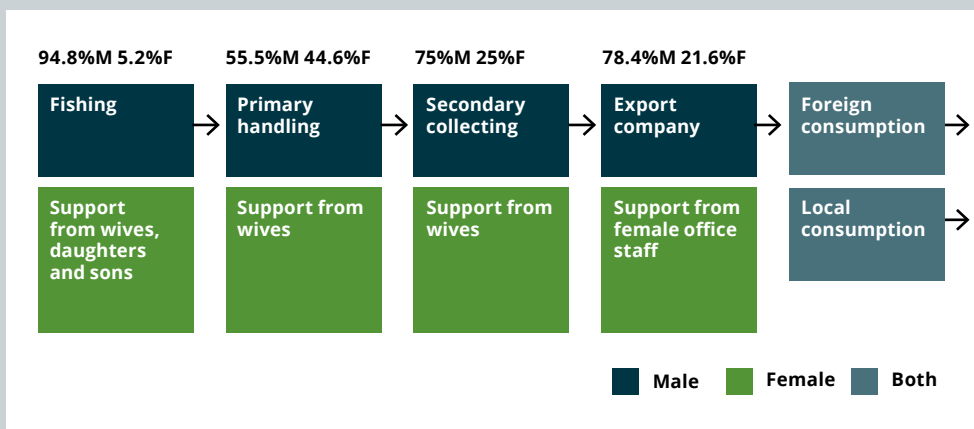


Figure 3.1.5: Female and male participation in value chain for GFP

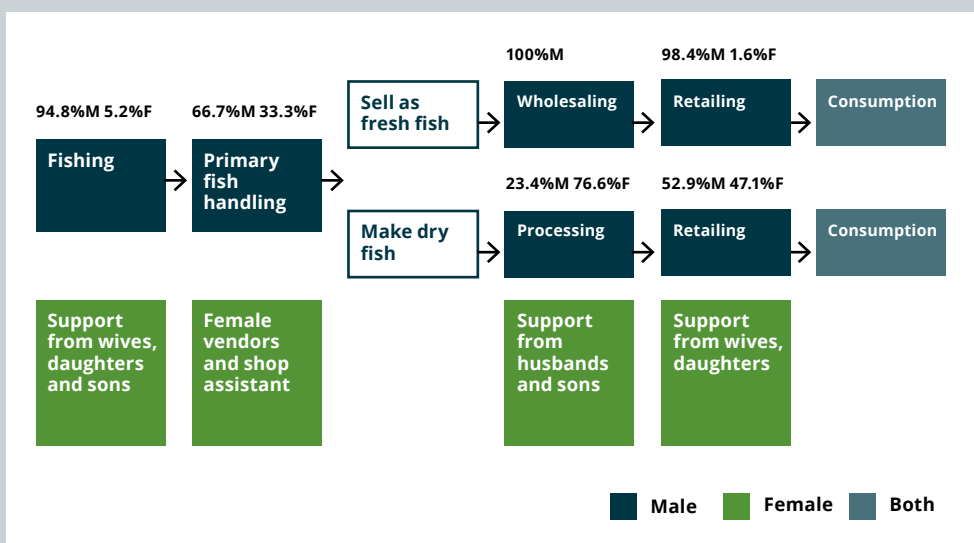


Figure 3.1.6: Female and male participation in value chain for finfish

Table 3.1.4: Activities conducted by men, women, boys and girls with RFOs, fishers and collectors

	RFO	Fishers	Collectors
Men	• Registration and legal documentation • Appointing society officers • Participating in society meetings and workshops • Hiring labour • Reporting financial transactions • Arranging refreshments for visitors • Making society-related decisions • Hatchery management • Transporting of PLs and fingerlings • Stocking • Purchasing fishing equipment • Safeguarding boats • Protecting the reservoir from illegal fishing • Searching for prices for other reservoirs • Negotiating with buyers • Conducting sales • Serving as shop assistants	• Harvesting from the village reservoir • Scaling • Grading • Cleaning • Transporting boats	• Decision-making • Engaging with RFOs • Collecting from village reservoirs • Handling and grading GFP • Keeping the product on ice
Women	• Reporting financial transactions • Participating in meetings with moderate contribution • Labour hiring • Society decisions • Arrangement of refreshments • Cleaning and documenting maintenance activities in the hatchery • Documentation of stocking	• Cleaning fishing gear • Scaling • Grading	• Handling and grading GFP • Cleaning
Boys		• Cleaning boats	• Supporting fish handling and collecting
Girls	• Arrangement of refreshments	• Cleaning fishing gear	• Supporting fish handling and collecting



SWOT analysis of Sri Lankan value chains of GFP and finfish

The strengths, weaknesses, opportunities and threats apparent in Sri Lankan value chains of GFP and finfish are listed in the following SWOT analysis.

Strengths

Market-related strengths include:

- strong demand, especially locally for fish and internationally for high-value GFP
- strong demand for dry fish in local markets
- most activities along finfish and GFP value chains have low costs and low risk
- fishing contributes significantly to sustainable livelihoods for villagers, providing an additional income-earning source that in some cases is more profitable than agricultural activities (such as paddy rice cultivation)
- finfish prices are affordable for villagers
- finfish production contributes to food security in local villages.

Institutional strengths include:

- experienced fishers
- strong local institutions in RFOs, who are effectively managing fishing intensity
- engagement of villagers along the value chain
- an established export market for GFP
- fishing activities generate agribusiness job opportunities through support services such as input supply, marketing and transport
- vertical integration of value chain activities in some regions, which injects much-needed finances into fish and GFP production, increasing the availability of seed stock and bears some risk for fishers.

Product strengths include:

- organic production
- large size of GFP and diverse range of finfish species
- natural nutrition in reservoirs means that supplementary feeding is not needed.

Weaknesses

Market-related weaknesses include:

- daily harvest per fisher is low and uncertain
- lack of local demand for GFP and dependence on fluctuations in international markets
- export markets underdeveloped for finfish
- lack of competition along the value chain (in some regions, there is only one primary collector)
- lack of comprehensive grading for quality or size by fishers and collectors – most grading is conducted by exporters – price signals for quality and size are not transferred down the value chain, potentially leading to price asymmetry and market control in the chain
- lack of information and poor coordination between and across actors in the value chain.

Institutional weaknesses include:

- subsistence nature of fishing (fishers often only catch enough to fulfil daily requirements)
- GFP is considered a by-catch of fishing
- fishers financially depend on export companies for GFP sales
- difficulties accessing loans and insurance from banks as fishing is considered an informal activity
- high interest rates.

Product weaknesses include:

- poor availability of good quality seed for stocking reservoirs; there is especially a lack of quality wild broodstock
- the production of seed requires significant scientific knowledge, technical capacity and financial support, and is risky
- poor understanding of the economically optimum stocking density and fishing intensity across reservoirs and fish species
- harvesting is labour intensive and time consuming
- lack of technically efficient harvest technology for GFP – a high proportion of GFP are damaged in gillnets, and the GFP damage the gillnets which affects fishing activities
- perishable nature of GFP and finfish – local and international buyers prefer live or fresh products
- poor storage practices along the chain, especially for GFP, and a lack of understanding of optimal ways to store and transport GFP.

Opportunities

Market-related opportunities include:

- there are no close substitutes at the reservoir level for GFPs
- GFP have strong international demand and are a high-price commodity
- the international market for GFP is large
- significant potential to improve the quality of marketing in local and international markets
- potential to expand international markets through the introduction of certification, branding (as quality and organic) and traceability
- economic benefits to fisheries through improved grading of GFP and finfish by

species, size and quality at landing sites to reflect consumer preferences.

Institutional opportunities include:

- significant opportunity to transform traditional informal fishing activities into formal enterprises through innovation and commercialisation of activities
- potential to improve inclusivity and equity through training to improve skills in various activities across the value chain, especially for women
- possibilities for pursuing profit-sharing, employment mechanisms and volunteer support in adjacent and downstream villages to manage conflicts and to lower incentives for illegal fishing
- capacity to improve understanding of optimal stocking densities and fishing intensity within RFOs and NAQDA, and pursue strong community-based governance arrangements
- implementing advanced water management systems such as pumps, rainfall pattern monitoring and improved forecasting before stocking PLs to reduce mortality associated with low- and high-rainfall events.

Product opportunities include:

- private and private-public partnerships to improve broodstock, hatchery techniques and availability of high-quality seed
- consideration of quarterly or gradual stocking, rather than annual stocking
- implementing GFP-specific harvesting equipment such as traps
- cultivation of GFP through fencing off sections of reservoirs, stocking PL prawn into these areas away from predation, and minimising the likelihood of prawns getting damaged by, and damaging, fish gillnets

- potential to improve understanding of optimal marketable size, growth rate and growth periods
- improving knowledge and understanding of storage requirements along the value chain for freshness
- encouraging value-added processing for diversified products.

Threats

Market-related threats include:

- new entrants into fishery, leading to reduced harvests for all licence holders and causing conflict among the villagers
- substitution between finfish species
- strong bargaining power of export companies involved in activities along the value chain
- high product quality requirements of international markets
- traders and collectors bear high risk
- GFP exporters are price-takers; prices are dependent on international market conditions.

Institutional threats include:

- multiple use conflicts between agriculture and fishing activities over water allocation in the dry season; fishing is secondary to agricultural uses in terms of determining water allocation
- illegal catching
- insufficient technical capacity and financial constraints of fishers, especially for stocking.

Product threats include:

- predator damage from birds and other aquatic predators (tortoises, crocodiles and predator fish species) resulting in harvest loss and reduced quality
- uncertainty of harvest due to seasonal variability

- limited water circulation in reservoirs leading to the spread of disease and fungal infestations
- pollution from agricultural run-off containing pesticides and fertiliser which contaminate resource and negatively impact fish health
- some reservoir areas have limited natural nutrition.

Comparative data from other countries and fisheries

Value chain analysis is a growing field of research within the agricultural and fisheries sector. Literature on this topic suggests that the general areas of sector improvement that are highlighted in value chain analyses include:

1. improving the planning, legal and regulatory framework for sustainable management of the resources
2. increasing the quantity and improving the regularity and continuity of production
3. improving the quality and safety of products
4. improving the mechanisms for cooperation among the value chain actors
5. reducing the time needed to reach the customer
6. minimising transactional costs
7. improving the capacity of chain actors to follow and assimilate technology and market developments (Parke 2013).

Value chain analysis is useful for identifying actors in the value chain, estimating the profit share of each actor in the chain, and identifying constraints and opportunities along the chain.

Many of the value chain weaknesses and threats we have identified in this paper are common to fisheries in other

countries. Such weaknesses and threats in production include lack of modern knowledge, poor harvesting technologies, poor storage facilities, illegal fishing and weak governance. Market-related threats include price fluctuations, poor quality supply, asymmetry in price transmission, insufficient value-added, seasonality of demand, and food loss and food waste. These constraints are experienced across the world, especially in low to middle-income countries in Africa (for example, Aziz et al. 2023 and Kamaylo et al. 2021) and Asia (for example, Kamaylo et al. 2021 and Navy and Sophea 2012).

With respect to prawns, value-chain analysis conducted in other countries has highlighted similar weaknesses and threats as those presented in this paper. This is especially true for poor access to high-quality PLs during stocking periods, high mortality of PLs, poor access to bank loans so cash advances are given by traders and local investors as an informal loan system, difficulties paying back these cash advances, lack of processing, lack of grading at farm-gate and associated low prices, poor profitability for fishers, limited investment, poor information flows and underdeveloped organisation of the value chain (Joffre and Aung 2012; González-Figueroa 2024).

Upon comparing data from other countries and fisheries, it is apparent that Sri Lanka has advantages that are not experienced in other countries. This includes profitability of fishing due to low costs, low risk associated with fishing activities and the established export market for GFP.

Specific recommendations from value-chain analyses in other countries have been made in terms of stricter regulation on size limits of harvest, seasonal closures, improvements of monitoring schemes, introduction of certification processes,

development of post-harvest facilities, increased capacity for effective extension services, creating access to formal credit facilities and habitat protection (Acharjee et al. 2023; Awel et al. 2018; Kamaylo et al. 2021; Navy and Sophea 2012; Rosales 2017). Most studies make recommendations for changes in individual aspects of the value chain but do not go on to developing a comprehensive strategy for the transformation of activities throughout the value chain.

Applying project findings for the enhancement of Sri Lankan CBF

There is great potential for reducing inefficiencies and capitalising on opportunities to expand livelihoods and improve food security of villagers in proximity to Sri Lanka's CBF (Abeyrathne et al. 2020). Sri Lanka's CBF have significant advantages over similar fisheries in other countries; especially the profitability of fishing due to low costs and low risks, and the established export market of GFP. Our earlier SWOT analysis outlines significant opportunities that can be exploited through:

- 1. production efficiencies** (private and private-public partnerships for improving availability and quality of seed stock, implementing GFP-specific harvesting equipment, fencing off GFP culture areas, improving storage and transportation facilities, and encouraging value add)
- 2. institutional arrangements** (such as improving capacity and skills for improved inclusivity and equity, innovative governance arrangements to manage conflicts and lower illegal fishing, and implementing advanced water management systems and seasonal forecasting)

3. improved marketing (such as introducing grading at landing sites, certification, branding and traceability).

To comprehensively exploit these opportunities requires a sector-wide development strategy. Fishing strategies have been developed in other parts of the world, generally to achieve one or a few aims within the fishing sector, such as combatting illegal, unreported and unregulated fishing, promoting sustainable fishing², and supporting coastal communities through community-based management³. Few strategies have a sector-wide perspective across the length and breadth of the value chain.

Though sector-wide strategies are rare, they have the potential to create significant transformation of value chains. ACIAR has co-funded 2 such sector-wide strategies – The *Myanmar Pulses Sector Development Strategy* (2017) and Pakistan's *Pulses Industry Development Strategy* (2023). The development of both these strategies is having enormous benefit in these countries, creating cooperation across stakeholders in the value chain, and transforming livelihoods and food security in the agricultural sector.

Development of a sector-wide strategy for Sri Lanka's CBF will require extensive and comprehensive stakeholder engagement with fishers, RFOs, villagers, collectors, processors, exporters, agribusiness, academia, non-government organisations (NGOs) and all levels of government. It could be led by government – perhaps NAQDA or directly by the Ministry of Fisheries and Aquatic Resources.

2 For example, Australia's 'Combating IUU Fishing and Promoting Sustainable Fisheries in Southeast Asia Program, available at <https://www.agriculture.gov.au/>.

3 For example, Asia-Pacific Economic Cooperation's Road Map on small-scale fisheries and aquaculture, available at <https://www.apec.org/>.

To be effective, the strategy should include:

1. A broad vision. For example, an inclusive, regionally and globally competitive, sustainable and adaptable culture-based fisheries sector contributing to the socioeconomic wellbeing of all members of the value chain and contributing to the development of Sri Lanka's national economy.
2. Carefully crafted objectives.
3. An implementation plan.
4. A resourcing strategy for all parts of the implementation plan (including private and public funding, and investment from aid and overseas development assistance).
5. A monitoring and evaluation plan.

We suggest that Sri Lanka pursue developing a CBF development strategy, so that opportunities along all parts of the value chain can be exploited for improved wellbeing of all stakeholders of CBF in Sri Lanka.

Acknowledgements

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