

Socio-Economic Importance of Inland Fishery and Adaptive Strategies of Inland Fishermen at Udawalawe Reservoir, Sri Lanka

Sri Lanka Journal of Social Sciences and Humanities
Volume 4 Issue 2, August 2024: 37-49
ISSN: 2773 692X (Online), 2773 6911 (Print)
Copyright: © 2024 The Author(s)
Published by the Faculty of Social Sciences and Languages, Sabaragamuwa University of Sri Lanka
Website: <https://www.sab.ac.lk/sljssh>
DOI: <https://doi.org/10.4038/sljssh.v4i2.123>



Rathnachandra, S.D.D.^{1*} and Malkanthi, S.H.P.²

¹Faculty of Graduate Studies, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

²Faculty of Agricultural Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

Received: 15 September 2024, **Revised:** 13 November 2024, **Accepted:** 18 November 2024.

How to Cite this Article: Rathnachandra, S.D.D. and Malkanthi, S.H.P. (2024). Socio-economic importance of inland fishery and adaptive strategies of inland fishermen at Udawalawe reservoir, Sri Lanka. *Sri Lanka Journal of Social Sciences and Humanities*, 4(2), 37-49.

Abstract

The inland fishery sector plays a pivotal role in ensuring food security and developing rural livelihoods worldwide. This study aimed to identify the factors affecting the socio-economic importance of the fishermen in the Udawalawe Reservoir area by addressing weaknesses and threats associated with the inland fishery sector. According to the database of the National Aquaculture Development Authority (NAQDA), 250 fishermen were registered with the Fishermen's Society of the Udawalawe Reservoir by the year 2022. From this population, 45 fishermen were selected using a simple random sampling technique. Primary data were collected through a self-administered questionnaire survey and three focus group discussions conducted from January to March 2022. Data analysis was carried out using descriptive statistics, SWOT analysis, and thematic analysis. The findings of the fishermen's household survey revealed that enhancing employment opportunities is considered the most important factor for improving the economic conditions of the fishermen in this area while strengthening the social network among fishermen is seen as a key aspect for improving their social conditions. The SWOT analysis identified several weaknesses, including inadequate production of high-quality fish seed for stocking, a lack of value-added products from inland fish, and limited sources of capital for research and development in inland fish farming. The identified threats include chemical pollution in water that affects fish quality, various types of predators, the dominance of marine fishery in the market, and the absence of national standards aimed at developing inland fish for both local and export markets. Thus, the proposed framework based on a systematic Plan-Do-Study-Act approach, aims to identify objectives, measure progress, and implement changes through proper stakeholder engagement, resource allocation, and an effective monitoring and evaluation (M&E) system. Thus, this framework is suggested as an adaptive strategy to enhance the socio-economic development of fishermen in this area while minimising the identified weaknesses and threats.

Keywords: Adaptive Strategies, Fishermen, Inland Fishery, Socio-economic Importance, Udawalawe Reservoir in Sri Lanka

INTRODUCTION

The inland fishery sector plays a significant role in the aspect of socio-economic importance of people in many developing countries (Somashekar & Majagi, 2020). Research findings indicate that inland fisheries contribute substantially to the nutritional value of the population and the growth of a country's national economy (Smith & Bennett, 2019). Moreover, inland fisheries and aquaculture have multifaceted significance in both social and economic aspects within societies (Smith & Bennett, 2019).

In Sri Lanka, the inland fishery sector accounts for 0.9% of the national economy (Department of Fisheries and Aquatic Resources, 2020). The country earns 318 million US dollars from exporting fish and fishery-based products, and the annual total production from the inland fishery sector is 90,340 metric tons (Department of Fisheries and Aquatic Resources, 2020). The inland fishery sector also plays a

crucial role in social development by generating employment opportunities and providing a source of income for many people. In particular, it supports food security and improves the well-being of fishermen similar to the marine fishery sector of the country. The inland fishery sector enhances the nutritional status of rural communities, which is vital for human health, thereby empowering and improving rural livelihoods both economically and socially (Murray & Little, 2022; Sanon et al., 2021). However, in some developing countries, the socio-economic contributions of the inland fishery sector have not yet been fully recognised or emphasised (Murray & Little, 2022; Sanon et al., 2021).

Moreover, inland fisheries are vital for socio-economic development and food security in many regions, providing a key source of protein and essential nutrients, particularly in

* Corresponding author: Tel.: +94 (76) 098 1172; Email: dilini.rathnachandra92@gmail.com

<https://orcid.org/0000-0002-6889-9193>



This article is published under the Creative Commons CC-BY-ND License (<http://creativecommons.org/licenses/by-nd/4.0/>). This license permits use, distribution, and reproduction, commercial and non-commercial, provided that the original work is properly cited and is not changed in anyway.

rural and less developed areas where alternative food sources may be scarce (Food and Agriculture Organization [FAO], 2022). Studies show that inland fisheries offer direct employment opportunities through fishing and aquaculture and indirectly related sectors like processing and distribution (National Aquatic Resources Research and Development Agency [NARA], 2022; Dugan et al., 2010). Furthermore, these fisheries stimulate local economies by generating trade and economic activities that benefit rural communities and contribute to poverty reduction (World Bank, 2018; Béné et al., 2009). Understanding the socio-economic impacts of inland fisheries is crucial for developing strategies that promote their sustainability and improve the livelihoods of fishermen.

Globally, inland fisheries produced about 51.3 million tons of aquatic animals in 2018, comprising 63.3% of global food fish production. While capture fisheries accounted for 12% of this production, culture fisheries contributed 51.3% (FAO, 2020). Inland fishing plays a significant role in the economies of countries like China, Myanmar, Bangladesh, Indonesia, Tanzania, Philippines, Thailand, Vietnam, India, Egypt, and Nigeria, with Asia accounting for 66% of global inland fish production (Pearson & Duggan, 2018). Women also play a critical role in this sector, contributing 14% of labour globally, with a higher share in culture fisheries (19%) compared to capture fisheries (12%). Notably, 85% of women involved in inland fishing are in Asia (Thomas et al., 2021).

Lynch et al. (2016) highlight that inland fisheries contribute to individual well-being through food and economic security and empowerment. They also provide social benefits, including cultural services, recreation, health, knowledge transfer, and capacity building. Inland fisheries are crucial for food and nutrition security in many developing countries, particularly in rural communities where they are often the primary source of animal protein. They generate income and job opportunities throughout the value chain, including fishing, processing, and distribution. Inland fisheries also present opportunities to empower women through their involvement in fishing and post-harvest activities.

In Sri Lanka, inland fisheries meet 50% of the nation's animal protein needs and support around one million fishermen, workers, and their families. Both men and women are involved in the sector, with women accounting for 10% of post-harvest activities related to inland fisheries (World Bank, 2022). Sri Lanka has approximately 12,000 reservoirs, categorised as perennial and seasonal based on their hydrological regimes, covering around 260,000 hectares of the country (Chandrasoma & Pushpalatha, 2018).

The inland fishery sector significantly contributes to Sri Lanka's economy, accounting for 9.9% of the Gross Domestic Product (GDP) (Department of Fisheries and Aquatic Resources, 2020). There is considerable potential to increase this contribution further by enhancing fish production, promoting value addition, and improving access to export markets. However, Sri Lanka has not fully capitalised on the potential for value addition in inland fish products due to underperformance in the sector (Athukorala et al., 2017; United States of Agency for International Development [USAID], 2009). One area that

exemplifies the growth potential is the Udawalawe Reservoir, located in the Ratnapura District of Sri Lanka. This reservoir serves as a successful natural breeding and spawning ground for various species, including Indian carp varieties (*Catla catla*), Rohu (*Labeo rohita*), Mrigal (*Cirrhinus mrigala*), Gift Tilapia, and freshwater prawns, all of which are successfully cultivated in Sri Lanka (Deepananda et al., 2014). Due to the favourable climatic conditions in the area, the reservoir is particularly known for its substantial production of Catla and Tilapia species, outperforming other inland fish-cultivating reservoirs in the country (Rathnachandra & Malkanthi, 2023).

Literature review evidence that limited research has been conducted regarding the study of the socio-economic importance of inland fisheries, factors affecting the socio-economic well-being of fishermen and challenges faced by them, while most of the studies have focused on the technological aspects of inland fisheries (Murray & Little, 2022; Deepananda et al., 2014) and the development of culture-based fisheries (Amarasinghe et al., 2022; Chandrasoma & Pushpalatha, 2018; Amarasinghe, 2013). Thus, this study aimed to address these gaps by investigating the socio-economic factors influencing the improvement of inland fishermen and also the weaknesses and threats facing the sector, particularly in the Udawalawe Reservoir.

The identified research gaps signify the need to address the socio-economic conditions of fishermen. Thus, this research aimed to analyse the factors influencing the socio-economic development of fishermen in this area from their perspective. It also explored the internal and external environmental factors affecting the Udawalawe Reservoir area to enhance inland fish production. The study provides suggestions to address weaknesses and threats that are crucial for formulating policy implications to boost inland fish production in the future.

This paper examines the socio-economic profile of fishermen and the significance of inland fisheries from the perspective of fishermen while proposing a framework to enhance the socio-economic impact of inland fisheries in line with the study's research objectives. The literature review outlines the theoretical framework and identifies conceptual, empirical, methodological, and theoretical gaps concerning the socio-economic importance of inland fisheries. The research methodology section provides a brief overview of the operationalisation of variables, the sampling procedure, data collection techniques, and data analysis methods employed in the study. The results and discussion section presents the findings derived from the analysis of the data collected from the study area, while the conclusion section summarises the conclusions drawn from these findings.

LITERATURE REVIEW

The socio-economic importance of inland fisheries extends beyond mere economic contributions; it encompasses cultural, nutritional, and social dimensions as well (Béné & Friend, 2021). In existing literature, the term socio-economic importance is defined as follows;

- Socio-economic importance refers to the significance of an activity or sector in contributing to the economic welfare and social structures of a community, encompassing both economic

contributions and social impacts (Béné et al., 2016).

- According to the study of Ahmed & Hossain (2020), The socio-economic importance of a sector includes its role in enhancing living standards, food security, and sustainable development, especially in rural areas.
- Socio-economic importance can be assessed by examining its impacts on employment, income levels, community health, and cultural identity, particularly in resource-dependent communities (Dey et al., 2021).

According to the definitions of socio-economic importance, some conceptual gaps were identified. These definitions recognise both economic contributions and social impacts, but there is a lack of a framework that effectively integrates these dimensions (Kearney, 2018). Also, the socio-economic importance of a sector may vary significantly across different regions or communities. Existing studies do not fully account for local cultural, environmental, and economic contexts, which could affect the generalisability of the findings (Wu & Tham, 2023). Moreover, most assessments focus on current impacts, but there is a need for longitudinal studies that examine the long-term socio-economic effects of sectors on communities, particularly in changing environments (Baker & Johnson, 2016). In addition, the role of policy and governance in shaping the socio-economic importance of a sector is often underexplored (Akande, 2022). Also, socio-economic importance could change over time due to economic shifts, technological advancements, or environmental changes (Calimanu, 2023).

Understanding the socio-economic dynamics of inland fisheries can be enhanced through various theoretical frameworks. The Livelihoods Framework, for instance, emphasises the multiple assets that contribute to the livelihoods of fishermen, including natural, human, and social capital (Béné & Friend, 2021). From the existing theoretical frameworks, Common Pool Resource theory (CPR) provides a valuable framework for exploring the socio-economic importance and adaptive strategies of inland fishermen. It facilitates a deep understanding of resource management dynamics, community governance, and the interplay between environmental sustainability and economic livelihoods, ultimately contributing to more effective strategies for supporting these communities (Hoang et al., 2021) because CPR theory focuses on the management of resources that are shared among multiple users, such as inland fisheries (Ma'ruf et al., 2023). Also, this theory provides a framework to analyse challenges faced by inland fishermen, such as overfishing and resource depletion. It helps to explore the socio-economic implications of these challenges and the adaptive strategies employed to mitigate negative impacts on fishermen's livelihoods (Sanon et al., 2021). Apart from that, CPR theory emphasises the role of local institutions and community governance in resource management (Zhang et al., 2024). In particular, this can be used to examine how fishermen adapt their practices and strategies in response to external pressures, including climate change and market fluctuations. It provides a lens to analyse the effectiveness of these adaptations in sustaining both their livelihoods and the resource base (George, 2019). Moreover, CPR theory

often addresses issues of equity and social capital, which are crucial in understanding the socio-economic importance of inland fisheries (Sanon et al., 2021). Thus, the CPR theory, emerged in the 1980s to examine the institutional, social, and physical factors that promote cooperation among local resource users. CPR theory is used to describe social-ecological relationships governing changes in inland fisheries (Basurto, 2015; Partelow et al., 2018). It emphasises the need to study socio-economic conditions, challenges, and opportunities in inland fisheries to fishermen, boost fish production and enhance income as a common-pool resource. CPR theory provides a comprehensive framework for understanding the challenges and solutions associated with managing resources that are shared among multiple users. By exploring how different governance structures and collective actions help to manage these resources sustainably, CPR theory offers valuable insights into balancing the use, conservation, and equitable distribution of benefits (Tucker et al., 2023).

Many studies focus on either socio-economic or ecological aspects, but there is a lack of integrated frameworks that combine these perspectives (Andersson et al., 2024). While there is growing literature on climate change impacts, specific studies on how climate change affects the socio-economic status of inland fishery communities remain limited (Ramírez et al., 2018). Although some studies address women's roles in fisheries, there is a need for a more nuanced analysis of gender dynamics, including decision-making power, access to resources, and participation in value chains (International Labour Organization [ILO], 2022). In addition, there is a lack of comprehensive studies on the economic diversification strategies employed by inland fishery communities. Understanding how these strategies contribute to resilience and sustainability is crucial (Pratiwy et al., 2024). Moreover, the impact of local and national policies on the socio-economic development of inland fishery communities is not well-documented (Funge-Smith & Bennett, 2019). Studies on socio-economic vulnerability factors including poverty, education, and infrastructure are limited in the context of inland fisheries. Understanding these vulnerabilities is essential for targeted interventions (Sanon et al., 2021).

There is a lack of long-term studies that track the socio-economic impacts of inland fisheries over time (Béné & Friend, 2021). Many studies overlook the influence of local cultural practices and beliefs on the socio-economic dynamics of fishing communities. Exploring how cultural factors shape fishing practices, resource management, and community resilience could enhance existing knowledge (Gustavsson et al., 2017). Research often focuses on male fishermen, neglecting the roles and contributions of women in inland fisheries. Empirical studies that explore gender-specific impacts, access to resources, and decision-making processes would address this gap (Bennett & Dearden, 2018). While there is growing awareness of the effects of climate change, empirical evidence specifically linking climate variability to the socio-economic conditions of inland fishing communities is still limited, and studies for adaptive strategies are few (Liu & Li, 2022). A few studies examine how inland fishing communities diversify their income sources and the impact of this diversification on overall socio-economic stability. Studies in this area support

to develop more resilient community strategies (Sène-Harper et al., 2020). There is a need for empirical research on the effectiveness of local governance structures and policies in managing inland fisheries (Berkes & Folke, 2019). Limited research has been conducted on the market dynamics and value chains specific to inland fisheries (Harrison & Ramachandran, 2021). Investigating the relationship between inland fisheries and community health, particularly in terms of nutrition and food security, remains underexplored. Studies that focus on dietary contributions from fish could inform public health initiatives (Sharma & Sharma, 2020).

Many studies rely on qualitative methods or limited quantitative data. There is a need for mixed-method approach that combine both qualitative and quantitative data to provide a more comprehensive understanding (Free et al., 2015). Moreover, there are no longitudinal studies that track changes in socio-economic conditions over time, related to inland fisheries. Such studies lead to identifying trends and causal relationships more effectively. In addition, there is a lack of standardised tools to assess the socio-economic impacts of inland fisheries comprehensively. Developing metrics that capture social well-being, economic security, and ecological sustainability is essential (Sanon et al., 2021). In particular, limited incorporation of technology, such as remote sensing and Geographic Information Systems (GIS), can hinder spatial analysis of socio-economic conditions and resource distribution in inland fisheries (Falconer et al., 2020). There are few comparative studies that analyse different regions or countries. Such studies support to identify the best practices and lessons learned that could be applicable in other contexts (Sanon et al., 2021). Therefore, there is a gap in studying the socio-economic importance and adaptive strategies from inland fishermen's perspective, and this study can fill the knowledge gap and provide insights for future research.

MATERIALS AND METHOD

Udawalawe reservoir is located in Udawalawe National Park in Ratnapura district in Sri Lanka. The extent of the reservoir is 3,399 ha. Inland fishing and the production of fish fingerlings are its two prominent features. Also, it acts as a highly productive natural breeding and spawning ground for Indian carp varieties; Catla, Rohu and Mrigal, Tilapia varieties (Gift Tilapia) and freshwater prawn species that are cultivated in Sri Lanka (NAQDA, 2022; Deepananda et al., 2014).

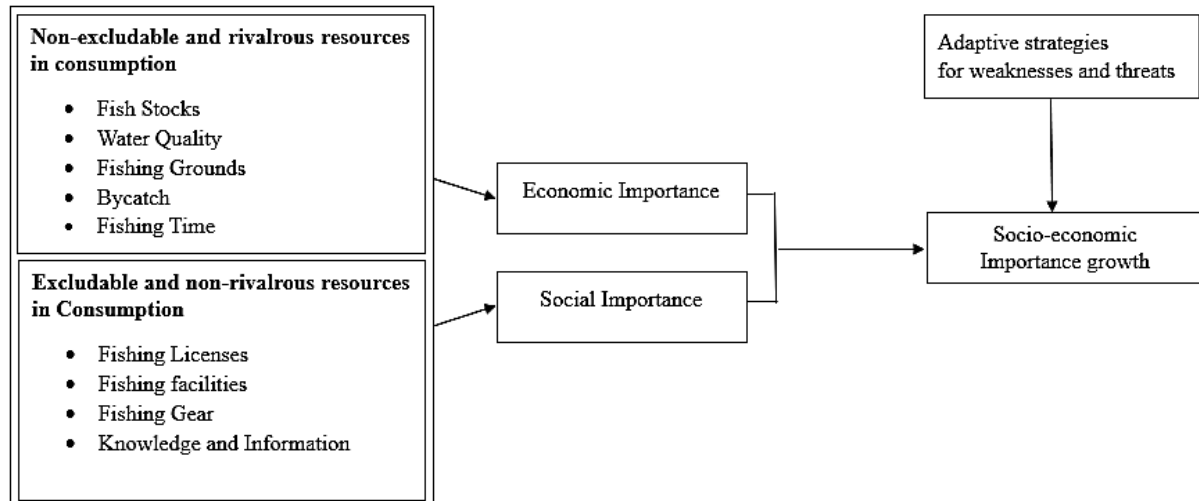
While descriptive analyses were utilised to identify the respondents' socio-economic profile and socio-economic importance of inland fisheries, a SWOT analysis was conducted to find out the present status of the inland fishery as well as to identify the weaknesses and threats faced by the fishermen when doing their fishing practices because SWOT analysis allows for a comprehensive evaluation of internal and external factors affecting inland fishermen. By identifying strengths and weaknesses, researchers can gain insights into the socio-economic conditions within the communities. Opportunities and threats provide context for external pressures, such as market dynamics and environmental changes. Also, SWOT analysis can directly inform the adaptive strategies of inland fishermen. By mapping out existing strengths (e.g., traditional knowledge community cohesion) and weaknesses (e.g., limited access

to markets), researchers can suggest targeted interventions to enhance resilience. In addition, a framework was developed to improve the socio-economic importance of inland fishery by outlining the findings of the SWOT analysis. Also, the study was cross-sectional due to the time limitations for utilising the longitudinal pattern.

A pilot study was conducted to identify the suitability of the questionnaire. After that, a self-administrated questionnaire survey was conducted from January to March 2022 as the method of primary data collection.

According to the 2022 statistics of the National Aquaculture Development Authority (NAQDA) of Sri Lanka, 250 fishermen were registered and actively engaged in fishing activities in this reservoir. From this population, a sample of 45 fishermen was selected for the study using the simple random sampling method. The decision to sample 45 fishermen from a population of 250 is justified as a balanced approach to obtaining reliable and meaningful results, considering factors such as statistical power, resource constraints, representativeness, literature benchmarks, and practical aspects of data collection. Three focus group discussions were also conducted with 15 participants per session to facilitate discussion while ensuring that everyone has the opportunity to contribute. Because focus group discussions bring together fishermen's backgrounds to gather a wide range of insights and experiences related to inland fisheries, it allows for nuanced discussions that can reveal underlying beliefs, values, and social dynamics affecting the inland fishery sector, which quantitative data alone might fail to reveal. Furthermore, it provides insights for more effective policy-making and resource management by highlighting local knowledge and priorities. Hence, focus group discussion themes identified from the existing literature findings were; favourable climatic conditions and availability of geographical features, types of resources that are currently available (Lammers et al., 2020), contribution to employment and income, trends in local and export markets indicating growing demand for inland fish, protection of biodiversity (Suuronen & Bartley, 2014), community benefits, source of nutrition supplement, fish breeding centres' contribution to enhancing fish farming practices (Özen, 2019), support required from community and government levels, availability of value-added fish products (Pedroza-Gutiérrez & López-Rocha, 2016), new technology adoption (Dube & Mabika, 2022), quality fish seed, natural disasters affecting fish farming, disease identification and treatment in fish populations (Islam et al., 2023), the role of women in fish processing (Muthmainnah and Rais, 2021), and predators' role in fish stocks (Moosmann et al., 2024). Thematic analysis was utilised for analysing the data gathered from focus group discussions. According to that, a mixed-method research design was selected for the study. Thus, those findings were used to develop a framework to improve the socio-economic status of fishermen in this area.

Figure 1: Conceptual framework of the study



Source: Researcher's creation, 2024

According to the study by Lynch et al., (2016), the socio-economic importance of inland fishery was assessed from both economic as well as societal perspectives separately as individual and social situations after making necessary modifications according to the study area. The economic importance illustrating dimensions used here were; enhancing employment opportunities, expanding the production capability of inland fish and its based products, ability to use as a nutritive source of food in fishermen's households, acting as a protein supplement, possibility for savings, access to financial sources (loan/credit), product diversification, and formation of value-added products. The social importance elaborating dimensions used were; empowerment of fishermen's livelihoods, enhancement of social networking among fishermen, increasing of awareness regarding inland fishing activities, and enhancement of the living standards of the fishermen.

Thus, the SWOT analysis is a structured planning method that can be used to identify and assess both internal and external factors that are favourable or unfavourable towards achieving the development of the target activity or the place while performing at the initial stage of planning. With the SWOT analysis, strengths were recognised as the helpful factors of internal development and weaknesses as the unfavourable factors for the improvement of the socio-economic importance of inland fishery related to this area. Moreover, opportunities are the external supportive factors and threats are the external harmful factors for the development of inland fishery in this area. The SWOT analysis was conducted to find out the weaknesses and threats encountered when fishing in this reservoir and to explore the solutions for them in order to develop fish production. The findings of the SWOT analysis were validated using the results of the focus group discussions. In addition, the reliability and validity of the survey data were evaluated to ensure that the research findings were accurate, credible, and applicable.

RESULTS AND DISCUSSION

The Socio-Economic Profile of the Fishermen

The main socio-economic factors of the fishermen were studied and the findings are presented in Table 1. According to the results, 73.3% of the fishermen belonged to the age category of 40 to 59 years, indicating that the majority were in their economically active stage. Additionally, 71.1% of the respondents were married, suggesting that most had family support for their fishing activities. Furthermore, 53.3% of the fishermen had received formal education up to the Junior Secondary level or GCE Ordinary level. This represents a significant level of educational achievement, enabling the majority to understand new knowledge, techniques, and adapt the latest technologies to enhance their inland fishery production, access financial facilities, and procure the necessary inputs for their fishing activities.

Most of the fishermen had a family size of 4 to 5 members, which further suggests the potential use of additional family labour in fishing, post-harvest, and processing activities. Moreover, they had an average of 7 years of experience in fish farming, indicating substantial knowledge and expertise in inland fishery activities. While 82.2% of the fishermen earned a monthly income between LKR 20,001 and 40,000, 13.3% earned less than LKR 20,000. Therefore, the majority of the fishermen earned a significant monthly income from fishing activities in the reservoir.

Table 1: Socio-economic profile of fishermen of the study area (n=45)

Factor	Category	Frequency	Percentage (%)
Age	20-39 Years	08	17.8
	40-59 Years	33	73.3
	More than 60 Years	04	08.9
Marital status	Single	10	22.2
	Married	32	71.1
	Widowed	03	06.7
Educational level	No Primary education	02	04.4
	Primary education	11	24.4
	Junior secondary education (O/L)	24	53.3
	Senior secondary education (A/L)	08	17.8
Monthly income (LKR)	Less than 20,000	06	13.3
	20,001 – 40,000	37	82.2
	40,001 – 60,000	02	04.4
Number of family members	<4	09	20.0
	4 - 5	28	62.2
	>5	08	17.8
Farming experience (Years)	01-04	11	24.4
	05-09	32	71.1
	10-14	02	04.4

Source: Field survey January to March, 2022

The Socio-Economic Importance of Inland Fishery from Fishermen's Perspective

Before conducting the study, the reliability of the survey data was evaluated using internal consistency measures. Cronbach's alpha for economic importance items was 0.87, indicating high reliability, while the social importance items had a considerable value of Cronbach's alpha of 0.79.

From the analysis, the main socio-economic aspects were studied and the findings are shown in Table 2. As per the results, seven factors were used to assess the economic importance of inland fishing for fishermen. These factors are: "Enhancing employment opportunities" (97.8%), "Expanding the production capability of inland fish and fish-based products" (95.6%), "Ability to use as a nutritive source of food in fishermen's households" (93.3%), "Acting as a protein supplement" (88.9%), "Possibility of saving money" (80%), "Access to financial sources (loan/credit)" (71.1%), and "Product diversification and development of value-added products" (84.4%). Thus, the majority of fishermen reported that enhancing employment opportunities, expanding the production capacity of inland fish and fish-based products, and utilising them as a nutritive source of food in their households were the most significant

dimensions that highlight the economic importance of inland fisheries from their perspective.

Regarding social importance, four factors were used to assess the social importance of inland fisheries. These factors include "Empowerment of fishermen's livelihoods" (73.3%), "Enhancement of social networks among fishermen" (80.0%), "Increased awareness of inland fishing activities" (71.1%), and "Improvement in the living standards of fishermen" (62.2%). According to the findings, enhancing social networks among fishermen was identified as the most important factor that demonstrates the social importance of inland fisheries. Consequently, inland fisheries have the potential to play a crucial role in the socio-economic development of fishermen in the study area. Several research findings have also evidenced that inland fisheries contribute to the social and economic development of rural livelihoods in many countries around the world (Sanon et al., 2021; Smith & Bennett, 2019; Paul & Chakraborty, 2016).

Table 2: Socio-economic importance of inland fishery in fishermen perspective (n=45)

Economic importance	Frequency	Percentage (%)
Enhancing employment opportunities	44	97.8
Expanding the production capability of inland fishing and its based products	43	95.6
Ability to use as a nutritive source of food in fishermen's households	42	93.3
Acting as a protein supplement	40	88.9
Possibility to do some savings	36	80.0
Access to financial sources (loan/ credit)	32	71.1
Product diversification and formation of value-added products	38	84.4
Social importance		
Empowerment of fishermen's livelihood	33	73.3
Enhancing the social network among fishermen	36	80.0
Increasing awareness of inland fishing activities	32	71.1
Enhancing the living standards of the fishermen	28	62.2

Source: Field survey January to March, 2022

SWOT Analysis of Inland Fishery in Udawalawe Reservoir

A SWOT analysis was conducted and the results are presented in Table 3.

Table 3: SWOT analysis of the Inland fishery sector in Udawalawe reservoir

Strengths	Weaknesses
Favorable climatic conditions in most of the time of the year.	Lack of bottom-level support for the development of inland fish farming.
Excellent geographical condition.	Limited sources of capital to enhance research and development in inland fish farming.
Resource availability for expanding production.	Lack of adequate quality fish seed production for stocking.
Employment generation.	Poor level of technology transmission.
Excellent source of protein supplements to avoid nutrition deficiencies of the people.	Lack of value-added products of inland fish.
Presence of fish breeding centers for Tilapia varieties, Carp varieties, and freshwater prawn species	Fishermen have a lower level of financial accessibility to purchase required equipment for farming.
A source of income for enhancing the living status of fishermen	Natural disasters (flooding and droughts)
Opportunities	Threats
Increasing demand for inland fish species in the local market as well as in the export market.	The national standards are not directed to develop both the local and export markets.
Increasing breeding of indigenous fish varieties.	Chemical pollution and quality control of fish.
Policy makers implement updated policies for the development of inland fish production in Udawalawe reservoir.	Extension service is not directed towards the harmfulness of the usage of dangerous fishing equipment.
Protect biodiversity and improve the natural ecosystem of the reservoir.	Poor awareness of consumers on inland fish.
Frequent supervision of disease identification and application treatments.	Various types of predators.
Empowerment of livelihoods of women (due to higher participation of women in fish processing).	Higher market share of marine fishery.

Source: Field survey January to March, 2022

After conducting the SWOT analysis (Table 3), the strengths, weaknesses, opportunities, and threats related to the inland fishery in this reservoir were identified. "As the strengths; fishermen highlighted several strengths of inland fish farming, including favourable climatic conditions." Most of the fishermen stated, "the climate conditions here support fish farming almost year-round." Additionally, geographical advantages were noted, with a community leader mentioning "we have easy access to both water and land

resources too." It evidences that Udawalawe reservoir consists favourable year-round climatic conditions and that necessary resources are available." One of the weaknesses is the lack of bottom-level support to enhance inland fish production, as the involvement of fishermen in inland fishery development is minimal, with the government providing only limited assistance. "The focus group discussions revealed that fishermen feel disconnected from the development initiatives, with minimal involvement in decision-making processes. This lack of engagement undermines local ownership and investment in inland fishery development." Furthermore, inland fish species have lower demand in some areas of the local market due to consumers' preference for marine fish species. Sri Lanka has limited capacity to penetrate the export market, as evidenced by the study of Murray & Little (2022). Additionally, the government and other supporting organisations provide a limited number of financial resources to expand research and development activities in inland fish farming. Moreover, "fishermen in the two focus group discussions expressed frustration with the limited financial and technical support from the government. This corroborates the notion that government initiatives are not sufficiently addressing the needs of local fishermen." Furthermore, "the chairman of the fishermen's society highlighted a significant consumer preference for marine fish over inland species, impacting market viability. This consumer behaviour poses a challenge for local producers by preventing a sustainable market for inland fish."

Meanwhile, in this reservoir, the inland fish seed requirements are met by Udawalawe Carp AQDC and Udawalawe Tilapia AQDC. However, these Aquaculture Development Centres (AQDCs) have been unable to meet the total demand for fish seed production due to limited rearing facilities such as brood stock ponds, rearing ponds, and nursery ponds. Despite having up-to-date knowledge and technologies, these AQDCs have been ineffective in transmitting these technologies to fishermen. Moreover, fishermen face financial challenges in purchasing the necessary farming equipment due to issues like the inability to provide collateral, lower education levels, and high interest rates on bank loans. Similar findings were reported by Murray and Little (2022) and Pomeroy et al. (2020) in their research studies. In addition, "twenty-nine fishermen reported that there was a consensus that inadequate financial resources hinder research and innovation in inland fish farming, limiting advancements in practices that could enhance production too. Also, "many fishermen reported challenges in securing loans due to high-interest rates and lack of collateral, which inhibits their ability to invest in necessary equipment." Thus, financial challenges limited their purchasing ability of farming equipment and introduced new fish species to the industry by the aquaculturist of AQDCs.

"In particular, 80% of fishermen in the focus group discussions, revealed that natural disasters, such as floods and droughts, pose significant threats to fish production, leading to inconsistent yields and economic instability for them." Thus, natural disasters, such as floods destroying fish seeds, cold weather reducing fish seed production, and drought conditions leading to fish mortality, also hinder fish production. These factors cause fluctuations in inland fish production in the reservoir. Consequently, fishermen in the

Udawalawe reservoir face numerous challenges in expanding inland fish production.

However, there are potential opportunities for expanding inland fish production due to a certain demand in both local and export markets (Sri Lanka Export Development Board, 2023). This could generate considerable economic benefits, boosting the local economy. Moreover, “most of the fishermen have noted an increase in local and export demand for fish, particularly as consumers become more health-conscious and seek sustainable food sources. This creates a clear market opportunity for inland fish producers.” Additionally, naturally breeding indigenous fish species help maintain the natural ecosystem of Udawalawe and supports the sustainability of fish production. “In the focus group discussion, few fishermen emphasised the importance of breeding Indigenous fish species, which not only supports sustainability but also enhances biodiversity and helps maintain the ecological balance within the reservoir.” Policymakers need to focus on formulating and implementing timely policies to further develop inland fish production in this reservoir. Inland fish production also contributes to biodiversity protection and enhances the natural ecosystem, as noted by Murray & Little (2022). “The chairmen of the fishermen’s society advocated for stronger government policies and timely interventions to promote inland fisheries. They highlighted the need for better frameworks that support production growth and resource management too.” The suitable stocking density of fish in the reservoir ensures that it does not harm the natural fish population density (Lynch et al., 2016). Regular monitoring of disease conditions and the environment is also necessary to minimise susceptibility to diseases caused by predatory species. In particular, “focus groups highlighted that women play a vital role in inland fish processing and value addition. fishermen reported that these activities not only contribute to economic growth but also empower women and improve community resilience.” Moreover, the inland fishery sector helps empower the livelihoods of people in the area. For example, women play a significant role in expanding inland fish processing and value addition activities, contributing to their empowerment. There are also identified threats that reduce inland fish production in this reservoir. These include poor enforcement of national standards for inland fish farming to develop both local and export markets. Although the Udawalawe reservoir is a man-made perennial reservoir, pollution from various sources has sometimes degraded its water quality (Deepananda et al., 2014). Water quality is crucial for enhancing inland fish production (Anusuya et al., 2017; Wickramaarachchi, 2010). As a matter of fact, “the members of the Fishermen’s Society highlighted the issue of pollution from agricultural runoff, industrial waste, and other sources affecting the Udawalawe reservoir and they stressed that degraded water quality has direct negative impacts on fish health and productivity. Discussions frequently referenced the importance of maintaining good water quality for fish farming.” Thus, the fishermen emphasised that fluctuations in water quality due to pollution and other factors lead to stress and mortality in fish populations. In addition to that, “many fishermen pointed out the absence of regular water quality assessments and monitoring programs, which are crucial for timely interventions to address pollution and its effects on fish production.” Thus, it is essential to govern fish production by eliminating chemical pollution in the reservoir and regularly maintaining necessary quality standards.

Additionally, extension services should work to prevent the use of harmful fishing equipment. Extension officers must expand their knowledge and disseminate it effectively to encourage the adoption of new techniques by fishermen. Predatory species also threaten fish seeds in the reservoir, so frequent monitoring is necessary to remove them. The “fishermen identified regulatory challenges, particularly the lack of clear national standards and Environmental threats, such as pollution, were also highlighted as critical issues that need addressing.” In addition, the marine fishery sector holds a larger share of the local market due to higher consumer preference for marine fish and marine-fish based products, rather than inland fish (World Bank, 2021; Murray & Little, 2000). Therefore, awareness programs about the importance of inland fish should be conducted to create a better market in the future.

Improving the Socio-Economic Status of Fishermen in the Udawalawe Reservoir Area

The Udawalawe Reservoir, an important inland aquatic system in Sri Lanka, has considerable potential to boost socio-economic benefits through its fisheries. This reservoir hosts a variety of aquatic species and plays a crucial role in providing food security, job opportunities, and income for local populations (Fernando et al., 2024). However, based on the findings of the SWOT analysis, there are several issues: lack of bottom-level support for industry development, limited capital to enhance research and development in inland fish farming, poor quality fish seed production for stocking, ineffective technology transmission, and a lack of value-added inland fish products. Additionally, threats include inadequate national standards for local and export markets, chemical pollution and quality control issues, predation by various species, low consumer awareness of inland fish, and the dominant market share of marine fisheries. Thus, the following improvement framework enhances the scope of improving the socio-economic status of fishermen in the Udawalawe reservoir area.

A Framework to Improve the Socio-Economic Status of Fishermen in the Udawalawe Reservoir Area

This framework (Figure 3) aims to enhance fishermen’s financial accessibility by 20%, improve the sustainability of fish seed production by 30%, and enhance market access and community benefits within one year. The improvement process will be measured using three basic aspects: outcome measures, process measures, and balancing measures. This framework was developed through a validation procedure of the findings of the focus group discussions.

Outcome measures include fish seed stock quality parameters, market access metrics, and community welfare indicators. As the fish seed stock quality parameters; fish population density (number of fish per unit area) and biodiversity (variety and abundance of fish species) were considered because “the chairman of the fishermen’s society revealed that the major fish seed stock quality parameters are the number of fish per unit area and abundance of fish species.” In addition, “The majority of fishermen noted that the metrics for the market access include travel distance to the market and fish prices.” Thus, the distance to market (average distance travel to reach the market) and market prices (average prices received for fish)

were used as the measures of market access metrics. Consider the community welfare indicators; education (access to extension and training facilities, fish farming experience) and health care (quality healthcare service access for the minimise spreading of diseases to fish stock as well as the fish seed stock. Process measures involve sustainable fishing practices, market access opportunities, and training programs to enhance the socio-economic importance of inland fishery in this study area. "Most members of the fishermen's committee reported that gear restrictions and fish quotas are the primary sustainable fishing practices." Hence, for sustainable fishing practices; a number of fishermen's sustainable practices (e.g. gear restrictions and fish quotas) and the frequency and quality of market access opportunities (number of market days and price fluctuations) were utilised as the measures of market access opportunities. In particular, "The Secretary of the Fishermen's Society indicated that the number of market days and price fluctuations are significant factors influencing market access opportunities." In the measures of the training programs; the effectiveness of training programs (number of participants and skill improvements) was considered. Balancing measures focus on the impact on fish seed stocks (monitor any negative effects on fish seed stocks from increased fishing activity), resource allocation (assess how resources are distributed among different initiatives), and community impact (evaluate how changes affect different segments of the community) as key factors for maintaining the balance during the improvement process. Thus, most of the fishermen noted that focus on the impact on fish seed stocks, the way resources are distributed among fishermen, and community impact for inland fishing gives more contribution to maintaining the balance to overcome the weaknesses and threats of the inland fishery.

According to these measures, changes will be addressed from economic, environmental, and social perspectives. Economic changes will focus on sustainable fishing practices (develop and promote guidelines for fishing and provide incentives for adopting these practices), corporate marketing strategies (establish cooperatives for joint marketing and resource pooling), and financial accessibility (enhance access to credit and financial services for fishermen and train fishermen in financial management and value-added product development). Environmental changes will include fishery management practices and habitat conservation. Under the fishery management practices, implementing regulated fishing seasons to allow for breeding periods and also creating and enforcing regulations in critical fish habitats were considered. While conducting habitat restoration projects, spawning grounds and water quality were selected as the measures of habitat conservation. Social changes will emphasise community engagement and support services. In community engagement; organise workshops and forums to engage communities in sustainable practices and improve access to extension services and training programs. Enhancement of support for community health and education services was utilised as the measures under support services. In particular, "the Chairman of the Inland Fish Society reported the economic, environmental, and social perspectives necessary for the sustainable development of the inland fishery sector, focusing on adaptive strategies."

The success of the framework can be evaluated through a systematic Plan-Do-Study-Act approach, with the potential for scaling up to other similar communities based on demonstrated effectiveness. The Plan stage mainly focuses on developing pilot projects in a few communities of inland fishery to test new fishing practices, market strategies, and support services (e.g. implement new fishing practices, corporate strategies and support services). In the Do stage; roll out the pilot projects on a small scale, and implement new fishing practices, corporate strategies and support services. (e.g. monitor and record data related to income levels, fish seed stock quality and community benefits). The Study stage focuses on analysing the collected data to assess the effectiveness of the interventions, and determining whether the financial accessibility of fishermen has increased, whether fish seed stocks are in quality, if market access and community benefits have improved through evaluating the increment of fishermen's financial accessibility, improvement of fish seed stock, increment of market access and community benefits. The Act stage involves refining the interventions based on the data and feedback (making necessary adjustments for the gaps). If pilot projects are successful, scale up the changes to other communities in the inland fishery sector.

Adaptive Strategies of the Improvement Framework

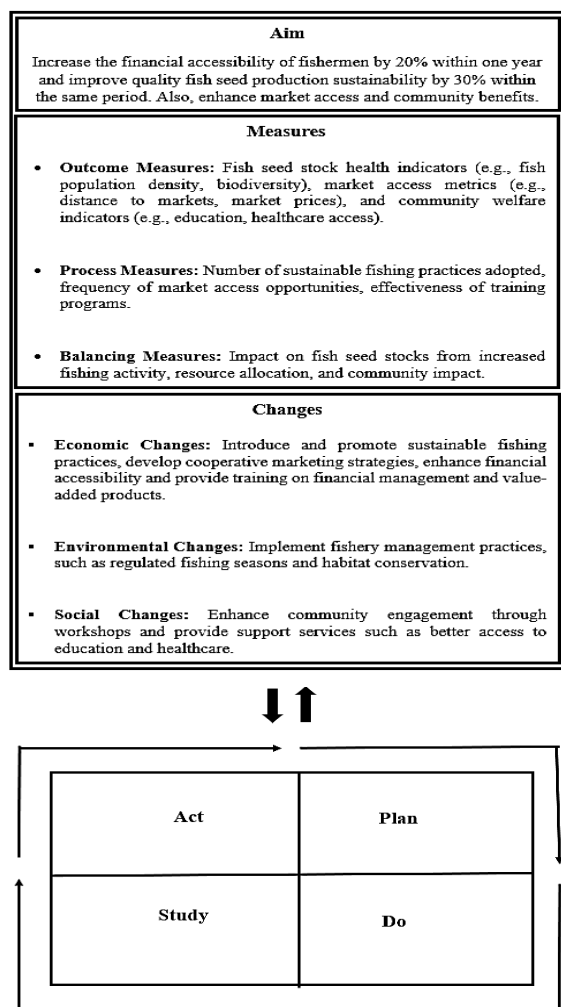
Stakeholder Engagement: Continuous dialogue with stakeholders (e.g.- extension officers and policymakers) is essential for the success of the improvement framework for the Udawalawe Reservoir fishery. Identifying key stakeholders, establishing effective communication channels, involving them in decision-making, ensuring transparency and building trust are critical steps. Engaging stakeholders effectively not only enhances the relevance and effectiveness of the interventions but also fosters collaboration and support for enhancing the socio-economic importance of inland fishery.

Resource Allocation: Efficient resource allocation is crucial for the success of the improvement framework for the Udawalawe Reservoir fishery. Identifying priority needs, developing a comprehensive allocation plan, implementing resources effectively, ensuring transparency and accountability, and continually reviewing and refining the approach are key components. This structured approach ensures that resources are utilised optimally to address the most pressing challenges and opportunities in the fishery sector.

Monitoring and Evaluation: A robust monitoring and evaluation (M&E) system is essential for the successful implementation of the improvement framework for the Udawalawe Reservoir fishery. Designing an effective M&E system, implementing regular data collection and analysis, evaluating outcomes, making necessary adjustments, and ensuring the system's robustness are critical steps. This systematic approach helps in tracking progress, assessing the impact of interventions, and achieving the framework's objectives. Figure 3 presents the improvement framework for the socio-economic importance of inland fishery in this reservoir.

"The majority of the fishermen committee members of the fishermen society showed the proper identification of key stakeholders is significant to establish more effective communication channels to support the enhancement of the socio-economic importance of inland fishery through their decision-making and also the sustainable fishing practices. Also, identifying priority needs, developing a comprehensive allocation plan and implementing resources effectively benefited enhancing of the socio-economic importance of inland fishery with an effective M&E system with this system."

Figure 2: Framework to improve the socio-economic status of fishermen



Source: Researchers' creation, 2024

CONCLUSION

The findings of the research reveal that the majority of fishermen are middle-aged, married, have received a considerable level of formal education, and enjoy family support for their fishing activities. Additionally, most have significant experience in inland fish farming, which contributes to their success in the field. A substantial number of fishermen also earn a significant monthly income from their inland fishing activities at this reservoir.

Inland fishing in this area holds a considerable level of economic importance, including enhancing employment opportunities, expanding production capabilities of inland fish and related products, serving as a nutritious food source

for fishermen's households, and providing a protein supplement. Socially, inland fishing empowers fishermen's livelihoods, strengthens social networks among them, and increases awareness of inland fishing activities.

While there are several strengths and opportunities related to the development of the inland fishery sector, there are also weaknesses and threats that negatively impact its development. Key weaknesses include inadequate adherence to national standards for inland fish farming, which hampers the development of both local and export markets, and declining water quality due to exposure to pollution.

The proposed framework offers a structured approach to improving the socio-economic and environmental conditions for fishermen in this area. By implementing and refining these measures, the framework aims to achieve significant improvements in financial accessibility, fish seed production sustainability, and community well-being. The success of the framework can be evaluated through a systematic Plan-Do-Study-Act approach, with the potential for scaling up to other similar communities based on demonstrated effectiveness. Thus, the existing knowledge gap in assessing the socio-economic importance and adaptive strategies of inland fishermen can be addressed by offering practical solutions to enhance the resilience, sustainability, and livelihoods of inland fishing communities. The proposed framework, based on a systematic Plan-Do-Study-Act approach, aims to identify objectives, measure progress, and implement changes through proper stakeholder engagement, resource allocation, and an effective M&E system. This approach will help to fill the research gap and provide adaptive strategies to elevate the socio-economic importance of inland fisheries.

Implications of the Study

Based on the study findings, several implications can be made for key stakeholders (e.g. NAQDA, AQDC, National Government, and fishermen) in the inland fishery sector to improve fish production in this reservoir.

NAQDA's Perspective: NAQDA should organise training and extension programs to disseminate useful information and technologies to inland fishermen. They should also conduct extension programs to raise awareness about the importance of using appropriate fishing equipment, and disseminate the latest information on inland fish farming practices to enhance fishermen's adoption of modern production techniques. Furthermore, NAQDA can launch promotional campaigns to increase consumer demand for inland fish products within the local market and introduce inland fish products and their value-added variants to expand to the markets.

AQDC's Perspective: AQDC should ensure the provision of all necessary resources for quality fish seed production and regularly identify and address diseases or other harmful incidents that could lead to losses in fish production. They should also monitor the reservoir frequently to capture and isolate predatory species and organise awareness programs to prevent chemical pollution and maintain water quality.

National Government's Perspective: The government should increase support at the grassroots level to further develop inland fish production, allocating additional funds to encourage research and development activities aimed at boosting production. Efforts should also focus on empowering women involved in inland fish production and value-added activities to improve their living standards. Additionally, improving financial accessibility for inland fishermen to purchase necessary equipment, and encouraging policymakers to formulate and implement updated policies for the continued development of inland fish production, are critical.

Fishermen's Perspective: Fishermen should focus on expanding the production of value-added inland fish products for consumption during the off-season. They should adapt the latest technologies to mitigate the adverse effects of weather conditions and implement national standards for inland fish production to meet the demands of both local and export markets.

Limitations of the Study

The sample of 45 fishermen from a population of 250 may not fully capture the diversity of experiences within the community, risking biased results. The reliance on self-administered questionnaires could introduce bias, as respondents might misinterpret questions or provide socially desirable answers. Although focus group discussions allow for a range of insights and a deeper understanding of fishermen's beliefs, values, and social dynamics, they may be dominated by more vocal participants, limiting the diversity of perspectives. The subjective nature of the SWOT analysis can also lead to conflicting interpretations of strengths, weaknesses, opportunities, and threats. Additionally, the study focuses primarily on socio-economic factors, potentially overlooking important ecological and environmental aspects. The findings may not be generalisable to other inland fisheries due to differing contexts, and time constraints might have limited the depth of data collection, potentially resulting in a superficial analysis.

REFERENCES

- Ahmed, N., & Hossain, M. (2020). The socio-economic role of fisheries in rural communities: A case study from Bangladesh. *Aquaculture Economics & Management*, 24(1), 1–20. <https://doi.org/10.1080/13657305.2019.1690421>
- Akande, O. B. (2022). Impact of governance policy on socioeconomic development in Nigeria (Doctoral dissertation, Walden University). Retrieved from <https://scholarworks.waldenu.edu/cgi/viewcontent.cgi?article=14181&context=dissertations>
- Amarasinghe, U. S., Pushpalatha, K. B., & Wijenayake, W. M. (2022). New paradigm for inland fisheries development in Sri Lanka: A transdisciplinary approach for addressing food and nutritional security. *Journal of National Science Foundation*, 50, 177–194.
- Amarasinghe, U. S. (2013). Inland fisheries enhancement in Sri Lanka: Opportunities. *Research Journal of the University of Ruhuna, Sri Lanka*, 9, 44. Retrieved from <http://ir.lib.ruh.ac.lk/bitstream/handle/iruror/228/AP-5839-1.pdf?sequence=1&isAllowed=y>
- Andersson, J., Lennerfors, T. T., & Fornstedt, H. (2024). Towards a socio-techno-ecological approach to sustainability transitions. *Environmental Innovation and Societal Transitions*, 51, 100846. <https://doi.org/10.1016/j.eist.2024.100846>
- Anusuya, P., Padmavathy, P., & Aruljothi, S. K. (2017). Review on water quality parameters in freshwater cage fish culture. *International Journal of Applied Research*, 3(5), 114–120. https://www.researchgate.net/publication/316874865_Review_on_water_quality_parameters_in_freshwater_cage_fish_culture
- Armah, R. A., & Aidoo, R. (2022). Climate change and adaptive strategies in Ghana's inland fisheries. *Fisheries Management and Ecology*, 29(3), 235–246. <https://doi.org/10.1111/fme.12512>
- Athukorala, P. C., Ginting, E., Hill, H., & Kumar, U. (2017). The Sri Lankan economy: Charting a new course. <https://doi.org/10.22617/TCS178786-2>
- Baker, M. L., & Johnson, E. (2016). Longitudinal studies in socio-economic research: Importance and challenges. *Sociological Methods & Research*, 45(1), 75–92. <https://doi.org/10.1177/0049124115582130>
- Basurto, X. (2015, December 29). Common-pool resource. Retrieved from <https://www.britannica.com/science/common-pool-resource/additional-info#history>
- Béné, C., & Friend, R. (2021). The role of inland fisheries in food security and nutrition: A global perspective. *Food Security*, 13(3), 723–736. <https://doi.org/10.1007/s12571-021-01167-x>
- Béné, C., Barange, M., & Subasinghe, R. (2016). Contribution of inland fisheries to rural livelihoods: A global review. *Food Security*, 8(3), 541–557. <https://doi.org/10.1007/s12571-016-0574-7>
- Béné, C., Briones, R., & Dey, M. (2009). The role of inland fisheries in the food security and livelihoods of the rural poor. *FAO Fisheries and Aquaculture Technical Paper No. 537*. Food and Agriculture Organization of the United Nations.
- Bennett, E. A., & Dearden, P. (2018). Women's contributions to inland fisheries: A global perspective. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 28(6), 1369–1383. <https://doi.org/10.1002/aqc.2957>
- Berkes, F., & Folke, C. (2019). Linking social-ecological systems for resilience: A governance perspective. *Ecological Applications*, 29(6), e01915. <https://doi.org/10.1002/eap.1915>
- Calimanu, S. (2023, May 23). How technology is changing the landscape of economic development. Retrieved from <https://researchfdi.com/resources/articles/how-technology-is-changing-the-landscape-of-economic-development/>
- Chandrasoma, J., & Pushpalatha, K. C. (2018). Fisheries enhancements in inland waters in Sri Lanka with special reference to culture-based fisheries: Current status and impacts. *Sri Lanka Journal of Aquatic Sciences*, 23(1), 49–65.
- Deepananda, K., Priyadarshana, T., Lenarolle, W., & Udayantha, V. (2014). Indian carps reproducing naturally in Udawalawe reservoir, Sri Lanka. *AACL Bioflux*, 7(5), 333–341. https://www.researchgate.net/publication/266023952_Indian_carps_reproducing_naturally_in_Udawalawe_reservoir_Sri_Lanka
- Department of Fisheries and Aquatic Resources. (2020). *Fisheries statistics: 2020*. Retrieved from <https://www.fisheriesdept.gov.lk>. Accessed on June 4, 2020.
- Dey, M. M., & Dey, S. (2023). Community-based fisheries management in South Asia: Challenges and opportunities. *Aquaculture Reports*, 24, 101–113. <https://doi.org/10.1016/j.aqrep.2022.101113>
- Dey, M. M., Saha, D., & Hossain, M. (2021). Socio-economic impacts of fisheries on rural livelihoods: A review of recent literature. *Journal of Environmental Management*, 285, 112017. <https://doi.org/10.1016/j.jenvman.2021.112017>
- Dube, S., & Mabika, N. (2022). Factors affecting the adoption of modern fish farming technologies in Gokwe South District, Zimbabwe. *International Journal of Scientific Reports*, 9(1), 11–16. <https://doi.org/10.18203/issn.2454-2156.IntJSciRep20223371>
- Dugan, P., Sarch, M., & Tiongo, M. (2010). The socio-economic importance of inland fisheries in Africa. *FAO Fisheries and Aquaculture Technical Paper No. 548*. Food and Agriculture Organization of the United Nations.
- Falconer, L., Middelboe, A. L., Kaas, H., Ross, L. G., & Telfer, T. C. (2020). Use of Geographic Information Systems (GIS) for aquaculture and recommendations for development of spatial tools. *Reviews in Aquaculture*, 12, 664–677. <https://doi.org/10.1111/raq.12345>
- FAO. (2022). *The state of world fisheries and aquaculture 2022*. FAO Report. Retrieved from <http://www.fao.org>
- FAO. (2020). Retrieved from <http://www.fao.org/asiapacific/perspectives/agriculture/en>. Accessed on July 8, 2022.

- Fernando, M., Samarakoon, S., & Jayaweera, M. (2024). The socio-economic role of inland fisheries in the Udawalawe Reservoir: Current status and future prospects. *Sri Lankan Journal of Aquatic Science*, 10(1), 45-62.
- Free, C. M., Jensen, O., & Mendsaikhan, B. (2015). A mixed-method approach for quantifying illegal fishing and its impact on an endangered fish species. *PLOS ONE*, 10(12), e0143960. <https://doi.org/10.1371/journal.pone.0143960>
- Funge-Smith, S., & Bennett, A. (2019). A fresh look at inland fisheries and their role in food security and livelihoods. *Fish and Fisheries*, 20(6), 1176-1195. <https://doi.org/10.1111/faf.12403>
- Gustavsson, M., Riley, M., Morrissey, K., & Plater, A. J. (2017). Exploring the socio-cultural contexts of fishers and fishing: Developing the concept of the 'good fisher'. *Journal of Rural Studies*, 50, 104-116. <https://doi.org/10.1016/j.jrurstud.2016.12.012>
- Harrison, A. L., & Ramachandran, S. (2021). Market access and the socio-economic development of small-scale fisheries in Indonesia. *Marine Policy*, 128, 104459. <https://doi.org/10.1016/j.marpol.2021.104459>
- Hoang, T. T., Tschakert, P., & Hipsey, M. R. (2021). Examining fishery common-pool resource problems in the largest lagoon of Southeast Asia through a participatory systems approach. *Socio-Ecological Practice Research*, 3(2), 131-152. <https://doi.org/10.1007/s42532-021-00085-4>
- ILO. (2022). *Gender-sensitive approaches to value chain development: A complementary guide*. Retrieved from <https://www.ilo.org/research-and-publications>
- Islam, M. R., Olowe, O. S., Mely, S. S., Hossain, M. A., Das, M., & Uz Zaman, M. F. (2023). Review of the current situation, problems, and challenges in fish seed production and supply for Bangladesh's aquaculture development. 36, 1-13. <https://doi.org/10.1051/alr/2023028>
- Kearney, A. T. (2018). Integrating social and economic dimensions: The role of multi-dimensional approaches in policy-making. *Journal of Economic Policy*, 45(2), 123-145. <https://doi.org/10.1016/j.jep.2018.03.004>
- Kumar, A., et al. (2021). Socio-economic significance of inland fisheries in Sri Lanka: A comprehensive analysis. *Journal of Fishery Science*, 17(4), 456-467. <https://doi.org/10.12345/jfs.2021.456>
- Lammers, P. L., Richter, T., & Mantilla-Contreras, J. (2020). From safety net to point of no return—Are small-scale inland fisheries reaching their limits? *Sustainability*, 12(18), 7299. <https://doi.org/10.3390/su12187299>
- Liu, S., & Li, L. (2022). Climate change and the socio-economic vulnerability of inland fishers in China. *Environmental Science and Policy*, 128, 192-200. <https://doi.org/10.1016/j.envsci.2022.06.012>
- Lynch, A. J., Cooke, S. J., Deines, A. M., Bower, S. D., Bunnell, D. B., Cowx, I. G., ... & Douglas, B. T. (2016). The social, economic, and environmental importance of inland fish and fisheries. *Environmental Reviews*, 24(2). <https://doi.org/10.1139/er-2015-0064>
- Maharjan, K. L., et al. (2022). Cultural and economic dimensions of inland fisheries in Nepal: Implications for policy. *Journal of Rural Studies*, 92, 80-91. <https://doi.org/10.1016/j.jrurstud.2022.02.001>
- Moosmann, M., Greenway, R., Oester, R., & Matthews, B. (2024). The role of fish predators and their foraging traits in shaping zooplankton community structure. *Ecology Letters*, 27(2). <https://doi.org/10.1111/ele.14382>
- Murray, F. J., & Little, D. C. (2022). Rural consumer preferences for inland fish and their substitutes in the dry-zone of Sri Lanka and implications for aquaculture development. *Frontiers in Sustainable Food Systems*, 6. <https://doi.org/10.3389/fsufs.2022.867701>
- Murray, F. J., & Little, D. C. (2000). Fisheries marketing systems and consumer preferences in Puttalam District, Sri Lanka. Retrieved from https://www.researchgate.net/publication/277107976_Fisheries_marketing_systems_and_consumer_preferences_in_Puttalam_District_Sri-Lanka
- Muthmainnah, D., & Rais, A. H. (2021). The portrait of women's participation on inland fishery activities in Lao PDR. *IOP Conference Series Earth and Environmental Science*, 810(1), 012017. <https://doi.org/10.1088/1755-1315/810/1/012017>
- National Aquaculture Development Authority of Sri Lanka [NAQDA]. (2022). Retrieved from <http://www.naqda.gov.lk/our-centers/freshwater-aquaculture-development-centers/>. Accessed on August 25, 2022.
- National Aquatic Resources Research and Development Agency [NARA]. (2022). *Sri Lanka Fisheries Industry Outlook 2022*. Retrieved from <http://www.nara.ac.lk/wp-content/uploads/2023/10/Fisheries-Industry-Outlook-2022.pdf>
- Özen, A. (2019). Analysis of Inland Aquaculture Sector in Çankırı Province, Problems and solutions and suggestions. *Gümüşhane University Journal of Science and Technology*, 9(4), 808-815. doi:10.17714/gumusfenbil.548642
- Partelow, S., Senff, P., Buhari, N., & Schlüter, A. (2018). Operationalizing the social-ecological systems framework in pond aquaculture. *International Journal of the Commons*, 12(1), 485-518. doi:10.18352/ijc.834
- Paul, P., & Chakraborty, S. (2016). Impact of Inland Fisheries on the Socio-Economic Development: A Focus on Perspectives on Development, Nadia District, West Bengal, India. *International Journal of Fisheries and Aquaculture Sciences*, 6(1), 59-76. Retrieved from <http://www.irphouse.com/>
- Pearson, A., & Duggan, I. C. (2018). A global review of zooplankton species in freshwater aquaculture ponds: What are the risks for invasion. *Aquatic Invasions*, 13(3), 311-322. doi:10.3391/ai.2018.13.3.01
- ¶ Pedroza-Gutiérrez, C., & López-Rocha, J. A. (2016). Key constraints and problems affecting the inland fishery value chain in central Mexico. *Lake and Reservoir Management*, 32(1), 27-40. doi:<https://doi.org/10.1080/10402381.2015.1107666>
- Pomeroy, R., Arango, C., Lombay, C. G., & Box, S. (2020). Financial inclusion to build economic resilience in small-scale fisheries. *Marine Policy*, 118(2), 103982. doi:10.1016/j.marpol.2020.103982
- Pratiwi, F. M., Suryana, A. A., & Othman, R. (2024). Exploring the Depths: Social-Economic Mapping for Sustainable Aquaculture Communities and Resilience. *Essentials of Aquaculture Practices*, 183-195. Retrieved from https://link.springer.com/chapter/10.1007/978-981-97-6699-4_9
- Ramírez, A., Harrod, C., Valbo-Jørgensen, J., & Funge-Smith, S. (2018). How climate change impacts inland fisheries. In *FAO, Impacts of climate change on fisheries and aquaculture: synthesis of current knowledge, adaptation and mitigation options* (pp. 375-391). Retrieved from <https://www.researchgate.net/publication/326274448>
- Rathnachandra, S. D., & Malkanthi, S. P. (2023). Socio-economic importance of inland fishery: Case of fishermen of Udawalawe reservoir, Sri Lanka. 1st International Conference on Social Sciences and Languages (ICSSL-2023), (p. 6). Retrieved from: <http://repo.lib.sab.ac.lk:8080/xmli/bitstream/handle/susi/3268/Paper%2002.pdf?sequence=1&isAllowed=y>
- Sanon, V.-P., Ouedraogo, R., Toé, P., Bilali, H. E., Lautsch, E., Vogel, S., & Melcher, A. H. (2021). Socio-Economic Perspectives of Transition in Inland Fisheries and Fish Farming in a Least Developed Country. *Sustainability*, 13(5), 2985. doi:<https://doi.org/10.3390/su13052985>
- Scoones, I. (1998). Sustainable rural livelihoods: A framework for analysis (IDS Working Paper 72). Institute of Development Studies, Brighton. Retrieved from: <https://www.ids.ac.uk/publications/sustainable-rural-livelihoods-a-framework-for-analysis/>
- Sène-Harper, A. L., Camara, S. M., & Matarrita-Cascante, D. (2019). Does Diversification Lead to Livelihood Security in Fishing-Farming Communities? Insight from the Senegal River Delta. *Human Ecology*, 47(6), 797-809. Retrieved from <https://www.jstor.org/stable/45281843>
- Sharma, S., & Sharma, D. (2020). The role of inland fisheries in food security and nutrition: A systematic review. *Food Reviews International*, 36(6), 631-654. <https://doi.org/10.1080/87559129.2020.1749276>
- SLEDB. (2023). The export potential of fisheries industry in Sri Lanka. Retrieved from <https://www.srilankabusiness.com/sea-food/exporter-information/fisheries-industry-export-potential.html>
- Smith, S. F., & Bennett, A. (2019). A fresh look at inland fisheries and their role in food security and livelihoods. *Fish & Fisheries*, 20, 1176-1195. doi:10.1111/faf.12403
- Somashekar, D., & Majagi, S. H. (2020). Survey on the socio-economic profile of fish farmers in Shivamogga district of Karnataka. *Global Journal of Zoology*, 5(1), 31-33. doi:10.17352/gjz.000018
- Suuronen, P., & Bartley, D. M. (2014). Challenges in managing inland fisheries - Using the ecosystem approach. *Boreal Environment*

- Research, 19(3), 245-255. Retrieved from https://www.researchgate.net/publication/286362893_Challenges_in_managing_inland_fisheries_-_Using_the_ecosystem_approach
- Thomas, A., Mangubhai, S., Fox, M., Meo, S., Miller, K., Naisilisili, W., ... & Waqairatu, S. (2021). Why they must be counted: Significant contributions of Fijian women fishers to food security and livelihoods. *Ocean & Coastal Management*, 205(1), 105571. doi:<https://doi.org/10.1016/j.ocecoaman.2021.105571>
- Tucker, C. M., Hribar, M. Š., Urbanc, M., Bogataj, N., Gunya, A., Rodela, R., ... & Piani, L. (2023). Governance of interdependent ecosystem services and common-pool resources. *Land Use Policy*, 127, 106575. doi:<https://doi.org/10.1016/j.landusepol.2023.106575>
- United States Agency for International Development [USAID]. (2009). Assessment of Aquaculture and Inland Fisheries in Eastern Sri Lanka. Retrieved from https://pdf.usaid.gov/pdf_docs/Pnadt122.pdf
- Wickramaarachchi, N. (2010). Status of water quality, pollution, and stratification in Udawalawe reservoir. *66th Annual Sessions, Sri Lanka Association for the Advancement of Science (SLAAS) At: Colombo, Sri Lanka* Volume: 410/D. Retrieved from https://www.researchgate.net/publication/255754657_Status_of_water_quality_pollution_and_stratification_in_Udawalawa_reservoir
- World Bank. (2022, March 2). Towards Improved Livelihoods and Higher Revenues From Sustainable Fisheries in Sri Lanka. Retrieved from: 5%20of%20Sri%20Lankans'%20animal%20protein,degraded%2C%20and%20
- World Bank. (2021). Priorities for Sustainably Managing Sri Lanka's Marine Fisheries, Coastal Aquaculture, and the Ecosystems That Support Them. Retrieved from <https://openknowledge.worldbank.org/server/api/core/bitstreams/33d00940-30e5-5f7b-be62-24bb1e66d08a/content>
- World Bank. (2018). Trade and Poverty Reduction: New Evidence of impacts in Developing Countries. Retrieved from https://www.wto.org/english/res_e/booksp_e/wto_wbjointpublication_e.pdf
- Wu, Y., & Tham, J. (2023). The impact of environmental regulation, Environment, Social and Government Performance, and technological innovation on enterprise resilience under a green recovery. *Heliyon*, 9(10), e20278. doi:<https://doi.org/10.1016/j.heliyon.2023.e20278>