

Socio-Economic Dynamics and Community Well-Being in Small-Scale Fisheries: A Study of the Pethalai Fishing Community, Sri Lanka

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ABSTRACT

This study explores the socio-economic dynamics of small-scale fisheries targeting *Thenus orientalis* (slipper lobster) in Pethalai, Sri Lanka. Using a mixed-methods approach, data were collected from 100 fishermen over twelve months (January-December 2023) through structured surveys, interviews, and focus group discussions. Analysis focused on four domains: socio-economics, fishery resource management, and community well-being. Fishery was characterised by a experienced workforce, with 38% having 21-30 years of fishing experience, mostly male (98%) and married (90%), and low education levels (52% Grade 5 level). Fishing intensity was high, with 42% operating 26-30 days per month and 93% owning boats. Daily catches averaged one to five kg, peaking during October-December, monthly income from slipper lobster ranged from less than LKR 10,000 to LKR



30,000. All catches were sold to wholesalers at a fixed price. Principal Component Analysis showed strong internal consistency across domains and economic vulnerability, market dependency, environmental adaptation, strong social cohesion, traditional knowledge, interest in sustainability, limited market access, high costs, and restricted training. Findings indicated, need for integrated strategies for social protection, market diversification, capacity building, and participatory decision making to enhance sustainability in this fishery.

Key Words: small-scale fisheries, *Thenus orientalis*, socio-economic dynamics, community well-being, fishery resource management, mixed-methods

INTRODUCTION

Small-scale fisheries, targetting *Thenus orientalis* (slipper lobster), are important to the livelihoods, food security, and economic stability of coastal communities in Sri Lanka (FAO, 2024a.; World Bank, 2022). In Sri Lankan coastal communities such as Pethalai, well-being was tied to fisheries-based livelihoods, where fishing provided incomes (Peramunagama and Amarasinghe, 2013). Socio-economic factors were shaped by environmental sustainability, economic resilience, and social welfare (Mozumder et al., 2018). Small-scale fisheries provided direct and indirect employment to many of Sri Lanka's coastal communities, with fishing approximately 586,000 people (~12% of the national population) (World Bank, 2022). These small-scale fishing were highly important for local economies which reduce poverty providing food security, especially in regions

where alternative employment is limited (FAO, 2023; Béné et al., 2007). However, fishing communities showed low socio-economic status due to limited education, high costs of fishing (fuel, maintenance), and big households, which made them vulnerable to economic shocks (Béné, 2009). Further, this vulnerability was increased by fluctuating market demand, political influences, and supply chain disruptions (World Bank, 2022; Kanike, 2023) making them poorer, which further intensified by national economic crises and inflation (Das, 2012). High fishing costs, limited access to alternative livelihoods, intensified the fishing effort, sometimes using illegal fishing activities, on marine resources, which led to the overexploitation which threatened both resource sustainability and community welfare (Allison and Ellis, 2001; Pomeroy et al., 2016; World Bank, 2022). It was shown that over exploitation of slipper lobster stocks, weak regulatory enforcement, and climate change, declined lobster stocks and increased vulnerability among fishing communities (Béné, 2009; Mills, et al., 2011; World Bank, 2024). Sustainability of these fisheries is further threatened by non optimum management practices (Parma, et al., 2006; Lindley, 2022). Climate and environmental changes not only impact marine resources but also the social and mental well-being of fishing communities, making them poorer (Hernández-Delgado, 2015; World Bank, 2022). Women's role in post-harvest activities and household maintenance frequently went unrecognized and unsupported in current many managements (FAO, 2024b.; World Bank, 2022). Social cohesion, strong leadership, and active engagement in fisheries management are essential for building resilience and sustainability of both fishery resources and livelihoods (Sutton, and Rudd, 2016. ; World Bank, 2022). Recent recommendations indicated, to integrate social protection and

livelihoods with fisheries management to support vulnerable coastal communities for multifaceted sustainability (World Bank, 2022; Satoh et al., 2024). Improved collaboration among local governments, fishermen, and other stakeholders is necessary to address illegal fishing, improve resource management, and strengthen community welfare (World Bank, 2022).

Small-scale fishing communities in Sri Lanka play an important role in coastal livelihoods, food security, and employment, but these have shown socio-economic pessimisms that affect those' s well-being and sustainability. Ibrahim, (2020) and Ragavan, (2025) also indicated that coastal capture fisheries provided livelihoods and nutrition and social stability for communities. Research in Batticaloa district showed that many marine small-scale fishermen experienced livelihood insecurity, with limited market access and training opportunities (Jeyarajah, 2016). Evidence from northern Sri Lanka further highlighted how sea insecurity and high fishing efforts harm the sustainable fisheries-based livelihoods and well-being of fishermen (Koralagama and Peramunagama, 2022). Pathmanandakumar, (2017), also highlighted those small-scale fisheries in Sri Lanka are mostly with weak governance and declining stock conditions, which affect the sustainability and well-being of communities.

Despite growing recognition of these challenges within Sri Lankan small-scale fisheries, there remains a notable gap in integrated research that simultaneously examines socio-economic security, resource management practices, technology adoption patterns, and well-being within specific fisheries and communities. This study addresses this gap by

investigating these interconnected factors within the slipper lobster fishery of Pethalai. The specific objectives of this study are two: (1) to assess the current socio-economic vulnerabilities and resource management practices among slipper lobster fishermen in Pethalai; and (2) to propose integrated, evidence-based procedure for strengthening the economic resilience of the fishery. The findings are baseline information for policymakers, fisheries managers, and fishing communities to enhance both the sustainability of slipper lobster resources and the well-being of such fishing communities in Sri Lanka.

CONCEPTUAL FRAMEWORK

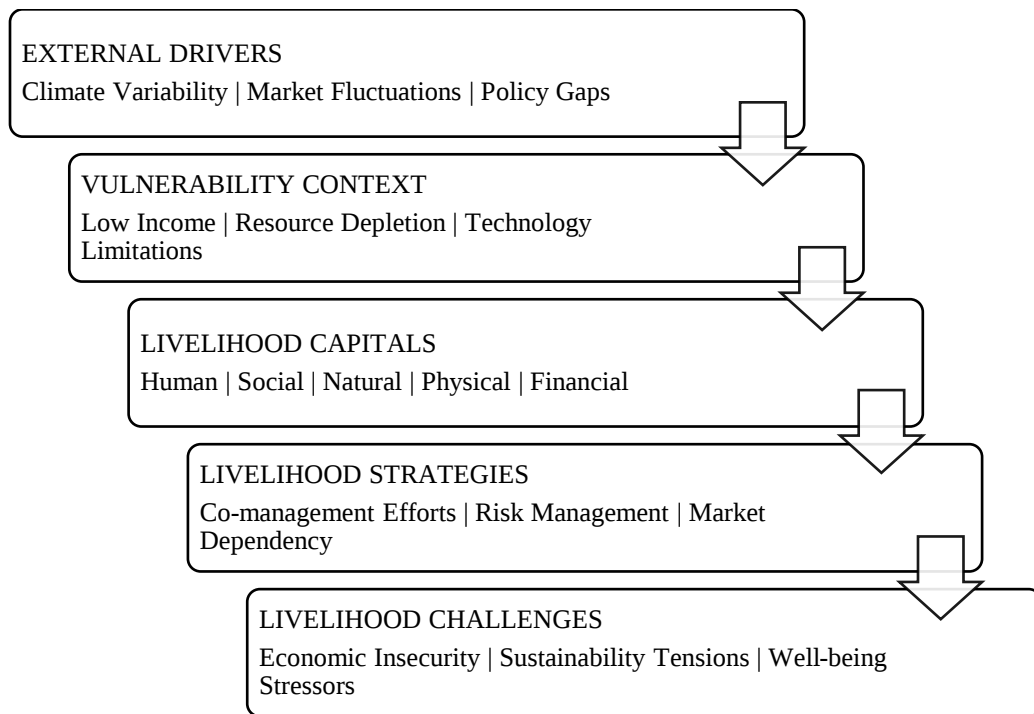


Figure 1: Conceptual framework for Pethalai Slipper lobster fishery

Above framework in figure 1 showed that external drivers interact with the community's vulnerability context. Considering the livelihood capitals, households prefer on co-management and risk management, even though they depend on wholesale markets. However, the community experienced economic insecurity, unsustainability, and well-being stressors highlighting the gap between current conditions and desired outcomes of economic security, resource sustainability, and community well-being.

LITERATURE REVIEW

Small-scale fisheries, including slipper lobster fisheries, provided significant livelihoods to coastal communities, making their sustainable management essential for both ecosystem health and long-term resource viability (Korda and Stead, 2020; Bolin et al., 2021). However, illegal fishing continued to harm sustainability in many such fisheries (Ehud, 2007), while strong leadership and community cohesion have been shown to support ecological and economic resilience (Gutiérrez et al., 2011).

Socio-economic factors, including labor costs, fuel, market fluctuations, and global supply chain disruptions-significantly influenced fishing efficiency and community well-being (Sangun et al., 2018; Gephart et al., 2017; Fathoni et al., 2019; Bassett et al., 2021). Integrating these considerations into a community-based management approach was therefore essential for sustainable fishery resources (Garcia, 2010). Climate change increased above pressures by threatening both lobster population sustainability and the livelihoods of fishing community (Kofinas and Chapin, 2009; Ishikawa et al., 2015). Community well-being was shaped by education, health, economic stability, and social

capital (Voyer et al., 2017; Sung and Phillips, 2018), while mental health was shaped by decision-making capacity and productivity (Chandler, 2024; Sorensen et al., 2022). Technology adoption, for improving efficiency, affected by financial issues and limited access to training among small-scale fishers (Berkes and Seixas, 2005; Lucchetti et al., 2023). Gender roles, particularly women's contributions to post-harvest activities, also needed greater attention (Harper et al., 2013). Empowering fishermen through policy education and participatory management remained very important for sustainability and equity among fishermen (Pomeroy and Berkes, 1997; Jentoft et al., 2010; Monnereau, 2012).

METHODOLOGY

This study of the Pethalai fishing community in Sri Lanka employed a mixed-methods research design to investigate the socio-economic dynamics of *T. orientalis* bycatch and other target catch economy. The methodology followed standard frameworks on socio-economic impacts in coastal fisheries (Allison and Ellis, 2001; Béné et al., 2007), the importance of harvest practices for resource sustainability (Kelleher, 2005), and integrated resource management approaches (Gutiérrez et al., 2011; Lehtonen, et al., 2021). This research also studied the role of community engagement and governance in fisheries sustainability (McClanahan et al., 2024; Jupiter et al., 2017) in the Pethalai fishing community.

Pethalai was a coastal fishing village located in Batticaloa district, Eastern province of Sri Lanka (7°55'45.6"N, 81°32'37.1"E), Situated along the eastern coast, the village was characterized by shallow coastal waters with depths ranging from 10 to 50 meters, extending approximately ten kilometers from shore where fishers typically operate. The area had a tropical monsoon climate with two distinct monsoon seasons: southwest monsoon (May-September) and the northeast monsoon (December-February), which influenced fishing patterns and seasonal catch variations. Pethalai had approximately 100-day boat fishermen with a total population of around 380,000 individuals. Pethalai was purposively selected for this study because it represented a typical small-scale slipper lobster fishing community in eastern Sri Lanka, with fishermen depend mostly on fishing, prevailing economic problems, and limited alternative livelihoods. The manageable community size (100 registered day boat fishermen), and community fishery leaders as well as fishermen expressed willingness to participate in the research.

Sampling strategy and data collection

The research was conducted over a twelve-month period from January to December 2023. Initial pre-testing and pilot surveys were done in the data collection, focusing on four domains: economic factors, social factors, fishery resource management factors, and community well-being factors (Ogada, 2013; Cinner, et al., 2013; Voyer et al., 2017; Turunen, et al., 2025). Before data collection, informed consent was obtained from all participants on the first page of the questionnaire. Participants were told that participation was voluntary, that they could refuse or withdraw at any time, and that responses would remain confidential and would be used only for research. No personal identifiers were

linked to the results, and data were stored securely with restricted access. Participants could skip any question, and all data were anonymised before analysis. All 100 registered fishermen in Pethalai were included in the study and completed the structured questionnaire (Martínez-Mesa et al., 2016). A smaller subset of these respondents was then selected purposively for informal interviews and focus group discussions to ensure construction of thematic word table and to grab important responses (Palinkas et al., 2015).

The target population was all 100 registered active day boat fishers in Pethalai, defined as individuals who held fisheries cooperative society registration or a valid fishing license. An approach included all 100 fishermen in the structured questionnaire (100% response rate) to maximize representativeness, eliminate sampling bias, and enhance statistical power (Martínez-Mesa et al., 2016). For qualitative data, 25 fishermen participated in in-depth interviews (around two hours), and three focus group discussions included eight to ten participants each, selected randomly (Palinkas et al., 2015).

Qualitative and quantitative data collection

Quantitative data were gathered through structured questionnaires to obtain information on demographics, fishing practices, income, and responses of fishery resource management, incorporating Likert scales to quantify attitudes across the four research domains aforementioned (Dawes, 2008). Qualitative data collection involved informal interviews and focus group discussions, to obtain information on community experiences, challenges, and opportunities related to *T. orientalis* catch and other catches. These qualitative methods were used to understand socio-economic conditions and mental health factors within this

community (Barclay, et al., 2017). Structured questionnaires covered four domains: economic factors, social factors, fishery resource management, and well-being. Five-point Likert scales (1 = Strongly Disagree to 5 = Strongly Agree; 1 = Very Poor to 5 = Very Good) quantified attitudes (Dawes, 2008). These methods well captured socio-economic conditions and well-being concerns (Barclay et al., 2017).

Quantitative data were analyzed using Statistical Package for Social Sciences (SPSS) (v26.0) and Microsoft Excel. Principal component analysis (PCA) on the four domains assessed data suitability using Kaiser-Meyer-Olkin ($KMO > 0.6$) and Bartlett's test ($p < 0.05$), extracted components using eigenvalue > 1 , and applied varimax rotation.

Qualitative data were given as thematic analysis (Braun and Clarke, 2006) as a word table , and qualitative and quantitative data were integrated to provide understanding of the fishery and fishermen well-being (Jacob et al., 2010; Barclay et al., 2017).

RESULTS

The Pethalai fishing community was characterized by a mature and experienced fisherman. Based on survey data, 38% of fishermen had 21-30 years of experience, 30% had 11-20 years, and 18% had over 30 years of fishing experience, which showed an occupational tradition. Most participants were between 41-50 years old (38%), followed by those aged 31-40 (28%) and 21-30 (16%), indicating that the community was a middle-aged, individuals, which was similar to findings of Zytoon, and Basahel, (2017). Fishing remained a male-dominated livelihood in the area, with 98% of respondents identifying as

male (Limuwa, and Synnevåg, 2018). Most were married (90%) and lived in nuclear families, with 34% of households comprising four members and 24% having five members. In terms of education, 52% had only completed up to grade five, and just 8% had reached advanced level qualifications. These statistics showed low education levels within the community, which is one reason for limited alternative incomes also for modern fisheries technologies (Maddox, 2007 ; Olale, and Henson, 2012). Fishing activity was intense and regular. Approximately 42% of respondents reported fishing 26-30 days per month, and 28% worked 21-25 days per month. While, 91% of the fishermen engaged in full-time fishing. 93% of fishermen owned boats, primarily small one-day vessels. All respondents used gill nets with a mesh size of 4½ inches, which show shared technological approach. The fishing grounds were also consistently reported; all participants fished in the Pethalai area, traveling more than two km offshore and operating at least two km from the shoreline. Daily total fish catches were typically 11-20 kg for 42% of respondents, with 28% catching 21-30 kg. For slipper lobster, 40% reported daily catches of 1-2 kg, 30% less than one kg, and 20% between 3-5 kg, showing its role as a moderate, seasonal income supplement. Regarding seasonality, 52% of fishermen identified October to December as the main slipper lobster season, followed by 34% during January to March. Only 14% reported significant catches during April to September. Income levels reflected a range of economic conditions. From general fishing, 40% of respondents earned between LKR 60,001-80,000 monthly, and 30% earned LKR 40,001-60,000. In terms of income specifically from slipper lobster, 36% earned LKR 10,000-20,000, 30% earned less than LKR 10,000, and 20% earned LKR 20,001-30,000 per month. Operational costs were high, ranging from LKR

12,000 to 90,000 monthly, with an average of approximately LKR 56,000. Fuel expenses were the highest cost component. Only 4% of respondents reported paying taxes related to fishing, and none reported receiving government subsidies. All respondents sold their catch, including slipper lobsters, exclusively to wholesalers. The price was fixed at LKR 3,500 per kilogram, with all fishermen stating that quantity and quality were the determinants of price. Since they depend on a single buyer network their bargaining power for price is limited. Furthermore, none of the respondents employed post-harvest techniques; the majority sold 1-2 kg of slipper lobster per day without further processing. This lack of value addition, combined with moderate catch and high operating costs, created an economic instability in the long run.

Table 1. Reliability test output of SPSS fishing community analysis: economic, social, and well-being factors in Pethalai

Aspect	No. of Items	Cronbach's α	KMO	Bartlett's Sig.	PCA Outcome	Key Interpretation
Resource Management	11	>0.90	>0.90	<0.001	Clear factor structure	High reliability; suitable for PCA
Economic Factors	21	0.948	0.939	<0.001	2 components (54.44%)	Multidimensional economic challenges
Social Factors	10	0.88	0.902	<0.001	1 component	Strong community cohesion

Aspect	No. of Items	Cronbach's α	KMO	Bartlett's Sig.	PCA Outcome	Key Interpretation
					(48.25%)	
Well-Being Factors	25	0.941	0.872	<0.001	4 components (81.76%)	Multidimensional well-being structure

Source: primary survey data

Table 2. Summary statistics of economic, resource management, social, and well-being indicators in the Pethalai Slipper lobster fishery community based on Likert scale response.

Aspect	N	Items	Mean Range	SD Range
Resource Management	100	11	3.35 - 3.63	0.76 - 0.91
Economic Factors	100	21	3.43 - 3.54	0.67 - 0.85
Social Factors	100	10	3.07 - 3.41	0.91 - 1.50
Wellbeing Factors	100	25	3.07 - 3.41	0.91 -1.50

Source: primary survey data

Table 1 showed the reliability test output of SPSS fishing community analysis: economic, social, and well-being factors in Pethalai, while, Table 2 showed the Summary statistics of economic, resource management, social, and well-being indicators in the Pethalai Slipper lobster fishery community based on Likert scale responses. Across all four domains, respondents showed moderate agreement.

Economic Factors

The PCA conducted on economic factors in the Pethalai fishing community (N=100) revealed good sampling adequacy (KMO = .939) with Bartlett's Test of Sphericity confirming sufficient correlations between items ($\chi^2(210) = 1149.455$, $p < .001$). The high internal consistency among all items (Cronbach's $\alpha = .948$) suggests a good understanding of economic challenges facing the community.

PCA extracted two components showing 54.44% of total variance in economic factors. The first component, economic resource management, had 49.24% of variance. Risk management showed the strongest loading (.773), then community support for technology adoption (.760) and market information systems (.736), indicating fishing efficiency and market information were mandatory for economy in current fishery. High loadings on fish distribution efficiency and infrastructure improvement strengthens above, while moderate to strong loadings for environmental forecasting and sustainable technology adoption showed fishermen were aware of ecological-economic interdependence reflected in their own words: "Knowing the weather and water really helps us plan when and where to fish."

The second component, collaborative development, explained 5.19% of variance. Positive loadings, environmental collaboration (.434), planning flexibility (.315), and market information (.308) showed fishermen were aware on adaptive managements. Negative loadings on policy dialogue (-.364) and financial skills (-.313), significantly said, active engagement with policy making process was weak; neglecting their decision making power directly affect their livelihoods. Limited financial literacy further indicated this, so they

couldn't manage risk, no access credit, and no plan beyond immediate income needs. Fishermen acknowledged this tension clearly: "We try to make money now but we need to fish in future" and "It's hard to get the money we need."

Resource management factors

The statistical analysis of fisheries resource management system in the Pethalai fishing community showed strong internal consistency and construct validity. With a Cronbach's alpha of 0.908, the resource management showed high reliability. The inter-item correlation matrix showed moderate to strong positive correlations between all variables (ranging from 0.307 to 0.664), indicating cohesive measurement of the items.

Factor analysis produced a KMO value of 0.921, indicating high sampling adequacy, while Bartlett's test ($\chi^2 = 502.208$, $p < 0.001$) confirmed the appropriateness of the factor analysis. The PCA extracted one dominant factor explaining 52.34% of the total variance, with all items showing substantial factor loadings (communalities ranging from 0.402 to 0.582). The PCA revealed strong positive loadings across all governance principles on the first principal component (PC1). Congruence between local rules and conditions and graduated sanctions showed the highest loadings, suggesting these principles were particularly influential in successful governance structures. The consistently high loadings across all variables on PC1 (all above 0.63) indicated covariance among these principles. Fishermen expressed strong preference for self governance: "It's important to us how the system supports our way of doing things by ourselves", while also recognising the value of broader

institutional connections: "We agree that the system should warn us before it punishes us for doing something wrong."

Social factors

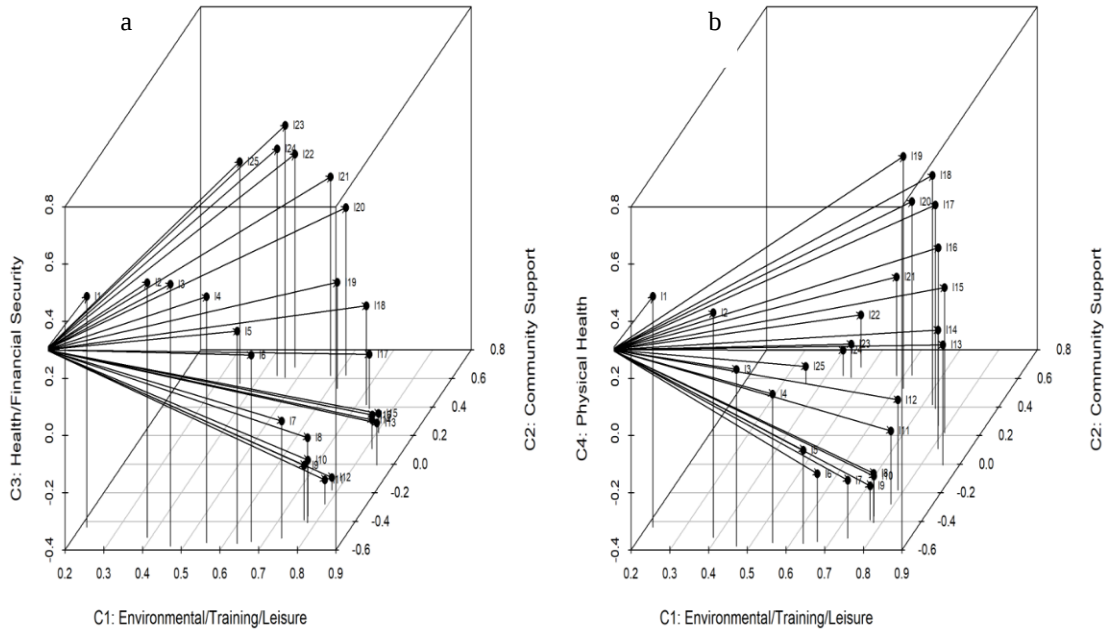
The survey demonstrated strong social cohesion within the Pethalai fishing community. Reliability analysis showed a Cronbach's alpha of .880, indicating higher internal consistency among the measured social dimensions. PCA confirmed the unidimensional structure of the community cohesion scale, with the first component explaining 48.25% of total variance. All items loaded on this single factor with communalities ranging from .379 to .553.

The sampling adequacy was very high (KMO = .902) with a significant Bartlett's test ($\chi^2=363.315$, $p<.001$), confirming the appropriateness of factor analysis. Factor loadings on the primary component ranged from 0.616 to 0.744. High loadings for social support accessibility and internal conflict resolution underscored social systems' role in fostering resilience. The positive association between cultural preservation and community support highlighted how traditional practices reinforced social bonds. High loadings for family involvement and gender roles revealed that family structures were central to community stability. Elevated PCA loadings for ceremonial gatherings suggested support of social status and ceremonial cohesion. Fishermen were direct about what held their community together: "Supporting each other was what keeps our community strong" and "Every family member, young and old, has an important role to play."

Well-being Factors

The survey on fishing community well-being showed strong psychometric properties, indicating its reliability and validity as a measurement instrument. Cronbach's alpha ($\alpha = .941$) showed high internal consistency reliability across all items. The KMO measure of sampling adequacy (.872) confirmed the data's appropriateness for factor analysis, while Bartlett's test of sphericity ($\chi^2 = 3198.949$, $df = 300$, $p < .001$) indicated sufficient correlations among variables.

PCA revealed four significant components with eigenvalues above 1, collectively explaining 81.76% of the total variance. The four components represented distinct but interrelated dimensions of well-being among fishing communities: overall resilience and well-being, and responsibility and adaptation. Inter-item correlation analysis showed strong relationships between conceptually related items, with high correlations between items addressing nutritional access, environmental concerns, and community support. Communalities ranged from .573 to .900, indicating that the extracted components explained a substantial portion of each variable's variance. The most strongly represented items in the factor structure were those related to community resources, sense of belonging, and stress reduction through leisure.



Source: Primary survey data

Figure 2. Three-dimensional PCA loading plots showing the distribution of well-being indicators across principal components. (a) C1-C2-C3 and (b) C1-C2-C4. Each vector represents a survey item, and labels (I1-I25) correspond to well-being items

The three-dimensional loading plots of Figure 2 showed the distribution of well-being indicators across principal components. The plot of most variables shows strong positive loadings along Component 1, indicating that environmental awareness, training, and leisure-related attributes are important. The contribution of community support and social cohesion go towards Component 2 with positive loadings, while health and financial stress dimensions go towards Component 3. The plot 1 b Component 1 has a strong influence, and another set goes forward to Component 4, indicating physical health and well-being. The leisure and community interaction-related items tend to cluster in the positive region

of Components 2 and 4, indicating these items combinedly effect the well-being. This plot showed that well-being is multidimensional, with higher responses related to environmental capacity, community support, financial and psychological conditions, and physical health.

Table 3. Well-being word table

Well-being Factors	Idea of fishermen
Overall physical and mental health for fishing work	"Many of us feel somewhat good about our health for fishing."
Duration of stress, anxiety, or low energy	"The most of us feel stressed or low for a while, but it's not all the time."
Worry about money for essentials	"Many of us often worry about having enough money for the basics."
Choosing between paying for essentials due to limited income	"A lot of us sometimes have to pick what essentials to pay for when money's tight."
Affordability of fresh and nutritious food	"Some of us find it hard to afford fresh, good food around here."
Diet providing energy for work	"Some of us don't always get the energy we need from our food for our fishing work."
Access to nutritious food while at sea	"Getting good food while we're fishing at sea can be tough for some of us."
Concern about environmental threats to fishing	"A good number of us are really worried about the environmental risks to our fishing."
Confidence in adapting practices to environmental changes	"Some of us are really sure we can change our fishing ways when the environment does."

Well-being Factors	Idea of fishermen
Personal responsibility for environmental protection	"A bunch of us feel it's on us to look after the fishing environment."
Preparedness for potential dangers at sea	"Few of us feel quite ready to handle dangers when we're out at sea."
Access to learning or training	"Some of us think it's hard to get to learning or training that could help us."
Factors preventing learning or development participation	"A fair few of us don't join learning or training as much as we want."
Relevance and currency of training opportunities	"Few of us who think the training we can get is right up-to-date."
Participation in leisure activities	"Some of us get to do fun things outside work just enough, but we'd like more."
Enjoyment of types of leisure activities	"Most of us like certain kinds of fun things to do when we're not working."
Leisure activities with friends, family, or community	"A lot of us enjoy spending time with people we know when we're relaxing."
Leisure activities reducing stress	"For some of us, doing fun stuff helps shake off the stress."
Contribution of play and leisure to physical well-being	"We think relaxing and playing is important for staying fit and well."
Sense of belonging and connection in the fishing community	"Plenty of us feel like we really belong and are connected in our fishing community."
Community support in difficult times	"Some of us believe our community sticks together when times are hard."

Well-being Factors	Idea of fishermen
Ease of getting support when needed	"It's hard for some of us to find help when we're in a bind."
Availability and quality of community services	"A few of us are happy with the services we can get in our community."
Ease of walking or biking to access services	"Getting to places we need by walking or biking is okay for most of us."
Community prioritization of certain issues	"Few of us see that our community puts some issues first before others."

Source: Primary survey data

DISCUSSION

Fishery Information

The demographic and operational patterns suggested a highly experienced and hardworking community, similar to findings of Zytoon and Basahel (2017). Finding of fishing remained male-dominated aligned with research by Limuwa and Synnevåg (2018) on gender dynamics in small-scale fisheries. The market structure revealed economic vulnerabilities. The uniformity in pricing and dependency on a single buyer network limited fishermen's price negotiation. Lack of value addition, combined with low catch volumes and high operating costs, made the fishermen economically unsustainable. They need for market diversification, value chain enhancement, and capacity development to ensure long-term resilience, as indicated by Ahmed and Sturrock (2006). Low formal education levels within the community prevented access to alternative income sources or

modern fisheries technologies, consistent with findings by Maddox (2007) and Olale and Henson (2012), who documented how limited education constrains economic mobility in fishing communities.

Economic Factors

Economic pressures shaped both management decisions and community resilience in small-scale fisheries (Crona et al., 2017; Béné, 2009). In Pethalai, the conflict between immediate income needs and long-term sustainability showed low financial literacy and limited alternative income sources (Allison and Ellis, 2001; Schuhbauer, 2017). Practical financial training, loan schemes fitted to fluctuation incomes of fishermen, and higher fishermen participation in decision-making were the solutions to this issue (Mahmudah et al., 2024; Puspasari et al., 2024; Pomeroy et al., 2020; Pomeroy et al., 2001; Gietzen et al., 2022; Béné, 2003; Jentoft, 2000). Risk management was the strongest loading, showing weather risks, equipment failure, and price instability fishermen faced. Affordable insurance mechanisms and loans were solutions for managing these risks (Murphy et al., 2012; Islam et al., 2015; Haque et al., 2015; Sainsbury et al., 2020). Market information access, fish selling efficiency, and infrastructure improvement also loaded strongly, indicating providing mobile apps on prices, cooperative marketing, and value-added processing (Brinson et al., 2011; Aura et al., 2019; Pascual-Fernández et al., 2019; Penca et al., 2021; Cayabyab et al., 2019; Purcell et al., 2019; Adhuri et al., 2016). Inaccurate market information failed timely fish catch and resource sustainability (Purcell et al., 2017; Prosperi et al., 2019), while reducing fishing effort during low catch offers measurable long-term fish stock benefits (Mardle and Pascoe, 2002). Indicating environmental patterns

and providing sustainable fishing technology were required by fishermen for the ecological-economic interdependence of this fishery (Hobday et al., 2016; Bradley et al., 2019; Stephenson et al., 2022). Despite positive attitudes toward rules and regulations, active policy dialogue loaded negatively indicating collaborative governance discrepancies documented elsewhere (Innes and Booher, 2003; Bogie, 2016; Wescott, 2005; Bennett et al., 2021; Basurto et al., 2020). Addressing this needed strong leadership, clear communication, and integrated institutional frameworks (Sutton and Rudd, 2016; McGinnis and Ostrom, 2014; Stoll et al., 2021).

Resource Management factors

The survey was reliable and adequate across respondents (Parma and Cinti, 2014). A single dominant factor reflected fishermen's knowledge of Ostrom's resource management principles (Ostrom, 1990; Cumming et al., 2020). Strong acceptance of graduated sanctions showed that fishermen looked rules should be fair and proportionate, improving agreement (Karper and Lopes, 2014; Basurto et al., 2016), while obtaining local knowledge into decision-making was mentioned as essential for sustainability by them (Jentoft, 2023). Fishermen showed clear awareness of overfishing and pollution risks, preferring adaptive community led management and local self-governance (Divsalar et al., 2024; Martin et al., 2007; Petersen, 2007; Berkes, 2010; Trimble and Berkes, 2015; Roux et al., 2019; R de Bulhão Pato et al., 2011).

Participatory activities remained the key weakness. Low engagement showed top-down management (McCay and Jentoft, 1996), and limited collective dialogue further limited

readiness collective action among fishermen (Bodin, 2017; Roberts et al., 2019; Takakura, 2021). Fishermen liked warning-based responses to violations on sanctions, reflecting justice to such violations, with multifaceted governance frameworks (Gustavsson et al., 2021; Carlisle and Gruby, 2019).

Social factors

Social life in the Pethalai community was an interconnected system, (Dacks et al., 2020). The strong cohesion showed that fisheries governance linked with managing social systems along with managing fish stocks (Jentoft, 2007). PCA loadings for social support and internal conflict resolution showed fishermen can resolve disputes internally and manage shared resources more effectively (Ostrom, 2002; Coulthard, 2012).

Traditional fishing here, were expressions of identity also these were informal safety nets during periods of scarcity (Platteau, 1997; Aswani, 2020). Strong loadings for family involvement, gender roles, and ceremonial participation showed sustaining fishing community cohesion (McGoodwin, 2001; Nunan et al., 2018). The transmission of fishing knowledge from generation to generation further reflected their resilience was built through practice and relationships (Ruiz-Mallén and Corbera, 2013). Equity too was essential to communal well-being (Gray, 2024). Limited educational attainment made them to enter into fishing only, which led to economic instability and lessening adaptive capacity, when fish stocks decline (Maddox, 2007; Jentoft, 2000).

Well-being factors

Well-being in the Pethalai fishermen showed an interconnected structure where economic security, social cohesion, and community support were linked (Coulthard et al., 2014; Britton and Coulthard, 2013). Financial issues were the dominant stressor, which was common to fishing populations worldwide (Andrews et al., 2021; King et al., 2021; Béné and Friend, 2011; Clay and Smith, 2022). Economic pressure also affected well being, i.e. reduced participation in training and leisure activities, indicating seasonal fluctuations of income, affected health and skills in the long run (Sumaila et al., 2021).

Even though they had fish as food, they suffered from nutritional inadequacy, as they tend to sell their quality fish catch, rather than consume it (Fabinyi et al., 2017; Golden et al., 2016; Muzari, 2016) due to economic pressures affecting their physical well-being.

Strong PCA loadings for environmental responsibility showed these fishermen hold well-developed ecological knowledge (Ruddle, 1994). But they couldn't adapt to changing environments due to lack of precise information, financial resources, and alternative livelihoods (Stoll et al., 2017; Whitney et al., 2017; Wongbusarakum et al., 2021).

Geographic isolation, time limitations, and a mismatch between designed programmes with actual needs all align with fishermen's low participation to management events (Mahmud et al., 2012; Watson et al., 2016; Kalikoski and Allison, 2010). Dangerously, lack of skills deepen economic pressures, endangering them to vulnerability to both environmental and market shocks (Allison and Ellis, 2001).

Strong fishermen's connections supported resource sharing and collective responses during hardships (Barnes et al., 2020; Goulden et al., 2013). Yet support systems for them were lacking, a common feature of isolated fishing communities, with histories of institutional marginalization (Béné et al., 2016). Leisure activities were very helpful, according to fishermen's responses for stress relief and social bonding, again economic pressures, limit leisure activities, which harm mental and physical well-being (Winwood et al., 2007; Britton and Coulthard, 2013; Johnson et al., 2018).

CONCLUSION

The Pethalai fishing community reflects the multifaceted challenges of small-scale fisheries worldwide: economic insecurity, market changes, limited financial and risk management capacity, infrastructure and service shortfalls, governance participation gaps, training barriers, mental health and food security concerns, and constrained adaptive capacity. These issues form interlinked vulnerability cycles that weaken well-being and sustainability. Yet the community also possesses strong social cohesion, resilient traditional governance, rich indigenous knowledge, cultural continuity, and openness to appropriate innovation, assets that can anchor sustainable management and development. Effectively addressing these challenges requires integrated, timely strategies that provide economic support, better governance, social development, well-being enhancement, and environmental sustainability. Priority actions include giving fruitful participatory governance, financial literacy and market information systems, risk-management mechanisms, collective action opportunities, and mental health support. Broader

interventions, such as cooperatives, market and infrastructure improvements, livelihood diversification, co-management with legal recognition, gender equity, and climate adaptation capacity, must link with community rhythms and build on community strengths. Clear stakeholder roles, better monitoring and adaptive management, and multiple collaborations are essential for implementation success.

This research stresses that sustainable fisheries management extends beyond biological and ecological considerations to cover social-ecological systems where community well-being, economic viability, cultural integrity, and equitable governance are required. Community-based and co-management approaches, which improve ecological, social and governance outcomes in small-scale fisheries globally, are essential to this procedure. Supporting the community's urgent needs, balancing present income with future resource sustainability, strengthening social bonds, and enabling collective voice, highlights that, whatever the governance, it must be participatory, adaptive and empowering rather than top-down. Realizing this integrated vision requires commitment from government agencies, civil society, research institutions, and private actors to move beyond conventional paradigms and establish adaptive, broad, and environment and fishermen-friendly pathways that place fishing community well-being and self-determination.

Despite the current study's very valuable findings, there were several limitations. Since the 100 respondents were from Pethalai community, its limiting generalizability of other fishing communities in Sri Lanka or the broader South Asian context. The data were collected from the respondents' answers to the questions; the amount of catch, income

levels, and Likert scale questions may be recall-biased or may depend on the social desirability biases of respondents. Seasonal fluctuations in livelihood, economic factors, and well-being were difficult to capture from respondents without cross-sectional survey questions. Since this was a male-dominated fishing community, a female-inclusive understanding of the community was difficult to achieve. Furthermore, it only reflects the fishermen's perspective without considering other stakeholders.

Based on the limitations identified, future research can be recommended. A cross-study on economic factors, resource availability and seasonal well-being should be conducted. The roles of women should be identified, whose contributions to the Pethalai fishing economy are often underrepresented by gender inclusive methodologies. Implementation and research on financial literacy programs, market structure analysis, community-based resource management procedures, and cooperative marketing procedures can also be strongly recommended.

This study holds the significance of the United Nations Sustainable Development Goal 14 (Life Below Water), particularly goals 14.4 and 14.b, which call for regulations of fish catch to stop overfishing and provide access for small-scale artisanal fishermen to marine resources and markets. Current study findings showed that the Pethalai slipper lobster fishery has no seasonal harvest restrictions, post-harvest value addition practices, or different types of market access, all of which showed requirements of sustainability and equity among fishing communities over management under SDG 14. High PCA loadings on awareness of overfishing and environmental degradation showed the ecological

awareness required to support SDG 14.2. SDG 14.2 indicates the necessity of sustainable management and protection of marine and coastal ecosystems.

But lack of optimum government support, improper monitoring of policies, and dependence on a single buyer showed there are several gaps to address in achieving SDG 14.c. This SDG 14.c indicates the necessity of international procedures for governance of fisheries. Pethalai fishing community showed income defects, improper market access, and lack of financial literacy, indicating that sustainability should be achieved with a combination of both social and economic development, as shown by the SDGs of the UN. These issues in the particular fishing community are interconnected, so in order to achieve SDG 14, as well as achieve long-term ecological and socioeconomic sustainability, optimum management measures, community-based resource management procedures and proper market access development must be targeted.

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