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Fisheries Management for Food Security and Poverty Eradication

The Case of Small-Scale Fisheries in Vietnam

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Fisheries Management for Food Security and Poverty Eradication: The Case of Small-Scale Fisheries in Vietnam*

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Abstract

Small-scale fisheries, are crucial to support the welfare of coastal communities. Nonetheless, in Vietnam prolonged overexploitation and inadequate management have led small-scale fisheries into an uncertain future, leaving fishing households vulnerable to poverty and food insecurity. This study examines the role of small-scale fisheries in Vietnam in promoting food security and alleviating poverty within fishing households. Utilizing latent profile analysis, we categorize fishing households based on dimensions of poverty and food insecurity as well as explore the potential of fisheries management measures in eradicating poverty and improving food security. Our findings reveal that, overall, small-scale fisheries in Vietnam have significantly contributed to the well-being of fishing households, enhancing both income and food security. However, we found two distinct groups of fishers. One group, representing 65 percent of households in our sample, is characterized by higher incomes and greater food security, is denoted in the study as "protected households". The second group, comprising 35 percent of our sample, is challenged in both dimensions, and is denoted as "vulnerable households". Protected households are more likely to be located in areas where access limitations are enforced, often accompanied by livelihood enhancement opportunities. These results imply that future policies for small-scale fisheries should foster synergies among various interventions aimed at conserving fisheries resources, alleviating poverty, and ensuring food security.

Keywords: Poverty, food security, small-scale fisheries; Vietnam fisheries

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Abstract

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1. Introduction

The promotion of food security and poverty eradication have been critical to the development agenda of small-scale fisheries worldwide (Béné et al., 2016), driving progress towards the UN Sustainable Development Goals (SDGs) (e.g., Goal 1: no poverty and Goal 2: zero hunger) as well as intersecting with environmental and social development goals and the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries. Small-scale fisheries possess various socioeconomic and environmental dimensions that should capture the full attention of managers and academics (Béné, 2003). However, national and international policy discussions seldom include small-scale fisheries, despite their provision of income and food that, in many cases, cannot be easily replaced by alternative sources (Lynch et al., 2017). Over the years, small-scale fisheries have been poorly managed and overexploited (Jackson et al., 2001; Allan et al., 2005). Once regarded as an inexhaustible resource, small-scale fisheries are now recognized as a sector in crisis (Pauly et al., 2005), posing threats to ecosystem health, livelihoods, and food security (Bavinck et al., 2005; Béné et al., 2007).

Approximately 120 million people worldwide depend on fishing for their livelihoods, and over 90 percent of them are engaged in small-scale fisheries, which are responsible for more than half of the global fish catch (FAO, 2022). As such, small-scale fisheries are rarely perceived as a distinct industry but rather are intricately intertwined with the economic, social, and cultural fabric of local communities, as well as broader social and ecological systems (Jentoft, 2014). To safeguard fisheries livelihoods and the interests of other stakeholders, it is essential for the ecological system to exhibit resilience against development, environmental degradation, and resource exploitation (Laugen et al., 2014). However, due to an increasing population and prevalent issues of hunger and poverty, fisheries production is already nearing the maximum

capacity of ecosystem productivity (Garcia & Rosenberg, 2010). In the past decades, the growth in marine capture catch has stagnated or slowed down (Mcclanahan et al., 2013). Consequently, limited access to alternative natural resources and employment opportunities, as well as a poor management, may result in fishers being stuck in a poverty-environment trap, resulting in the overexploitation of existing natural resources (Lynch et al., 2017; Barbier & Hochard, 2019). These factors may further hinder economic growth and social development (WCED, 1988).

With this backdrop, small-scale fisheries management policies will increasingly need to deal with interlinkages between resource degradation, poverty, and food security (Mcclanahan et al., 2013). It is crucial to gain a comprehensive understanding of the contribution of small-scale fisheries to food security, poverty alleviation, and development goals, as well as the associated trade-offs and dilemmas arising from management decisions. Such understanding can inform the development of fisheries management policies that harmonize ecological and economic concerns while also considering the broader welfare benefits associated with small-scale fisheries.

This paper offers empirical evidence on the role of small-scale fisheries and management measures in addressing two out of seventeen SDGs (i.e., no poverty and zero hunger), using the small-scale fisheries in Vietnam as a case study. Small-scale fishing is vital for the well-being of coastal communities in Vietnam. It provides food (Harper & Sumaila, 2019), employment, and income for some of the poorest segments of society (Pomeroy et al., 2009).

Vietnamese fisheries are managed within a state planning framework, implemented through a top-down mechanism. Within this system, planning for total fish landings in the upcoming year consistently exceed those of the previous year. Annual catches consistently surpass total catches planned by the government, often exceeding the sustainable yield potential of fisheries resources (Hai, 2018). This increases the pressure on fish stocks and their surrounding

ecosystems, as well as exacerbating the socio-economic challenges faced by fisherfolk. To address these issues and promote more sustainable fishing practices, there is a growing recognition of the need to reform the fisheries management system. This includes adopting more participatory approaches that engage fishers, local communities, and other stakeholders in decision-making and management processes. The introduction of co-management and adaptive indicators-based management approaches as well as the establishment of marine protected areas (MPAs) marks a significant shift in the management paradigm of Vietnamese fisheries and marine resources. However, even with progress made, small-scale fisheries are vulnerable to threats, including overcapacity and overfishing, as well as external threats like climate change and market uncertainty (Pomeroy et al., 2009; Ngoc et al., 2009; Ngoc, 2018). This underscores the importance of enhancing the effectiveness of small-scale fisheries management in Vietnam.

The objectives of this study are threefold. First, we will assess the evidence on how and to what extent Vietnamese small-scale fisheries contribute to food security and poverty eradication, using indicators related to food, income, and employment. Second, we employ latent profile analysis (LPA) to categorize fisheries households based on dimensions of poverty and food security. This analytical approach aims to provide a better understanding of the fishing activities and lives within these households, which is a prerequisite for the development of more sustainable approaches to small-scale fisheries management. Third, by applying a membership function in the interpretation of latent profiles, we examine the linkage between management measures, fishers' compliance, and livelihood diversification concerning issues of food security and poverty.

A significant finding in our study is that small-scale fisheries play a crucial role in supporting the livelihoods and food supply of fishing communities. Households employing diverse livelihood strategies and residing in areas where fisheries are regulated through access limitations

tend to have a greater likelihood of achieving higher income and better food security. This valuable insight can inform fisheries management policies that employ various interventions to address issues related to food insecurity and poverty.

Conducting latent profile analysis of attributes for poverty and food insecurity within fisheries households is an important contribution to the literature on fisheries management. Previous research often evaluates the contribution of fisheries to livelihoods and food systems (Béné et al., 2007; Simmance et al., 2022; Béné et al., 2016; Hartje et al., 2018; Bell et al., 2018; Belhabib et al., 2015; Teh & Pauly, 2018) or investigates poverty and food insecurity in fisheries in the context of social-ecological system dynamics (Garcia & Rosenberg, 2010; Onyango & Jentoft, 2010; Nayak et al., 2014; Purcell & Pomeroy, 2015; Cissé et al., 2015) rather than identifying poverty and food insecurity dimensions of fisheries households in the relation to resource degradation and management strategies. Findings from latent profile analysis can enhance policymakers' understanding of the complexity of the situation of fisheries households. These results can assist policy makers to identify target households in the fight for poverty alleviation and food security as well as effective management measures.

Our paper is organized as follows: section 2 provides a brief review of small-scale fisheries and issues of food security and poverty; section 3 presents materials and methods; section 4 presents the results; and section 5 provides general discussion and conclusions.

2. Small-scale fisheries, food security and poverty

Small-scale fisheries are regarded as a pro-poor activity as they are a labor-intensive and easy-to-enter industry that contribute significantly to the promotion of social and economic sustainability for coastal communities, where they make up a crucial component of the country's rural development (Béné, 2006; Béné & Friend, 2011; Allison, 2011; Béné et al., 2016;

Kawarazuka & Béné, 2010; Lynch et al., 2017). The benefits from small-scale fisheries are not always fully appreciated as they relate to both income and non-income components of poverty such as people's capabilities (abilities which help them to earn a living), vulnerabilities (shocks and stresses to which people are exposed), and participation (capacity to affect decision-making processes) (Walmsley et al., 2006; Arthur et al., 2022).

Poverty is a multifaceted and dynamic phenomenon (Béné et al., 2007). In the context of small-scale fisheries, poverty has often been understood primarily in terms of income, linked to the frequently reported low incomes of small-scale fishers (Onyango & Jentoft, 2010). However, poverty encompasses a broader concept that includes access to essential resources for meeting basic human needs like food, and health, education, and other services (Spicker, 1999). With this perspective, it becomes apparent that poverty in fisheries communities cannot be solely attributed to fishing resources or catch (Béné et al., 2007). Instead, it is influenced by a combination of sectoral and non-sectoral factors (Neiland & Béné, 2004). Effective management plays a crucial role in ensuring the successful functioning of a fishery and sustaining the livelihoods of fishers (Walmsley et al., 2006; Mcclanahan et al., 2013). However, in many cases, particularly when fishery management systems are ineffective, external factors beyond the fisheries sector, influence the poverty levels experienced by fishing communities. (Mcclanahan et al., 2013; Lynch et al., 2017).

The significant contributions and importance of small-scale fisheries in poverty alleviation arise from the interconnections and interactions across various domains and levels (Béné, 2006). These include household-level wealth generation, community-level rural development, and national-level economic growth (Béné et al., 2007). At the household level, small-scale fisheries provide livelihoods, employment opportunities, and cash income, which is critical in funding

access to services such as health care and education (Walmsley et al., 2006). While small-scale fishing may not always yield substantial economic gains for households, it serves as a protective mechanism, preventing them from sinking deeper into poverty and functioning as a "safety net" (Béné, 2006; Béné et al., 2007).

Poverty and food security are closely linked, and elimination of hunger is a prerequisite of poverty eradication (Béné et al., 2007; Arthur et al., 2022). Food security, as defined by the 1996 World Food Summit, refers to a state in which all individuals have consistent physical, social, and economic access to adequate food that meets their dietary requirements and preferences for an active and healthy life. The four fundamental factors that determine food security are: *(i)* food availability, *(ii)* food access, *(iii)* food utilization and *iv)* stability of these dimensions over time (FAO 1996). People who lack access to sufficient food are considered poor.

The contribution of fisheries to food security can be measured by *i)* the amount and quality of food consumed in relation to a health standard (e.g., World Health Organization); *ii)* physical access to food such as direct fish supply; and *iii)* economic access to food, such as income generated by fisheries and post-harvesting processing (Béné et al., 2007). Therefore, the outputs of households' fishing activities, both in terms of fish catch and cash income, make up household income, which is then utilized to achieve food security (Hartje et al., 2018). Poverty is the main significant barrier to enhancing food security.

Addressing food security and poverty is a top priority for development agendas and poverty alleviation strategies. However, the pursuit of these objectives generates threats to the sustainability of diverse global ecosystems and the health of the natural environment (Coulthard et al., 2011). It's important to highlight that there isn't a straightforward connection between production, resource availability, and poverty (Leach et al., 1999). This indicates the need for

research to center on natural resources and the various social, cultural, and political factors influencing the relationship between the impoverished and these resources, as well as between different socio-economic groups (Béné, 2003).

3. Materials and Methods

3.1. Small-scale fisheries in Vietnam

The distinction between small-scale and large-scale fisheries, and their classification, is often based on factors such as vessel type, gear type, or fishing distance from the coast (Gibson & Sumaila, 2017; Smith & Basurto, 2019). In Vietnam, small-scale fisheries are defined as those that operate in the near-shore coastal area (Pomeroy et al., 2009), involving vessels with a length not exceeding 12 meters (Decree 26/2019/NĐ-CP). These fisheries have long played a significant role in the marine capture fishery industry in Vietnam, both in terms of overall fishing effort and catch volume (Pomeroy et al., 2009; MARD, 2021). As of 2022, there were 38,500 small-scale fishing vessels in Vietnam, accounting for nearly 45 percent of all fishing vessels in the country (MARD, 2021). Investments in small-scale fishing vessels are relatively modest compared to offshore vessels, leading to a rapid increase in the number of small-scale vessels over the years, exerting significant pressure on marine resources and the environment (Ngoc et al., 2009). However, since 2014, with the release of Decree No. 67/2014/ND-CP promoting offshore fishing through subsidies for vessel construction, there has been a significant change in the composition of the fishing fleet. The number of small-scale fishing vessels has declined in favor of an increase in offshore fishing vessels (MARD, 2021).

The management of the small-scale fisheries sector in Vietnam lacks a dedicated legislative framework. The Fisheries Development Strategy for 2030 and the vision for 2045 and The Fisheries Law of 2017 authorize fisheries regulation through a quota system. However, quota

implementation has so far only been piloted for offshore fishing vessels. Efforts are currently underway to define quotas for each province in small-scale fisheries. Additionally, the government has formulated strategies to gradually introduce co-management practices in small-scale fisheries and establish marine protected areas to revitalize marine resources and ensure sustainable development of the fisheries industry.

The present study was conducted in the provinces of Phu Yen, Khanh Hoa, and Ninh Thuan, located on the Central Southern Coast (Fig. 1). This area encompasses highly productive marine ecosystems that provide various ecosystem services, including significant fisheries resources. The Central Southern region is highly dependent on fisheries for its economy, and most provinces in the area exhibit higher growth rates in the agricultural, forestry, and fisheries sectors than the national average (MARD, 2021). The fishing capacity of vessels in the Central Southern Coast has increased recently and shows no signs of decline (MARD, 2021). Overfishing has taken place for many years, resulting in unsustainable fisheries development. In an effort to tackle this issue, the government plans to progressively reduce the number of coastal fishing vessels, particularly those with inefficient fishing gear and gear that has a detrimental impact on fisheries resources. It further plans to limit catches to the level of maximum sustainable yield to recover resources, achieve maximum economic efficiency, and ensure sustainable development of fisheries (MARD, 2021).

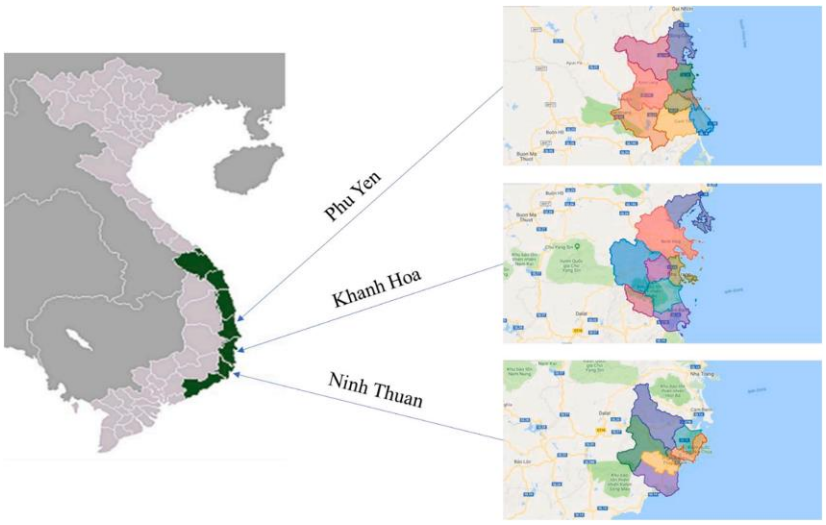

Fig. 1. The location of Central Southern Coast of Vietnam.

3.2. Latent profile analysis

Latent profile analysis is one of the Finite mixture modeling techniques. This approach categorizes models as either Latent Class Analysis (LCA) or Latent Profile Analysis, determined by whether the observed variables are categorical or continuous. Latent profile models seek to identify various existing but unrecognized subgroups of people as the source of population heterogeneity (Peugh & Fan, 2013). It is therefore assumed that individuals can be classified into categories (subpopulations) with varied probability and according to configurable features of their personal and environmental characteristics. Unlike conventional, non-latent clustering techniques (such as k-means clustering and hierarchical clustering), LPA regards profile membership as an unobserved categorical variable, with a value that indicates which profile an individual belongs to with a particular degree of probability (Magidson & Vermunt, 2002).

According to Lazarsfeld and Henry (1968) and Peugh and Fan (2013), a typical LPA model equation that separates the variance of the ith observed continuous response variable in the kth latent profile into its between-profile and within-profile components, respectively, is as follows:

$$\sigma_i^2 = \sum_{k=1}^{K} \pi_k (\mu_{ik} - \mu_i)^2 + \sum_{k=1}^{K} \pi_k \sigma_{ik}^2$$

where μ_{ik} and σ_{ik} are the variable i's profile-specific k means and variances, respectively, and π_k denotes profile density, which is the proportion of N participants who fit profile k. LPAs presume that *i)* samples obtained from a heterogeneous population are a mixture of K profile-specific distributions; *ii)* observed y indicator variables are normally distributed; and *iii)* the profile-specific mean vectors μ_k are the profile-specific (k) observed variable means. To simulate y fluctuation with a minimal number of estimated parameters, two LPA model constraints are typically imposed. First, the local independence assumption asserts that, subject to proper latent profile extraction or enumeration, all y are uncorrelated within each k latent profile, and all k-specific off-diagonal covariance matrix elements are zero. Second, the homogeneity assumption stipulates that the elements of the major diagonal of the covariance matrix that are distinctive to a given profile must be equal across all profiles. (i.e., $\sum_k = \sum, Y_k \sim N[\mu_k, \sum]$, (Lubke & Neale, 2006; Magidson & Vermunt, 2002). Overall, local independence and homogeneity presume that latent profile-specific (k) covariance matrices are diagonal and homogeneous and that latent profiles differ only in their y - variable location (μ_k), not their y - variable relationship type ($\sum$, (Lubke & Neale, 2006).

3.3. Data

The data utilized in this study were obtained through a household survey. A field visit was first undertaken to gather insights into fishing practices and sociocultural characteristics of the fishing communities and to inform the survey design. This was followed by pilot testing of the survey instrument. The pilot test provided valuable information, leading to revisions in the questionnaire, which included various sections covering fishers' fishing activities, sources and

types of livelihoods and incomes, social capital and trust, as well as their perceptions regarding fisheries resource degradation. Additionally, one section of the questionnaire specifically focused on women's roles in fisheries, including their involvement in decision-making processes, production, credit utilization, and the utilization of income derived from fishing.

Data collection took place in the provinces of Phu Yen, Khanh Hoa, and Ninh Thuan between June and October 2022. As reported by the Department of Fisheries in Phu Yen, Khanh Hoa, and Ninh Thuan, the number of fishing vessels in 2020 was approximately 4100, 9800, and 2500, respectively. Small-scale fishing vessels account for 89%, 85%, and 70% of all fishing vessels, respectively. Our survey targeted four villages in Khanh Hoa and two villages each in Phu Yen and Ninh Thuan Provinces. The management strategies employed in these villages vary and include approaches such as open access, co-management, and access limitation. Additionally, certain villages feature management systems incorporating co-management through the formation of fisheries community groups designed specifically for marine protected areas (MPAs).

Interviews with respondents took approximately 20 minutes each, and were conducted by trained students from Nha Trang University. The interviewers were assigned to various roads within the villages and respondents were sampled while on the road. The fishers who spent the most time in fishing activities in each household were chosen for interviews. A total of 302 fishers (162 in Khanh Hoa, 80 in Phu Yen and 60 in Ninh Thuan) were recruited throughout the course of our survey.

Table 1 provides a summary of the general characteristics of individuals in the sample. The respondents included in the study were all males, as men take the primary responsibility for fishing. On average, they were 46 years old and had nearly 23 years of experience in fishing. Almost 95% of the respondents had received education up to primary or secondary school level, indicating less

than 9 years of formal education. The average household consisted of 4.3 individuals. Forty percent of these households pursued livelihoods beyond fishing.

Table 1

Sample characteristics of respondents and summary statistics of variables

Variable	Mean	Std. dev.
Socioeconomic characteristics		
Age	46.00	10.32
Education		
Primary school	182	60.26 %
Secondary school	103	34.11%
High school	17	5.63 %
Experience in fishing (years)	22.81	10.71
Number of family member (persons)	4.30	1.29
Dummy for other livelihoods	0.40	0.49
(1 = if household engage in other livelihoods;		
0 = otherwise)		
Fishing activity characteristics		
Number of days at sea (days)	218.64	66.33
The length of vessel (m)	10.85	2.59
Fisheries resources		
(1= totally disagree; 5 = totally agree)		
Degradation in fish resources	3.76	0.84
Management measures		

(1 = Yes; 0: otherwise)		
Co-management/ Community based management	0.52	0.50
Access limitation	0.62	0.48
Compliance		
(1: Yes; 0: 0therwise)		
Fishers in your region comply with regulation	0.33	0.47
Conflict		
(1 = Yes; 0 = otherwise)		
Conflicts with other fishers	0.18	0.38

The fishers included in the sample utilized vessels with an average hull length of 10.8 meters. These vessels were operational at sea for an average of 218 days per year, resulting in an average annual catch of 55,528 kilograms. Fishers also perceived a decline in the condition of fisheries resources in the last five years. Approximately 52 percent of the fishers reported the existence of co-management systems, while 62 percent reported the implementation of access limitations, such as marine protected areas (MPAs), locally managed marine areas (LMMAs), or closed seasons in their respective fishing grounds. Adherence to regulations is of great significance for effective management, yet only 33 percent of the fishers agreed that other fishers comply with fisheries regulations in their areas. Additionally, approximately 18 percent of the fishers encountered conflicts with other fishers while engaging in fishing activities at sea.

A section of the questionnaire was utilized to develop a food insecurity scale, including five items that address various aspects of food security and hunger (see Appendix Table 8). Our study employed a 3-point Likert scale, where a response of 1 indicated "Never true", 2 represented

"Sometimes", and 3 denoted "Often". Therefore, a higher score indicates higher levels of food insecurity. The primary difficulties faced by these households revolve around the affordability of balanced meals that include four essential components: protein, carbohydrates, vegetables, and fats. Additionally, insufficient funds to purchase food were identified as a significant challenge.

Our study also examined fishers' interpersonal relationships, emphasizing their relationships with other fishers, community members, community leaders, and fisheries department officers (see Appendix Table 9). A 5-point Likert scale was employed to collect this information, where a rating of 1 signified "Very poor", 2 indicated "Poor", 3 denoted "Fair", 4 represented "Good", and 5 indicated "Very good". Overall, fishers had better relationships with other people in community than with other fishers, community leaders, and fisheries department officers.

4. Results

4.1. Contribution of Vietnamese small-scale fisheries to food security and poverty eradication

We assess the contribution of small-scale fisheries to food security and poverty eradication at the household level in three areas: food, income, and employment (see Table 2). For food, we consider both food consumption and food expenditure. On average, each household in our survey consumes 8.7 fish meals per week, utilizing approximately 6.5 kg of fish catch for their weekly food needs. Fish constitutes about 30 percent of the total food consumed by the household, highlighting its significant role in the diets of most fishing households. Furthermore, income earned from fisheries makes an important contribution to food expenses, accounting for 33 percent of the total household expenditure on food.

Table 2 also presents the findings of a t-test conducted to examine the difference in fish consumption and food expenditure between poor and non-poor households. In this study, poverty

is defined based on per capita income, with households classified as poor if their per capita income is below 1.5 million VND (1 USD = 23.200 VND) per month in rural areas and below 2 million VND per month in urban areas (Decree 07/2021/NĐ-CP). Our study comprised 22 poor households, accounting for 7.3 percent of all households in our selected provinces. While there was no significant difference observed in fish consumption between poor and non-poor households, as fishers frequently utilize their own catches for daily food, a significant difference in daily food expenditure was evident between the two groups. The non-poor households allocated an average of 165,000 VND per day for food, whereas the poor households spent only 134,000 VND.

The role of small-scale fisheries in providing livelihoods and generating income for small-scale fishing households is presented in Table 3. On average, 1.7 individuals within a household are engaged in fisheries-related activities, including both fishing and post-harvesting activities, representing 67 percent of household members involved in income generation. The average monthly per capita income amounts to 4.54 million VND, with 83.3 percent of that income derived from the fisheries sector. These findings indicate that small-scale fisheries provide economic well-being to households in terms of both income and livelihoods. This income closely aligns with the average monthly income per capita of Vietnam in 2022, which was recorded at 4.67 million VND (TCTK, 2023). The number of household members engaged in income generation does not significantly differ between poor and non-poor households, but the income per capita of non-poor households is nearly three times higher than that of poor households.

Table 2.

Contribution of fisheries into households' food consumption and expenditure

Food consumption and expenditure	Whole sample	Non Poor (n = 280)	Poor (n=22)	P diff
	Mean/ SD	Mean/ SD	Mean/ SD	
Fish consumption (Number of fish meals consumed per week)	8.69 (4.24)	8.68 (4.22)	8.81 (4.62)	0.88
Average weekly catch of fish for household consumption (kg)	6.37 (3.73)	6.36 (3.75)	6.54 (3.57)	0.82
The percentage of household food accounted for by fish caught	30.87 (15.99)	31.07 (15.79)	28.40 (18.54)	0.45
Expenditure on food bought during the day (thousand VND/day)	162.78 (60.87)	165.03 (61.55)	134.09 (43.05)	0.02
Share of income from fisheries used for food expenditure (%)	32.99 (19.86)	32.83 (20.09)	35.06 (16.89)	0.62

Table 3.

The employment and income from fisheries

	Whole sample	Non poverty (n = 280)	Poverty (n = 22)	P diff
	Mean (SD)	Mean (SD)	Mean (SD)	
Employment				
Number of household members who earn a living	2.75 (1.19)	2.77 (1.21)	2.50 (0.85)	0.30
Number of household members engaged in fisheries	1.64	1.65	1.54	0.55

	(0.85)	(0.86)	(0.59)	
Number of household members directly engaged in fishing	1.22	1.24	1.04	0.10
	(0.54)	(0.55)	(0.21)	
Number of household members engaged in post harvesting activities	0.42	0.41	0.50	0.50
	(0.55)	(0.56)	(0.51)	
Income				
Monthly income per capita (VND)	4.54	4.77	1.62	0.00
	(2.54)	(2.49)	(0.31)	
Monthly income per capita from fisheries sector (VND)	3.71	3.89	1.42	0.00
	(2.35)	(2.34)	(0.43)	
Monthly income per capita from fishing activities (VND)	3.53	3.70	1.28	0.00
	(2.35)	(2.34)	(0.44)	
Monthly income per capita from post-harvesting activities (VND)	0.18	0.19	0.14	0.66
	(0.44)	(0.45)	(0.31)	
Percentage of income from fisheries (%)	83.29	82.85	88.87	0.26
	(23.88)	(23.89)	(23.53)	

4.2. Latent profile analysis

Section 4.1 highlights the difference in income and food expenditure between impoverished fishing households and those not classified as poor. Another pertinent concern is whether non-poor households genuinely enjoy food security and are shielded from the risk of falling into poverty. We conduct the analysis with different profiles for fishers' food insecurity and poverty attributes. Food insecurity is assessed across dimensions, including food availability,

food access, and food utilization. Poverty is evaluated by income, as well as material poverty like capital investment (represented by the length of vessels) and non-material poverty such as interpersonal relationships, also known as social capital.

We assume that the five indicators related to food and hunger and four indicators related to social relationships (see Table 8 & 9 in Appendix) collectively represent latent variables related to fishers' perceptions of their family's food insecurity status and social capital. To explore the association between the latent dimensions of food and social capital, we employ exploratory factor analysis (EFA) prior to entering latent class analysis (see Table 8 & 9 in Appendix). The internal consistency of each item, as measured by Cronbach's alpha, falls within the range of 0.74 to 0.80 for food insecurity and 0.76 - 0.82 for social capital. The EFA, which includes five items for food and four items for social capital, provides support for our hypothesis of a unidimensional construct for each variable. All standardized factor loadings are statistically significant ($p < 0.01$) and range from 0.63 to 0.81 for food insecurity and from 0.81 to 0.85 for social capital. Additionally, Bartlett's test of sphericity for both variables yields a significant result ($p < 0.01$), and the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy indicates an overall value of 0.81 for food insecurity and 0.66 for social capital. Therefore, we include these items as food insecurity and social capital variables in the latent profile model.

The typical approach for performing LPA involves a step-by-step process of building models, starting with a one-profile model and gradually adding a profile at a time (Weller et al., 2020). We examined one, two and three profile models. Using the AIC and BIC criterion, we compared three models (see Table 4). AIC and BIC values with lower values are preferable. Despite the statistical preference of the model utilizing three profiles over the two-profile model based on multiple information criteria, we also conducted an analysis, as recommended by Scarpa

and Thiene (2005), to assess the significance of parameter estimates across profiles. This examination revealed that the two-profile model was the preferred model. We also estimated a latent profile model with membership function. Therefore, we report a two-profile model with profile membership variables.

Table 4.

Comparison of models

Model	ll(model)	df	AIC	BIC
1 profile	-1758.48	8	3532.96	3562.64
2 profile	-1709.74	13	3445.48	3493.72
3 profile	-1688.18	18	3372.35	3439.14

Table 5 presents the statistics of variables for each of the two profiles and the average posterior probabilities associated with latent profiles to which individuals were assigned. As can be seen, all of the variables used in the model have a significant effect on the classification of respondents. Based on posterior probability of profile membership, fishers were assigned to one of the two profiles. 106 fishers (35%) being assigned to latent profile 1 and 196 fishers (65%) assigned to latent profile 2. For profile 1, the mean score is 3.58 (SE = 0.25) for monthly income per capita, 1.90 (SE = 0.03) for food insecurity, 10.87 (SE = 0.27) for hull length and 2.86 for social capital. Compared to profile 1, fishers assigned to profile 2 has had higher mean score for monthly income per capita, 5.05 (SE = 0.18), but a lower mean score on food insecurity. Notably, the mean scores for hull length and social capital are not significantly different between the two

profiles. Given that Profile 1's per capita income falls below the national average of 4.67 million VND/person/month and their greater food insecurity, the group in this profile is labeled as "Vulnerable Households". The group with the second profile, with a higher income per capita than the national average and less food insecurity, is labeled as "Protected Households". The results derived from the latent profile analysis indicate a negative relationship between food insecurity and income, highlighting the poverty-food insecurity nexus.

Table 5.

Profile-specific marginal means

Variables	Profile 1		Profile 2		Test statistic	
	Vulnerable households		Protected households		T	P
	Margin	std. err	Margin	std. err		
Monthly income per capita	3.58	0.25***	5.05	0.18***	- 5.31	0.00
Food insecurity	1.90	0.03***	1.15	0.02***	30.29	0.00
Vessel length	10.87	0.27***	10.83	0.19***	-0.12	0.90
Social capital	2.86	0.09***	2.93	0.07***	- 1.03	0.30
Profile Probability	0.35 (n =106)		0.65 (n = 196)			
Log-likelihood	-1672.99					

*** Significant at 1%.

Table 6.

Profile membership function

	Coefficient	Std. err.
Profile 1 (Vulnerable households - base outcome)		
Profile 2 (Protected households)		
Dummy for other livelihoods	0.83	0.34**

Perception of the depletion of fish stock	0.50	0.21**	
Co-management/ Community based management	-1.20	0.34***	
Access limitation	0.69	0.34**	
Fishers' compliance	2.09	0.41***	
Fishing conflicts	-0.73	0.43*	
Constant	-1.68	0.90*	-

*** Significant at 1%; ** Significant at 5%; * Significant at 10%.

Table 7.

Sociodemographic characteristics between latent profiles

Characteristics	Profile 1 Vulnerable households N = 106		Profile 2 Protected households N = 196		Test	P
	Mean/N	SD	Mean/N	SD		
Education						
Primary school	58		124		$\chi^2(2) = 2.11$	0.34
Secondary school	41		62			
Highschool	7		10			
Age	47.49	10.55	45.20	10.14	t = 0.85	0.06
Fishing experience	24.58	10.72	21.86	10.60	t = 2.13	0.03
Number of household members who earn a living	2.60	1.19	2.83	1.18	t = -1.59	0.11
Number of household members engaged in fisheries	1.16	0.53	1.25	0.55	t = -1.30	0.19

We also predict respondents' latent profile membership in relation to the "Vulnerable household" profile (Table 6). We use dummy variables for other livelihoods, management measures like co-management and access limitations, fishers' compliance with regulations, fishing conflicts, and perception of fishers concerning depletion of fish stocks as the explanation. All of these are significant predictors of profile membership. "Protected households" are more likely to participate in various income generating activities outside fisheries than "vulnerable households". Fishers in this profile are more likely to perceive that fish stocks have been depleted. Importantly, "protected households" are less likely to be located in villages with co-management or community-based management and more likely to be located in villages that are managed by access limitation measures. Fishers belonging to the "protected household" group also reported greater compliance with regulation and enforcement by other fishers in their areas and less conflict with other fishers related to fishing activity.

To characterize the two-profile solution, each profile was cross-tabulated with variables such as education, age, fishing experience, number of household members who earn a living, and number of household members engaged in fishing activities (see Table 7). There only significant difference in socio-demographic characteristic between the two profiles relate to age and fishing experience. Interestingly, the fishers in profile 1, the vulnerable households, tended to be older and have more fishing experience.

5. Discussion and Conclusions

Ensuring the future livelihoods of small-scale fishers in Vietnam is contingent upon the implementation of substantial changes to fisheries and marine resource policies (Garcia & Rosenberg, 2010; Purcell & Pomeroy, 2015). Poor fisheries management can result in social instability as well as the diminishment of economic opportunities and the means of livelihood for

small-scale fishers (Walmsley et al., 2006; Lu & Yamazaki, 2023). To devise effective development and management policies, it is crucial to gain a comprehensive understanding of the linkage between fisheries management and corresponding benefits for local fishing communities. This study has enriched our understanding regarding the role of small-scale fisheries in improving food security and alleviating poverty as well as "leaving no one behind" in achieving the Sustainable Development Goals within coastal households in Vietnam. It has also shed light on policy and management approaches that can address the challenges of poverty and food insecurity faced by people who rely on common pool resources and prevent vulnerable fishing households from falling into poverty.

We have identified three different pathways in which small-scale fisheries can contribute to the wellbeing of fishing households. First, by directly providing fish for household consumption; second, by generating cash income from fish sales, which is used for meeting overall food needs; and third, by generating livelihood and income opportunities for household members. Overall, small-scale fisheries in Vietnam provide an average of 30 percent of these households' food needs, with 33 percent of the income generated from fisheries being allocated to family food expenses. This finding aligns with the existing literature on the role of fisheries in providing sustenance which indicates that fisheries contribute about 19 percent of the protein intake of fishers' households. This percentage can surpass 25 percent in the most impoverished countries and reach as high as 90 percent in remote coastal or inland areas and in small island developing states (Béné et al., 2007). In Pacific Island countries and the Mekong River Basin, this contribution ranges from 50 to 90 percent in Pacific Island states and 49 to 82 percent in the Mekong River Basin (Ainsworth et al., 2021; Bell et al., 2015).

Furthermore, small-scale fisheries in Vietnam make a noteworthy contribution to both employment and income. In Vietnam they provide jobs for 67 percent of individuals contributing to household earnings, including men engaged in fishing and women involved in post-harvesting activities, and account for 83 percent of the total income within these households. This indicates that small-scale fisheries in Vietnam serve as a crucial "safety net" for fishers and their families, particularly those with limited skills., as well as a pathway to enhance women's empowerment.

The majority of fishing households (92.7 percent) exhibit a per capita income greater than the national average. Households in the Profile 1, 35 percent of households in our sample, have a per capita income that is below the national average. This group consists of older fishers who may have fewer opportunities for alternative livelihoods, and therefore rely primarily on fisheries-related activities. These households risk falling into poverty if adequate support for alternative livelihoods is not provided. The households in the profile 2, 65 percent of our sample, have a per capita income greater than the national average. They have more per capita income and better food security than households in profile 1. This can be attributed in part to their pursuit of diversified livelihoods. It is worth noting that both groups acknowledge a decline in fish stocks in recent years. Therefore, while small-scale fisheries play a significant role in poverty reduction and mitigating hunger, it appears that they may not substantially enhance the overall living standards of fishers, given the issue of over-exploitation and resource degradation. It is importance therefore for fishing households to supplement their fisheries income with other income sources to prevent them from falling into poverty.

Our study also investigated fisheries management and regulatory compliance, as well as conflicts among fishermen. Fisheries management in Vietnam primarily emphasizes offshore fisheries, where quota systems have recently been implemented. In contrast, small-scale fisheries

are governed by less stringent regulation, with a focus on implementing co-management or community-based management, and zoning systems from the creation of marine protected areas (Pomeroy et al., 2009; Ngoc, 2018). Our findings show that, although co-management and community-based management have been institutionalized throughout Vietnam, fishers located in the study areas (who more likely fall into profile 1), were less likely to experience improved incomes and food security. The co-management approach in Vietnamese fisheries was introduced in 1994. It was officially endorsed by MARD in 2007 by the establishment of the Fisheries Co-Management Task Force. Since then, over 40 fisheries co-management models have been piloted in Vietnamese fishing communities. However, most have not been sustained after the end of external financial support (Hai 2018). An innovative approach to co-management strategies is required to preserve marine resources and guarantee the livelihoods of coastal communities.

Fishers in areas where fisheries are subjected to limited access management were more likely to fit profile 2 and have higher incomes and greater food security. This can be explained by the fact that limited access regulations, typically associated with the establishment of Marine Protected Areas (MPAs) or Locally Managed Marine Areas (LMMAs), frequently prioritize both the preservation of biodiversity and the enhancement of local residents' well-being. In this context, fishing households may receive financial assistance, training in technical skills, and opportunities for alternative livelihoods like aquaculture or tourism (Ngoc, 2018), which ultimately enables them to generate income beyond fishing. This group is also less likely to be involved in fishing-related conflict and more likely to comply with regulations. The absence of conflict is one of the proxies for social capital, indicating the existence of networks that can facilitate cooperation among fishers (Yamazaki et al., 2018). This in turn may improve the management of pool common resources and facilitate compliance.

We draw three possible policy implications from findings in the study, based on the poverty–food security and poverty -natural environment nexus found in this study. First, ongoing depletion of fisheries resources may lead to fish becoming unattainable for fishers in the future (Mcclanahan et al., 2013). Fisheries management policies should therefore prioritize efforts to counteract the deterioration of marine ecosystems and strengthen the contribution of small-scale fisheries to human well-being. Policies and management strategies for fisheries should be developed within an integrated social-ecological system which preserves and rebuilds fish stocks and recognizes the role of humans in shaping ecosystem processes (Nayak et al., 2014). Improvements in the food security and economic status of poor and vulnerable groups are a critical measure of policy success (Arthur et al., 2022), and our study suggests that the effectiveness of fisheries management measures hinges on the availability of alternative livelihood opportunities for local fishing households. Alternative livelihood strategies, combined with resource management practices may support existing rural livelihoods and help decrease the strain on marine resources and conserve the environment. In Vietnam, alternative livelihood projects along with establishing marine protected areas have long been used as a strategy for reducing local level threats to species, habitats, or resources of conservation concern (Ngoc et al., 2012; Ngoc, 2018; Nguyen, 2019). Various strategies can be applied, including training in alternative livelihoods and providing financial support to small-scale fishers. These training programs should provide skills development in areas such as aquaculture, sustainable agriculture, and eco-tourism, thereby facilitating a diversified income base for fishing households. Additionally, financial support mechanisms such as low-interest loans could be established to assist small-scale fishers in transitioning to alternative livelihoods.

Second, solutions to the problem of poverty and resource degradation must revolve round making small-scale fisheries more economically efficient while finding the means to conserve fish stocks. Since poverty in fisheries is the result of "too many people and vessels depending directly on too few fish" (Cunningham et al., 2009), a solution could involve regulating access by implementing an effective property rights system. The implementation of property rights is being considered as an approach that could decrease the race to fish among fishers, as granting them secure tenure encourages them to safeguard their fishing resources by. The proposed quota system for small-scale fisheries by the Vietnamese Government should be put into effect. It is equally vital to involve impacted fishers in shaping food and fishing rights policies. Additionally, application of limited access models like the creation of MPAs may work towards mitigating local threats and support fisheries management and biodiversity conservation efforts. Vietnam has established 11 MPAs out of 16 planned nationwide. The primary objectives of these MPAs are centered on biodiversity conservation, with no focus on fisheries management. However, the effectiveness of MPAs for biodiversity conservation in Vietnam is challenged by threats from human activities (Ho et al., 2014; Ngoc, 2018). Fishing, in particular, represents a significant impact that should be addressed within the scope of MPAs. Well designed and effectively managed MPAs could achieve multiple objectives. MPAs need to be adequately regulated to address both biodiversity conservation and fisheries management, with careful monitoring of their socio-economic impacts.

Third, fisheries communities in Vietnam serve as an illustration of collective effort, local competition for access and control of resources, and social distribution (MARD, 2021; Pomeroy, et al., 2009; Ngoc et al., 2009; Ngoc, 2018) which necessitate a focus on achieving equity and sustainability in management to further bolster food security and alleviate poverty. Policies should

be formulated to safeguard the fundamental human rights of vulnerable resource users and ensure the effective distribution of benefits from common pool resources, thereby promoting the endurance of ecosystems and economically viable fisheries.

From our study, we identify at least two promising research trajectories to enhance the management of small-scale fisheries. The first involves examining the viability of various policies designed to support poorer households in adopting new livelihood strategies. This inquiry should assess their impact on the standard of living, well-being, and the sustainable management of fish resources. The second research trajectory suggested by our analysis revolves around the humans and nature nexus. The current state of Vietnamese small-scale fisheries underscores its social, ecological, and economic unsustainability, emphasizing the necessity for transformative governance. Investigating trade-offs among these dimensions and assessing how they contribute to sustainability would be a crucial contribution to the development of transformative governance for small-scale fisheries in Vietnam.

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References

Allan, J. D., Abell, R., Hogan, Z., Revenga, C., Taylor, B. W., Welcomme, R. L., & Winemiller, K. (2005). Overfishing of inland waters. *BioScience*, *55*(12), 1041–1051. https://doi.org/10.1641/0006-3568(2005)055[1041:OOIW]2.0.CO;2

Allison, E. H. (2011). Aquaculture, fisheries, poverty and food security. *World Fish Center Working Paper 65*, 61. https://doi.org/Working Paper 2011-65.

Arthur, R. I., Skerritt, D. J., Schuhbauer, A., Ebrahim, N., Friend, R. M., & Sumaila, U. R. (2022). Small-scale fisheries and local food systems: transformations, threats and opportunities. *Fish and Fisheries*, *23*(1), 109–124. https://doi.org/10.1111/faf.12602

Barbier, E. B., & Hochard, J. P. (2019). Poverty-environment traps. In *Environmental and Resource Economics* (Vol. 74, Issue 3). Springer Netherlands. https://doi.org/10.1007/s10640-019-00366-3

Bavinck, M., Diallo, R. C. M., Heijden, P. van der, Kooiman, J., Mahon, R., & Williams, S. (2005). *Interactive fisheries governance: a guide to better practice* (Issue Delft: Eburon Publishers. 72 pp).

Belhabib, D., Sumaila, U. R., & Pauly, D. (2015). Feeding the poor: Contribution of West African fisheries to employment and food security. *Ocean and Coastal Management*, *111*, 72–81. https://doi.org/10.1016/j.ocecoaman.2015.04.010

Bell, J. D., Cisneros-Montemayor, A., Hanich, Q., Johnson, J. E., Lehodey, P., Moore, B. R., Pratchett, M. S., Reygondeau, G., Senina, I., Virdin, J., & Wabnitz, C. C. C. (2018). Adaptations to maintain the contributions of small-scale fisheries to food security in the Pacific Islands. *Marine Policy*, *88*(May), 303–314. https://doi.org/10.1016/j.marpol.2017.05.019

Béné, C. (2003). When fishery rhymes with poverty: a first step beyond the old paradigm on poverty. *World Development*, *31*(6), 949–975. https://doi.org/10.1016/S0305-750X(03)00045-7

Béné, C. (2006). Small-scale fisheries: assessing their contribution to rural livelihoods in developing countries. *FAO Fisheries Circular. No. 1008. Rome, FAO. 2006. 46p*.

Béné, C., Arthur, R., Norbury, H., Allison, E. H., Beveridge, M., Bush, S., Campling, L., Leschen, W., Little, D., Squires, D., Thilsted, S. H., Troell, M., & Williams, M. (2016a). Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence. *World Development*, *79*, 177–196. https://doi.org/10.1016/j.worlddev.2015.11.007

Béné, C., Arthur, R., Norbury, H., Allison, E. H., Beveridge, M., Bush, S., Campling, L., Leschen, W., Little, D., Squires, D., Thilsted, S. H., Troell, M., & Williams, M. (2016b). Contribution of fisheries and aquaculture to food security and poverty reduction: assessing the current evidence. *World Development*, *79*, 177–196. https://doi.org/10.1016/j.worlddev.2015.11.007

Béné, C., & Friend, R. M. (2011). Poverty in small-scale fisheries: old issue, new analysis. *Progress in Development Studies*, *11*(2), 119–144. https://doi.org/10.1177/146499341001100203

Béné, C., Macfadyen, G., & Allison, E. H. (2007). Increasing the contribution of small-scale fisheries to poverty alleviation and food security. *FAO Fisheries Technical Paper. No. 481. Rome.*, 125p.

Cissé, A. A., Doyen, L., Blanchard, F., Béné, C., & Péreau, J. C. (2015). Ecoviability for small-scale fisheries in the context of food security constraints. *Ecological Economics*, *119*, 39–52. https://doi.org/10.1016/j.ecolecon.2015.02.005

Coulthard, S., Johnson, D., & McGregor, J. A. (2011). Poverty, sustainability and human wellbeing: A social wellbeing approach to the global fisheries crisis. *Global Environmental Change*, *21*(2), 453–463. https://doi.org/10.1016/j.gloenvcha.2011.01.003

Cunningham, S., Neiland, A. E., Arbuckle, M., & Bostock, T. (2009). Wealth-based fisheries management: using fisheries wealth to orchestrate sound fisheries policy in practice. *Marine Resource Economics*, *24*, 271–287. https://doi.org/10.1086/mre.24.3.42629655

Decree 07/2021/NĐ-CP. Multidimensional poverty standards for the period 2021 – 2025. Vietnamese: Quy định chuẩn nghèo đa chiều giai đoạn 2021 - 2025.

Decree 26/2019/NĐ-CP. Detailing some articles and measures to implement the fishery law. Vietnamese: Quy định chi tiết một số điều và biện pháp thi hành Luật Thủy sản.

FAO. (2022). The State of World Fisheries and Aquaculture 2022. Towards Blue Transformation. *Rome, FAO. Https://Doi.Org/10.4060/Cc0461en The*.

Garcia, S. M., & Rosenberg, A. A. (2010). Food security and marine capture fisheries: characteristics, trends, drivers and future perspectives. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *365*(1554), 2869–2880. https://doi.org/10.1098/rstb.2010.0171

Gibson, D., & Sumaila, U. R. (2017). Determining the degree of 'small scaleness' using fisheries in British Columbia as an example. *Marine Policy*, 86, 121–126. https://doi.org/10.1016/j.marpol.2017.09.015

Hai, V. D. (2018). Fisheries Planning and Management in Vietnam: an explanation of ineffectiveness. PhD thesis. Aalborg Universitetsforlag.

Harper, S., & Sumaila, U. R. (2019). Distributional impacts of fisheries subsidies and their reform. IIED Working Paper, 30.

Hartje, R., Bühler, D., & Grote, U. (2018). Eat your fish and sell it, too – Livelihood choices of small-scale fishers in rural Cambodia. Ecological Economics, 154(July), 88–98. https://doi.org/10.1016/j.ecolecon.2018.07.002

Ho, T. V. T., Woodley, S., Cottrell, A., & Valentine, P. (2014). A multilevel analytical framework for more-effective governance in human-natural systems: A case study of marine protected areas in Vietnam. *Ocean & Coastal Management*, 90, 11-19. https://doi.org/10.1016/j.ocecoaman.2013.12.015

Jackson, J. B. C., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., Bradbury, R. H., Cooke, R., Erlandson, J., Estes, J. A., Hughes, T. P., Kidwell, S., Lange, C. B., Lenihan, H. S., Pandolfi, J. M., Peterson, C. H., Steneck, R. S., Tegner, M. J., &

Warner, R. R. (2001). Historical overfishing and the recent collapse of coastal ecosystems. *Science*, *293*(5530), 629–637. https://doi.org/10.1126/science.1059199

Jentoft, S. (2014). Walking the talk: implementing the international voluntary guidelines for securing sustainable small-scale fisheries. *Maritime Studies*, *13*(1), 1–15. https://doi.org/10.1186/s40152-014-0016-3

Kawarazuka, N., & Béné, C. (2010). Linking small-scale fisheries and aquaculture to household nutritional security: an overview. *Food Security*, *2*(4), 343–357. https://doi.org/10.1007/s12571-010-0079-y

Laugen, A. T., Engelhard, G. H., Whitlock, R., Arlinghaus, R., Dankel, D. J., Dunlop, E. S., Eikeset, A. M., Enberg, K., Jørgensen, C., Matsumura, S., Nusslé, S., Urbach, D., Baulier, L. C., Boukal, D. S., Ernande, B., Johnston, F. D., Mollet, F., Pardoe, H., Therkildsen, N. O., … Dieckmann, U. (2014). Evolutionary impact assessment: Accounting for evolutionary consequences of fishing in an ecosystem approach to fisheries management. *Fish and Fisheries*, *15*(1), 65–96. https://doi.org/10.1111/faf.12007

Lauria, V., Das, I., Hazra, S., Cazcarro, I., Arto, I., Kay, S., Ofori-Danson, P., Ahmed, M., Hossain, M. A. R., Barange, M., & Fernandes, J. A. (2018). Importance of fisheries for food security across three climate change vulnerable deltas. *Science of the Total Environment*, *640–641*, 1566–1577. https://doi.org/10.1016/j.scitotenv.2018.06.011

Leach, M., Mearns, R., & Scoones, I. (1999). Environmental entitlements: Dynamics and institutions in community-based natural resource management. *World Development*, *27*(2), 225–247. https://doi.org/10.1016/S0305-750X(98)00141-7

Lu, Y., & Yamazaki, S. (2023). Fish to fight: Does catching more fish increase conflicts in Indonesia? *World Development*, *170*, 106337. https://doi.org/10.1016/j.worlddev.2023.106337

Lubke, G., & Neale, M. C. (2006). Distinguishing between latent classes and continuous factors: resolution by maximum likelihood? *Multivariate Behavioral Research*, *41*(4), 499–532. https://doi.org/10.1207/s15327906mbr4104_4

Lynch, A. J., Cowx, I. G., Fluet-Chouinard, E., Glaser, S. M., Phang, S. C., Beard, T. D., Bower, S. D., Brooks, J. L., Bunnell, D. B., Claussen, J. E., Cooke, S. J., Kao, Y. C., Lorenzen, K., Myers, B. J. E., Reid, A. J., Taylor, J. J., & Youn, S. (2017). Inland fisheries – invisible but integral to the UN Sustainable Development Agenda for ending poverty by 2030. *Global Environmental Change*, *47*(October), 167–173. https://doi.org/10.1016/j.gloenvcha.2017.10.005

Magidson, J., & Jeroen K Vermunt. (2002). Latent class models for clustering: a comparison with K-means. *Canadian Journal of Marketing Research*, *20*(1), 36–43.

MARD. (2021). *Vietnam's fisheries development strategy to 2030, vision to 2045. Hanoi.*

Mcclanahan, T., Allison, E. H., & Cinner, J. E. (2013). Managing fisheries for human and food security. *Fish and Fisheries*, *16*(1), 1–26. https://doi.org/10.1111/faf.12045

Nayak, P. K., Oliveira, L. E., & Berkes, F. (2014). Resource degradation, marginalization, and poverty in small-scale fisheries: Threats to social-ecological resilience in India and Brazil. *Ecology and Society*, *19*(2). https://doi.org/10.5751/ES-06656-190273

Neiland, A. E., & Christophe Béné. (2004). Poverty and small-scale fisheries in West Africa. In *Springer-Science Business Media, B.V.*

Ngoc, Q. T. K. (2018). Impacts on the ecosystem and human well-being of the marine protected area in Cu Lao Cham, Vietnam. *Marine Policy*, *90*(November), 174–183. https://doi.org/10.1016/j.marpol.2017.12.015

Ngoc, Q. T. K., Armstrong, C. W., & Kim Anh, N. T. (2012). Indicators for assessing marine protected areas-the case of the Nha Trang Bay Marine Protected Area in Vietnam. *Asian Fisheries Science*, 25, 52-65.

Ngoc, Q. T. K., Flaaten, O., & Anh, N. T. K. (2009). Efficiency of fishing vessels affected by a Marine Protected Area - The case of small-scale trawlers and the Marine Protected Area in Nha Trang Bay, Vietnam. *Integrated Coastal Zone Management*, 189–206. https://doi.org/10.1002/9781444316285.ch15

Nguyen, V. H. (2019). Tourism and poverty: perspectives and experiences of local residents in Cu Lao Cham MPA, Vietnam. *Tourism in Marine Environments*, 14(3), 179-197. https://doi.org/10.3727/154427319X15631036242632

Onyango, P., & Jentoft, S. (2010). Assessing poverty in small-scale fisheries in Lake Victoria, Tanzania. *Fish and Fisheries*, *11*, 250–263. https://doi.org/10.1111/j.1467-2979.2010.00378.x

Pauly, D., Watson, R., & Alder, J. (2005). Global trends in world fisheries: impacts on marine ecosystems and food security. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *360*, 5–12. https://doi.org/10.1098/rstb.2004.1574

Peugh, J., & Fan, X. (2013). Modeling unobserved heterogeneity using Latent Profile Analysis: a Monte Carlo Simulation. *Structural Equation Modeling*, *20*(4), 616–639. https://doi.org/10.1080/10705511.2013.824780

Pihlajamäki, M., Sarkki, S., & Haapasaari, P. (2018). Food security and safety in fisheries governance – a case study on Baltic herring. *Marine Policy*, *97*(September 2017), 211–219. https://doi.org/10.1016/j.marpol.2018.06.003

Pomeroy, R., Thi, N., & Thong, H. X. (2009). Small-scale marine fisheries policy in Vietnam. *Marine Policy*, *33*, 419–428. https://doi.org/10.1016/j.marpol.2008.10.001

Pomeroy, R., Thi Nguyen, K. A., & Thong, H. X. (2009). Small-scale marine fisheries policy in Vietnam. *Marine Policy*, *33*(2), 419–428. https://doi.org/10.1016/j.marpol.2008.10.001

Purcell, S. W., & Pomeroy, R. S. (2015). Driving small-scale fisheries in developing countries. *Frontiers in Marine Science*, *2*(JUN), 1–7. https://doi.org/10.3389/fmars.2015.00044

Simmance, F. A., Nico, G., Funge-Smith, S., Basurto, X., Franz, N., Teoh, S. J., Byrd, K. A., Kolding, J., Ahern, M., Cohen, P. J., Nankwenya, B., Gondwe, E., Virdin, J., Chimatiro, S., Nagoli, J., Kaunda, E., Thilsted, S. H., & Mills, D. J. (2022). Proximity to small-scale inland and coastal fisheries is associated with improved income and food security. *Communications Earth and Environment*, *3*(1). https://doi.org/10.1038/s43247-022-00496-5

Smith, H., & Basurto, X. (2019). Defining small-scale fisheries and examining the role of science in shaping perceptions of who and what counts: a systematic review. *Frontiers in Marine Science*, *6*. https://doi.org/10.3389/fmars.2019.00236

Spicker, P. (1999). Definitions of poverty: twelve clusters of meaning. *The International Glossary of Poverty (Eds D. Gordon and P. Spicker). ZED Books, CROP International*, 229–243.

Teh, L. C. L., & Pauly, D. (2018). Who brings in the fish? The relative contribution of small-scale and industrial fisheries to food security in Southeast Asia. *Frontiers in Marine Science*, *4*(FEB), 1–9. https://doi.org/10.3389/fmars.2018.00044

Walmsley, S., Purvis, J., & Ninnes, C. (2006). The role of small-scale fisheries management in the poverty reduction strategies in the Western Indian Ocean region. *Ocean and Coastal Management*, *49*(11), 812–833. https://doi.org/10.1016/j.ocecoaman.2006.08.006

WCED. (1988). Our Common Future. Oxford: Oxford University Press. https://doi.org/10.1080/07488008808408783

Weller, B. E., Bowen, N. K., & Faubert, S. J. (2020). Latent Class Analysis: a guide to best practice. *Journal of Black Psychology*, *46*(4), 287–311. https://doi.org/10.1177/0095798420930932

Yamazaki, S., Resosudarmo, B. P., Girsang, W., & Hoshino, E. (2018). Productivity, social capital and perceived environmental threats in small-island fisheries: insights from Indonesia. *Ecological Economics*, *152*(March), 62–75. https://doi.org/10.1016/j.ecolecon.2018.05.020

Appendix

Table 8

Results from factor analysis for food insecurity

Factor	**Item**	Mean (SD)	**Loading**	**Uniqueness**	**Eigenvalue**	**Cronbach α**
Food insecurity					2.88	0.80
(1: Never true; 2: Sometimes ; 3: Often)	The food that I bought just didn't last and I didn't have the money to get more.	1.47 (0.54)	0.76	0.42		0.74
	I couldn't afford to eat balanced meals comprising four key components: protein, carbohydrates, vegetables, and fat.	1.63 (0.77)	0.80	0.37		0.75
	In the last 12 months, I did cut the size of my meals or skip meals because there wasn't enough money for food.	1.32 (0.50)	0.78	0.39		0.75
	In the last 12 months, I did eat less than I felt I should because there wasn't enough money to buy food.	1.53 (0.60)	0.81	0.34		0.73
	In the last 12 months, I was hungry because I couldn't afford enough food.	1.08 (0.28)	0.63	0.59		0.81

Bartlett's test of sphericity: $\chi 2$= 487.55; df = 10; p = 0.00; K.M.O = 0.81

Table 9

Results from factor analysis for social capital

Factor	Item	Mean (SD)	Loading	Uniqueness	Eigenvalue	Cronbach α
Social capital					2.05	0.84
(1: Very poor; 2: Poor; 3: Fair; 4: Good; 5: Very good)	Relationship with other fishers	2.88 (0.91)	0.81	0.34		0.82
	Relationship with people in the community	3.11 (0.89)	0.82	0.34		0.81
	Relationship with community leaders (in solving community problems and family problems)	2.81 (1.29)	0.85	0.28		0.76
	Relationship with fisheries department officers (to acquire information on productive fishing ground and fishing season and for their guidance on coping with natural disaster and climate change)	3.83 (1.27)	0.83	0.31		0.77

Bartlett's test of sphericity: $\chi 2 = 717.77$; df = 6; p = 0.00; K.M.O = 0.66