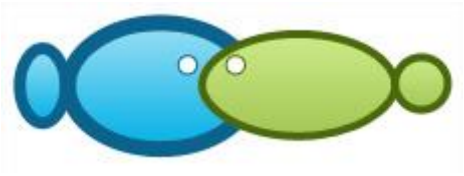

Measuring factors effect to livelihood performances of small-scale fishermen: evidence from Ca Mau Province, Vietnam

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Abstract. Small-scale in-land fishermen are one of the most vulnerable communities because of their uncertain income. However, fishermen could prosper if they have good control over their livelihood capitals. The study aims to measure the effect of livelihood capitals on the level of livelihoods' performances using a sustainable livelihood framework approach. Respondents of the study were 90 persons (N=90) in Ca Mau Province, Vietnam. The result showed that livelihood variation of communities was low, at 5,851 USD·household^{-1}·year^{-1}, with 62.4% of earnings contributed from key activity. Human capital was relatively poor with a low educational level but long experience (24.2±8.7 years). Natural capital includes wetlands and natural freshwater fish. While wetland provides wide fishing ground for fishers, natural freshwater fish stocks are degrading. The physical capital, including fishing gear and boats/motorcycles serving for fishing, was well equipped. The financial access ability was very limited. Social capital helps fishermen have high involvement with social-political organizations. The number of laborers, fishing area, net usage for fishing, number of income sources, and number of captured species influenced significantly their annual income. Overall, the livelihood of fishing households is very unsustainable. Sustainable livelihood strategies should focus on vocational training, and farming object variation to create livelihood diversity and support in terms of policies and management mechanisms.
Key Words: capital, communities, fishing gear, in-land fishing, U Minh.

Introduction. Vietnam is one of the largest aquaculture and fisheries producers in the world, playing a significant role in the country's economic development since it is ever-expanding, achieving high growth rates, and creating great foreign currency (Ministry of Industry and Trade of Vietnam 2022). In 2022, total seafood production was nine million tons, of which, the wild capture production, considering an ongoing shift to aquaculture, reached 3.86 million tons. Seafood export turnover in 2022 is estimated at 11 billion USD (VASEP 2023). The sector has supported greatly to the community's livelihood, making an important contribution to poverty alleviation deduction, nutrition security and economic development (FAO 2022).

The Mekong Delta plays an important role in ensuring food security for the country. This place provides a valuable source of fresh water for human life and socio-economic activities. The biodiversity of freshwater ecosystems is relatively high, but it is threatened by domestic and industrial water pollution, construction of dams and roads, dredging, and overfishing of freshwater aquatic resources (Van et al 2016). Ca Mau is the leading province in terms of seafood in our country with a fishery output of 241 thousand tons in 2021 (Vietnam General Statistics Organization 2023). The wetland of U Minh Ha has long been known as the cradle of wild fish spawning in the wild, concentrated in communes such as Khanh Thuan, Khanh An, Khanh Lam. Fisheries in inland waters represent important roles in poverty alleviation, food security, livelihood, ecosystem function and biodiversity. It provides a source of a low-cost nutrition, contributes to the livelihood, ensures biodiversity conservation, diversifies genetic resources, maintains ecological balance, contributes to increase the efficiency of natural water areas usage, promotes economic growth, protects the ecological environment, and contributes to hunger eradication and poverty alleviation (Betcherman & Marschke 2016; Funge-Smith

& Bennett 2019). However, coastal fishing households throughout areas such as South and Southeast Asia are suffering by depletion of fish stocks (Betcherman & Marschke 2016; Arthur et al 2022). A sharp decrease for fish captured caused decrease in income of local people, resulted in unbalanced food sources, pushed up the prices of some essential commodities for local people, especially the group of fishermen whose livelihoods directly depend on the freshwater fish resources (Bathara et al 2021). The fishermen's livelihood can be prosperous if they have good control over their livelihood's capitals, e.g. human, natural, social, financial and physical resource assets (Betcherman & Marschke 2016; Bathara et al 2021). Therefore, this study was conducted in attempt to find out and measure the livelihood capitals of small-scale inland fishing households, and to determine how they affect their livelihoods' performance in U Minh District, Ca Mau Province, Vietnam.

Material and Method. The analysis in this study relies primary on quantitative data from survey methods, namely observing and interviewing fishing households (usually to the household head) directly using a structured questionnaire as a guide to obtain data. We conducted the survey from March 2023 to August 2023 at U Minh District, Vietnam (Figure 1). The selection of the communes was done deliberately with the consultation to local authority - the Department of Fisheries, Ca Mau province. The Yamane (1967) formula was applied to determine sample size. The original formula is as follow:

$$n = \frac{N}{1+N*e^2}$$

Of which, n denotes the sample size, N denotes the total population and e denotes error. The total number of inland fishing households at surveyed area is 540 households, consisting of three communes, namely Khanh Thuan with 210 household, Khanh Lam with 180 household, and Khanh An with 150 household. Likewise, the corresponding respondents at three communes are 31, 30, and 29 respondents, respectively.

The data is obtained directly from face-to-face interviews with the respondents. A random method was applied for respondents' selection. Primary data collected includes status of livelihood capitals, which they are using for their economic activities using a questionnaire constructed following the DFID's sustainable livelihood framework (SLF) (DFID 2000; Neefjes 2000). The SLF provides a method of breaking down households' lives and livelihood strategies by addressing their livelihood capitals to a range of capitals, i.e. natural capital (production land area, source of production land, water resources, and natural seed resources), human capital (age, production experience, number of family employees, education level), financial capital (production cost, revenue, net profit, source of financial capital for production), physical capital (number of cages/fishing gears, facilities for production, means of transport, housing), social capital (member of any social group, source of information for production, supporting in production and forms of support, information system at the local level) (Figure 2).

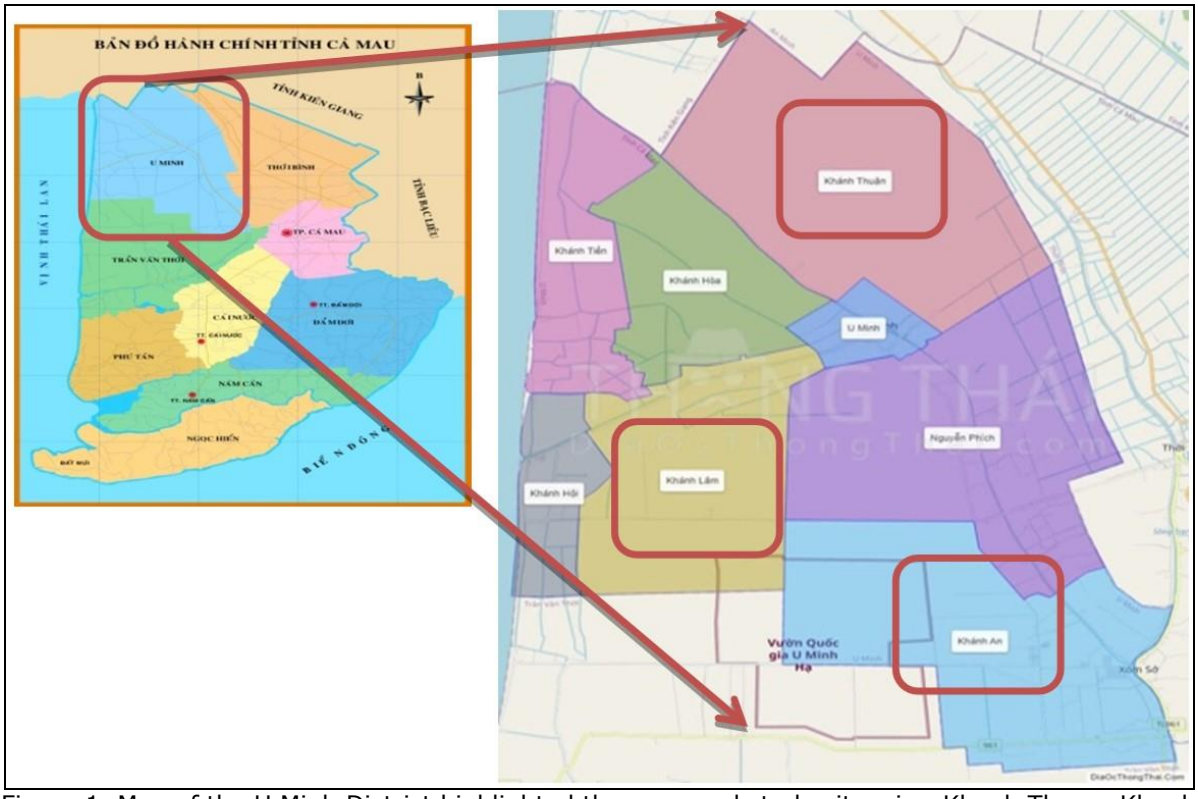

Figure 1. Map of the U Minh District highlighted the surveyed study sites, i.e. Khanh Thuan, Khanh Lam and Khanh An (map source: www.bandovietnam.net).

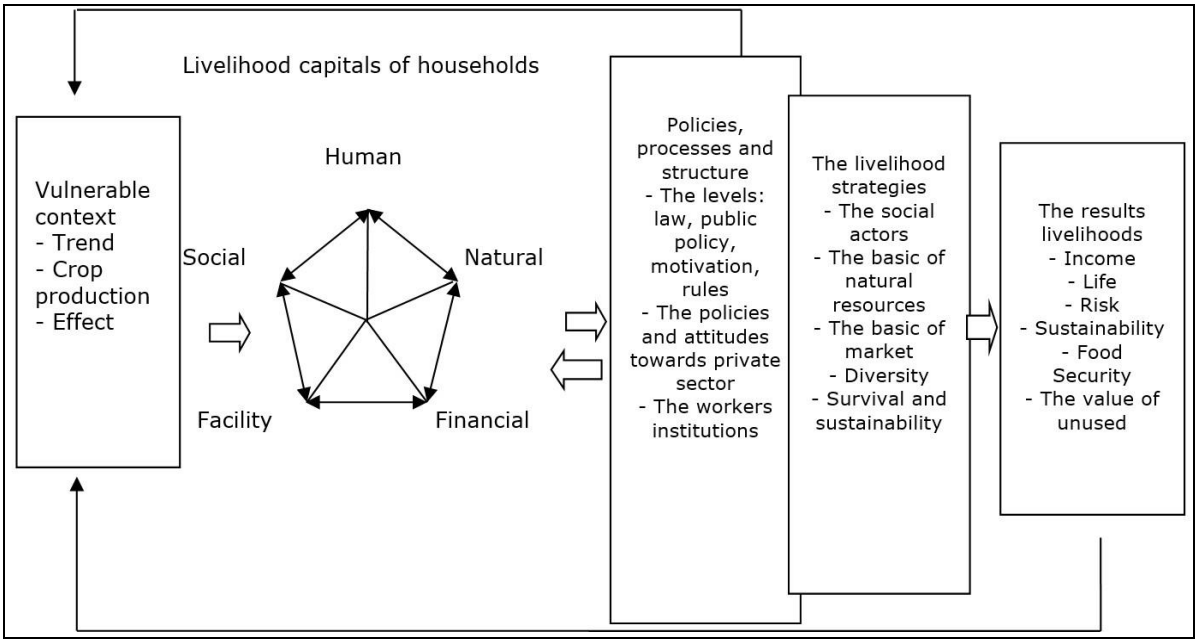

Figure 2. Sustainable livelihood framework (DFID 2000; Neefjes 2000).

According to DFID (2000), livelihood is a function of following five forms of livelihood capital:

$$\text{Livelihood} = f(\text{human, natural, physical, financial, and social capitals}) \quad (1)$$

To measure the livelihood performances, the total household income was used as mentioned by Bigsten and Kayizzi-Mugerwa (1992), Beall and Kanji (1999) and Owusu (2007). Consequently, the total income of fishing households was used as the key index of livelihood performances. The index is affected by five major types of livelihood capital

as mentioned above. The major livelihood components were translated into a composite index based on the five livelihood capitals mentioned above. The selection of subcomponents was subjective based on previously published studies and field experiences (Table 1).

Table 1

Description of livelihood components

Livelihood capitals	*Sub-components*	*Explanation (units)*	*Sources*
Human	Labour	No. of household members between 18 and 64 (people)	Ayana et al (2021) Rahman et al (2021)
	Education of household head	No. of schooling years (years)	Sunny et al (2019) Ahmmed et al (2021)
	Fishing experience	No. of year operating fishing activity (years)	Sarker et al (2020) Rahman et al (2021)
Natural	Fishing area	Average area travelling·trip^{-1} for fishing (ha)	Monwar et al (2014)
	Captured species	No. of fish species captured	Field observation
Physical	Fishing gears	No. of fishing gears used (net=1; other=0)	Field observation
	Production means	No. means (valuable tools/machines/instruments) used for production (units)	Dũng & Thuận (2020)
Financial	Income source	No. of income sources (sources)	Apine et al (2019)
	Access to formal credit	Access to a formal credit such as government of commercial banks (yes=1; no=0)	Sarker et al (2020) Rahman et al (2021)
Social	Membership in societal associations	Fishermen is a member of any societal associations (yes=1; no=0)	Monwar et al (2014) Sarker et al (2020)

We checked, coded and entered the collected data into the computer. Quantitative and qualitative data were analyzed using descriptive statistics with Statistical Package for Social Scientists (IBM SPSS Statistics 24) and Microsoft Excel 2016. Descriptive analysis is used to generate an overview of the data that has been collected following SLA framework. The display of the data is done by cross tabulating according to the parameters of several aspects of the livelihood capitals that support fishermen's livelihood. In order to assess livelihood capitals possessed by fishing households, we developed criteria for each type of the capital (described in Table 1). We evaluated them on a scale from one point (low) to five points (high) for each respondent's capitals and recorded a mean score per key capital presented in the results section. To evaluate effects of livelihood capitals' components to the livelihood performance, multiple linear regression was applied as follows:

$$\text{Livelihood} = Y = \beta_0 + \beta_1 X_1 + \ldots.+ \beta_n X_n + \mu \qquad (2)$$

Where Y is a dependent variable which takes the log of total annual income of the fishing households. This dependent variable is a major index of livelihood performance, which is measured in USD per household. X_1,…., X_n are the n independent variables. In this study, independent variables are sub-components of five livelihood capitals as mentioned in Table 1. In calculating the weights, β_0, β_1, …, β_n, regression analysis ensures maximal prediction of the dependent variable from the set of independent variables. This is usually done by least squares estimation.

Results

Livelihood activities and annual total income of fishing households. Table 2 shows the pattern of average annual income of fishing household and its structure. The total average annual income of in-land fishing household is 5,851 USD·household^{-1}·year^{-1}, equivalent to 1,395 USD·capital^{-1}. The study found that household's members conduct several livelihood activities to earn money apart from inland fishing activity – the main dimension that driven the study. Households where fishing was the primary activity had

the highest income by a largest sharing of the total income, at 3,651 USD·year^{-1} and 62.4%, respectively. Most households do combine more than one activity to the fishing activity. It is common, as we have seen, household members engage in various agricultural activities, such as rice cultivation, gardening, husbandry (pig, cow, and poultry), and aquaculture (small-scale shrimp farming and fish farming). As other regions of the MRD, rice cultivation is key livelihood activity, which generates 1,517 USD USD·household^{-1} of average total annual income, and contributes 26.0% of the total annual income. Households often combine fishing and agricultural activities one or both with wage and salary works or several form of self-employment as a seasonal pattern when fishing does not require as much time.

Table 2

Livelihood diversity and its' income of fishing household

Livelihood activity	% of participation (%)	Annual income (USD) (Mean ± STDEV)	% contributes in the total income (%)
In-land fishing	100	3,651 ± 1,974	62.4
Rice cultivation	40	1,517 ± 713	26.0
Orchard	58	295.6 ± 57,4	5.0
Husbandry	10	234.8 ± 104	4.1
Salary works	10	91.3 ±39.1	1.5
Aquaculture	5	17.4 ± 4.3	0.3
Others	5	43.5 ± 34.8	0.7
Total	-	5,851 ±3,722	100

Note: USD 1 = VND 23.200 (2022); Mean ± STDEV denotes for average value of 90 surveyed fishing household and standard deviation.

Review of major variables of livelihood capitals. U Minh District locates to the northwest of Ca Mau province, including the communes of Khanh An, Nguyen Phich, Khanh Lam, Khanh Hoi, Khanh Hoa, Khanh Thuan, Khanh Tien and U Minh town. The population by 2019 is 25,841 households, with 100,876 people, accounted for 8.46% of the province's population, of which, there are 52,024 men and 48,852 women; 97,010 Kinh people and 3,866 other ethnic people (U Minh People Committee 2021). In urban areas, there are 1,940 households, with 7,106 people. In rural areas, there are 23,901 households, with 93,770 people. Primary livelihood activities in the rural area are in-land fishing, aquaculture and agriculture.

Table 3

Descriptive statistics of major variables

General variables	*Variables*	*Unit*	*Value (Mean ± STDEV)*
Human	Labour	People	4.30±1.42
	Education of household head	Years	6.27±4.56
	Fishing experience	Years	24.2±8.7
Natural	Fishing area	Ha	5.40±2.5
	Captured specie	Species	3.8±2.8
Physical	Fishing gears		
	Net = 1	%	51.2
	Other = 0	%	48.8
	Fishing means/facilities	units	2.5±2.1
Financial	Income source	Sources	2.2±2.0
	Access to formal credit		
	Yes = 1	%	44.4
	No = 0	%	55.6
Social	Membership in societal associations		
	Yes = 1	%	75.6
	No = 0	%	24.4

Note: Mean ± STDEV denotes for average value of 90 surveyed fishing households and standard deviation.

The results show that the average age of the fishing household's heads was middle age, ranging from 40 to 60 years old. With respect to labour capacity, number of family employees was 4.30 people and 80% of the fishing activities were in charge by male, usually the household's head and his son, due to the hard work and outdoor working. Educational level of fishermen, displayed by the schooling years, has been recognized as an essential sub-component of human capital for increasing rural resident's ability to create livelihood possibilities. It revealed that the average schooling years were 6.27 years, at junior high school. The illiteracy rate was 9%, higher than average rate nationwide (3%) (Vietnam General Statistic Organization 2023). Low educational level influenced to upgrade incomes and improving their quality of life, and minimize awareness of the natural resource usage. Working experience for the current job is an important factor contributing to improve production efficiency. Particularly, fishermen had a long fishing experience at 24.2±8.7 years (Table 3). It clearly points out that in-land fishing is an indigenous employment of the study site. The distribution of age groups relates to nature of fishing activity as this livelihood requires both sufficient physical health and farming experience. Most of respondents have been continuously involved in fishing activity for more than 18 years. The sense of rural community in the Asian context is a known feature. Hence, the fishing households interact closely with each other to share the experience.

Small-scale freshwater fishing households obtain most their livelihood from resource-based activities. Most respondents are highly dependent on natural capital such as land resources and biological resources. With respect to the land resource, that is denoted by fishing area category in this study. It was revealed that fishermen carry fishing activity over a fishing ground calculated on average 5.40±2.5 ha. The Government, specific of Management Committee of U Minh Ha National Park, allocated local residents fishing ground. The U Minh Ha National Park was established in 2006 based on upgrading Vo Doi Nature Reserve. The operational regime of the National Park is wetland allocation with a definite term of 10 to 20 years to local residents for freshwater resource fishing and management. The fishing households lack access to land resources. The result shows that 72% of households did not own any land other than allocated fishing ground and their homestead. Fishermen reported that general declines in size of species catch and diversity have made capture fishing a more difficult form of livelihood for many fishers. Each fishing household can capture 1,121±235 $kg \cdot year^{-1}$, comprising of three to five economical fish species, e.g. snakehead (*Channa striata* Bloch, 1793), which accounted for 37,8% of the total fish catch, snakeskin gourami (*Trichopodus pectoralis* Regan, 1910), which accounted for 9.8% of the total catch, climbing perch (*Anabas testudineus* Bloch, 1792), which accounted for 5.5% of the total catch, knife fish (*Notopterus notopterus* Pallas, 1769), which accounted for 3.9% of the total fish catch, etc.

The physical capital of fishing households was evaluated based on fishing gears and production mean/facilities, e.g. boat and motorcycles possessed (Apine et al 2019). The results showed that fishermen used a variety of fishing gears, e.g. nets, fishing rods, traps which are known as "lờ" and "lợp" in Vietnamese. More than 51% of respondents reported nets are the most common fishing gears. The fishing household had 2.5 units of small and non-mechanized boats and motorcycles, estimated at 9,374 USD. Almost 96% of the fishing households interviewed owned boats and motorcycles used for fishing activities.

As in the aforementioned section, the current study revealed that fishermen had an average annual income of 5,851 USD with the contribution from 2.2 financial source on average. The minority of sampled households had savings, which they can utilize during emergency phenomena and are of low amount (41.1% at approximate 2,200 USD). In addition, because of low savings, fishing households had to take loans for production activities and expenditures. Only 44.4% of surveyed fishing households can access formal credit sources, e.g. commercial banks and government's financial organizations. The others had to lent from informal sources such as relatives or individual financial agencies to meet up their needs.

Social capital comprises social relations and platforms of social interaction between respondents and the others around them (Bathara et al 2021). These social relations are very important for fishermen in facing problems and emergencies. In this study, the membership in various societal associations is used as a sub-component of social capital. Various societal associations involve fishing groups, farmer union, and women union. It is revealed that approximately 75.6% of the surveyed fishing households were members of any fishing groups and/or other social organization.

Regression results. The livelihood performances of fishing households, reflected by annual income in the current study, can be influenced by various factors, which are sub-components of livelihood capitals 0. We conducted a multiple liner regression model to analyze these factors. A summary of the findings presented in Table 4 show that the number of family labour (who are in age ranging between 16 and 60 year-olds) had a positive and significant effect on their income. It is also revealed that there was an increase by 407.2 USD in the total annual income for every one ha increase in the fishing area. Further, the number of fish species captured had negative effects on their income. Specifically, fishing households' income decreases by 123.5 USD with one more species captured. Fishermen who utilize nets as a main fishing gear had 512.3 USD higher income compared to their counterparts. Lastly, diversity in livelihood (income sources) also influenced positively and significantly the income of the fishing households. In fishing households that carry out one more livelihood activity to earn money, their income increases by 609.9 USD.

Table 4

Determinants of the annual income of the fishing households

Explanatory variable	B	T	P-value
Constant	1,322	25.537	0.236
Labour (people)	276.0	1.112***	0.000
Education of household head (years)	74.39	1.916	0.378
Fishing experience (years)	20.69	1.348	0.276
Fishing area (ha)	407.2	2.255**	0.019
Capture species (species)	(123.5)	2.546**	0.08
Fishing gears (net = 1; Other = 0)	512.3	9.489***	0.0004
Fishing means/facilities	143.0	1.916	0.378
Income source (sources)	609.9	5.145***	0.0004
Access to formal credit (Yes = 1; No = 0)	35.0	0,605	0,187
Membership in societal associations (yes = 1; no = 0)	124.7	2,831	0,313
Observations (n) = 90 R=0.737	R2=0.543	R adjust =0.511	P=0.00***

Note: ***, **, * denote the significance level at 1%, 5%, and 10% respectively. (value) denotes for negative value.

Discussion. This study evaluated various livelihood capital of fishing households in the wetlands of Vietnam and its effects on their livelihood performances. The total annual income of fishing households was indicated for an index of livelihood performances (Tikadar et al 2022). We have chosen households rather than individuals (fishermen) as the unit of analysis since livelihood performances are typically made on every member of the family (Betcherman & Marschke 2016). The income of freshwater fishing household is still low, and, like other fisheries communities. The dependency ratio of each fishing household on the fishing activity is moderately high. Their mean income very low compared to the national income per capital (Vietnam General Statistics Organization 2023). Livelihood diversity is very important both to maximize income and because fishing activity often does not generate high income (Allison & Ellis 2001; Brugère et al 2008; Betcherman & Marschke 2016). However, fishing households are unable to diversify into other non-agricultural income generating activities. It shows clearly the features of rural economy in Southeast Asia (Brugère et al 2008; Muthmainnah et al 2019).

Number of family labour, educational level and fishing experience were determined in the human capital. It is found that human resources are available in the research area (U Minh People Committee 2021). However, the illiteracy rate was higher

than average rate nationwide (Vietnam General Statistic Organization 2023). Low educational level will result in slow technology, influenced to upgrade incomes and improving their quality of life, and the awareness of the natural resource usage is minimum; the lack of higher education facilities also contributes to a low educational level (Rakodi 2002). The long experience of fishing activity as a livelihood illustrates the sense of rural community in the Asian context. Hence, the fishing households interact closely with each other to share their experiences (Brugère et al 2008; Muthmainnah et al 2019; Rahman et al 2021). On the other hand, the study found that the natural asset of fishing household was moderate. The wetland area of U Minh provides fishing ground to the fishermen. Moon et al (2020) and Tikadar et al (2022) have stated that providing land resources facilitates farmers with complimentary income and foster environmental sustainability as they can access aquatic resources for their livelihood purpose. Thus, the fishing activity introduced is based on land use (Apine et al 2019). Likewise, land allocation to local fishermen from the U Minh Ha National Park provides natural capital access for fishermen. Local fishermen conducted fishing activities, captured freshwater fish for livelihood and human well-being purposes. However, the majority of respondents have no extra land except homestead land. Additionally, natural aquatic species are in degradation status, a consequence of the underlying causes of the decline of fisheries activities and production. The major threats to inland freshwater could affect the fishery resources threatening the survival of freshwater fishes (Muthmainnah et al 2019). Because natural capital is the most essential basis for the rural resident's subsistence, these above mentioned features are showing low levels of natural capital in general (Nicli et al 2019). The physical capital of fishermen was mainly evaluated on the basis of fishing gears and valuable tools/machines for production purposes, i.e. boats and motorcycles (Apine et al 2019; Tikadar et al 2022). Fishing nets were the main fishing gear for inland fishing activities besides fishing traps and hooks. Besides that, small boats with motor and motorcycles serving for fishing activities were documented in every fishing household during the survey. This finding is in line with results reported of Muthmainnah et al (2019) and Tikadar et al (2022). The fishermen in U Minh District, Ca Mau Province, Vietnam have low financial capital. The majority of fishermen had to take loans from banks and informal lenders, e.g. friends, relatives or individual financial agencies, who offer loans with relatively high interest ratio. Diversity in income sources is also low as mostly depend on fishing to earn money for the human well-being. Nevertheless, fishing households hardly make savings. The similar findings were reported by Hidajat (2015), Rana et al (2021) and Tikadar et al (2022). The social capital revealed that fishermen have high involvement with societal associations. Besides, they had a good relationship with surrounding neighbors. Therefore, the fishermen are provided regularly trainings and experience on their professional skills. Training and intensive coaching are necessary to increase their technical knowledge and skill to ensure the sustainability of their livelihood (Kamaruddin & Samsudin 2014).

Conclusions and recommendations. Livelihood capitals of small-scale inland fishing households, namely human capital, natural capital, physical capital, financial capital, and social capital are in the medium category. This study evaluated the status of these livelihood capitals and determined factors influencing their income. The study concludes that fishermen lacked diversification in income-generating activities. Their annual income still depends heavily on in-land fishing activity. Human capital is facing with challenge of low educational level and high illiteracy ratio. The natural resources were available for fishing households by providing wide fishing grounds. However, fish species were in degradation status. Their physical capital included fishing gears (mainly nets) and fishing equipment (such as boats and motorcycles). They had minimal financial capital and poor access to formal credit due to their limited income. Fishing households had limited involvement with local administrations but high involvement with local social-political organizations. The multiple regressions showed that their annual income was positively influenced by number of labours, fishing area, having nets for fishing, number of income sources, and was negatively influenced by number of captured species.

Based on the findings, this study recommends providing training on alternate income-generating activities to diversify livelihood activities and to decrease livelihood dependency on natural freshwater resources. Formal credit and micro-savings programs could play a vital role improving financial condition of small-scale fishing households. More NGO and government support is required by providing technical support, access to credit, or otherwise financed support, and therefore, might improve their livelihood status. This study also includes a few limitations. It addresses only small-scale inland fishing households at Ca Mau Province. A countrywide study should be conducted to provide an in-depth insight into a wide range of fishing household's livelihood. Hence, it will help to formulate more specific policies targeting the welfare of the small-scale fishing households in Vietnam.

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Conflict of interest. The authors declare that there is no conflict of interest.

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