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Livelihood sustainability of small-scale fishing households: an empirical analysis of U Minh wetland, Ca Mau province, Vietnam

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Abstract

This paper used the UK Agency for International Development sustainable livelihood framework to measure small-scale in-land fishing household's livelihood by sustainable livelihood capital index in the vulnerable context of aquatic natural resource depletion in the wetland forest of Ca Mau province, Vietnam. Findings indicated that fishing households' livelihood capital is unsustainable and inadequate. The result took note of the beneficial physical capital while underlining the human, natural, financial, and social capital's limitations in achieving livelihood sustainability. The limitations were found to be a low score of composite index of sustainable livelihood capital (less than an average score of 0.5) whereas the outstanding score of physical capital was found. Providing training in the adoption of new livelihood models, learning livelihood diversification, access to formal credit, and appropriate coverage of social safety-net programs might help mitigate the unsustainable livelihood of inland fishing households.

Keywords: Livelihood status, Sustainable livelihood capital index (SLCI), Small-scale, Inland fishing, U Minh

Introduction

Small-scale fisheries provide livelihood and food for millions of people and communities world wide. Small-scale fisheries are defined as "traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption" (FAO, 1998). Small-scale fisheries are characterized by often relying completely on fishing and fishing related activities, implementing simple fishing gear, and having limitation in ecological knowledge that is passed down through generations. The sustainability of small-scale fisheries has always been among the focal issues confronting our generation for its decisive role global food security (Allison & Ellis, 2001; Bathara et al., 2021; Thompson et al., 2016). In 2020, an estimated 58.5 million people were engaged all or part of their living from fish production and capture. Of these, approximately 21% were women, and 84% of fish farmers

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and fishers were in Asia (FAO, 2022). The continued expansion of commercial fisheries has taken place despite long-standing policy support for industrialisation of fisheries and neglect of the small-scale sector (FAO, 2022).

Inland fisheries mainly comprised small-scale fishing communities are one the most vulnerable and poorest community worldwide (Apine et al., 2019; Béné, 2009; Sadekin et al., 2021). Kasperson et al. (2001) defined broadly "vulnerability is the differential susceptibility to loss from a given insult". The concept of vulnerability has multiple dimensions, which are often inter-related and inter-dependent, but for simplicity they can be separated into three key components to aid in analysis: the degree of exposure to a threat, sensitivity to that threat, and resilience to perturbations (Thompson et al., 2016; Tuler et al., 2008). While the vulnerability of the fisheries and their socio-economic characteristics will also vary according to their spatial distribution and will need to be considered. Vulnerability to such income shocks is particularly worrisome in low-income countries, where a diet meeting basic energy requirements is beyond the reach of many. Their vulnerability is reinforced by the need to continue their activities in order to maintain their income and feed their families (FAO, 2022; Misk & Gee, 2020).

The Mekong River Delta (MRD), Vietnam plays a vital role in ensuring food security for the country. This place provides a valuable natural resources for human life and socio-economic activities. Of which, 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 diverse of 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). Ca Mau province is the leading province in terms of aquatic production in Vietnam with a fishery output of 241 thousand tons in 2021 (Vietnam GSO, 2023). The wetland of Ca Mau has long been known as the cradle of wild fish spawning in the wild. Currently, the demand for aquatic products, especially wild fish, is increasing. Taylor et al. (2016) pointed out that inland fish caught is the main source of food protein for people, especially in poor countries and territories with insufficient food sources. This statement is completely true for Ca Mau when inland wild fish is the main food source not only for local people but also for the whole country, some of which are also exported to neighboring countries such as Cambodia, Laos, Thailand and China (U Minh People Committee, 2021). Small-scale inland fishing households throughout area such as South and Southeast Asia, including Ca Mau province, are suffered by depletion of fish stock (Arthur et al., 2022; Betcherman & Marschke, 2016). A sharp depletion of aquatic resource in freshwater caused decrease in income of households, resulted in unbalanced food sources for local people, especially the group of fishermen whose livelihoods directly depend on the freshwater fish resources (Aziz et al., 2021; Bathara et al., 2021; Tikadar et al., 2022)., their livelihoods are being damaged and unsustainability. The diversity of freshwater fish in Ca Mau province is relatively high, but it is threatened in recent years by climate change, water pollution, construction of dams and roads, dredging, and overfishing of freshwater aquatic resources (U Minh People Committee, 2021; Van et al., 2016).

In the context of natural freshwater resource depletion as mentioned above, while there is a market in the country where catches of wild freshwater fish can be sold at a reasonable price and in sufficient quantities as meintion above, the fishing household's livelihood can be prosperous if they have good control over their livelihood's capitals in the production state, e.g. human, natural, social, financial and physical resource assets (Bathara et al., 2021; Betcherman & Marschke, 2016). Therefore, the study was conducted to attempt to find out and measure the sustainability of small-scale inland fishing household's livelihood using sustainable livelihood framework (SLF) analysis and sustainable livelihood capital (SLC) index (SLCI). The total 92 inland fishing households in U Minh District, Ca Mau province were interviewed. The 5-strata Likert scale was used to measure each component of five livelihood capitals before standardizing indexes. The paper proceeds, first, by discribing characteristics of study site and respondents. Second, it evaluates livelihood activities and their total income. Third, discription the current state of 5 livelihood capital before calculating composite index of SLC. Finally, the paper set outs discussion and some preliminary conclusion about the sustainability of small-scale inland fishing households from a livelihoods perspective.

Materials and Methods

Sustainability livelihood framework

The SLF provides a method of breaking down households' lives and livelihood strategies by addressing their livelihood capitals to five capitals in a given political and institutional context

(Fig. 1; Neefjes, 2000). It classifies these capital into 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 supports, information system at the local), which are, in turn, decided by a particular vulnerability context, i.e., the insecurity in the well-being against the external changes in the living context or the households' intrinsic issues in capacity lacking to cope with the unfavourable factors.

Sustainable livelihood capital index

To measure the livelihood sustainability, SLCI was used to quantify the levels of sustainability of the small-scale inland fishing community (Bhashani et al., 2021; Puente et al., 2022). The index is affected by five major types of livelihood capital, which were translated into a composite index based on the above-mentioned five livelihood capitals, namely natural capital, human capital, physical capital, financial capital, and social capital. The selection of subcomponents was subjective based on previously published studies and field experiences (Table 1). The SLCI calculation is needed three steps as follows:

Step 1: calculation values for each of the major components. Since all major components/sub-components are contributing equally to the overall index, a balanced weighted approach will be used to find the values of the components and their respective sub-components. Hahn et al. (2009) and Bathara et al. (2021) indicated that the fishermen's livelihood index value is obtained from the total value of five livelihood capitals, which equally necessary for a livelihood activity. Because the sub-components are measured in different scales, the values of the sub components are needed to be standardized. In this study, we adopted the standardizing approach proposed by Hahn et al. (2009) as Equation (1) follows:

$$\text{Index}\, S_d^i = \frac{S_d - S_{\min}}{S_{\max} - S_{\min}} \quad (1)$$

where S_d is the individual value of the components/sub-components of a response, and Smax and Smin are the maximum and minimum possible values, respectively.

Step 2: After standardizing all responses, the resulting values were averaged using the following equation.

$$M_d = \frac{\sum_{i=1}^{n} IndexS_d^i}{n} \quad (2)$$

where M_d is the averaged value of a measured component/sub-component of the sampled population, $IndexS_d^i$ is the standardized value of the ith response among the total number of n records.

Step 3: after standardizing the values for each of the five main componants, the next step is to calculated composite SLCI for each capital by the following equation.

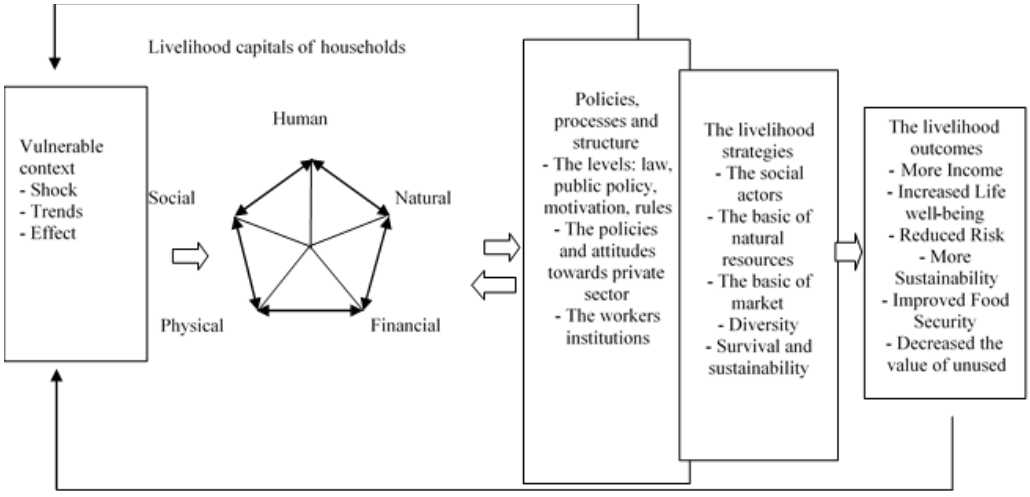

Fig. 1. Sustainable livelihood framework.

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Table 1. Description of livelihood capitals and the components to be measured

Livelihood capitals	Definitions and examples	Sub-components
Human	Workforce, knowledge, experience, age, working capacity, etc. To help people carry out various livelihood activities and achieve out-come desired design.	Household members, both fishermen and helpers (in number, age, and career) Labour capacity (production experience, fishing experience, education, training attendance)
Natural	Ownership of land, natural resources can be used for to carry out livelihood activities, such as average area travelling for fishing, forest, water, aquatic species.	Land (area of travelling for fishing and other agricultural activities) Aquatic biodiversity (number of fish species capture) Natural condition and weather (fishing season)
Physical	Essential infrastructure to support livelihood activities, such as energy, production facilities, ousing characteristics, vehicle ownership.	Production facilities (fishing gears used and other production facilities) Commodies (recreational facilities and other types of properties) Housing (types of house, house ownership and sanitary conditions)
Financial	Various sources of income/money and possible access on money sopurces that people use to achieve their life goals.	Savings (bank, cash or other forms of money accumulations) Credit access (concessional loans from a formal credit such as government of commercial banks, or direct lending from relatives, friends, etc.)
Social	Social relationships and holding positions in society, as well as level of involvement in politics party.	Membership in any societal associations Holding positionsin society and level of involvement Relationships with officials from relavent agencies and level

$$SLCI = \frac{\sum_{i=1}^{n} W_{Mi} \times M_{di}}{\sum_{i=1}^{n} W_{Mi}} \quad (3)$$

where W_{Mi} is the weighting factor, in this study, determined by the number of components or subcomponents used to measure different capitals. The SLCI values, therefore, range from 0 to 1, representing the least to the most sustainable. According to Kamaruddin & Samsudin (2014), household's composite index of SLC from 0.5 and above is considered as a household being sustainable capacity. Moreover, the composite index of SLC could be devided into 5-strata scales of livelihood sustainability, namely level 1: poorly unsustainable, level 2: unsustainable, level 3: modestly sustainable, level 4: ralatively sustainable and level 5: highly sustainable (Table 2).

Table 2. Measure of the level of sustainability of the sustainable livelihood capital index (SLCI)

Number	Value of sustainable livelihood capital index (SLCI)	Level of sustainability
1	0.00–0.19	Poorly unsustainable
2	0.20–0.39	Unsustainable
3	0.40–0.59	Modestly sustainable
4	0.60–0.79	Relatively sustainable
5	0.80–1.00	Highly sustainable

Adapted from Kamaruddin & Samsudin (2014) with permission of Conscientia Beam.

Study site

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. U Minh district currently has a natural area of 77,155 ha, occupies 14.62% of the natural area of the province. The population in 2019 was 25,841 households, with 100,876 people, accounted for 8.46% of the province's population. Of which, there was 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 was 1,940 households, with 7,106 people. In rural areas, there was 23,901 households, with 93,770 people. Primary livelihood activities in the rural area are in-land fishing, aquaculture, and agriculture.

The highlight of the district is U Minh Ha National Park which has the area of over 8,527.8 ha. On January 20, 2006, the Prime Minister issued Decision No. 112/2006/QD-TTg regarding converting the Vo Doi Nature Reserve into U Minh Ha National Park. On December 27, 2016, the Government issued Decree No. 168/2016/ND-CP on regulations on contracting forests, gardens and water surface areas by management boards of reserved forests, protective forests and companies (Prime Minister, 2016). The National Park has provided livelihoods for 30% of local resdidents of U Minh district.

Data collection and analysis

The analysis in this study relies primary on quantitative data

from survey method, namely observing and interviewing fishing households (usually to the fishermen) directly using a structured questionnaire as a guide to obtain data. We conducted the survey from January 2023 to August 2023 at U Minh district, Ca Mau province, Vietnam (Fig. 2). The selection of the communes, i.e., Khanh An and Khanh Lam, was done deliberately with the consultation to local authority - the Department of Fisheries, Ca Mau province as small-scale inland fishing activities are predominant at these communes. The Yamane formula was applied to determine sample size. The original formula is as follow:

$$n = \frac{N}{1 + N \times e^2} \quad (4)$$

Of which, n denotes for the sample size; N denotes for the total population; and e denote for error (e = 10%). The total number of inland fishing households at surveyed area is 540 households. Likewise, the corresponding respondents at two communes are 92 respondents. Of which, fishing households are divided into two groups including those residented at Khanh An commune (47 households) and those residented at Khanh Lam commune (45 households). The data is obtained directly from the face-to-face interviews with the selected respondents using random method. Which means that before going to interview fishermen, we met the local officials to discuss the physical conditions in targeting selected communes. The local officials provided the list of fishermen who settled in Khanh An and Khanh Lam communes. The, we applied a random function to select the respondents. If the respondents were not willing to join in the interview, an alternative respondent was selected using the same function.

The data analysis applied is descriptive statistic which is used to generate an overview of the data collected based on the respondents' answers through the distribution of items from each variable of five livelihood capitals in the SLF. A five-strata scale is used to determine the status of livelihood capitals and calculate the SLCI. According to the five-strata scale, it is used to measure attitudes, opinions, and perceptions of a person or group of people about social phenomena. By using a Likert scale, the variables to be measured are translated into sub-components of five dimensions of livelihood capital that was introduced in the SLF. Consequently, we applied the inferential statistics to further analyze the data for numerical/continuous variables suchthe SLCI calculated.

Results

Socioeconomic characteristics

Among two communes surveyed, Khanh An contributed 47 respondents (51.1%), followed by Khanh Lam with 45 respondents (49.9%). In gender term, male respondents are dominants with 68% records versus 32% females as the household heads

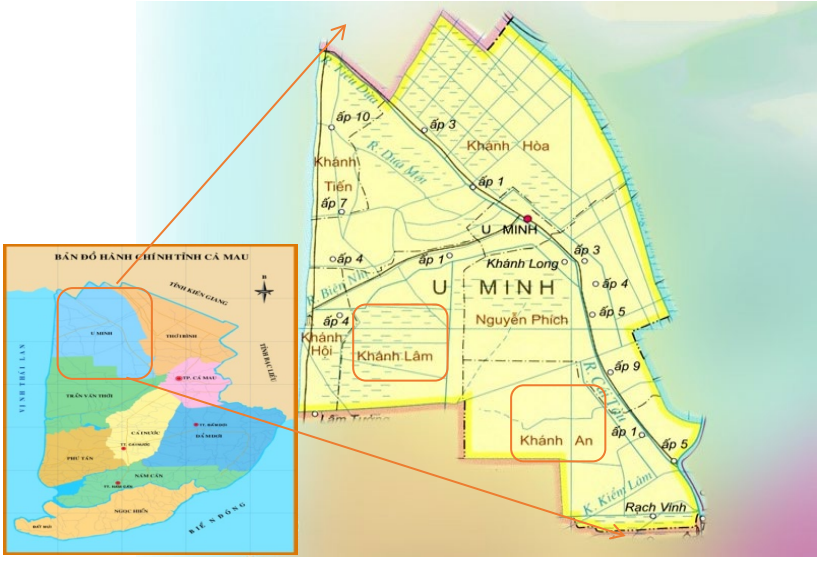

Fig. 2. Map of the U Minh district highlighted the surveyed study sites, i.e., Khanh Lam and Khanh An.

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in both study areas were male and directly carried out inland fishing activities. This gender bias can be attributed to the requirements for physical strength and knowledge on the aquatic resource conditions for the fishing activities. Regarding age, the average age of the fishing household's heads was middle age, ranging from 40 to 60 years old (51 on average). The distribution of age groups relates to nature of fishing activity as this livelihood requires both physical health and capture experience. With respect to labour capacity, number of family employees was 4.4 people and 80% of the fishing activities were in charge by male, usually the household's head and his son. The reason comprised heavy and outdoor working. Only 10% of respondents had engaged helpers by hiring labour but it is hard for them to find suitable people. 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 probability. It revealed that the average schooling year was 6.27, at junior high school. The illiteracy rate was 9.7%, higher than average rate of the whole nation (3%) (Table 3). Low educational level influenced to increase incomes and improve their quality of life, as well as minimize their awareness on the natural resource usage.

Livelihood activities and annual total income of fishing households

As mentioned in the SLF, the potential livelihood sustainability includes not only more income, increased well-being but also reduces vulnerability, improves food security and more sustainable uses of natural resources. In this study, household's income is an important index to measure the sustainability of rural households in coping to the vulnerabale context of freshwater aquatic resource depletion. The Table 2 shows the pattern of average annual income of fishing household and its contribution. The total average annual income of in-land fishing household is 5,996 USD/household/year, equivalent to 1,272 USD/capital (Table 4). The study found that household's members conducted several activities for their livelihood apart from inland fishing. Most households combined more than one activity to the fishing. It is common, as we have seen, household members engage various agricultural activities, such as rice cultivation, up-land crop, gardening, husbandry (pig, cow, and poultry), and aquaculture. Of which, fishing activity was the primary livelihood, which earned the highest income among livelihoods, and contributed the most in the total income, at 2,600 USD/year and 53.8%. As other regions of the MRD, agricultural cultivations were key livelihood activities, which contributes 35.4% of the total income. Households often combine neither fishing nor agricultural activities with wage, salary works, or several form of self-employment as a seasonal pattern when fishing do not require as much time.

Table 3. Respondents' profile

Indicator	Unit	Value
Gender		
Male	%	68
Female	%	32
Age	Year	51
Number of family employee	People	4.4
Hiring labour	%	10
Educational level		
Schooling year	Year	6.27
Illiteracy	%	9.7

Table 4. Livelihood diversity and its' income of fishing household

Livelihood activity	% of participation (%)	Annual income per household (USD) (Mean ± STDEV)	% contributes in the total income (%)
In-land fishing	100.0	2,600 ± 1,224	53.8
Up-land crop	70.0	1,442 ± 525	19.4
Rice cultivation	31.7	1,778 ± 813	14.2
Husbandry	26.7	1,333 ± 1104	6.4
Orchard	8.3	600 ± 557	1.8
Aquaculture	3.3	2,500 ± 403	1.7
Others	10.0	1,693 ± 234.8	2.8
Total	-	5,996 ± 2,221	100

USD 1 = VND 24.000 (2023).
Mean ± SD denotes for average value of 92 surveyed fishing household and its SD.

Livelihood capital status

Human capital

In addition to age, education level and labour force above mentioned, labour capacity component also includes working experience and working skills from training. With respect to the working experience for the current job, this is an important factor contributing to improve production efficiency. Particularly, fishermen had a long fishing experience at 21.9 years. It clearly points out that in-land fishing is an indigenous employment of the study site. Most of respondents have been continuously involved in fishing activity for more than 18 years. Regarding training participating, only 3% of respondents have official job trainings and 37.6% of the respondents occationally attended training sessions of farming-related from the local authorities such as agricultural extension or deparment of fisheries. Instead of official training participation, 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. In short, with respect to human capital, the inland fishing communities in the survey area are rich in labour quantity but limited in education and professional training, which might be resulted in unsustainable livelihood.

Natural capital

Small-scale fishing household 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 land area category in this study. It was revealed that each household owned 6.02 ha. Of which, fishermen carry fishing activity over an area calculated on average of 5.76 ha/household (Table 5). This land resource was allocated by the Government, specific of Management Committee of U Minh Ha National Park. The result shows that 72% of households did not own any land other than allocated wetland forest area for fishing and their homestead. The fishermen conducted fishing and several agricultural activities for their livelihood and have responsibility to re-forestration as well as conserve aquatic resources over the allocated land area.

Regarding natural aquatic species, fishermen reported that general declines in fish catch and diversity have made capture a more difficult form of livelihood for many fishers. Each fishing household can capture 1,121 kg/year, comprising of three to five economical fish species, e.g. snakehead (*Channa striata* Bloch, 1793), accounted for 37.8% of the total fish catch; snakeskin gourami (*Trichopodus pectoralis* Regan, 1910), accounted for 9.8% of the total catch; climbing perch (*Anabas testudineus* Bloch, 1792), accounted for 5.5% of the total catch; knife fish (*Notopterus notopterus Pallas*, 1769), accounted for 3.9% of the total fish catch, etc. Fishermen reported that the total number of wild fish species catched and comercial trade is modest at around 10 species. Therefore, most respondents have shown concerns about the natural bio-diversity decrease. There was a report that 64 out of 92 respondents (69.6%) has concerned on the serious depletion in wild indigenous fish over the past ten-years.

Table 5. Details of natural capital at the surveyed household

Natural capital components	Unit per household	Mean ± SD
Total land resource	Ha	6.02 ± 2.34
Wet-land forest allocated	Ha	5.76 ± 2.48
Diversity in fish catch	Species	3.71 ± 1.28
Quantity in fish catch	kg	1,181 ± 972

Physical capital

In this study, there are two componants of physical capitals, i.e., assets/facilities for production, and assets/facilities for living purposes. The results showed that fishermen used variety of fishing gears, e.g. gill nets, fishing rods, casting net, traps which known as "*lờ*" and "*lợp*" in Vietnamese. More than 43.7% of respondents reported gill net is the most common fishing gear (Fig. 3). Almost 96% of the surveyed fishing households owned small and non-mechanized boats, estimated at 9,374 USD used for fishing traveling. The second sub-componant explores the status of facilities own for living purposes of the community, including convenient amenities, housing status, and tap water and electricity system for household (infrastructure). In general, television, mobile phone and motorcycle are the most important devices/properties of amenities and almost respondents own personal one. With respect of housing, 73.9% of respondents is indigenous residents, who settlemented at the area from the time of their fathers. They reported that 72% have a one-story durable brick-wall house, making up the most popular, followed by the temporary cottage at 28%. Households accsess electricity and tap water resources has been improved greatly alongside the construction of water and electricity supply system in recent years. Specifically, 81.5% and 91.3% of respondents are currently using electricity and tap water, respectively, among which 73.8% confirm the good quality (achieving 4–5 score using 5-strata Likert scale; Table 6).

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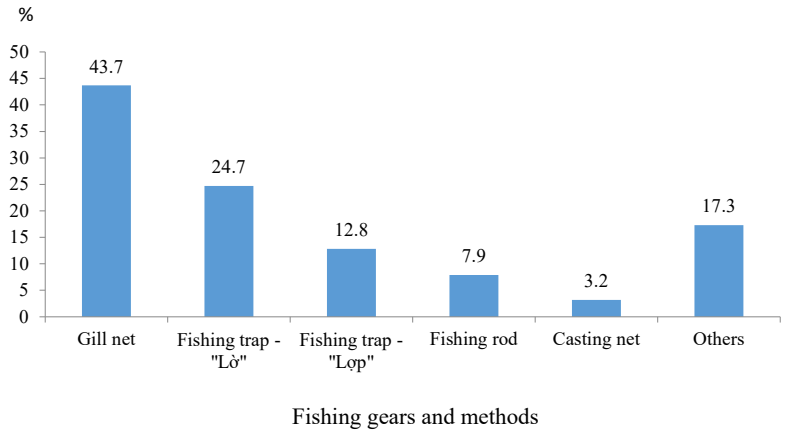

Fig. 3. Percentage of fishing gears usage denotes for production facility sub-component of physical capital.

Table 6. Details of assets/facilities living purposes

Physical capital sub-components	Quantity (n)	Percentage (%)
Television	92	100
Mobile phone	92	100
Music speaker	33	36
Refrigerator	79	86
Vehicals		
Small boats	92	100
Motocycles	70	76
Housing: 1-story durable brick-wall house	66	72
Electricity for domestic usage	75	81.5
Water system for domestic usage	84	91.3

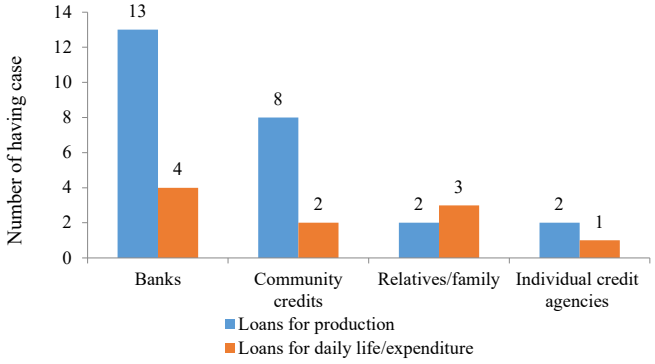

Fig. 4. Accessibility to loans.

Financial capital

The sub-components of financial capital include the readily capital and the accessible capacity to the money that can be mobilized when needed via various channel. The first component investigate household's saving status. The result shows that the minority of sampled households had savings, which they can utilize during emergency phenomena and at low amount (41.1% at approximate 2,200 USD). Most respondents would have only one way to save money (bank account or cash), and these amounts were accumulated year by year of the production. In addition, because of low saving, fishing household had to take loans for production activities and expenditures. Of which, only 27 of surveyed fishing households can access to official credit source, e.g. commercial banks and community credit. Although they were hesitant to tap upon relatives/family and individual credit agencies, they had to lent from those informal source to meet up their needs (Fig. 4). Most of them reported that they would not be comfortable to disclose their financial conditions/hardships.

Social capital

The sub-components of social capital comprise societal membership that illustrates household's connection to the society, and how useful he/she would find these social networks. It was found that households are member of various societal associations, involve Fishing Group, Farmer Association, Women Association, and Veteran Association. We observed that most respondents would asscociate with at least one organization (76.1%), with the most popular choices being the fishing group, farmer association and women association (70.7; 46.7% and 43.5%, respectively [Table 7]). With respect to the organizations' support, 71.4% of respondent who participate in such the social associations would realize/recieve the benefits/supports but at medium quantity and quality. Specifically, they might recieve

Table 7. Societal membership of inland small-scale fishing households at the surveyed area

Societal association	Quantity (n)	Percentage (%)
Fishing groups	65	70.7
Farmer association	43	46.7
Women association	40	43.5
Veteran association	24	26.1
Others	8	8.7
Pool respondents	70	76.1

the financial supports by applying rotational loans with low-interest loans from the Fishing Group or Women Associations under the operational regulations but at low amount (21%). We varified the supports by asking the question how often fishermen would recieve supports. The result found that the local goverment provides farming-ralated supports regularly such as trainings, market infomation, policies on land allocation and aquatic resource management, and livelihood transformation. However, local government generally plays a limited role compare to relatives/neighbors supports in term of everyday's life. Hence, fishing households occasionally participated in these trainings.

Livelihood sustainability

The mean and standard deviation data of small-scale inland fishing households for five livelihood capitals, classifying 20 SLCI indicators, are presented in Table 8. As can be seen to the Table, the human capital's SLCI varied from 0.329 to 0.559. There were 2 index values out of 5 indexes of human, namely education and fishing experience, are higher than 0.5, indicating sustainable feature of human capital. The natural capital index and financial capital index were entirely unsustainable, illustrated by index values of sub-components of either natural capital or financial capital not exceeding 0.5, ranging from 0.089 to 0.422. The highest sub-component indexs were shown in physical capital, as the results of infrastructure improvement policies that was analyzed in the section of physical capital.

The composite index of SLC was used to evaluate the livelihood status of small-scale inland fishing households in U Minh district, Ca Mau province. This index ranges from 0 to 1, representing from the lowest level of livelihood to the highest level of livelihood. The result of composite index of SLC is illustrated in Fig. 5. The livelihood of the surveyed households is unsustainable and unbalance. Specifically, the average SLCI of human,

Table 8. Sustainable livelihood capital indexes (SLCI)

Capitals/ component	Sub-components	SLCI (mean ± SD)
1. Human	1.1 Age	0.485 ± 0.227
	1.2 No. of people involved in the family	0.329 ± 0.168
	1.3 Education level	0.559 ± 0.277
	1.4 Fishing experience	0.525 ± 0.269
	1.5 Training participation	0.378 ± 0.488
2. Natural	2.1 Total land area	0.334 ± 0.173
	2.2 Wetland forest allocated area	0.340 ± 0.177
	2.3 Diversity in fish catch	0.342 ± 0.257
	2.4 Quantity in fish catch	0.224 ± 0.193
3. Physical	3.1 Fishing gears value	0.418 ± 0.250
	3.2 Household amenities	0.628 ± 0.323
	3.3 Housing-type of house	0.733 ± 0.445
	3.4 Vehicles-transportation	1.000 ± 0.000
	3.5 Electricity for domestic usage	0.811 ± 0.394
	3.6 Tap water for domestic usage	0.911 ± 0.286
4. Financial	4.1 Saving	0.422 ± 0.497
	4.2 Access to loans from official credits	0.300 ± 0.401
	4.3 Access to loans from un-official credits	0.089 ± 0.286
5. Social	5.1 Membership of social associations	0.756 ± 0.452
	5.2 Getting support from these social associations	0.102 ± 0.085

Mean ± SD denotes for average value of 92 surveyed fishing household and its SD.

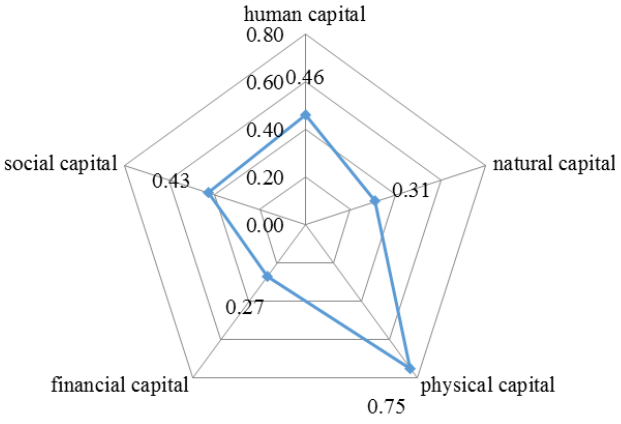

Fig. 5. The radar diagram of sustainable livelihood capital indexes presented by five capital indexes.

natural, financial, and social capitals, with figures ranging from 0.27 to 0.46, are substantially much lower than those of physical capital (0.75). The financial capital index was the lowest index

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among these livelihood capitals. It was followed by the natural capital index, at 0.27 and 0.31 respectively. The SLCI of human and social are just under-sustainable. Finally, the composite index of SLC of the small-scale inland fishing household was estimated at 0.443, lower than 0.5 and at the level of modest sustainability based on 5-strata Likert scale. The distribution of general SLCI by 5 levels of livelihood sustainability was 10.9%; 23.9%; 39.1%; 16.3%; and 9.8%, respectively.

Discussion

This study evaluated status of various livelihood capitals of the small-scale inland fishing households in U Minh district, Ca Mau province, Vietnam. The total annual income of fishing household indicated general livelihood performances since it is typically made on every member of the family (Betcherman & Marschke, 2016; Tikadar et al., 2022). The income of fishing households was still moderately, and, like other fisheries communities, heavily rely on the income from fishing activities (Sadekin et al., 2021). Allison & Ellis (2001) stated that Livelihood diversification is a feature of many fishing communities for the sustainability. Hence, it is impossible to sustain livelihoods through fishing alone. The fishermen's mean income was lower than that of national figure (at 2,048 USD per capita in 2022) (Vietnam GSO, 2023). The study found that the fishing households conducted fishing activities and other agricultural activites acrossing allocated land resource for livelihood and human well-being purposes. However, they are facing vulnerable context of low fish catch, reflecting depletion phenomenon of the natural aquatic resource. This vulnerable concept has shown in previous studies, e.g. Muthmainnah et al. (2019) and Tikadar et al. (2022) across the world. However, natural capital is a critical capital for environmental sustainability standard but it is not controllable by humans and cannot be used to increase stocks or catches. Description of the economic or social aspiration that is putting the function under threat or pressure, in terms of the benefit that its realisation would yield (Ekins et al., 2003). Therefore, fishing alone cannot sustain livelihoods, it is necessary to acquire diversified means of livelihood.

Looking at the status of five livelihood capitals, focusing on human capital, the illiteracy rate was higher than national rate (Vietnam GSO, 2023). Rakodi (2014), Ahmmed et al. (2021) and Tikadar et al. (2022) stated that low educational level would result in insufficience of knowledge and skills, therefore inhibiting them to implement income generating activities. Conversely, long experience of the fishermen illustrated that they interacted closely with each other to share the experience rather than profesional trainings (Brugère et al., 2008; Muthmainnah et al., 2019; Rahman et al., 2021). The physical capital of fishing households was mainly evaluated by fishing gear usage combined with valuable equipment for production purposes, i.e., boats and motorcycles, and living assets, i.e., house amenities, housing status and infrastructure for living conditions (Apine et al., 2019; Tikadar et al., 2022). Fishing gears and supported facilities were fully equipped for fishing. Well ownership of house amenities such as phone, television, music speaker, etc. and infrastructure such as electricity system and tap water were outstanding points of the communities as found at the studies of Ahmmed et al. (2021) and Tikadar et al. (2022). Financial capital is the most challenge for fishing households in the study site. Most of households did not own big amount of saving and unable to access formal credit. Findings from Hidajat (2015), Rana et al. (2021) and Tikadar et al. (2022) have shown similar results. Social capital comprises social relations and platforms of social interaction between respondents and the others surrounding them (Bathara et al., 2021). These social relations are very important for fishermen in facing problems and emergencies. However, the result revealed that fishing households had moderate involvement with social associations. Although the fishing households were provided regularly trainings on their professional skills, they reported that these traingings were insuficient and inapproriately. While training and intensive coaching are necessary to increase their technical knowledge and skill to ensure the sustainability of their livelihood (Kamaruddin & Samsudin, 2014).

The sustainability of the community is also reflected by adapting changes in three dimensions: (1) environment – adaptive to new environment changes; (2) economy – adaptive cost-friendly to most low to medium-income households, and (3) society – enhancing livelihoods by earning additional incomes (Nguyen et al., 2019; Trang & Loc, 2021). This study focused on the first and the third dimemsion - fishing households' adaption to freshwater aquatic resource depletion by earning additional incomes. Looking beyond the SLCI, and further into 20 sub-components of the five livelihood capitals, revealed an outstanding paradox. Among the five SLCI values, only the physical SLCI value was higher than the average value of the sustainable livelihood index. While low SLCI values of natural capital, financial capital, and social capital would hinder properly fishing households from adapting livelihood-sustainable

strategies. Heavily dependent on aquatic resources (in natural capital) stressors on their fishing-based livelihoods in terms of employment and income in many ways. While people can not controll the natural resources, it is necessary to acquire diversified means of livelihood to mitigate pressor on ntural resources.

Conclusion

This study was conducted to assess the livelihood status of inland small-scale fishing households in the vulnerable context of aquatic resource depletion. The findings indicated that the composit index of SLC of the selected households was unstable. Specifically, regardless of physical capital, the rest four livelihood capitals were unsustainable. Depletion of natural resources and heavy dependency on natural resources for livelihood caused severe to low levels of livelihood sustainability index of natural capital. Fishing alone can not sustain people livelihood, therefore, diversify livelihoods must be accquired. Poor diversity of income sources, and unable to access official credit contributed greatly to the unsustainable index of financial capital. Insufficient support from the social associations and low education level were some features of social and human capital. Only the physical capital index was beyond the average sustainable index.

Based on our findings, several policy implications could be generalized to other developing countries, like Southeast Asia. It is hard to make the small-scale fishing communities uot of poverty without synchronizing all stakeholders. For this reason, coordination across the sector is deciding factor. Specifically, local government need to provide trainings with efficient planning and implementation strategies for adapting new livelihood models. Learning about alternate income-generating activities to diverse livelihood activities to decrease livelihood dependency on natural freshwater resources. The study suggests that providing livelihood diversification opportunitities so that fishing households can diversify their income source rather than hevily relying on fishing-based livelihood. Then, household livelihood's resiliency to natural resource pressures can be enhanced. Transferring formal credit/funds from the public and private sectors to revive the fishery sector can contribute to improving the livelihoods of small-scale inland fishing households. Nevertheless, this study has some limitations, our findings took further notice that farmers' considerations and decisions are at multiple times not completely aligned with the government's zonation planning, in this case, use illegal gishing gears or expand fishing grounds beyond to allocated land area, these would ultimately compromise the effectiveness of the planning efforts of the government to cope with the aquatic resource depletion.

Competing interests

No potential conflict of interest relevant to this article was reported.

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Availability of data and materials

Upon reasonable request, the datasets of this study can be available from the corresponding author.

Ethics approval and consent to participate

Not applicable.

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