Assessing Social Vulnerability to Climate Change in a Fishery-Dependent Village in South Central Vietnam

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ABSTRACT

Fishery-dependent communities are highly susceptible to the impacts of climate change due to their proximity to vulnerable coastal areas and reliance on ecosystem services for their livelihoods. The study assessed the effects of climate change on the socioeconomic livelihoods and adaptive capacity of Xuan Tu, a community located in South Central Vietnam. The assessment employed the social vulnerability index (SVI) and adaptive capacity index (ACI). A hybrid data collection approach was utilized to gather information from households, and a composite method was employed to aggregate the data, enabling an assessment of community vulnerability. The findings indicated exposure, sensitivity, and adaptive capacity index values of 0.16, 0.34, and 0.26, respectively. The community exhibited a moderate vulnerability to climate change, with a social vulnerability index of 0.43. Notably, economic sufficiency, access to social groups, and level of education emerged as significant factors in reducing social vulnerability. To adapt to climate change, the community modified their fish feeding practices, fish culture methods, increased technology usage, and diversified their sources of income. However, the study identified a lack of institutional support as a significant obstacle to the community's autonomous adaptation. Based on these results, the study recommends livelihood diversification and the implementation of planned adaptation strategies to enhance preparedness for climate emergencies in South Central Vietnam.

1. INTRODUCTION

Countries in Southeast Asia are among the most vulnerable to climate change owing to socioeconomic factors and high climate risk exposure (Kay et al., 2023). Due to their proximity to high-risk areas, rural households and communities below the poverty line in Southeast Asia face the dual challenge of climate change impacts and unsustainable urbanization (Arfanuzzaman and Dahiya, 2019; Marotzke et al., 2020). Moreover, the dependency of these communities on natural resources for their livelihoods makes them more vulnerable to short-term and long-term climate change impacts (Asfaw et al., 2021).

Vietnam, a Southeast Asian country, is significantly impacted by extreme climatic events caused by rising temperatures, sea level rise, salinity intrusion, and increased typhoon intensity (Schmidt-Thome et al., 2015; Trinh, 2018; Nguyen et al., 2019). These changes have devastated key sectors contributing to the country's economic growth, such as the fishery sector (Do et al., 2021). The fishery sector, which experiences an average annual growth rate of 7.9%, employs 10% of the population and contributes 4-5% to the GDP, making it one of Vietnam's most promising economic sectors (Nguyen et al., 2017b).

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Vietnam's coastal communities rely heavily on the fishery sector for their livelihoods, making them particularly susceptible to climate stressors and disturbances (Nguyen et al., 2019). The south-central coast of Vietnam, in particular, has witnessed a rise in heavy rainfall and temperatures, rendering it more vulnerable to tropical cyclones (Ngo-Duc, 2014; Ho, 2018). In recent years, Khanh Hoa province in Southeast Asia has experienced a series of tropical cyclone events (Mau et al., 2019; Tran-Quang et al., 2020). Notably, the province has faced the destructive impact of record-breaking typhoons, such as Mirinae and Damrey, which have caused severe damage to aquaculture cages, fishing crafts, and shelters (DiGregorio, 2013).

Vulnerability assessment of coastal communities to climate change offers information on the impact of changes on their livelihood and ability to cope at the household level (Otto et al., 2017). Vulnerability assessment is multidisciplinary, with no generally accepted assessment method (Murphy et al., 2015). It may focus on the risk-hazard approach relying on biophysical and top-down information using climate projections or socioeconomic conditions relying on bottom-up information at the household level (Hammill et al., 2013). A concept used in assessing human ability or inability to cope with negative externalities in their livelihood is termed social vulnerability (Kelly and Adger, 2000). Social vulnerability determines the localized sensitivity of a community to climate change and the community's ability to cope with extreme events (Khan, 2012; Nguyen et al., 2019). Assessment at the household level is core to social vulnerability assessment as it directly targets vulnerable groups for effective risk management (Mason et al., 2021). It uses indices selected from deductive and inductive approaches. The former creates a social vulnerability index based on prior knowledge from the existing literature, while the latter uses variables that influence social vulnerability (Yoon, 2012). Studies on social vulnerability have also been undertaken in Vietnam (Adger, 1999; Rubin, 2014; Avelino et al., 2018; Huynh and Stringer, 2018; Huong et al., 2019). These studies focused on agriculture and natural resources, mainly in the Red River Delta and the Mekong Delta in the south.

To date, there are limited climate vulnerability studies in the south-central region of Vietnam, especially in Khanh Hoa Province. Despite being significant producer of spiny lobster with a 1,506 MT contribution to the country's total lobster production in 2020 (Hai and Speelman, 2020; Du et al., 2022; Phu et al., 2022), there is a lack of studies investigating climate vulnerability in the region. Specifically, there is no current study on the vulnerability of Xuan Tu Village, located in Khanh Hoa Province, where lobster farming originated. Moreover, Xuan Tu Lagoon is home to seagrass beds that support various aquatic fauna and flora, although the seagrass population has declined over the years due to the impact of extensive aquaculture and climate change (Nguyen et al., 2022). Given the significance of Xuan Tu Village for aquaculture and aquatic biodiversity in Vietnam, it is imperative to investigate the impact of climate change on this village to develop effective adaptation and resilience measures. Hence, this study targets this research gap by assessing social vulnerability at household scales in a coastal community in south-central Vietnam, building on existing social vulnerability assessment approaches. As there is no definitive index or approach to defining social vulnerability, a bottom-up approach was used based on the researchers' understanding of vulnerability (Khan, 2012). The study identified the socioeconomic vulnerability of the village at the household level and evaluated the factors influencing adaptation strategies and adaptive capacity. This work will enable government agencies to prioritize local adaptation strategies to climate change vulnerability.

2. METHODOLOGY

2.1 Description of the study area

Xuan Tu is a coastal village in Van Hung commune in Khanh Hoa, a South-Central Province in Vietnam (Figure 1). Xuan Tu Village covers 80 ha, with a total population of 2,735 people belonging to 553 households (Hue, 2010). With a bay area of 472 ha, 75% of the household are engaged in fishery activities (aquaculture and capture fishing), with a fish culture area of 118 ha, establishing the village as a prominent center for lobster aquaculture in Khanh Hoa (Tuan, 2004; Hue, 2010). Fishing activities have been banned near the co-managed Trao Reef Marine Reserve (Nguyen, 2010). The village lacks a medical facility but is accessible with good road networks and basic amenities such as the internet, telecommunications, and electricity. The village's proximity to the sea means it is affected by increased tropical cyclones, among other large-scale climate events in the Khanh Hoa Province.

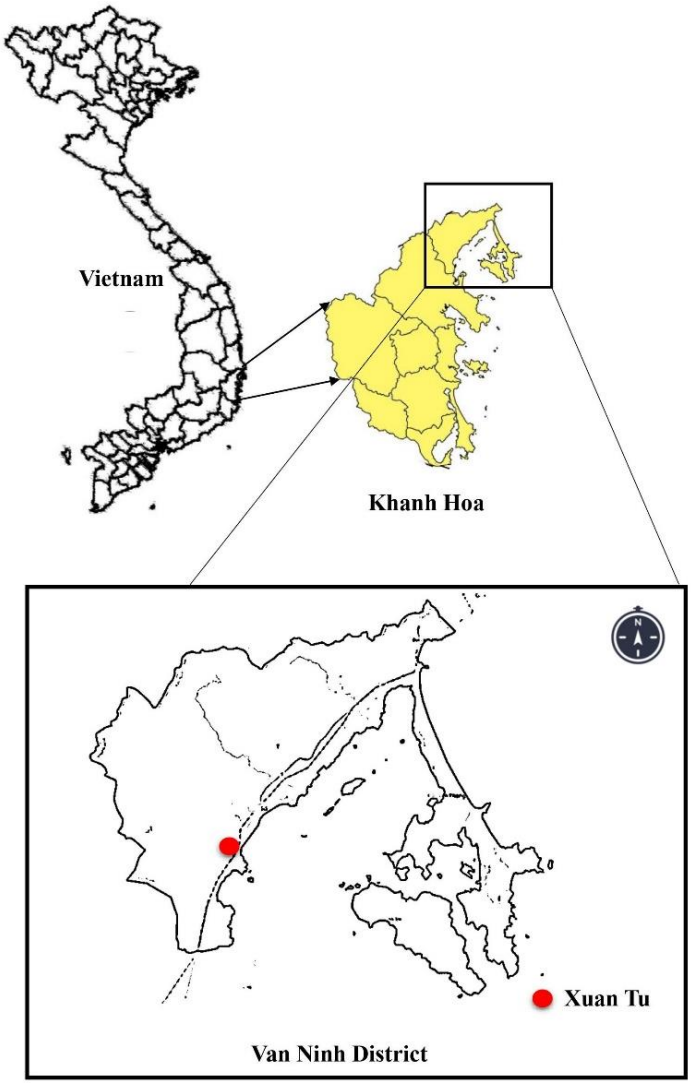

Figure 1. Map of Xuan Tu, a coastal village in South Central Vietnam

2.2 Data collection

This study employed a mixed-method approach using questionnaires and key informant interviews. A semi-structured questionnaire was administered to 61 heads of households (male and female). This method to ensure equal representation of households is based on a previously described method (Yamane, 1967). The mathematical representation of the sample size calculation is as follows:

$$n = \frac{N}{1 + N(e)^2} = \frac{553}{1 + 553(10\%)^2} = 84$$

Where; n represents the sample size, N denotes the total number of households, and e represents the assumed margin of error (10%). A higher margin error was used to balance between precision and practicality due to practical constraints such as time, resources, and responsiveness which may limit the ability to obtain a larger sample. However, some of the households were unresponsive.

Before implementation, a qualified translator from Nha Trang University translated the questionnaire into Vietnamese. Additionally, a qualified independent translator checked for accuracy to ensure translated accuracy and appropriateness, and the discrepancies were resolved through collaborative discussions. The interviews were conducted by a trained Vietnamese scientific interpreter familiar with the subject matter. The survey was designed with four sections: demographic characteristics, perception, livelihood, and adaptation measures. Four individuals in the community: a government official (village head), a manager of the Trao reef, an NGO official, and a spiritual leader, were interviewed to enrich the data collected. These interviewees were selected based on contacts made during the preliminary survey and

consultation with a researcher from Nha Trang University in Khanh Hoa Province, Vietnam, who was familiar with the area. Data collection was carried out from November 2017 to February 2018. It began with a preliminary survey and pilot testing of the questionnaire with 10 households in the community. This provided an overview of the general conditions of the community and facilitated the selection of indicators used in this study. The indicators were based on reviews of past disasters as reflected in previous studies (Wu et al., 2002; Zahran et al., 2008; Hou et al., 2016). Additional inputs were considered from community experts along with the household questionnaires administered. However, this may be subjective because the approach is characterized by expert knowledge and with lesser indicators (Vincent, 2004). The indicators were sub-subdivided to fit in with the IPCC's determinants of climate change: exposure, sensitivity, and adaptive capacity (IPCC, 2014). The Vietnam government statistical office supplied meteorological data on annual temperature, mean annual rainfall, data on storms, and coastal erosion, which form the exposure to climate change. These were selected based on consultation with the community leader and the Trao Reef Protected Area Officer. The data collected were used to develop a social vulnerability index and adaptive capacity index for climate change.

2.3 Indicator's functional relationship

Vulnerability indicators should be selected based on theoretical linkages between drivers of social vulnerability and socioeconomic conditions (Adger and Vincent, 2005). The criteria for selecting indicators were based on objective observation from the community and communication with the key informants, which were then linked to existing literature. There is no established standardized indicator or framework for quantifying vulnerability to hazards (Cutter et al., 2010). The IPCC determinant of vulnerability is exposure, sensitivity, and adaptive capacity (Table 1). According to IPCC (2001), exposure refers to the nature and degree to which a system is exposed to significant climatic variations. Indicators of exposure include mean annual temperature (Mendoza et al., 2014), mean annual precipitation, percentage of storms (Žurovec et al., 2017), and flood occurrences (Mendoza et al., 2014). Meanwhile, the level of sensitivity refers to how much risk exposure impacts the system. Indicators of sensitivity are; lack of income diversification (Eakin and Bojórquez-Tapia, 2008), percentage of fishers above 60 years (Wu et al., 2002), percentage of households without hazard-resistant shelter, and percentage of female-headed households (Jepson and Colburn, 2013). Exposure and sensitivity affect communities by increasing their susceptibility, hence their positive (+) relationship with vulnerability. Adaptive capacity describes the ability of a system to cope and create opportunities in a climate-related event. Adaptive capacity to climate change is dependent on access to loans, level of literacy (Deressa et al., 2008), access to information (Lo and Emmanuel, 2013), social group (Egyir et al., 2015), and poverty level (Adger, 1999). Adaptive capacity reduces vulnerability to climate change as it aids coping and development of adaptation strategies; therefore, it negatively (-) influences vulnerability. Table 2 shows the indicators of adaptive capacity identified from previous studies (Tan et al., 2018; Salik et al., 2015; Tan et al., 2018; Umamaheswari et al., 2021) and subjectively by the authors based on communication with experts in the community.

Table 1. Dimensions and indicators of vulnerability

Dimensions of vulnerability	Indicators	Explanation	References
Exposure	Mean annual temperature (+)	To understand climate pattern	Mendoza et al. (2014)
	Mean annual precipitation (+)	To understand climate pattern	Žurovec et al. (2017)
	Percentage of storms (+)	To detect the frequency of disasters	
	Percentage of flood occurrence (+)	To detect the frequency of disasters	Mendoza et al. (2014)
Sensitivity	Lack of income diversification (+)	To identify the livelihood status of the households	Eakin and Bojórquez-Tapia (2008)
	Percentage of fishers above 60 years (+)	Identify age-related sensitivity	Wu et al. (2002)
	Percentage of households without hazard resistant shelter (+)	To identify the preparedness of the households	Wu et al. (2002)

Table 1. Dimensions and indicators of vulnerability (cont.)

Dimensions of vulnerability	Indicators	Explanation	References
Sensitivity	Percentage of female-headed households (+)	To figure out if the gender of households affects coping	Jepson and Colburn (2013)
Adaptive capacity	Access to loan (-)	To identify whether they have access to credit	Ahsan and Warner (2014)
	Percentage of people with secondary school education (-)	To identify the level of literacy	Deressa et al. (2008)
	Percentage of people with access to information (-)	To identify their knowledge of climate change	Lo and Emmanuel (2013)
	Access to at least one social group (-)	To understand whether they have social supports	Egyir et al. (2015)
	Percentage of people above the poverty line (-)	To understand if income affects their copy mechanism	Adger (1999)

Table 2. Indicators of adaptive capacity

Component	Indicators	Explanation	References
Social support	Access to at least one social group	-	Tan et al. (2018)
	Percentage of people with secondary education	Education level of the household head	Salik et al. (2015)
	Percentage of people with quality shelter	The infrastructure is critical in determining a vulnerable population's ability to adapt.	Salik et al. (2015)
	Access to at least one information service	Access to technical information on the climatic occurrence	Tan et al. (2018)
Economic sufficiency	Access to loan	To determine whether households have access to credit	Tan et al. (2018)
	Percentage of people with diversified income	To understand whether households generate income from alternate livelihood activities	Umamaheswari et al. (2021)
	Improved technology	Access to improve fishing gear and cages	
	Per capita income	Higher-income might improve coping ability	
Institutions/ governance	Early warning from the district officer	Communication and early warning about impending climatic extremes	Umamaheswari et al. (2021)
	External support for adaptation		
	Climate education		
	Financial support from institutions		

2.4 Data analyses

The data were analyzed quantitatively to assess social vulnerability and adaptive capacity. Indicators of exposure and adaptive capacity were measured using different scales and units. For comparison, the indicators used were normalized. Indicator values were normalized between 0 and 1 based on the United Nations Development Program (UNDP, 1990) parameters for measuring the Human Development Index (HDI). The functional relationships of the indicators were used to determine the normalization equation. For positive correlation, the equation is as follows:

$$Xij = \frac{Xi - Min.\ Xj}{Max.\ Xj - Min.Xj}$$

And for negative correlation, the equation:

$$Xij = \frac{Max.\ Xj - Xi}{Max.\ Xj - Min.\ Xj}$$

Where; X_{ij} is the value of the normalized indicator (j) to study area (i), X_i is the actual value of the indicator to (i), and Min. X_j and Max X_j are the minimum and maximum values of the indicators, respectively. After normalization, the indicators were summarized into simple averages to form composite

indices using an equal weight method. This method assumes that all indicator variables carry the same weight and was chosen for simplicity and transparency. Interestingly, there is no consensus or justification for ranking the indicators into ranges of importance or priority (Cutter et al., 2010). Weighted averages introduce an element of arbitrary choice, and regression-based weight is only visible when there is an objective measure of vulnerability outcome (Heltberg and Bonch-Osmolovskiy, 2011). The normalized indicators were integrated into the composite subindices per their dimensions. The arithmetic mean of the indicators makes up this subindex. Therefore, the final value of the vulnerability index is obtained by the arithmetic sum of sub-indices (O'Brien et al., 2004; Žurovec et al., 2017). Quantification of social vulnerability must be mathematically expressed to show the relationship between the components (Nguyen et al., 2017a). Therefore, the mathematical expression, adapted from a previously described formula (Ahsan and Warner, 2014) for the social vulnerability index, is as follows:

$$\mathrm{SVI} = \sum \frac{1}{\mathrm{n}} \mathrm{E}, \mathrm{S}, \mathrm{AC} \quad (3)$$

Where; SVI is the social vulnerability index; E is exposure; S is sensitivity; AC is the Adaptive Capacity, and n is 3, representing E, S, and AC. An inverse value (1 minus indicator score) for adaptive capacity was used for the index calculation due to its inverse relationship with vulnerability (Ahsan and Warner, 2014). The index was scaled from 0 (low vulnerability) to 1 (high vulnerability) based on a previously described composite indicator framework (Ahsan and Warner, 2014). Descriptive statistics, including frequencies and percentages, were used to summarize data from the semi-structured questionnaire on fisher's demographic characteristics.

3. RESULTS

3.1 Characteristics and livelihood of the respondents

As shown in Figure 2, 51% of the population's livelihood strategy is linked to aquaculture, which is closely followed by fishing (31%). Fishmongers comprised 7% of the respondents, while people involved in other livelihood activities, such as net knitters and boat engineers, constituted 11% of the respondents. The dominance of aquaculture is reflected in the income it generates, as shown in Figure 3. The income generated from aquaculture exceeds that from fishing and other occupations.

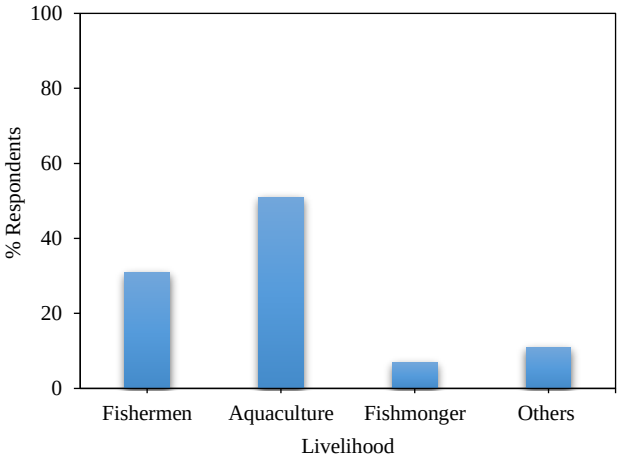

Figure 2. Livelihood of households in Xuan Tu Village, South Central Vietnam

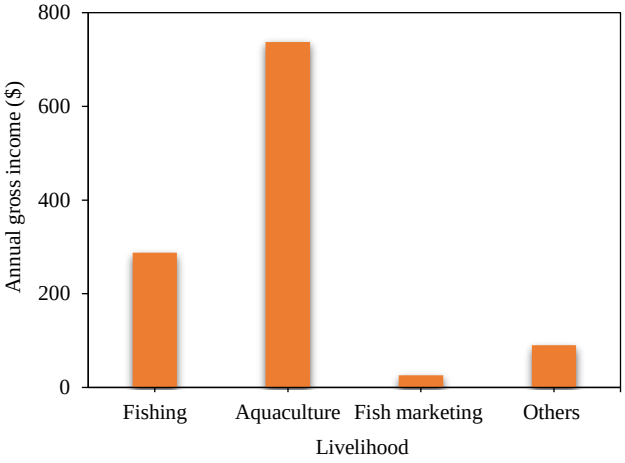

Figure 3. Annual income per livelihood in dollars (1$=22,769 Vietnamese dong)

3.2 Social vulnerability index (SVI) of the village of Xuan Tu

The sub-index of social vulnerability was calculated from vulnerability dimensions and analyzed using Microsoft Excel 2016. The findings from the analysis show that the index values of exposure, sensitivity, and adaptive capacity were 0.16, 0.34, and 0.26, respectively (Figure 4). Social vulnerability was determined by calculating the arithmetic mean of the sub-indices to give 0.43 a social vulnerability index. From the results, the social vulnerability of Xuan Tu Village is medium.

3.3 Adaptive capacity index

Based on the standard deviation of the indicators, the adaptive capacity sub-indices were ranked as follows: social capital ranked highest at 55%, economic sufficiency at 44%, and institutional support ranked lowest at 1%. The economic

sufficiency of the community is aided by access to loans and moderate-income generation, as illustrated in Figure 5. Apart from the early warning support from institutions, the findings illustrated in Figure 6 show that there is little support from institutions on climate education and financial support. Figure 7 shows that, socially, the community was better off due to the higher level of education, access to social groups, and access to information from various sources. However, they do not have access to shelters capable of withstanding extreme weather events.

3.4 Adaptation strategies

The findings revealed that the farmers changed the feeding regime and the type of fish cultured in response to climate change (Figure 8). Furthermore, there was an increase in the use of technology, and a few diversified their livelihood. However, a larger percentage of the respondents do not have adaptation strategies.

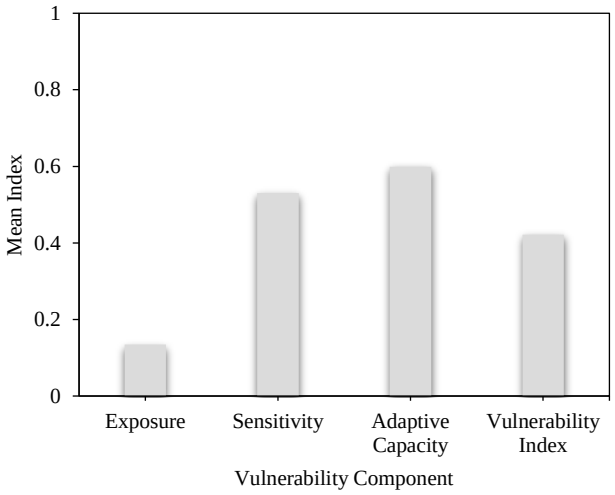

Figure 4. Social vulnerability index of Xuan Tu Village, South Central Vietnam

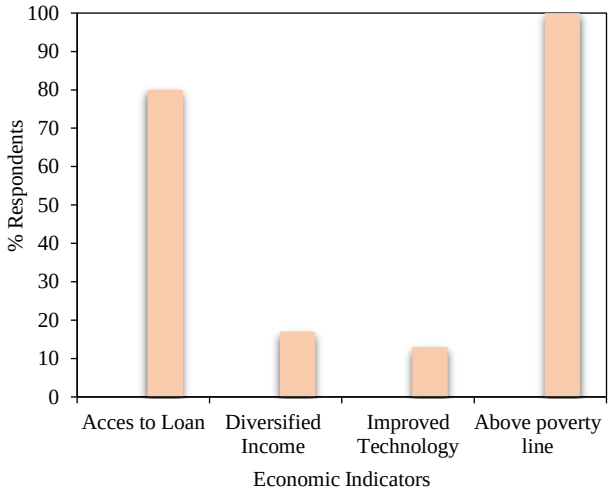

Figure 5. Economic indicators of adaptive capacity

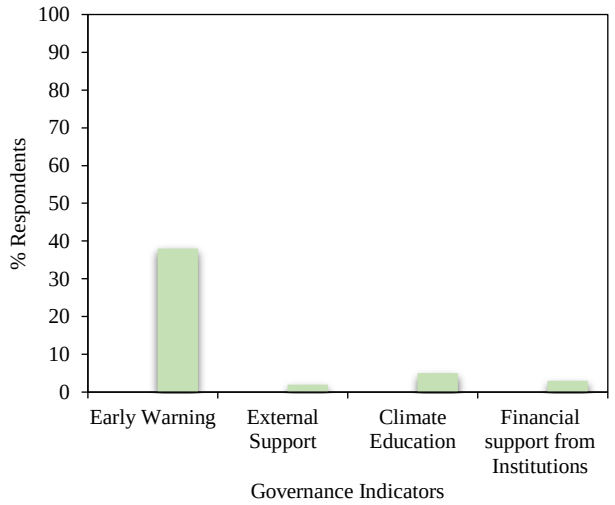

Figure 6. Governance Indicators of adaptive capacity

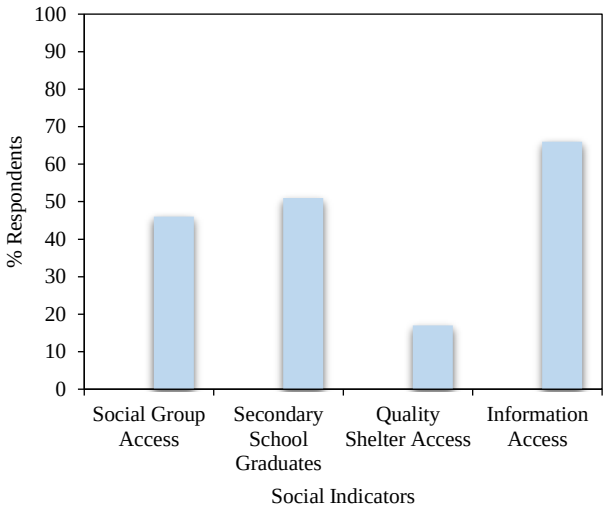

Figure 7. Social indicators of adaptive capacity

4. DISCUSSION

4.1 Social vulnerability and livelihoods

A community's vulnerability is site-specific; it can be determined by the communities' geographical location, exposure, and sensitivity (Adger et al., 2003; Ahsan and Warner, 2014). Our findings revealed that Xuan Tu is moderately vulnerable. Social vulnerability of a community describes the effects of social, economic and institutional factors that made them susceptible to climate change (Tate, 2012). We infer that the village's proximity to the sea, which dictated their livelihood, exposed them to the direct impact of climate hazards. This finding corroborates other researchers' assertion that communities in southern

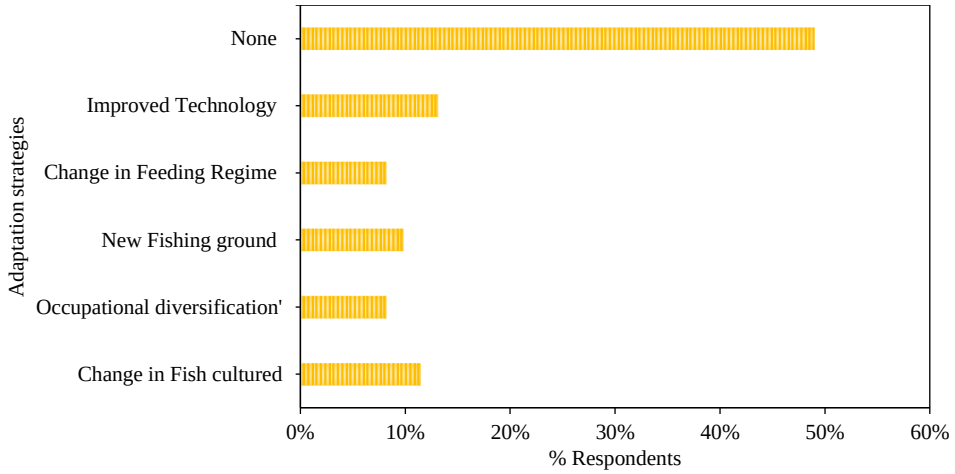

Figure 8. Adaptation strategies initiated by fish farmers in Xuan Tu Village

Vietnam are vulnerable due to their proximity to the body of water and aquaculture activities (Huynh et al., 2019; Truong et al., 2022). This study's higher sensitivity and medium vulnerability agreed with a previous study (Badjeck et al., 2010). Natural resource-dependent households, especially in fish-based communities, are sensitive to climate variability. This sensitivity within these communities can be attributed to climate-sensitive natural resources; therefore, their services are highly prone to extreme stressors or changes (Füssel, 2012; Okpara et al., 2017; Huynh and Stringer, 2018). For example, the agriculture-dependent households in Danang, Vietnam, were more vulnerable to climate change than those with diversified income sources (Huynh and Stringer, 2018). With 49% of households not diversifying their livelihoods, there would be a further increase in individual household susceptibility levels in the future, as the current single-livelihood approach is not sustainable. A sustainable livelihood approach is dynamic and ecologically coherent to achieve sustainability (Hussein and Nelson, 1998; Natarajan et al., 2022). Meanwhile, livelihoods which rely solely on agriculture and lack diversification are unsustainable (Barrett et al., 2001; Beltrán-Tolosa et al., 2022). With the inability to diversify into alternative income-generating activities, there is a tendency to increase sensitivity. Within a fishing-based livelihood, higher sensitivity and lower adaptive capacity where all households are exposed to the same stressor result in greater vulnerability, thus reducing a communities' ability to cope during climatic events. In addition to the low percentage of income diversification, it was found that most households in the area do not have access to quality shelters. Climate-resilient housing infrastructure helps mitigate the risk of climate-related vulnerability (Hernández, 2022). Lack of access to quality shelter could exacerbate climate change's impact and lead to displacement and loss of livelihoods. Fishermen face risks due to shifts in climate patterns caused by the overall increase in global temperatures and fluctuations in precipitation (Vincent-Akpu and Annor-Frempong, 2017). The ability of their households to adapt livelihood strategies will be influenced by governance processes, policies, and institutional capabilities (Huynh and Stringer, 2018). However, institutional discrimination exists in Vietnam, and impoverished individuals are inherently more at risk of natural disasters due to limited access to state resources (Adger, 1999). In the case of Xuan Tu, there is a clear indication of the requirement for detailed policies to reduce vulnerability to climate-related disasters at a local level.

Social vulnerability, defined as individuals' inability to cope with the consequences of hazards effectively, reflects the societal dynamics and its foundational social, economic, and political circumstances (Rubin, 2014). Recognizing the social vulnerability of Xuan Tu is influenced by various socioeconomic factors and institutional lapses is to provide evidence for decision-makers to provide adequate social improvements to tackle climate change. However, our choice of indicators and the selection criteria might have created a bias that could affect the result's credibility. Social vulnerability assessment is subjective and future considerations should focus on a more robust method of analysis that would reduce redundancy and uncertainty.

4.2 Adaptive capacity

A positive correlation exists between access to a social group, literacy level, economic welfare, and adaptive capacity. People with higher levels of education, income, and access to social gatherings have a greater propensity to adapt/cope with climate change, thus improving their resilience (Adger et al., 2003; Abdul-Razak and Kruse, 2017; Sarfo et al., 2019; Tran et al., 2020). The findings show that households in Xuan Tu are economically capable due to their higher-than-average income, surpassing the national average of $129 (General Statistics Office of Vietnam, 2021). A previous study observed similar findings for Southern coastal zones (Nguyen et al., 2019). Furthermore, higher income improved the adaptive capacity of agriculture-dependent communities in the Nikachu watershed, Bhutan (Choden et al., 2020). The income generated could have reduced their vulnerability because the access to capital will make it easier to adapt or restart after climate shock (Nor Diana et al., 2022). The higher education rate among respondents will positively correlate with or influence adaptive capacity within the community, and this is consistent with the findings of agrarian households in Bhutan and farmers in Nicaragua (Choden et al., 2020; Quiroga et al., 2020). Vulnerability is socially constructed and influenced by varying institutions and economics (Adger et al., 2003). Consequently, higher income and medium support from groups could improve the ability to withstand extreme climate hazards. In our study, the access to a social group in the households may have influenced their adaptive capacity. Similar findings were observed when assessing climate change in the Northern Mountainous Region of Vietnam (Ho and Kingsbury, 2019). Collective actions of society can improve their resilience in the face of threats posed by extreme climate events (Adger et al., 2003; Sarfo et al., 2019).

Higher education and access to social groups could have allowed them access to information. Information on climate change or early warnings can improve readiness to cope or adapt, improving adaptive capacity. This implies that respondents with access to information have a higher adaptive capacity than farmers with less access (Abdul-Razak and Kruse, 2017). Marine Conservation and Community Development (MCD), an NGO working in the community, asserted the Khanh Hoa People's Party Committee had a climate action plan between 2010 and 2015. MCD is important in creating adaptive livelihood through establishing an Eco-café, and support for the Local reef-protected area since 2008, coupled with training on the snout otter clam culture model. However, education on climate change is low in the community, and government efforts in the committee should focus on early warning systems prior to climate-induced events and should provide financial support to vulnerable social groups. The participation of citizens and stakeholders is an important aspect of climate governance (Sarfo et al., 2019). Hence, considerable efforts should be directed at 'social learning and institutional reflexivity' for efficient participation. The medium value of the adaptive capacity signifies that a community has a good capacity to cope with adverse situations, consistent with a previous study (Vincent-Akpu and Annor-Frempong, 2017).

4.3 Adaptation strategy and its barriers

Local communities rely on local knowledge, which is relevant in building resilience over climate change (Klein et al., 2014). In the case of Xuan Tu, the adaptation strategies were based on prevailing conditions which may not be a response to climate change. In response to the reduction in the catch, fishermen changed their fishing grounds by moving further into the South China Sea - a key informant attributed this change to migration and aquaculture. The cage density of lobster aquaculture and the conflict between water users is a problem in this community; this may have led to the change in the fishing ground (Tuan, 2004). These adaptation strategies are consistent with the findings of (Huynh et al., 2021) in two coastal communities in central Vietnam. Eight percent of households diversified into aquaculture, thus increasing their monthly earnings. Similarly, fishermen adapt their livelihood by diversifying into agriculture and other means in Trung Làng (Leithäuser and Holzhacker, 2020). However, these are autonomous adaptations, which are spontaneous responses to the impacts of climate change (IPCC, 2001). Barriers to these adaptations arise from the lack of financial assistance for affected individuals or units, hindering growth. The top-down government structure, which is non-participatory in ecological management, is also a significant challenge (Gverdtsiteli, 2023). Policies and governance processes play a role in determining property allocation and household livelihood strategies. Inadequate financial support, such as credit facilities and incentives, significantly affects unplanned

strategies (Avelino et al., 2018). This is in contrast to urban areas where adaptation plans are crucial for the development and sustainability of cities (Huynh and Stringer, 2018).

5. CONCLUSION

In conclusion, Xuan Tu Village is moderately vulnerable to climate change due to its exposure to environmental changes and the sensitivity of their livelihood. The study highlights that the village's economic and social capacities have strengthened its ability to adapt to climate change. Insufficient government assistance has hindered the community's efforts to adapt to climate change, highlighting the need for additional support from governmental or non-governmental organizations. There is a clear indication for renewed detailed policies to reduce vulnerability to climate-related disasters at the local level and a shift in priorities away from the government's current emphasis on national-level climate change adaptation initiatives to policies for disaster risk reduction. These policies should focus on building stronger community networks, improving access to information and resources, and involving the community in decision-making processes related to climate change. Additionally, efforts should be made to enhance the community's economic and social capacities by creating new livelihood opportunities or improving existing ones.

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