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Climate change, livelihood resilience, and gender: An intersectional analysis of Vietnam's forest-dependent communities

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ABSTRACT

Integrating gender-disaggregated data and adopting a gender-focused perspective are crucial for a comprehensive understanding of climate change issues. This study provides empirical evidence from two ethnic minorities in Vietnam, highlighting how perceptions of livelihood resilience vary by gender, geographical context, and ethnicity, with a particular emphasis on their intersections. Over 13 months, data were gathered through 3 focus group discussions, in-depth interviews with 9 key informants, field observations, and surveys of 136 households. The findings revealed a low average Household Livelihood Resilience (HLR) score of 0.434, indicating limited resilience among forest-dependent households facing external shocks. Notably, a significant gender gap was evident, with men demonstrating higher resilience levels than women, a disparity attributed to entrenched social norms and cultural practices. Women, often confined to domestic roles, faced barriers to community involvement and access to financial resources, which weakened their ability to cope with and recover from adverse events. To address these issues, the study advocates for climate actions that prioritize gender equality and aim to enhance women's resilience. This includes amplifying their voices through tailored training programs and initiatives such as women-managed microfinance groups. The study also emphasizes the policy implications for advancing gender equality, sustainable forest management, and livelihood resilience. However, this work has limitations, including a small sample size and reliance on self-reported data, which may introduce biases. Future research should involve a larger, more diverse sample of forest-

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dependent communities and examine various dimensions of vulnerability to provide a more nuanced understanding of resilience factors.

1. Introduction

In recent decades, international humanitarian and development organizations have intensified their focus on resilience-building efforts (Tran et al., 2022b). At the household and community levels, resilience typically denotes the ability of households to anticipate, withstand, and adapt to adverse events while upholding essential functions and pursuing well-being (Cutter et al., 2008). As the impacts of climate change become more pronounced, the proliferation of resilience programs holds promise for improving outcomes, provided they consider nuanced interpretations of perceptions and practices influencing individual adaptive capital (Lebel et al., 2014).

Understanding household livelihood resilience (HLR) is paramount for crafting effective development policies and interventions, especially in regions vulnerable to climate change. The Intergovernmental Panel on Climate Change (IPCC et al., 2018) warns that if no adaptation measures are taken, by 2100 the global mean sea level is projected to rise by approximately 0.1 m, potentially reducing the number of people exposed to related risks by up to 10 million. In line with data from the World Meteorological Organization (WMO), the global mean temperature in 2019 exceeded pre-industrial levels by 1.1 °C, marking record highs for both the 5-year (2015–2019) and 10-year (2010–2019) periods, with 2019 ranking as the second warmest year on record. Alarming, approximately 30% of the global population faces exposure to deadly heatwaves lasting over 20 days annually (Holuj and Curlin, 2020). These climate-related challenges, including the intensification of extreme events, have eroded food and water security, hindering progress towards Sustainable Development Goals (IPCC, 2022) and posing severe threats to the livelihoods of millions, particularly those in remote mountainous regions heavily reliant on agriculture and forestry.

Vietnam's extensive coastline, geographic positioning, and diverse topography and climates render it one of the most hazard-prone countries in Asia and the Pacific Region (World Bank & Asian Development Bank, 2020). Recent research by Duc et al. (2021) revealed that overall, compared to precipitation patterns, spatio-temporal changes in temperature show a clear warming trend across Vietnam. According to UNDP (2015), around 70% of the population is projected to face risks from natural disasters and extreme events, with annual economic losses estimated at 1.3% of GDP, or US\$3.85 billion during the 1990–2009 period. Estimates indicate that climate change could reduce national income by up to 3.5% by 2050 (Arndt et al., 2015). Forests are crucial for human well-being and ecological stability, but climate change poses significant challenges for forests and the communities that depend on them. As of 2023, Vietnam's forests covered 14,860,309 ha, or approximately 42% of the nation's land area (MARD, 2024). The country is a leading advocate of the payment for forest environmental services (PFES) system, which has raised nearly \$400 million since its introduction in 2008 (World Bank, 2019). Forests provide non-timber forest products (NTFPs) essential for around 24 million Vietnamese people, including 8.5 million ethnic minorities in upland regions (Sunderlin and Huynh, 2005). However, despite the support offered by NTFPs, they often fall short of significantly alleviating poverty. The World Bank (2018) reports that 9.8% of the population remained in poverty in 2016, with ethnic minorities—comprising only 15% of the total population—representing 73% of the poor. Research highlights the critical roles women play in forestry, which significantly affects household well-being and food security (World Bank, 2019). Climate change impacts women and men differently, making it important to understand the nuanced livelihoods and intersections within forest-based communities. Addressing these issues is essential for promoting gender equality and mitigating climate change impacts, in line with Sustainable Development Goals (SDGs). Despite a proliferation of studies examining the impacts of climate change on Vietnamese communities, the predominant focus remains on assessing the vulnerability of agrarian communities and susceptible regions (Cong et al., 2016; Dinh et al., 2023; Hoang et al., 2020; Ngu et al., 2023; Pham et al., 2020; Phuong et al., 2023a,b; Tan et al., 2023a,b).

Recently, despite significant efforts to amplify women's voices in Vietnam, they continue to face exclusion at both family and social levels. Ignoring their roles, rights, and responsibilities can exacerbate inequalities and fuel conflicts over resources. This issue is partly due to the lack of detailed gender data (UNEP, 2013; Edwin, 2020) and the insufficient integration of critical dimensions such as geography, ethnicity, and gender into resilience discourses, although recent studies have begun addressing these gaps (Ha et al., 2023; Phuong et al., 2023a,b; Sen et al., 2020). Carr and Thompson (2014) highlight the need to move beyond simplistic views of gender as a binary variable and instead consider it as a social factor intersecting with other characteristics, responsibilities, and roles. Recognizing that climate change affects men and women differently due to variations in traditional roles, societal expectations, and livelihood pursuits is crucial. Women, constituting the majority of the developing world's 1.4 billion impoverished individuals, often experience lower incomes, limited access to credit facilities and decision-making authority, and restricted control over resources, heightening their vulnerability to climate-induced adversities (USAID, 2024). Moreover, differing societal roles and responsibilities assigned to men and women result in varying opportunities for integrating sustainable alternatives into their lifestyles. Understanding these nuances is essential for effectively integrating climate change into development endeavors and bolstering the resilience of household livelihoods (Lebel et al., 2014). Our aim is to contribute to the advancement of this approach and to propose policy recommendations and implications for gender equality and sustainable forest management based on the results of this study.

Specifically, the research endeavors to (1) evaluate the overall HLR of these communities amidst climate change, identifying key strengths and vulnerabilities; (2) analysis how resilience varies among different cohorts based on gender, ethnicity, and geographic location, delving into the intersectionality of these factors; and subsequently (3) propose policy recommendations promoting gender equality and sustainable forest management, thereby enhancing the resilience of these communities to the escalating impacts of

climate change. Through these objectives, this study endeavors to enrich both theoretical and practical understandings of HLR within the climate change context. The insights garnered will not only advance academic knowledge but also guide the development of targeted interventions empowering women, fostering sustainable resource management, and cultivating more equitable and resilient communities in Vietnam.

2. Conceptual framework

2.1. Resilience concept and livelihood subjective resilience

According to IPCC (2022), resilience is conceptualized as the “capacity of social, economic, and ecosystems to cope with hazardous events or trends, responding or reorganizing in ways that maintain their essential function, identity, and structure, as well as biodiversity in the case of ecosystems, while also preserving the capacity for adaptation, learning, and transformation.” That said resilience manifests as a positive attribute when it sustains such capacities for adaptation, learning, and/or transformation.

In the fields of social sciences and humanities, resilience is a multifaceted concept that examines the intricate interactions between social and ecological systems, evaluating their abilities to endure and recover from disruptions (Roberts et al., 2019). It necessitates an acknowledgment of the interconnectedness and interdependence of these systems, necessitating an exploration of their dynamics while fortifying their adaptability to change (Tran et al., 2022b). Within the domain of social resilience, it denotes the exceptional capacity of individuals and communities to proactively prepare for and bravely withstand the diverse impacts of hazards, thus safeguarding their holistic well-being (Holling, 1973; Tanner et al., 2015). This conceptualization of resilience, transcending conventional frameworks, has prompted contemporary paradigms that acknowledge the inherent imperative for systems to adapt and evolve in response to challenges (Folke, 2006). Consequently, the constituents of resilience become intricately interwoven with unique contextual sentiments, prevailing threats, and the scale of analysis. However, the dynamic evolution of the definition and concept of resilience presents a significant challenge in achieving consensus on the fundamental elements constituting a resilient human system, engendering an environment of contradiction and ambiguity (Lin et al., 2017; Roberts et al., 2019). Nevertheless, resilience has emerged as a potent guiding principle in the humanitarian and development spheres, facilitating valuable cross-sectoral connections (Tran et al., 2022b). Amidst burgeoning global commitments and initiatives dedicated to fostering resilience, there exists an imperative to quantitatively assess and monitor its impact in practical contexts. Nonetheless, the actual implementation of resilience and the persistent ambiguity surrounding its definition pose significant obstacles, impeding progress in the development of robust measurement tools. Consequently, concerted efforts are underway to identify optimal methods for comprehensively assessing and evaluating the multifaceted nature of resilience.

Within the realm of livelihood resilience at household level, this term denotes the profound capacity of households to endure and rebound from various pressures, shocks, and environmental changes (Sen et al., 2020; Tran et al., 2022b). These challenges may stem from natural disasters or significant shifts in natural resources. When evaluating household resilience in their livelihoods, researchers and policymakers consider a myriad of factors contributing to a household’s resilience, encompassing human and social capital, financial resources, as well as physical and tangible assets (Phuong et al., 2023a,b). Together, these factors form a comprehensive framework for discerning both vulnerabilities and strengths within households and communities, empowering stakeholders to devise tailored strategies to bolster resilience and navigate future challenges judiciously. While resilience has garnered considerable attention in contemporary environmental and social science discourse, it has encountered criticism for its perceived failure to address social inequalities and environmental issues comprehensively. Inherent tensions arise from divergent analytical methodologies, particularly prevalent “top-down” approaches (Jones and Tanner, 2015).

To address these concerns, Tanner et al. (2015) introduced the Livelihood Subjective Resilience (LSR) framework, which operates at both individual and household levels. This framework emphasizes the transformative potential of individuals in safeguarding and enhancing their livelihoods amidst various disruptions, underscoring the pivotal roles of humanitarian organizations, individuals, and communities. As such, any endeavors aimed at fostering resilience must grapple with the fundamental question of “Resilience for whom?” (Tanner et al., 2015). Departing from traditional top-down approaches, the LSR framework integrates the valuable element of people’s self-assessment—their perceptions—to quantify livelihood capital enhancing resilience, thus providing invaluable insights compared to conventional methods. This departure underscores the paramount importance of adopting a socio-ecological systems perspective, especially in contexts where interactions between humans and their environments are deeply interconnected and systemic (Ha et al., 2023). Aligned with this evolving paradigm, the present study employs the innovative LSR method introduced by Tanner et al. (2015), utilizing household self-assessment to quantitatively evaluate resilience-enhancing livelihood capital from a bottom-up standpoint. Specifically, the study meticulously applies the quantified LSR framework to explore differentiating factors in LSR across diverse societies, explicitly considering variables such as ethnicity, gender, and region while elucidating intricate intersections among them.

2.2. Conceptual framework: an intersectional analysis

The rapid changes in the global climate system pose significant challenges to advancing the rights of marginalized groups and promoting gender equality. Women, in particular, face a heavier burden due to their reliance on natural resources and their central role in activities such as reforestation programs aimed at mitigating climate change impacts (Bäthge, 2010). However, it’s crucial to

recognize that the effects of climate change are not gender-neutral, with women and girls facing the highest risks.

Despite global attention on the importance of gender equality in forest governance, persistent and widening inequalities persist worldwide (Mullinax et al., 2018). For example, more than two-thirds of the 1.3 billion poorer in developing countries are women (Denton, 2002). Climate change impacts, such as water scarcity, deforestation, altered rainfall patterns, and rising temperatures, disproportionately increase women's workload in tasks such as fuel collection, water fetching, cooking, and ensuring food security for families and communities, as highlighted by the International Labour Organization (ILO, 2017). Women's heightened vulnerability to climate change impacts stems from discrimination, entrenched social norms, and traditional gender roles (Schalatek, 2009). They often face exclusion from decision-making processes, limited awareness of their legal rights, including land use rights, and restricted access to resources and assets (UNFCCC, 2019). These challenges may result from a lack of understanding of how gender dynamics influence forest governance, including gaps in gender-based evidence and limited representation of women in forest landscape governance. Gender disparities in forest governance are compounded by the unforeseen impacts of climate change, which disproportionately affect individuals based on gender, age, socioeconomic status, and ethnicity, hindering progress toward SDGs, including Goal 5 on Gender Equality and Women's Empowerment, and Goal 13 on Climate Action.

Gender, influenced by cultural, social, and psychological factors, intersects with variables such as education level, location, status, and ethnicity. In this study, we categorize ethnicity to elucidate differences between ethnic groups in the study area, alongside gender and region (Fig. 1). Djoudi et al. (2016) emphasize differences in perceptions between men and women as a key aspect of gender analysis. Additionally, gender is often intertwined with cultural norms, responsibilities, and rights associated with women and men (Djoudi et al., 2016). Socioeconomic disparities and geographical considerations are also crucial in climate change analysis, with evidence indicating significant inequalities in access to climate-related information and adaptation strategies among ethnic minority families in remote rural areas (Ha et al., 2023; Phuong et al., 2023a,b). Furthermore, gender intersectionality varies across ethnic groups due to sociocultural regulations, influencing perspectives on climate change impacts (Soetanto et al., 2017). Thus, understanding these intersections is vital for developing nuanced approaches to resilience-building at the household level. Future research on climate change should adopt multidisciplinary approaches to effectively address these complex issues.

3. Methods

3.1. Research sites

In Vietnam, approximately 25 million people, including 12 million ethnic minorities, reside in forested areas and rely partially or entirely on forests for their livelihoods (FSIV, 2009). This study focuses on communities living in and around the buffer zone of Pu Mat National Park, located in the communes of Tam Hop and Tam Thai in Tuong Duong District, Nghe An Province, Vietnam. Pu Mat National Park, designated as a special-use forest, spans 94,816.95 ha and is a key region within the Western Nghe An World Biosphere Reserve, officially recognized by UNESCO on September 18, 2007 (PCNA, 2022). The park's buffer zone is inhabited by 60,621 individuals from ethnic groups including Kinh, Thái, Tho, H'Mong, Nung, and Tày Poọng, spread across 38 villages in 8 communes and 3 districts (PCNA, 2022). The local communities rely significantly on forest products, which constitute 50–60% of their total income (Chinh et al., 2017; IDCP, 2000).

Tam Hop and Tam Thai were selected for this study due to their geographical context, reliance on forest resources, and ethnic composition. Both communes are located in Tuong Duong District (Fig. 2), one of the poorest mountainous areas in Vietnam (GOV,

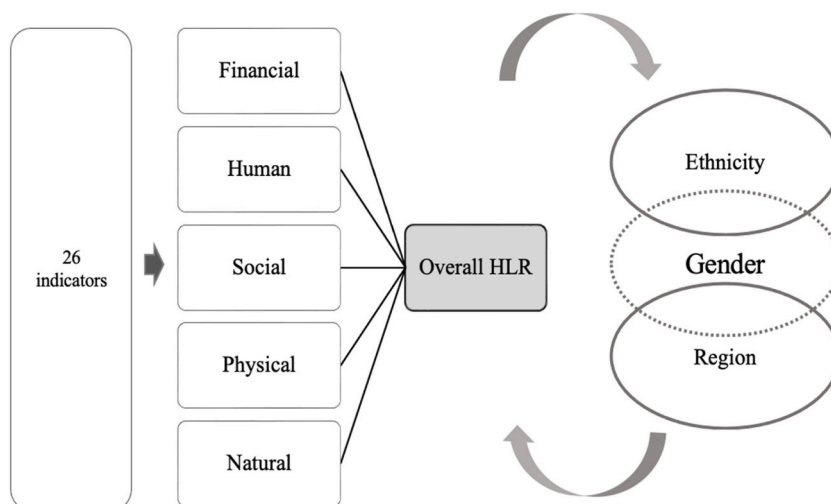


Fig. 1. Conceptual framework of the research.

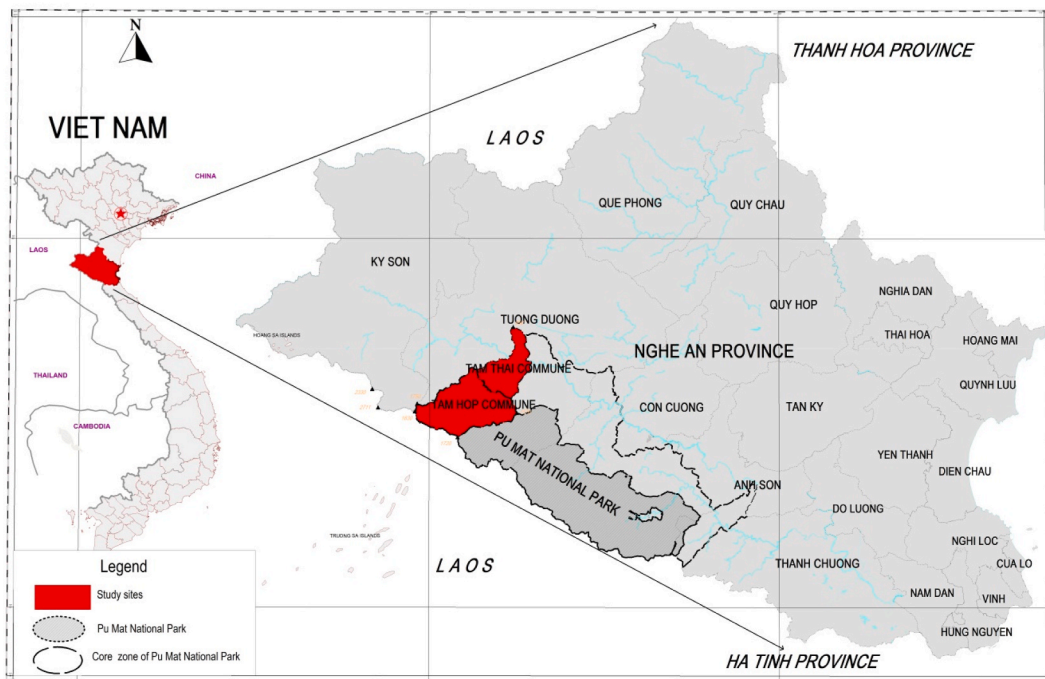


Fig. 2. Map of the study site in Nghe An province, Vietnam.

2022), and are situated within or near the park's buffer zones. From 2016 to 2020, Tam Thai was classified as a Region II commune (difficult), while Tam Hop was classified as a Region III commune (very difficult) (GOV, 2017). Tam Thai, located below the Cha Lap stream, covers 12,390.52 ha, with 91.35% consisting of forestry land. It comprises nine villages and 1221 households, predominantly of the Thái ethnic group, with 37.10% of households classified as poor (TTCP, 2023). Tam Hop, situated above the Cha Lap stream, encompasses 23,210.31 ha, with 97.41% forested. It includes five villages and 530 households, 62% of whom are poor (THCP, 2023). The commune's challenging topography features steep slopes and multiple streams. The heavy dependence on forests and agriculture makes both communes highly vulnerable to climate change. Low educational levels and deeply rooted cultural practices further hinder adaptation efforts, highlighting the need for targeted research and policy development to address their specific challenges.

3.2. Data collection

In this study, the LSR framework, introduced earlier, was conducted by using HLR approach. Fundamentally, this framework hypothesizes the livelihood resilience based upon five key capitals: physical, natural, financial, social, and human, which were assessed by the responses of the male or female head of the household. Our study assumes that the household head's responses indicate their families' perceptions of the levels of livelihood resilience within their respective households, thereby serving as proxies for LSR (Jones and Tanner, 2015). The household survey, FGDs and in-depth interviews was conducted between July 2023 and March 2024 in the Quy Hop and Tuong Duong districts through a semi-structured questionnaire. The Slovin formula (1960) was used to calculate the sample size (n) to ensure the sample's representativeness, as outlined in Equation (1).

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

The sample size (n) is determined using the Slovin formula, where N represents the total population and e represents the margin of error. The margin of error is derived from the chosen confidence level; for instance, a confidence level of 90 percent corresponds to a margin of error of 0.1, which is considered as an accurate. Consequently, a total of 136 households were selected for face-to-face interviews, with 76 households from Tam Hop and 60 from Tam Thai. The survey employed a semi-structured questionnaire divided into seven sections. The first section collected general household information, including age, gender, and income. Sections two through six addressed 26 indicators related to physical, natural, financial, social, and human capital, respectively. The final section included open-ended questions aimed at exploring difficulties related to land access, climate change impacts on their livelihoods, and gender division of labor at both household and community levels, providing qualitative data for analysis. A pilot test of the questionnaire was conducted with eight local farmers and two commune officers to refine the instrument and gather secondary data from

annual socio-economic reports at the district and commune levels. For the official survey, each interview lasted between 45 min and 1.5 h, and the snowball sampling technique was used to select participants. During this process, a local woman who is a commune officer assisted with local knowledge and served as a language translator when necessary, facilitating trust between researchers and respondents. Additionally, three focus group discussions (FGDs) and on-site observations were conducted in this study. Two FGDs were organized for each ethnic group, one of which, one comprised only the women group (3–4 participants) and the other comprised with both men and women (6–8 participants). This inclusivity is crucial in gender research to strength the voices and perspectives of marginalized individuals within the community, particularly in public session. Furthermore, in-depth interviews were conducted with 9 stakeholders in different sectors, including 2 district officials, 3 commune officials, 2 village heads, a representative from the women's union, and a village patriarch. These interviews provide the deeper insights into the diverse political-economic, cultural, and social norms prevalent within each ethnic group's context.

3.3. Measurement of the household livelihood resilience

Our study used the balanced weighted method to compute the HLR (Hahn et al., 2009; Sen et al., 2020; Tran et al., 2022b). According to the HLR method, the overall resilience score of each household (h) is determined by aggregating the scores of the five composite capital components, consisting of 26 indicators, as illustrated in Table 1. The selection of these 26 indicators followed a two-pronged approach. Initially, we based our criteria on prior research, including studies by Hahn et al. (2009); Phuong et al. (2023a, b); Sen et al. (2020); Tran et al., 2022b; and Tran et al. (2023), which resulted in a list of 33 criteria. After pilot testing the questionnaire and consulting with local officials, we eliminated 9 criteria that were deemed unsuitable. These excluded criteria included those related to aquaculture land area, fishing income, and large assets such as automobiles/trucks, which were not relevant to the study area. We then incorporated two additional criteria – payments for forest environmental services (PFES) and monthly salary – to better reflect the local context. Each indicator contributes equally to the resilience index, despite variations in the number of indicators within each major component (Hahn et al., 2009).

The calculation method was shown in three main steps in detail as follows.

Initially, all sub-components were normalized to a common scale ranging from 0 to 1 to address the different scales of each variable. Two normalization techniques were used based on the nature of the relationship with household resilience (Sen et al., 2020). Indicators positively correlated with resilience, such as higher education levels and income diversification, were normalized using Equation (2):

$$\text{Index}_h = \frac{S_h - S_{\min}}{S_{\max} - S_{\min}} \quad (2)$$

where Index_h represents the normalized value of a sub-indicator for h, S_h represents the observed sub-component for h, and S_{\max} and S_{\min} represent the maximum and minimum values across the whole sample, respectively. Conversely, indicators expected to negatively impact resilience, such as distance to the nearest school or livestock values, were standardized using Equation (3):

$$\text{Index}_h = \frac{S_{\max} - S_h}{S_{\max} - S_{\min}} \quad (3)$$

Subsequently, the scores for each capital component were computed by averaging the related indicators, as shown in Equation (4):

$$M_h = \frac{\sum_1^n \text{index}_{hi}}{n} \quad (4)$$

where M_h represents the indicators for each capital of h, Index_{Shi} represents the indicator indexed by i comprising each major indicator, and n represents the number of indicators.

Finally, after normalization, the component scores were averaged to calculate the score for each of the five capitals such as financial, human, social, physical, and natural, respectively. The HLR was then computed as the weighted mean of these components by using Equation (5):

$$\text{HRL}_h = \frac{7x\text{Fin}_h + 3x\text{Hum}_h + 5x\text{Soc}_h + 5x\text{Phy}_h + 6x\text{Nat}_h}{26} \quad (5)$$

where HRL_h represents the resilience index of h, Fin_h , Hum_h , Soc_h , Phy_h and Nat_h represent the scores for the five livelihood capitals (major components) of h.

Basically, a higher HLR score indicates greater livelihood resilience, while a lower HLR score indicates the less livelihood resilience. Additionally the component scores of each capital and the overall HLR index were particularly compared in different ethnic groups (Thái and Tày Poọng), different genders (women and men), different regions (Tam Hop and Tam Thai communes), and their intersections to explore the major differences (disparities) in household livelihood resilience among small-scale farmers. Independent t-test was used to determine the significance and correlations among these variables by using IBM SPSS Statistics 20.

Table 1

Post-normalization scores of 26 indicators and 5 livelihood capitals for climate household resilience in case study.

Livelihood capitals	Indicator	Measure	Average
Financial (F)	Non-poor	0.390	0.207
	Bank deposit	0.015	
	Residential land	0.262	
	Agricultural land	0.113	
	Forest land	0.177	
	No-rely on forest	0.125	
Human (H)	Monthly salary	0.368	0.457
	Insurance card	0.882	
	Total labors	0.423	
	Higher education	0.066	
Social (S)	Participation in CSOs	0.368	0.439
	Place belonging	0.523	
	Training courses	0.662	
	Helping	0.324	
	Information sources	0.321	
Physical (P)	Residential land	0.262	0.679
	Access to road	0.956	
	Access to health facilities	0.635	
	Access to school	0.734	
	Irrigation system	0.809	
	Forest land	0.177	
Natural (N)	Agricultural land	0.113	0.393
	Forest land	0.177	
	Rice crops	0.875	
	Crop diversification	0.500	
	Livestock diversification	0.500	
	PFES	0.193	
Overall			0.435

4. Key findings

4.1. Household livelihood resilience

The findings revealed an average overall livelihood resilience score of 0.434 (below 0.5), indicating a low level of livelihood resilience to climate change within the study area. This is primarily attributed to the significantly low scores in the financial (0.207) and natural (0.393) indices among livelihood capitals, whereas the physical index ranked the highest with a score of 0.679 (see more in Table 1 and Fig. 3).

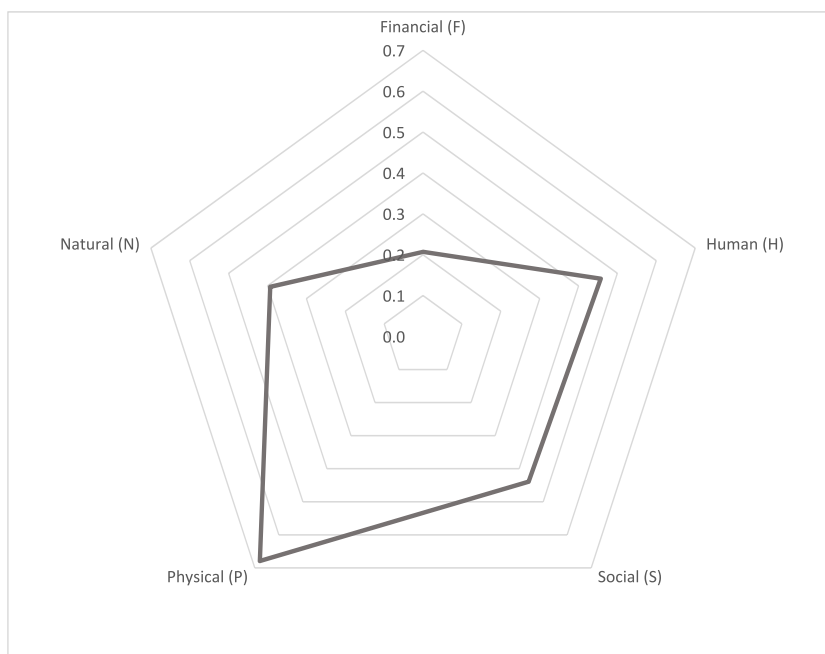


Fig. 3. Five capitals of household livelihood resilience.

Specifically, the physical index achieved the highest score due to access to facilities, such as access to roads (0.95), schools (0.734), and irrigation systems (0.8). This result contributes to positive outcomes resulting from recent governmental investments in infrastructure development initiatives, such as the Program to support rapid and sustainable poverty reduction for 61 poor districts (Program 30a), the Socio-economic development program for extremely difficult communes in ethnic minority and mountainous areas (Program 135), and the National target program on building new rural areas (2010–2020). Evidence from on-site observations further supports this argument. In fact, we observed that all roads in the area were paved with cement concrete and every household had access to electricity. The irrigation and water systems were also well established. An elderly woman remarked, “life has changed a lot compared to before; transportation is now much more convenient and easier.” In addition to improvements in physical capital, human and social capital are also notably high, with scores of 0.457 and 0.439, respectively. This high level of human capital is attributed to the widespread availability of health insurance, with 88.2% of residents covered. Additionally, locals are actively engaging in training courses focused on disaster risk reduction and climate change adaptation (0.662 score). The district agricultural extension and the provincial vocational training center have also played a key role by providing livelihood skills training that supports socio-economic development.

Conversely, the lowest score of financial resources, with a score of 0.207, was mainly due to lower in bank savings deposits and agricultural land use rights. It highlights the prevalent inadequacy of production materials and financial resources among households to mitigate risks, particularly in mountainous conservation areas. Policies aimed at protecting deforestation have prompted changes from slash-and-burn agriculture to wet rice cultivation, however, alternative support mechanisms such as PFES remain challenging. Furthermore, agricultural land for cultivation is scarce, caused by increasingly severe impacts of climate change, therefore, it is necessary for local communities to adapt livelihood strategies and mitigate external challenges. In addition, the rate of poverty is quite high, with two-thirds of respondent households falling below the poverty line. Additionally, among the remaining indicators, the index associated with higher education attainment is notably low (<0.1), potentially serving as a significant impact in sustainable household livelihood development and forest resource conservation efforts.

4.2. Differences in livelihood resilience scores among groups

The study revealed three main observations about differences in livelihood resilience scores among groups (Table 2; Fig. 4). Firstly, it is evident that men achieved a higher overall livelihood resilience score than women, significant at $p < 0.05$. Among the five capitals, men’s social capital is significantly higher than women’s ($p < 0.01$). This variation is primarily due to three indicators: Residence period, Participation in training courses, and Helping. Men tend to have longer residence periods in the village compared to women (averaging 48 years for men and 32 years for women), largely influenced by local customs. Additionally, among the family members, the higher percentage of men participated in training/drills on natural disaster prevention compared to women. Moreover, a larger proportion of men claimed to offer or receive help within the village during the crisis period compared to women.

The second observation indicates that while there’s no difference between Tam Hop and Tam Thai, Tam Thai demonstrated a higher level of livelihood recovery, primarily due to financial capital ($p = 0.003$) at $p < 0.01$. Household survey data revealed that Tam Hop has a higher percentage of poor households and most of the households are relying on agriculture and forests as their main sources of livelihood compared to Tam Thai. Additionally, Tam Thai has a higher proportion of households with salaried earners and larger land holdings for both residential and agricultural purposes compared to Tam Hop.

The third finding of our study indicates no significant differences between the two ethnic groups. However, the Thái ethnic cohort demonstrated a marginal advantage overall, particularly discernible through statistically significant indicators of natural capital. Specifically, approximately 91% of Thái ethnic households engage in the cultivation of two wet rice crops annually, contrasting with a lower proportion of 80% among Tày Poọng ethnic households. Moreover, the Thái ethnic populace exhibits a greater propensity towards cultivating a diverse array of crops and raising livestock compared to their Tày Poọng counterparts. These results highlight ongoing disparities in the adaptive capacities of the two groups regarding agricultural transitions. Tày Poọng women, for instance, face challenges transitioning from upland fields to wet rice cultivation due to unfamiliarity with the practice. In contrast, Thái women, who have traditionally practiced swidden agriculture, have shifted to exclusive farming, leading to increased productivity. This shift demonstrates the Thái group’s superior adaptive capacity and proactive engagement in livelihood development compared to the Tày Poọng group. Based on these findings, policy recommendations for promoting sustainable forest management are outlined in the

Table 2
Differences in livelihood resilience scores among groups.

Variables		Overall	Financial	Human	Social	Physical	Natural
Gender	Male	0.447	0.218	0.432	0.528	0.684	0.377
	Female	0.419	0.193	0.418	0.368	0.673	0.406
	<i>t-test</i>	<i>0.012**</i>	<i>0.355</i>	<i>0.587</i>	<i>0.000***</i>	<i>0.618</i>	<i>0.313</i>
Region	Tam Hop commune	0.422	0.170	0.434	0.460	0.675	0.376
	Tam Thai commune	0.438	0.251	0.414	0.432	0.683	0.410
	<i>t-test</i>	<i>0.289</i>	<i>0.003***</i>	<i>0.438</i>	<i>0.356</i>	<i>0.710</i>	<i>0.235</i>
Ethnicity	Thái	0.432	0.221	0.418	0.425	0.684	0.414
	Tày Poọng	0.423	0.174	0.440	0.496	0.667	0.314
	<i>t-test</i>	<i>0.563</i>	<i>0.106</i>	<i>0.404</i>	<i>0.029**</i>	<i>0.453</i>	<i>0.030**</i>

Note: **, *** denote statistically significant differences (*t-test*) at the 5%, and 1% levels respectively.

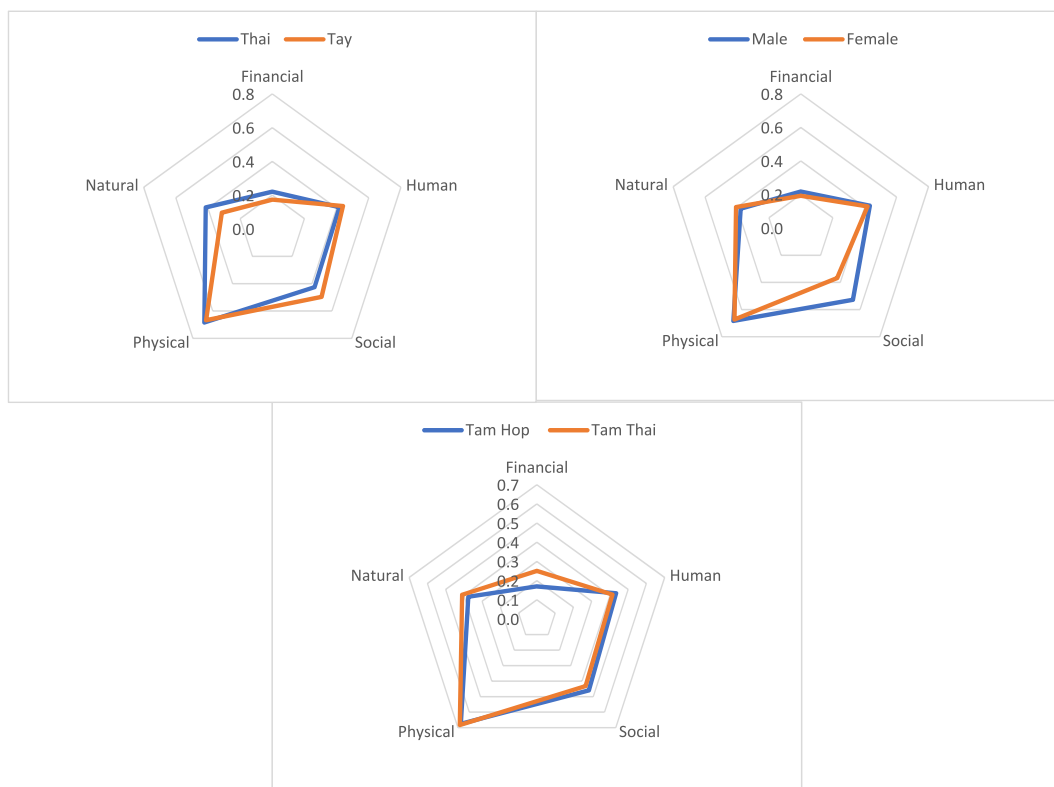


Fig. 4. Differences in livelihood resilience scores among groups.

discussion section. Additionally, our study indicates that the Tày Poọng community has a higher level of social capital, partly due to their active participation in natural disaster prevention training, a practice less common among the Thái demographic.

4.2. Analytical intersectionality of household livelihood resilience

The findings indicate a notable gender disparity in livelihood resilience despite shared ethnicity and geographical proximity, with men generally showing the higher resilience levels than women in the context of climate change. This phenomenon can be attributed to three primary factors: financial capital, social capital, and physical capital.

Within the context of ethnic homogeneity, no discernible disparity in resilience was observed between men and women in the Thái ethnic group. However, among the Tày Poọng ethnic group, men demonstrated significantly higher resilience indices than women, with statistical significance levels at $p < 0.01$ (Table 3). Specifically, indicators of financial, social, and physical capital among Tày Poọng ethnic men surpassed those of women, indicating a discrepancy in gender resilience levels within this ethnic cohort. This suggests a varying degree of gender equality in livelihood resilience across different ethnic groups. In this case, it is evident that the

Table 3
Gender intersectionality of household livelihood resilience.

Variables		Overall	Financial	Human	Social	Physical	Natural
Gender-Ethnicity	Male Thái	0.447	0.229	0.424	0.503	0.668	0.412
	Female Thái	0.421	0.215	0.414	0.368	0.697	0.416
	<i>t-test</i>	0.158	0.669	0.766	0.000***	0.315	0.910
	Male Tày Poọng	0.448	0.204	0.443	0.562	0.706	0.330
	Female Tày Poọng	0.375	0.118	0.435	0.368	0.590	0.370
<i>t-test</i>	0.004***	0.078*	0.823	0.000***	0.004***	0.495	
Gender-Region	Male Tam Hop	0.446	0.195	0.441	0.522	0.706	0.366
	Female Tam Hop	0.338	0.134	0.423	0.372	0.629	0.392
	<i>t-test</i>	0.003***	0.069*	0.555	0.000***	0.006***	0.548
	Male Tam Thai	0.451	0.263	0.414	0.540	0.640	0.399
	Female Tam Thai	0.430	0.243	0.414	0.365	0.710	0.417
<i>t-test</i>	0.367	0.648	0.992	0.001***	0.067*	0.619	

Note: *, *** denote statistically significant differences (t-test) at the 10% and 1% levels respectively.

degree of gender parity in livelihood resilience within the Thái ethnic group is more pronounced.

Regarding geographical resilience indices, men residing in the Tam Hop area exhibited significantly greater recovery indices compared to women, with statistical significance levels at 1%. This trend echoed findings in the ethnicity analysis, with financial, social, and physical capital playing pivotal roles. Conversely, in the Tam Thai commune area, no notable difference in resilience was detected between genders. However, it is noteworthy that women in this area displayed higher physical capital indices than men, seemingly attributed to their involvement in indoor agricultural production and their predominant role in managing household finances, including the allocation of PFES. This phenomenon underscores the importance of considering gender dynamics in assessing household resilience.

In summary, the findings reveal that men exhibit higher levels of resilience than women, even within the same ethnic group and geographic region. Women encounter numerous barriers due to cultural, socio-economic, and institutional factors that restrict their access to forest resources and economic opportunities. The research, which includes interviews, focus group discussions, and field observations, identifies entrenched social norms, traditional practices, and gender-based divisions of labor as fundamental contributors to these challenges. In both Thái and Tày Poong communities, men are regarded as the “pillar of the household” (“trụ cột của gia đình” in Vietnamese), bearing primary responsibility for earning the household income, while women’s roles are predominantly limited to domestic responsibilities such as cooking and childcare. These established roles continue to impede women’s engagement in social activities, livelihood development, and their overall status within the family and society. Our study also uncovers troubling trends in educational attainment, which pose significant barriers to creating sustainable livelihoods and conserving forest resources. Specifically, 5.8% of individuals are illiterate, and 41.1% only complete primary school education. Furthermore, 39.9% of households live in poverty, a rate much higher than the provincial and national averages. Poverty also leads to psychological challenges, such as shyness and low self-esteem, especially among women, which impedes their participation in community activities crucial for climate adaptation. Impoverished households often avoid interacting with external entities due to concerns about their financial difficulties. These insights are critical and will shape the recommendations and policy implications discussed in the following section.

5. Discussion and implications

Resilience, as defined by [Holling \(1973\)](#), encompasses the capacity of individuals, communities, and systems to adapt, recover, and show adaptive success after adverse events or challenges. In the context of climate change, resilience-building aims to enable these entities to adapt to environmental changes, while also addressing underlying vulnerabilities ([Lin et al., 2017](#)). Thus, understanding the livelihood resilience of marginalized groups to climate change is crucial for achieving climate justice and fostering sustainable and equitable development. Based on these principles, our analysis focuses on three key discussions to further explore this theme.

Firstly, our data show that the study area’s overall mean livelihood resilience score is 0.434 (below 0.5), which indicates low levels of resilience to external shocks. This is largely attributed to notably low scores in the Financial (0.207) and Natural (0.393) indices, underscoring the critical role of these resources in strengthening the resilience of highland households in Vietnam. These findings have significant implications for policymakers and practitioners focused on strengthening the livelihood resilience of vulnerable communities. To address these challenges, we propose several interventions. Firstly, it is crucial to enhance support for vulnerable households by helping them diversify their livelihoods and reduce their reliance on forest resources. This support could include initiatives such as raising livestock, growing a variety of crops, and cultivating medicinal plants under the forest canopy, as well as improving their skills. Secondly, increasing funding for forest environmental and ecosystem services is essential. Besides, the government should collaborate with international NGOs to implement carbon credit programs, which can provide additional income for forest owners. Thirdly, locally-led microfinance programs could offer small loans to vulnerable households. This support would enable them to expand small businesses and strengthen their financial resilience ([Phuong et al., 2023a,b](#)). However, effective management of these programs remains a critical issue. We advocate for the implementation of robust monitoring and evaluation mechanisms, including regular audits and progress assessments, to ensure that funds are utilized efficiently and as intended. This monitoring should be tailored to the community’s specific needs and incorporate beneficiary feedback to address issues promptly. Besides, capacity building and financial literacy training are crucial for maximizing the impact of microfinance programs. We also recommend the establishment of local management committees composed of community members to oversee fund allocation and usage. These committees would ensure transparent decision-making that reflects community priorities, with representatives from vulnerable groups to enhance accountability and responsiveness. Fourthly, investments in education and skill development can empower vulnerable households, particularly ethnic minorities, with the essential skills to secure better employment opportunities, thus strengthening their financial resilience. Additionally, social safety net programs, such as conditional cash transfers, can provide a safety support for vulnerable households during crises like natural disasters or economic shocks, thereby enhancing their financial and social resilience ([Apuri et al., 2018](#); [Hossain and Banik, 2022](#); [Tran et al., 2022a](#)). Furthermore, community-based disaster risk reduction programs can prepare vulnerable households, including ethnic minority communities, to mitigate the impacts of disasters, thereby enhancing their overall resilience ([Van Huynh et al., 2020](#)). Finally, policies and programs that promote economic empowerment for women, such as access to credit, training, and support for women-led enterprises, can enhance the financial resilience of vulnerable households, especially those led by women in ethnic minority communities ([Amoak et al., 2023](#); [Fan et al., 2022](#); [Vo et al., 2021](#)).

Secondly, and most importantly, our findings reveal that across all social groupings, males often have higher livelihood resilience levels than women, emphasizing the need to address gender inequality in efforts to reduce disaster risk and build resilience. These findings align with previous research findings ([Fan et al., 2022](#); [Ha et al., 2023](#); [Phuong et al., 2023a,b](#); [Tran et al., 2022b](#)), highlighting the importance of this issue. Notably, men typically have longer tenure in rural areas compared to women, averaging 48 years for men and 32 years for women, largely due to local customs. This discrepancy in tenure contributes to women having fewer local networks

and a limited understanding of the local context, adversely affecting their personal resilience. Moreover, a higher proportion of men report family members participating in disaster preparedness activities compared to women, indicating disparities in social capital and ethnic/regional aspects. A community leader in Tam Thai commune observed a gender disparity in participation levels across various village activities. For instance, men tend to be more involved in important meetings such as voter outreach, village meetings organized by the Front's working group, and various training sessions, often facilitated by the commune. Similarly, disaster preparedness training programs organized by the commune predominantly see male participation. Conversely, commune meetings held 1–2 times per month, primarily addressing village issues, witness higher participation from women. Despite this, decision-making authority remains predominantly vested in men. Nonetheless, women actively participate in disaster preparedness training and exercises, contributing to community resilience and recovery. Therefore, it is imperative to expand the scope of training initiatives beyond traditional sectors such as agriculture to encompass diverse fields. This expansion can facilitate more inclusive participation, ensuring that individuals from all backgrounds are equipped to contribute effectively to resilience-building efforts.

From another perspective, our results reveal that Thái ethnic women exhibit higher resilience and adaptation compared to Tày Poọng women, largely due to their shift towards intensive paddy field farming and crop diversification. Additionally, Thái women surpass Thái men in physical capital metrics such as land use rights, agricultural cultivation, and PFES. This highlights the potential for development programs and policies to be more effective by amplifying women's voices and integrating their roles and responsibilities. To advance sustainable forest management while accommodating the distinct practices of various ethnic groups, we recommend the development of tailored agricultural support programs. For Tày Poọng women, targeted training in wet rice cultivation should improve adaptability and productivity, while Thái women would benefit from support in sustainable livestock management and crop diversification. Facilitating knowledge exchange programs where Thái community members can share their expertise with Tày Poọng communities will foster mutual learning. It is also crucial to integrate beneficial traditional agricultural practices into modern, sustainable methods that reduce environmental impact. Promoting community-based approaches to forest management that involve both Thái and Tày Poọng communities will ensure collaborative efforts in managing and protecting forest resources, thus supporting environmental conservation and improving livelihoods. Additionally, involving local communities, including women and ethnic minorities, in the policy-making process is essential to address their perspectives and needs effectively in sustainable forest management strategies.

Additionally, our study reveals a concerning trend regarding low levels of higher education attainment (<0.1), which poses a substantial barrier to sustainable livelihood development and forest resource conservation efforts. In-depth interviews conducted in Phong village, Tam Hop commune, revealed that the majority of the village's current population typically completes only up to secondary school, with few progressing to high school due to financial constraints that limit their ability to afford further education. Consequently, some individuals resort to residing in boarding houses to access schooling opportunities. Additionally, for the elderly, belonging to the preceding generation, access to education was limited due to early marriage or prevalent illiteracy resulting from challenging circumstances. Mrs. Lo (name anonymized), aged 67, recounted how familial obligations disrupted her schooling, as she had to cease attending after a week due to a family tragedy, subsequently leading to her marriage. Similarly, Mr. Vy, aged 37, shared his educational experience, stating that "I completed only grade 1, while my child has reached grade 2". He expressed "a desire for his child to progress to grade 3, yet the family currently faces financial difficulties hindering this aspiration". In light of these challenges, urgent action is warranted to address educational deficiencies, particularly among vulnerable populations. Initiatives such as free literacy classes for the elderly and targeted efforts to encourage ethnic minority students' school attendance are crucial steps in this regard. Moreover, the integration of social and ethical considerations, including local constraints and perceptions, is essential in designing community-based livelihood resilience-building programs (Phuong et al., 2023a,b). By incorporating these factors, interventions can be tailored to local contexts, enhancing their effectiveness and ensuring their alignment with community needs and capacities.

Finally, our research highlights traditional social norms, entrenched cultural interventions, and poverty persist as significant determinants contributing to low resilience levels, rendering communities susceptible to external shocks. These findings align with previous research findings (Carter et al., 2007; Tan et al., 2023a,b; Van Huynh et al., 2020) and reveal a troubling cycle of poverty exacerbating vulnerability. Limited access to financial resources, including banking services, due to poverty constrains investment in production and business diversification, crucial for economic growth and climate resilience (Nguyen et al., 2021). Moreover, poverty engenders psychological barriers such as shyness and low self-esteem, impeding meaningful community engagement vital for climate adaptation. This concern is caused by impoverished households' hesitance to engage with external entities due to poverty-related concerns. Until poverty is effectively addressed, significant progress in livelihood restoration remains elusive. These findings highlight the multifaceted challenges impoverished households encounter and emphasize the imperative of inclusive participation in local organizations to bolster livelihood resilience (Phuong et al., 2023a,b). Targeted poverty alleviation interventions are urgently needed to enhance adaptive capacity and resilience, particularly among marginalized communities facing climate change. Economic empowerment initiatives, coupled with confidence-building measures and supportive environments, are pivotal in fostering sustainable livelihoods and resilience (Ha et al., 2023; Phuong et al., 2023a,b).

Furthermore, gendered labor arrangements, social identity constructs, and cultural norms disproportionately affect men and women, with women bearing the brunt of external shocks. For instance, the Tày Poọng ethnic minority residing in Phuong village, Tam Hop commune, largely comprises impoverished households engaged in subsistence farming and forestry. Limited access to information, predominantly for women confined to domestic or forest-related activities, exacerbates their vulnerability. The Tày Poọng ethnic minority residing in Phuong village, Tam Hop commune, inhabits an isolated area within the forest, in close proximity to Pu Mat National Park's special-use forest. With a predominant focus on farming, cassava cultivation, and secondary forestry products, the community faces considerable socioeconomic challenges, characterized by low education levels and predominantly impoverished

households. Tày Poọng women, primarily engaged in domestic or forest-related activities, encounter barriers to accessing information due to limited social interaction and minimal involvement in business ventures. Mr. Vieng, a 37-year-old resident of Phong village, noted that “due to the limited economic opportunities, women’s interactions with the outside world are minimal, primarily confined to work and home duties”. An official from Tam Hop commune highlighted the significant role of Tày Poọng women in household responsibilities and income generation, “often necessitated by men’s alcohol consumption habits”. Despite this, decision-making power typically rests with men within the community, perpetuating gender disparities.

To address these gender disparities, targeted interventions are needed to empower women economically, enhance access to education, and challenge traditional gender roles and expectations within the community. This could involve initiatives such as vocational training programs for women, awareness campaigns on gender equality, and promoting women’s participation in decision-making processes at both household and community levels. Additionally, integrating a gender perspective into development policies and programs is essential to ensure inclusivity and promote equitable opportunities for both men and women. Persistent propaganda and training campaigns delivered through various mediums aim to foster gender equality. Sharing lessons learned and effective gender integration strategies among localities and social organizations, such as women’s unions and youth groups, is vital. Lastly, we conclude with a haunting quote by a gender expert – “providing women with the opportunity to venture beyond their villages and explore the world is paramount to enhancing their resilience.”

We add that while the Vietnamese government has implemented several laws and policies to enhance women’s rights, such as the National Strategy on Gender Equality for 2021–2030 and the Project Supporting Women in Starting a Business for 2017–2025 (GOV, 2023), our surveys reveal that women, particularly those from poorer backgrounds, continue to face significant structural disadvantages. They still encounter limited access to land, information, and formal credit, and their participation and decision-making power in both household and social contexts remain restricted. One notable initiative aimed at promoting gender equality in mountainous communes and districts is Project 8: Implementing Gender Equality and Addressing Key Issues for Women and Children. This project is part of the national target program for socio-economic development in ethnic minority and mountainous areas for the 2021–2030 period, specifically covering 2021 to 2025. As the organization in charge of implementing Project 8, the Vietnam Women’s Union has made efforts to promote, communicate, and educate to raise awareness at all levels, sectors, communities in ethnic minority-inhabited areas and mountainous areas to gradually change awareness and promote gender mainstreaming in the implementation of local socio-economic development tasks. However, despite these efforts gender inequality still persists.

For example, the Women’s Union of the Tuong Duong district has organized training sessions and awareness campaigns in various communes and villages. However, according to Ms. Ha from the commune’s women’s association notes, “the efforts for gender equality are only in numbers, but in reality there is no real equality between men and women, many families still have a belief that men are superior to women, and domestic violence still exists.” Mrs. Pham from the Women’s Union of Tuong Duong District adds that “to improve the effectiveness of propaganda and increase awareness widely and substantially, it is necessary to promote propaganda for both women and men. Men should be engaged to assist women with domestic tasks and create more opportunities for women to participate in social activities.” Furthermore, although the government has implemented 188 policies in ethnic minority and mountainous areas, including 136 specifically addressing ethnic minorities (GOV, 2023), gender equality programs often fail to address the distinct needs of ethnic minority women. Persistent issues, such as the cultural preference for men over women, underscore the need for broader cultural change. Achieving gender equality requires not only creating supportive conditions for women but also addressing underlying societal attitudes and educating families and communities. Therefore, we recommend that the government and policymakers review and refine existing gender equality policies. Special attention should be given to developing and implementing targeted policies for women across various sectors to better address their specific needs and challenges.

6. Conclusion and limitations

This study utilizes empirical evidence from two ethnic minorities in Nghe An province, Vietnam, to illustrate how perceptions of livelihood resilience amid climate change differ across genders, geographic locations, and ethnic groups, with a specific focus on the intersections of these factors. To conduct a nuanced analysis, we examined how demographic factors relate to the perception of HLR. Over a year fieldwork period, primary data was gathered through three focus group discussions, in-depth interviews with 9 key stakeholders, field observations, and face-to-face interviews with 136 households. The research underscores the pivotal role of gender in shaping resilience, highlighting a significant gender gap wherein women exhibit lower resilience levels than men due to entrenched social norms and constrained access to resources. These findings underscore the importance of adopting an intersectional approach that considers the intricate interplay of gender, ethnicity, and geographic location in understanding and addressing vulnerability in the context of climate change. By employing a gender-based analytical framework and collecting gender-disaggregated data, this study offers a unique perspective to the existing body of research on HLR in Vietnam. The results emphasize the necessity for targeted interventions that not only enhance overall community resilience but also specifically address the unique challenges faced by women in these communities. This includes promoting gender equality through tailored training initiatives, fostering women’s economic empowerment via microfinance groups, and implementing policies supporting sustainable forest management practices.

While this study provides valuable insights, it has certain limitations. It focused on two specific communities in Central Vietnam, and its findings may not be broadly applicable to other regions or community types. Additionally, reliance on self-reported data might introduce biases, and the study did not explore other potentially relevant factors like household size, age, and education levels. Future research should broaden the scope to encompass a larger and more diverse sample of forest-dependent communities across Vietnam. Longitudinal studies could track changes in HLR over time, offering deeper insights into the enduring impacts of climate change and the efficacy of various interventions. Furthermore, incorporating additional variables and examining the interplay between different

dimensions of vulnerability (e.g., economic, social, environmental) would provide a more holistic understanding of the factors influencing resilience in these communities.

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CRedit authorship contribution statement

Ho Thi Phuong: Supervision, Investigation, Conceptualization. **Nguyen Quang Tan:** Writing – review & editing, Writing – original draft, Visualization, Software, Resources, Methodology, Conceptualization. **Phan Thi Quynh Nga:** Writing – review & editing, Investigation. **Le Quang Vuong:** Writing – review & editing, Methodology, Investigation. **Dao Thi Minh Chau:** Writing – review & editing, Investigation. **Nyein Chan:** Writing – review & editing. **Kyaw Win:** Writing – review & editing. **Khin Nilar Swe:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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