

**ASSESSMENT OF LIVELIHOOD VULNERABILITY TO CLIMATE CHANGE:
A CASE STUDY AT CO TU ETHNIC COMMUNITIES
IN HOA VANG DISTRICT, DA NANG CITY**

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Abstract. In Viet Nam, climate change is becoming more and more obvious, causing many difficulties for people's livelihood, especially for ethnic minorities, who still have limitations in terms of education and responding skills and therefore they have very few livelihood options. The Co Tu people are ethnic minorities living mainly in the mountainous communes of Hoa Vang district, Da Nang City, Viet Nam. The consequences of climate change directly affect the physical and spiritual life of the local inhabitants. The objective of this study is to assess the livelihood vulnerability to climate change for the Co Tu ethnic group in Hoa Vang district, Da Nang City based on the Livelihood Vulnerability Index (LVI). This empirical research has implemented the framework for Livelihood Vulnerability to Climate Change proposed by Intergovernmental Panel on Climate Change (IPCC). The results of the study show that the livelihood vulnerability of the Co Tu ethnic group in Da Nang is relatively low, in the Co Tu people in Phu Tuc village have a livelihood vulnerability lower than the Ta Lang and Gian Bi villages. However, some aspects need to be improved such as social network, health, food, and household living conditions. This research contributes to raising awareness against climate change and environmental protection; at the same time, it helps management agencies to have appropriate policies to ensure synchronous development and improve all aspects of the community's life.

Keywords: climate change, Co Tu ethnic group, Da Nang city, livelihood vulnerability index.

1. Introduction

The effects of climate change have become more and more undoubtedly in Vietnam. Typhoons have been increasing in both quantity and intensity, especially since more "super storms" occurred. The rainfall volume changes non-seasonally, also non-spatially, causing many severe floods. The complicated and extended heat has caused numerous issues for people's livelihoods, specifically in Co Tu ethnic group – Hoa Vang district, Da Nang City. Due to the remote distance, people in this area often have difficulty accessing information, market access, public services, and education. Production activities are mainly based on experience. In recent years, climate change and its implications have continuously increased, leading many Co Tu people to lose crops and suffer from poverty. However, the effect of climate change on local people's livelihood still has not been clearly assessed.

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Da Nang City is an area that is strongly affected by climate change, natural disasters, and urbanization (Tran T. A. *et al.*, 2022). In order to mitigate the impacts of climate change on communities, and enhance people's awareness of climate change response activities, studying sustainable socio-economic policies, especially for ethnic minority areas is necessary to assess the livelihood vulnerability due to climate change. Co Tu people in Da Nang City reside mainly in 3 areas of Hoa Vang district, in the mountainous areas west of Da Nang City, including communities in Phu Tuc village, Hoa Phu commune, Ta Lang and Gian Bi villages, Hoa Bac commune. There have been few studies on the topics of livelihood vulnerability at the domestic and global extent, therefore this research provides an important background both in theoretical and practical aspects, especially since it is conducted in Hoa Vang district of Da Nang City from the geographical basis.

2. Content

2.1. Understanding the Livelihood Vulnerability Index

The definition of vulnerability has been mentioned in various studies in the literature (Turner *et al.*, 2003, Barroca *et al.*, 2008, Hinkel, 2011, IPCC, 2014). The Intergovernmental Panel on Climate Change (IPCC) defined vulnerability as “the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt” (IPCC, 2014). According to IPCC, vulnerability is considered as a function of three main components: exposure, sensitivity, and adaptive capacity (Figure 1).

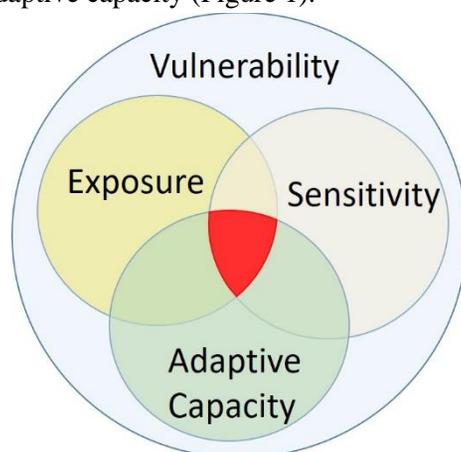


Figure 1. Concept of Climate Change Vulnerability (Adapted from IPCC, 2014)

The Livelihood Vulnerability Index (LVI) was first developed by Hahn *et al.* (2009) in a case study in the Republic of Mongolia (Africa). LVI uses a number of variables that cover aspects related to climate change under the IPCC framework including exposure to natural disasters and climate change, household resilience and household sensitivity to the impact of climate change. This indicator is calculated mainly based on primary data collected through household interviews.

Within the scope of this study, the authors used the sustainable livelihoods of (Hahn *et al.*, 2009) to conduct the analysis, as it is a simpler livelihood framework, with clear criteria and is easier to use than other frameworks. However, due to the fact that the research territory is at the commune level and the access and inheritance of resources are limited, the authors focus on a number of specific and essential components of livelihood and make appropriate adjustments.

Regarding the economic and social characteristics of Hoa Phu and Hoa Bac communes, some LVI sub-components have been omitted, modified, or added compared to the LVI components of Hahn et al. (2009). For example, the issues of malaria or conflicts in water use are not included in the vulnerability index in Hoa Phu and Hoa Bac communes because these issues do not clearly appear in this region. The main and secondary components for calculating the LVI for the Co Tu ethnic group in Hoa Phu and Hoa Bac communes are shown in Table 1.

The authors have designed a set of indicators assessing livelihood vulnerability for the Co Tu ethnic group in Da Nang City, consisting of 7 main components: household characteristics, livelihood strategies, social networks, health, food, household living conditions, natural disasters and climate change.

**Table 1. Index of livelihood vulnerability (LVI)
for ethnic minorities in Hoa Vang district, Da Nang City**

Key components/indicators	Explanation of indicators	Source
1. Household characteristics		
Dependent populations	Population under 15 years and over 60 years per family	Hahn (2009)
% female heads of households	The percentage of heads of households is female. If the head of the household is male and often does not stay at home, the head of the household is considered female	Hahn (2009)
% of householders who have not finished primary school	The Percentage of households with heads of households who have not finished primary school	Hahn (2009)
Poverty rate (%)	The Percentage of households with income levels below the prescribed poverty line (less than \$1.90 a day)	Additional authors
2. Livelihood strategies		
% of households making a living mainly depend on agriculture /forestry	The Percentage of households that consider agriculture/forestry to be the main source of life for the family	Hahn (2009)
% of households with family members working outside the locality	The percentage of households indicated that at least one person in the family went to earn a living elsewhere (city/province)	Hahn (2009)
% of households with members of working age who are unemployed/ underemployed	The Percentage of households indicated that at least one family member of working age was unemployed/underemployed.	Additional authors
3. Social networks		
% of households do not have access to information sources	The percentage of households that do not have at least one type of information media such as television, radio, telephone, internet...	Additional authors
% of households receiving support from mass government	The percentage of households receiving support from government agencies in the	Hahn (2009)

agencies in the past 12 months	past 12 months	
Average distance/time to commune administrative center (km or min)	Average distance/time from household to commune center (km or minute) – get information	Additional authors
4. Health		
% of households with family members suffering from chronic and serious diseases	The percentage of households with people in the family with chronic diseases such as diabetes, heart, asthma, and cancer,...	Hahn (2009)
% of households with people in need of regular care	The percentage of households with people in need of daily care (elderly, young children, disabled people)	Author edit from Hahn (2009)
Average time to the nearest medical facility	Average time to commune health station (minutes)	Hahn (2009)
5. Food		
% of households without food sources / mainly self-produced food	The percentage of households that do not have a primary source of food from farming and animal husbandry	Hahn (2009)
The average number of months of lack of food	The number of months the family has difficulty earning a living	Hahn (2009)
% of households without food reserves	The percentage of households that do not stockpile food (excluding the share sold)	Hahn (2009)
6. Household living conditions		
% of households using water mainly from natural sources for daily life	The percentage of households using domestic water mainly from natural sources such as ponds, lakes, rivers and streams, and rainwater,...	Hahn (2009)
% of households do not have enough water to use for living all year round	The percentage of households that reported insufficient water for year-round living	Hahn (2009)
% of households using septic sanitation works	The percentage of households using septic toilets	Additional authors
% of households with non-permanent houses are easily destroyed by tornadoes/typhoons, rainstorms, ...	The percentage of households with non-permanent houses (collapsed, weak houses) are prone to roof speed, falling by tornadoes/typhoons, rainstorms.	Additional authors
7. Natural disasters and climate change		
The average number of natural disasters affecting families in the past 5-7 years	Total floods, droughts, landslides, typhoons, ... impact on the family in the last 5-7 years	Hahn (2009)
% of households not receiving early warning of impending	The percentage of households that do not receive information about natural disasters	Hahn (2009)

natural disasters	(floods, rainstorms, ...) is urgent to have a response plan.	
% of households have suffered property damage due to natural disasters in the past 5-7 years	Percentage of households with property damage affecting family life caused by natural disasters in the past 5-7 years	Hahn (2009)
% of households with injuries/deaths due to natural disasters in the past 5-7 years	Percentage of households with injuries or deaths caused by natural disasters in the past 5-7 years	Hahn (2009)

Source: Authors synthesis and additions from Hahn et al., 2009

This set of indicators is then reclassified according to the (IPCC, 2014) approach for assessment of climate change vulnerability as shown in Table 2.

Table 2. Elements constituting the vulnerability index according to the IPCC

Constituent elements of LVI – IPCC	Main factors
Exposure	Natural disasters and climate change
Adaptive Capacity	Demographics
	Livelihood strategy
	Social and financial networks
Sensitivity	Health
	Food
	Family living conditions

Source: Hahn et al., 2009

2.2. Research Methodology

2.2.1. Data collection method

Hoa Bac and Hoa Phu communes which locate in Hoa Vang district, Da Nang City has a total of 17 villages of which 14 villages are mainly Kinh ethnic people, and 3 villages are mostly Co Tu ethnic community. These 3 Co Tu ethnic groups reside in the villages of Ta Lang (Hoa Bac), Gian Bi (Hoa Bac), and Phu Tuc (Hoa Phu). The study focuses on the evaluation of LVI for the Co Tu ethnic community in Da Nang, and therefore 3 villages of Ta Lang, Gian Bi, and Phu Tuc were selected. The total number of households in 3 villages according to the statistics of the communes is 389 households. The authors conducted a social survey of 150 households of the Co Tu community in the study area to collect field data and synthesized the LVI. The field survey on livelihood vulnerability due to climate change was conducted through household interviews in April 2022. The questionnaire is designed based on the information to be collected in Table 1. The authors contacted the village leaders and deputies to get assistance in inviting households for an interview. The basic information about the number of households surveyed is shown in Table 3 below.

Table 3. Information about the selected locations and number of surveyed households

Village name	Number of households	Number of households surveyed	Central geographic coordinates	
			Latitude	Longitude
Ta Lang	103	30	16°07'01"B	107°58'01"E
Gian Bi	148	60	16°07'11"B	107°59'06"E

Phu Tuc	138	60	15°02'47"B	108°02'47"E
Total	389	150		

Source: Authors

2.2.2. Method of calculating the Livelihood Vulnerability Index due to climate change

a. Livelihood Vulnerability Index (LVI)

LVI applies the equal weight method for key elements. Each sub-element is measured with different units, so it is necessary to first standardize them to be comparable.

$$S_d = \frac{S_d - S_{\min}}{S_{\max} - S_{\min}}$$

In which, S_d is a secondary element of the d community, S_{\min} and S_{\max} are the smallest and largest values reflecting the low and high livelihood vulnerability respectively.

An index for each major vulnerability factor is calculated as an average of standardized secondary indicators:

$$M_d = \frac{\sum_{i=1}^n \text{index} S_{di}}{n}$$

In which, M_d is the major vulnerability factor for the d community, S_{di} represents the sub-factor index i , and n is the number of sub-factor indicators in the primary factor index. The average value of the main indicators is considered LVI:

$$LVI_d = \frac{\sum_{i=1}^8 W_{mi} M_{di}}{\sum_{i=1}^8 W_{mi}}$$

Where LVI_d is the LVI for community d . M_{di} is the value of each major indicator, and W_{mi} represents the weight of each component. This study applied the equal weighting scheme for all components of LVI.

b. LVI according to the approach of the IPCC (LVI - IPCC)

LVI - IPCC is calculated to apply the same indicators used in LVI calculations (Hahn et al., 2009). Here, instead of integrating all factors into LVI, they are divided into 3 groups of vulnerable factors in terms of exposure, sensitivity, and adaptability to climate change (see Table 2 above). Each of the 3 elements according to the IPCC is calculated using the following formula:

$$CF_d = \frac{\sum_{i=1}^n W_{mi} M_{di}}{\sum_{i=1}^{8n} W_{mi}}$$

In which, CF_d is one of the factors that make up the LVI - IPCC (exposure, sensitivity, and adaptability) for the d community, W_{mi} is the weight for each major factor and M_{di} is the main factor I of the d region. Then LVI - IPCC is calculated by the following formula:

$$LVI - IPCC_d = (e_d + s_d + a_d) / 3$$

Where $LVI - IPCC_d$ is the indicator of the livelihood vulnerability of the community d using the IPCC's vulnerability framework, e is the exposure value, s is the sensitivity, and a is the adaptive capacity of the community d . These components are calculated based on the specific group of key factors as shown in Table 3.

2.3. Results and discussions

2.3.1. Characteristics of the Co Tu ethnic group in Hoa Vang district – Da Nang City

Co Tu ethnic people are concentrated in the western mountains of Quang Nam province, Thua Thien Hue province and Da Nang City, a few live in the Western Truong Son mountainous region of Laos. There are two groups, the Co Tu group in the highlands and the Co Tu group living in the lowlands. Co Tu people in Da Nang City currently belong to the lowland

Co Tu group, living in Hoa Phu and Hoa Bac communes, Hoa Vang district. The Co Tu ethnic group (Ca Tu, Ka Tu) is part of a community of 54 ethnic groups in Vietnam. The Co Tu language belongs to the Mon-Khmer language family (South Asian language) and is related to Ta Oh and Bru - Van Kieu. The population of this ethnic group in the whole territory of Vietnam is about 74.2 thousand people (Committee for Ethnic Minorities Affairs, 2022).

The traditional production activity of the Co Tu people is mainly cultivating in the way of handing out trees with axes and knives and burning, then poking holes with sticks to examine seeds, weeding with scrapers with bending iron blades, and stripping rice by hand. Polycultures and intercropping are applied usually, and after every few crops, the land is abandoned for a long time before further cultivation. There is only one crop is planted per year.

The domestic animals of the Co Tu culture are mainly buffalo, pigs, dogs, and chickens. However, the daily source of food is mainly brought back by gatherers, hunters and fishermen. Craftsmanship only includes weaving and pottery in some places bordering Vietnam - Laos; own knitting developed widely. The commodity economy is limited, and the form of exchange of things is still popular today.

Village community relations are quite close. A village is a residential unit in a certain and distinct location that is self-governing based on custom, headed by the respected "village elder". Social divisions are not yet deep. The inheritance is determined by guillotine gongs, buffaloes, jewelry, and fabrics.

The highlight of the Co Tu people's costume is the decorative pattern woven directly with beads of various types: plastic beads, lead beads, and agate beads. Accompanying the costume is the jewelry of materials such as pig fangs, silver, and agate, ...

The Co Tu community has created and preserved the unique cultural values of their nation in terms of costumes, music, festivals and customs. These cultural features have contributed to the diversity of Vietnamese culture.

2.3.2. Results of the livelihood vulnerability index (LVI) for the Co Tu ethnic group in Hoa Vang district

a) Household characteristics

The general vulnerability index in terms of household characteristics of the Co Tu people in Gian Bi village is 0.455; of Co Tu people in Ta Lang village is 0.347 and of Co Tu people in Phu Tuc village is 0.260 (Table 4). The Co Tu community in Gian Bi village has more vulnerable household characteristics than the Co Tu community in Ta Lang and Phu Tuc villages. This difference is mainly due to the fact that the Co Tu community in Gian Bi village has a high percentage of dependent population, a very young age of the head of household and a lower level of education.

b) Livelihood strategy

The vulnerability index of the Livelihood Strategy of the Co Tu ethnic group in all three villages is relatively high. The vulnerability of the Co Tu ethnic group in Gian Bi and Ta Lang villages are higher than that of Phu Tuc village (0.387 and 0.365 compared to 0.324 in Table 4). The percentage of households with family members working elsewhere is very small (12% in Gian Bi village; 15.3% in Ta Lang village and 24.5% in Phu Tuc village). Similarly, the number of households with members working in occupations other than agriculture is also very small, especially for the Co Tu community in Ta Lang and Gian Bi villages (accounting for 18.5% for Ta Lang village and 12.3% for Gian Bi village), while in Phu Tuc village accounting for 36.5%. Households with members working elsewhere or in occupations other than agriculture, when a natural disaster occurs in the locality, will be less vulnerable.

c) Social network

Social and financial networks indicate the level of access to information, the level of cooperation that helps within the community with organizations, governments and the financial viability of the community. The better the accessibility, the easier it is to adapt to events happening in the community (e.g. droughts, floods). The level of access to information in the household depends on the type of media owned by the family as well as the distance from the household to the commune center. The survey results show that people's access to information is quite good, there are no households that do not have information facilities for the Co Tu ethnic group. This fact leads to the low social network vulnerability index in all three villages that are shown in Table 4, in which Phu Tuc village has the lowest one due to better access to social information.

d) Health

Public health is reflected in the percentage of households with family members in need of regular care (young children, the elderly), and people with chronic and serious diseases with poor health. Co Tu ethnic communities in Gian Bi, Ta Lang and Phu Tuc villages have public health index of 0.088%; 0.176% and 0.035%, respectively. The distance to the medical facility in the commune center for the Co Tu ethnic group in Phu Tuc village is on average 5 km, while for Co Tu people in Ta Lang and Gian Bi villages is 10 km. In general, the Co Tu community in Phu Tuc village is less vulnerable than the other two villages (Table 4).

e) Food

The results of the field survey on the characteristics of food sources and the vulnerability index of the Co Tu ethnic group showed that most households here mainly spend their own money to buy food. Therefore, the number of months with food difficulties in the Co Tu community is still high (2 months). There was almost no difference in the crop diversity index and the percentage of households without food reserves for the Co Tu community in all three villages.

f) Household living conditions

The number of water vulnerabilities in the three villages of Gian Bi, Ta Lang and Phu Tuc is 0.054%; 0.035%, and 0.13%, respectively. The vulnerability index of houses and productive land of the Co Tu ethnic group in Hoa Vang district is high, in Gian Bi village is 0.153%, Ta Lang village is 0.173% and Phu Tuc village is 0.057%. Regarding housing, it can be seen that Co Tu people in Hoa Vang district live in non-permanent and semi-permanent houses, mainly houses that were subsidized for construction in 2002 and 2003.

g) Natural disasters and climate change

This study conducted a survey on natural disasters that occurred in the period 2014 to 2021 in the study area and calculated the vulnerability index of exposure to natural disasters and climate change in the Hoa Vang district. The survey results showed that Co Tu households in Ta Lang and Gian Bi villages had a higher level of vulnerability than Co Tu households in Phu Tuc village. However, the difference is not much (0.294; 0.276 compared to 0.215) mainly due to the level of exposure to natural disasters according to people's assessments.

h) Composite Livelihood Vulnerability Index (LVI)

The results of comparing the livelihood vulnerability index of the main components of the Co Tu ethnic people in all three villages are shown in Figure 2 and Table 5. The LVI index of Gian Bi is 0.288, Ta Lang is 0.270 and Phu Tuc is 0.174, respectively (Table 5). It can be seen that the Co Tu ethnic group in Ta Lang and Gian Bi villages are more vulnerable in terms of LVI than the Co Tu ethnic group in Phu Tuc village. This difference is mainly due to the social networks, health and food of the Co Tu ethnic group in Ta Lang and Gian Bi villages are

more vulnerable. Meanwhile, Co Tu people in all three villages are most vulnerable in terms of livelihood strategies.

2.3.3. Livelihood Vulnerability according to IPCC (LVI – IPCC)

The degree of livelihood vulnerability according to IPCC of the Co Tu ethnic group is shown in Table 4, Table 5 and Figure 2. The LVI-IPCC ranges from 0 (least vulnerable) to 1 (most vulnerable). The results show that all three villages have low average livelihood vulnerability, in which the Co Tu community in Phu Tuc village is less vulnerable to climate change than the Co Tu people in Ta Lang and Gian Bi villages.

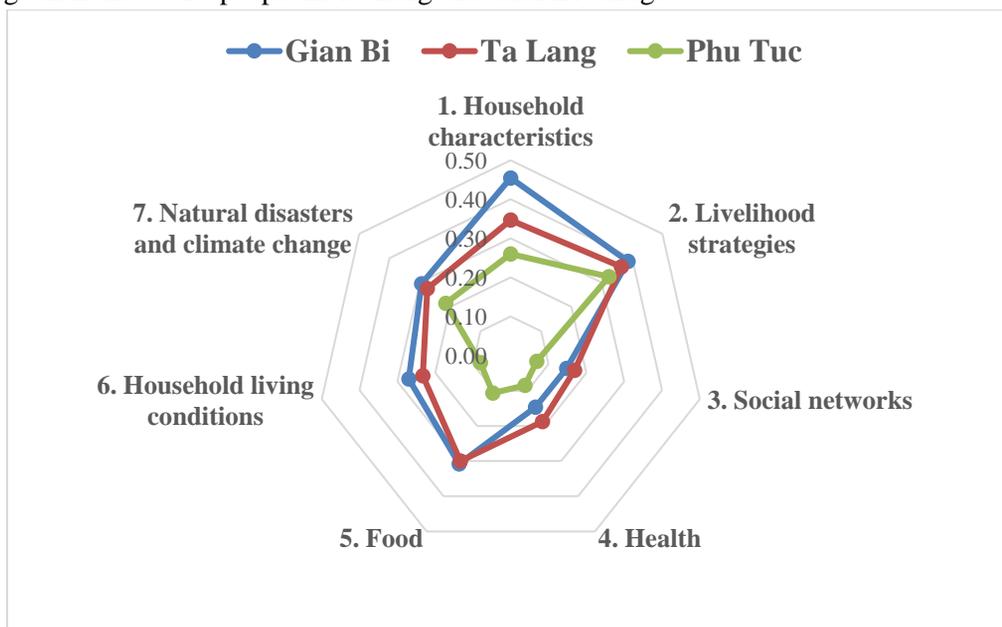


Figure 2. The number of vulnerable ethnic livelihoods of Co Tu ethnic group in Hoa Vang district, Da Nang city is divided by communes

Source: Author's elaboration.

Table 4. Livelihood Vulnerability Index of Components according to IPCC (LVI - IPCC) of Co Tu ethnic group, Hoa Vang district, Danang City

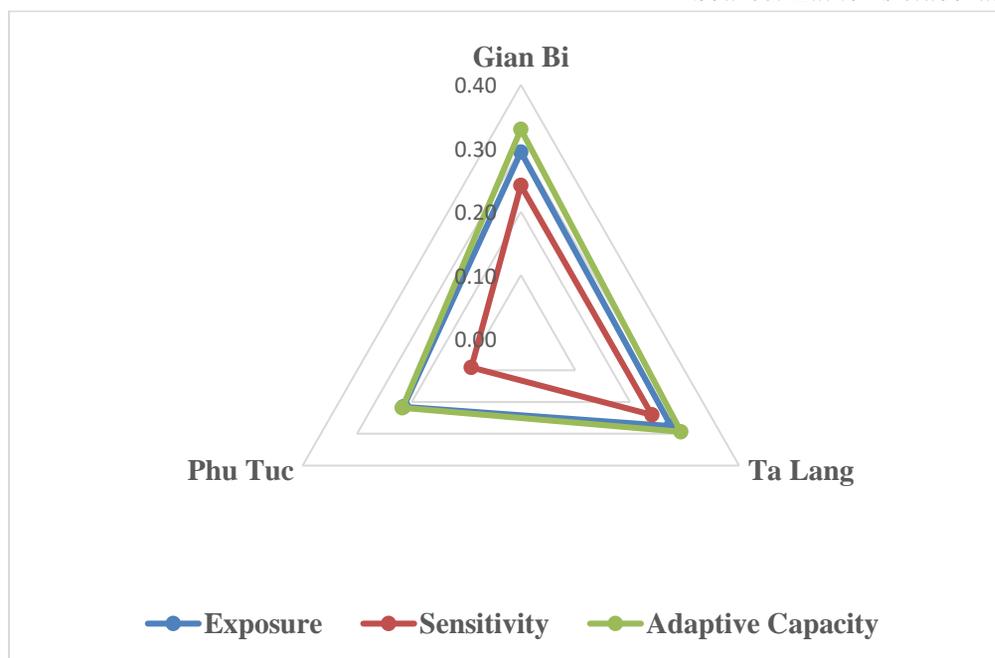
LVI-IPCC Components		Gian Bi	Ta Lang	Phu Tuc
Exposure	Natural disasters and climate change	0.294	0.276	0.215
Adaptive Capacity	Household characteristics	0.455	0.347	0.260
	Livelihood strategy	0.387	0.365	0.324
	Social and financial networks	0.148	0.169	0.068
Sensitivity	Health	0.146	0.188	0.085
	Food	0.308	0.300	0.107
	Family living conditions	0.270	0.233	0.081

Source: Author's elaboration

Table 5. Livelihood Vulnerability Index of Components according to IPCC (LVI - IPCC) for Co Tu ethnic group, Hoa Vang district, Da Nang City

Components according to IPCC	Gian Bi	Ta Lang	Phu Tuc
Exposure	0.294	0.276	0.215
Sensitivity	0.241	0.240	0.091
Adaptive Capacity	0.330	0.293	0.217
LVI - IPCC	0.288	0.270	0.174

Source: Author's elaboration.



Source: Author's elaboration

Figure 2. IPCC Livelihood Vulnerability Index (LVI-IPCC) of the Co Tu ethnic group in Hoa Vang district, Da Nang City.

Regarding exposure to natural disasters and climate change, there are no significant differences between the three villages. This shows that all three communities are affected by climate change similarly. However, the Co Tu ethnic community in Phu Tuc village has a much lower sensitivity (based on indicators of health, food, and household living conditions) to climate change than the Co Tu ethnic communities in the Gian Bi village and Ta Lang villages. Meanwhile, the adaptive capacity to climate change (based on indicators of household characteristics, livelihood strategies and social networks) of the Co Tu community in Phu Tuc village is also lower than these indicators in Ta Lang and Gian Bi villages. This leads to the lowest LVI livelihood vulnerability index of the Co Tu community in Phu Tuc village. The two remaining villages, Gian Bi and Ta Lang, show higher vulnerability to climate change in terms of LVI. The results of this study indicate that it is necessary to have policies to improve the sensitivity index, as well as improve the adaptive capacity to climate change for the Co Tu communities in Gian Bi and Ta Lang villages.

2.3.4. Potential approaches in mitigation of the livelihood vulnerability to climate change for the Co Tu ethnic communities in Da Nang

In order to minimize the vulnerability caused by climate change for ethnic Co Tu people in Hoa Vang district, it is necessary to take interventions to improve living conditions. It can be clearly seen that the vulnerability of the livelihood strategy is relatively high because all three villages' livelihoods rely on agriculture. There are very few households that have members who go for working outside the community as well as in other economic sectors. The information collected during the field investigation showed that the income was largely based on agriculture and forestry.

It can be seen that the relatively high social and financial vulnerability of the Co Tu ethnic people is mainly due to the fact that this community depends heavily on physical and financial support from the government and within the community.

Improving the health targets of the Co Tu ethnic minority community is also a very important issue to reduce the vulnerability to climate change in this community. Contributing factors to this vulnerability are mainly the distance to the nearest health facility and the proportion of households with people in need of care, mainly young children. Children are susceptible to the weather. When extreme weather events such as heat, and cold occur, children easily get sick. Meanwhile, the medical facility is quite far from the Co Tu ethnic communities. Thus, strengthening the health network is a very important solution to enhance the health of the community, thereby increasing resistance to extreme weather.

Although the vulnerability of household characteristics is not too high, it is an important factor related to the community's ability to adapt to climate change. Regarding this factor, the indicator contributing to the high vulnerability of the Co Tu community in Hoa Vang district is mainly the low level of education. Up to 45% of household heads have not finished primary school. Therefore, in order to reduce the vulnerability to this household characteristic, it is very important to improve the educational level of the Co Tu community, at least the ability to read and write. The survey shows that most Co Tu women living in these villages are mostly not or very limited in communicating in the Kinh language (Vietnamese). This can also be seen as one of the limitations of access to information and leads to a limitation on the ability to adapt to climate change.

In addition, the housing vulnerability index is the lowest in all 3 villages in the 7 indicators calculated in this study. However, the field survey of this study has observed that the houses of Co Tu households are still very temporary and easily destroyed if there are natural disasters, especially typhoons.

The most important policy that could be identified from this study is the diversification of the livelihood strategies for the local Co Tu communities. Based on the natural resources and indigenous values of Co Tu community in Da Nang, eco-tourism could be considered as a potential economic sector for these villages (Ministry of Culture, Sport and Tourism, 2021). In 2019, Hoa Vang District People's Committee has decided to establish a project to support the development of a community eco-tourism model in the Hoa Bac commune. The project was implemented with many contents such as repairing and restoring the Guol houses in the two villages of Ta Lang and Gian Bi, and building a display house for handicraft products of the Co Tu ethnic group. This model of community eco-tourism development is really a new sustainable livelihood for the Co Tu ethnic community and helps them eliminate hunger and reduce poverty with their natural values and indigenous culture.

3. Conclusion

Based on the LVI and LVI - IPCC analysis results, both Co Tu ethnic communities in Gian Bi and Ta Lang villages are more vulnerable to climate change than the Co Tu ethnic group in Phu Tuc. The difference is mainly because the Co Tu ethnic community in Phu Tuc village has a much lower sensitivity than people in the other two villages while the adaptive capacity index in Ta Lang and Gian Bi are relatively high. The household characteristics and livelihood strategies are the biggest contributors to the high vulnerability to climate change in both Gian Bi and Ta Lang villages. Based on the analysis of the components contributing to the climate change livelihood vulnerability index above, the proposed interventions for policy-makers to reduce livelihood vulnerability to the people of Co Tu in 3 villages of Ta Lang, Gian Bi, Phu Tuc: (1) If there is a policy to support the implementation of interventions for the people of Hoa Vang district to mitigate the effects of climate change and to improve the adaptability of local communities, priority should be given to the two villages of Ta Lang and Gian Bi because these communities are more vulnerable than Phuc Tuc. (2) Planning of commodity crops, planting areas as well as markets could be considered an important solution in improving livelihood strategies for all three Co Tu villages. (3) Strengthening health facilities in three villages to improve the health of the community thereby increasing resilience to extreme weather. (4) Improve education, especially for women and young children. This solution is very important because as education or awareness increases, it will lead to positive effects for other factors such as better access to information and better livelihood strategies. (5) Eco-tourism could be considered as a sustainable livelihood for Co Tu communities in Hoa Vang district and the government investment should be distributed to the development of eco-tourism in these Co Tu villages in Da Nang City.

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