



RESEARCH ARTICLE

# Indigenous knowledge in climate change adaptation: Case studies of ethnic minorities in the Northern Mountain Region of Vietnam

*Kiến Thức Bản Địa Trong Thích Ứng Biến Đổi Khí Hậu: Nghiên cứu trường hợp của các cộng đồng dân tộc thiểu số tại Vùng Núi Phía Bắc Việt Nam*

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This study aims to investigate the indigenous knowledge (IK) of three ethnic minority groups in the Northern Mountain Region (NMR) of Vietnam. The groups include (1) Tay people who live at lower elevations; (2) a Dao community who tend to live in the middle elevations and (3) Hmong farmers who mainly reside at higher elevations areas of the mountain. This research intends to identify climate change (CC) and its impact on agricultural cultivation and find out how these groups can adapt to CC by applying their IK in agriculture practices. Data was collected through focus group discussions (n=9), in-depth interviews (n=80), and participant observation. From the 80 respondents, 27 live in Bac Kan province, 23 in Yen Bai province and 30 in Son La province; those who had experience in agricultural production, elderly and village heads. The results show that the NMR weather has significant changes that negatively impact agriculture cultivation and local livelihood. Although the respondents are from different ethnic minorities, these farmers are highly aware of the CC risks, leading into adaptation practices. While the Tay people's major adaptation strategies include the use of a variety of native plants and changing planting calendars, the Dao and Hmong people apply intercropping and local techniques methods in terracing fields using local varieties of livestock. Our findings highlight the importance of using the IK of ethnic minorities in adaptation towards CC. A better targeting about the use of local resources in future national policies and projects is encouraged.

*Nghiên cứu này nhằm thu thập kiến thức bản địa (IK) của ba nhóm dân tộc thiểu số ở Miền núi phía Bắc (MNPB) của Việt Nam bao gồm (1) dân tộc Tày chủ yếu sống ở vùng thấp; (2) Người Dao có xu hướng sống ở các độ cao trung bình; và (3) người Hmông chủ yếu cư trú ở các khu vực đồi núi cao. Nghiên cứu này nhằm xác định tình hình biến đổi khí hậu (BĐKH) và tác động của nó đối với sản xuất nông nghiệp, đồng thời tìm hiểu cách thức các nhóm dân tộc thiểu số này có thể thích ứng với BĐKH bằng cách áp dụng các kiến thức bản địa của họ vào thực tiễn sản xuất nông nghiệp. Dữ liệu được thu thập thông qua thảo luận nhóm tập trung (n = 9), phỏng vấn sâu (n = 80) và quan sát người tham gia. Trong số 80 người được hỏi, có 27 người sống ở tỉnh Bắc Kạn; 23 người ở tỉnh Yên Bái và 30 người ở tỉnh Sơn La, là những người có kinh nghiệm sản xuất nông nghiệp, người cao tuổi và trưởng thôn. Kết quả cho thấy thời tiết ở khu vực MNPB đã có những thay đổi so với trước gây tác động xấu đến canh tác nông nghiệp và sinh kế của cộng đồng. Mặc dù những người được hỏi từ các dân tộc khác nhau nhưng họ đều nhận thức được sự thay đổi này của thời tiết, do đó họ đã có những thích ứng riêng. Trong khi người Tày sử dụng giống cây trồng địa phương và thay đổi lịch thời vụ thì người Dao và Hmông chọn phương pháp xen canh và áp dụng kỹ thuật bản địa trên đất ruộng bậc thang và sử dụng giống vật nuôi bản địa. Các phát hiện của chúng tôi giúp hiểu được tầm quan trọng của việc sử dụng IK trong thích ứng với BĐKH của các dân tộc thiểu số, từ đó có thể hướng đến mục tiêu tốt hơn việc sử dụng các nguồn lực địa phương trong các chính sách và dự án quốc gia trong tương lai.*

**Keywords:** indigenous knowledge; ethnic minorities; climate change; adaptation; Northern Mountain Region.

## 1. Introduction

Vietnam is a multi-ethnic country holding 54 ethnic minorities. Ethnic minorities often reside in mountainous and remote areas; they are also scattered throughout Vietnam's territory (United Nations Population Fund (UNFPA) and Ministry of Health, 2017). Many villages and

communes have 3 to 4 different ethnic minorities living together. The residence location plays a vital role in people's cultural and cultivation practices (Tung et al., 2017). Although ethnic minorities differ in customs and traditions, forests and shifting cultivation still play an essential role for most ethnic minorities (Aparna & Trivedi, 2011; World bank, 2018).

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The Mong, Thai, Dao, Van Kieu, Ja Rai, E De, and Ba Na people, living in many provinces and cities across the country, still depend on the forest. Many regions also have forestry production, such as medicinal herbs, firewood, and handicraft materials (CEMA, 2016; O’Leary, 2010). Additionally, ethnic minorities also conduct agricultural practices with the characteristics of upland cultivation (Thang, 2019). If the lowland rural areas have little difference in the development level, the rural regions of ethnic minority and mountainous regions are diversified in the socio-economic development level.

Vietnam has 53 ethnic minorities (14,118,232 inhabitants) in nearly 3 million households (accounting for 14.7% of the country’s population) living in communities in 51 provinces and cities. The most inhabited areas are the Northern Mountain Region (NMR) (about 6.7 million people), followed by Tay Nguyen (2 million people), North Central, and Central Coast (1.9 million people); this accounts for 3/4 of the total country area (Thang, 2019; Tung et al., 2017). Farmers in the ethnic minority community reflect their social lifestyles’ cultural ethnic characteristics and adapt to the region’s natural environment (Kpadonou et al., 2012; Thang, 2019). Indigenous knowledge of ethnic minorities is passed down from generation to generation through social practices. It guides and regulates social relationships and those between people and nature. It contained in all the physical and spiritual aspects of social life such as food production, cattle and poultry breeding, food storage and processing, collection and use of medicinal plants etc. (Hoan et al., 2016; Chuong et al., 2020).

Studies on indigenous knowledge in livelihood activities are also diverse. These include experiences in land use, water use, weather forecasting and changes in livelihood strategies. The newest research on the IK in Vietnam of Chuong et al. (2020) indicates that when farmers apply IK in their farming systems, soil erosion rates tend to decrease as compared with non-indigenous knowledge (NIK) practices. However, few studies have focused on the use of IK in adapting to climate change for reducing risks and maintaining livelihoods in the upland areas.

## 2. Research methods

### 2.1. Case studies

This study was conducted in 3 communes representing three ethnic groups in the NMR: Nam Mau (Ba Be district, Bac Kan province), in the Northeast region characterized by the Tay ethnic group who mainly live in the lower parts; Khai Trung commune (Luc Yen district, Yen Bai province), in the Northwest region, which is characterized by the Dao people who often live in the halfway of mountains; and Long He commune (Thuan Chau district, Son La province), in the highlands of the Northwest, typical of the Hmong. The study areas are shown in Figure 1. As an empirical work of social research, this study required a continuous and iterative process. A qualitative method is suitable for this kind of study; it allows researchers to discover rather than test variables (Corbin & Strauss, 2008).

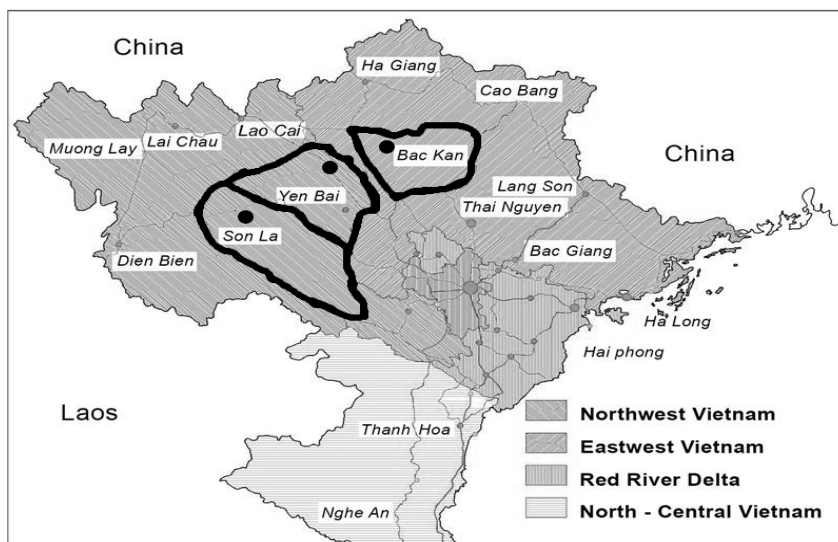


Figure 1. Map of case studies in Vietnam

(Source: Floriane and Jaime, 2013)

### 2.2. Data collection and sampling techniques

Data was collected by applying a purpose sampling technique with the priority of “information-rich” respondents, who are able to provide the most relevant

and detailed information on the study topic (Monique et al. 2011; Merton et al. 1990). The farmers’ selection for an interview followed two strategies: The gatekeeper technique was used to select persons who have knowledge about the characteristic of community members and usually are prominent (or play an essential role) in the community. They also help the

researcher to build trust with participants encouraging them to talk freely during interviews. The snowball technique was used to select respondents by asking key informants or study participants who could provide information for the study or ask respondents to refer other respondents who may provide the answers.

Concerning the sample size of the interviewed persons, the principle of saturation (Glaser and Strauss 1967, cited by Monique 2011) was followed, the researcher continued expanding the sample size until no new data was supplied; a continuation of the interviewing process would become repetitive. In total, in-depth-interviews with 27 people in Bac Kan, 23 people in Yen Bai, and 30 people in Son La was conducted with 9 group discussions and participant observation in 9 villages belonged to the 3 provinces. Data was analyzed with the support of MAXQDA10.

**Table 1. Farmers' perceptions of climate risks (unit: %)**

Amount of rain/ temperature	The Tay people (in Bac Kan)	The Dao people (in Yen Bai)	The Hmong people (in Son La)
Increasing	26.00	22.00	23.00
Decreasing	0.00	0.00	0.00
Irregular	74.00	78.00	77.00

(Source: Surveys, 2019)

A 26% of the respondents in the Tay minority agreed that the amount of rain and temperature is increasing. It is 22% and 23% in the Dao and Hmong communities respectively; in average, 76% of the respondents indicated that nowadays the amount of rain and temperature are very irregular. In May, the temperature tends to be higher while rainfall is at its lowest; this causes drought and negatively affects the farmers' agriculture practices.

The irregular rainfall and temperature cause many natural hazards such as flash flooding, storms, drought, frost, and harsher winters. Focus group discussions with Tay people in Nam Mau commune (Ba Be district, Bac Kan province) revealed that in 2018, there were about 15 flash flooding events and three drought periods in the area. The Dao people in Khai Trung (Luc yen, Yen Bai) reported four extreme cold events, eight extreme hot events and 30 massive rainfall events in their community. The Hmong minority in Long He (Thuan Chau, Son La) indicated that their villages are recently more affected by drought and landslides in summer than during extreme cold and frost in winter.

### 3. Results and discussion

#### 3.1. The current situation of climate change as perceived by respondents

The NMR climate is changing rapidly with extreme weather events increasing in frequency and are often difficult to predict. By interviewing local people, considerable differences in the quantity of rainfall and temperature were found; these has caused many natural hazards such as flooding, landslides, and drought. The data in the Table 1 shows that most respondents agree that the amount of rain is increasing and changing in irregular ways; it is the same with the case of temperature.

#### 3.2. The impact of climate change on the agriculture practices of local people

##### 3.2.1. Impact on crop production

Village heads in the communities explained that 85% of the villagers depend on agriculture in Nam Mau. A 90% and 95% in Khai Trung and Long He, respectively. Recent weather variations have negatively affected both crop and livestock production. Crops in the study areas were affected by climate change in production and cultivation areas, resulting in a loss of income and overall food security. The appearance of pest and diseases occur more often in rice and corn. It causes the raising of production costs such as pesticides and labor reducing productivity. The production cost in terms of electricity, pumps, and irrigation was also increased due to climate adaptation activities. The schedule for planting the crop had to be delayed, due to a deficit of water or drought, resulting in loss of income and low productivity due to prolonged growth period. Due to climate change and extreme weather, the water level of rivers and streams in the communes have decreased with severe water shortages.

**Table 2. Impacts of climate change on crop production from the perspective of local people**

Main crops	The Tay people	The Dao people	The Hmong people
Rice	<ul style="list-style-type: none"> <li>- pests and diseases appear more</li> <li>- drought and cold reduce productivity</li> <li>- paddy rice was buried by flooding</li> <li>- extreme cold affected the root system</li> </ul>	<ul style="list-style-type: none"> <li>- more pests and disease</li> <li>- drought in the summer season</li> <li>- cold in the beginning and drought in the middle of spring season caused production loss</li> </ul>	<ul style="list-style-type: none"> <li>- more pests and diseases</li> <li>- drought and irregular rainfall affected to productivity and harvest time</li> <li>- landslides reduced cultivation areas</li> </ul>
Corn	<ul style="list-style-type: none"> <li>- drought in the planting time and intensive rain during the flowering time affected to productivity</li> </ul>	<ul style="list-style-type: none"> <li>- drought during flowering time</li> </ul>	<ul style="list-style-type: none"> <li>- drought, hail, and whirlwind damaged maize fields and reduced productivity</li> <li>- Irregular rainfall affected to the flowering time and reduced productivity</li> </ul>
Beans	<ul style="list-style-type: none"> <li>- drought</li> </ul>	<ul style="list-style-type: none"> <li>- drought</li> </ul>	<ul style="list-style-type: none"> <li>- drought</li> </ul>
Others	<ul style="list-style-type: none"> <li>- forest was burnt twice in 2018 due to the long-lasting of drought and high temperature</li> </ul>	<ul style="list-style-type: none"> <li>- 8 extreme cold events in 2018 damaged fruit trees</li> </ul>	<ul style="list-style-type: none"> <li>- fruit trees were affected by hail and whirlwind</li> </ul>

(Source: Surveys, 2019)

### 3.2.2. Impacts on livestock

The Tay minority raised mainly poultry and pigs; in recent time, irregular climate has impacted their production because of epidemic breaking out, especially with the hybrid breeding. Dao and Hmong people focus on growing cattle (e.g., horses, buffalos and cows) however, the recent harsh winter affected the cattle; with the extreme cold, frost causing disease and lack of food for cattle were

problematic. The long-lasting cold spells in Khai Trung commune (February 2018) killed many cattle (buffaloes and cows). The commune's temperature dropped as low as 4-8° C for ten days, causing 27 death of buffaloes and cows. Rising temperatures during the summer lead to a higher water demand but water supply is not fully met. Low temperature (extreme cold and damaging cold) makes food scarce for animals, at the same time, it reduces their resistance and increases the risk of infectious diseases.

**Table 3. Local people's perspective on the impacts of climate change on livestock**

Main livestock	The Tay people	The Dao people	The Hmong people
Cattle	<ul style="list-style-type: none"> <li>- cows lack food and have swollen hoof diseases in winter</li> </ul>	<ul style="list-style-type: none"> <li>- foot and mouth diseases</li> </ul>	<ul style="list-style-type: none"> <li>- less food for cattle because of drought, cold, and frost</li> <li>- extreme cold affected negatively to cattle (swollen hoof disease or death)</li> <li>- irregularity of hot and cold caused the outbreak of many diseases</li> </ul>
Pigs	<ul style="list-style-type: none"> <li>- epidemic outbreak</li> </ul>	<ul style="list-style-type: none"> <li>- African Swine fever outbreak</li> </ul>	<ul style="list-style-type: none"> <li>- White feces disease in piglets</li> </ul>
Goat		<ul style="list-style-type: none"> <li>- diseases in the digestion system</li> </ul>	<ul style="list-style-type: none"> <li>- Diarrhea</li> </ul>
Poultry	<ul style="list-style-type: none"> <li>- digestive system diseases, bird flu</li> </ul>	<ul style="list-style-type: none"> <li>- diseases in the digestion system</li> </ul>	<ul style="list-style-type: none"> <li>- Newcastle Disease, coccidiosis, and other chicken diseases</li> </ul>

(Source: Surveys, 2019)

### 3.3. The use of Indigenous knowledge of local people adapting to climate change

#### 3.3.1. The characteristic of respondents

In recent years, general and extreme weather events have affected the agricultural production of ethnic minorities located in the northern mountainous region, therefore, farmers have used many activities to adapt to the changing climate. This study provides an overview of the

demographics of households (Table 4). In general, more than 70% of the respondents are graduated from secondary or primary school with only 21% have a high school degree. Most farmers are of working age (under 60 years old) occupied 94.99%. Farmers have an experience of more than 10 years in agriculture, accounting for 93.75%. It also indicates that the Dao people has more land in average than the other 2 groups, with up to 2.32 ha.

**Table 4. Characteristics of respondents**

Characteristics		Result (N=80)		The Tay people	The Dao people	The Hmong people
		n	%	n	n	n
Education	Primary	26	32.00	2	21	03
	Secondary	37	47.00	21	03	13
	High school	17	21.00	04	06	7
Age	<40	23	28.74	01	12	10
	40 - 60	53	66.25	22	18	13
	>60	4	5.01	4	0	0
	average	41.70	-	45	37.8	42.3
Experiences in agriculture	<10 years	5	6.25	01	4	0
	10-30	55	68.75	12	21	22
	> 30 years	20	25.00	14	5	01
	average	21,32	-	30.16	13.8	20.0
Total land area	<1ha	9	11.25	03	03	03
	1-6	71	88.75	17	27	27
	average	2.14	1-	1.83	2.32	2.27

(Source: Surveys, 2019)

### 3.3.2. Indigenous knowledge of the Tay people

Nam Mau commune has complex terrain separated by rivers, streams, and a high sloping land. There are two larger rivers in the area, the Nang River and Cho Lung River. In summer, the weather is characterized by heavy and intense precipitation, causing flash floods and landslides. In winter, it is typically cold and dry. Cultivated areas are mainly narrow strips of land along rivers, streams, and low valleys. In 2018, about 50 ha of corn and rice were damaged by flash floods and 14 ha of rice fields were waterlogged.

The Tay is the largest minority in Bac Kan. Living along the rivers and around the lake bed, they have experience in paddy rice, tending livestock and weather forecasting. For the later, the Tay people have developed personal techniques involving a keen observation of various faunal and floral movements being uniquely attuned to other physical changes in their surroundings. Those observations include: (1) Observation of the sky; there will be great sunlight and hot the next day if there are many stars. In the early summer months, if there were rainbows in the south, there will be drought. A rainbow that appears in the east is said to be a sign of an imminent storm. (2) Observation of bamboo; bamboo shoots falling on the big bamboo tree or the tree blooms, it will rain heavily. If bamboo shoots grow fast, white in color, easily having flooded. (3) Observation of bees; if bees build low nests, that year will have a lot of rain. (4) Observation of water surface: if there is moss floating on the water surface, it is going to rain and flood. (5) Observation of plants; if longan and litchi have plenty of fruit: the weather will be hot that year. Currently, the weather becomes more irregular, making it difficult to predict by experience.

People know how to update weather forecasts through media such as television, radio, loudspeakers and appropriate response measures. For experience in climate

change adaptation activities, the Tay people identified 2 main areas where they must apply adaptation techniques due to changing weather patterns: (1) Using local varieties; local crop varieties and domestic animals have existed for a long time. Bao Thai rice, Khau Nua Lech (tolerant to drought), green beans, soybeans, black chickens, and black pigs having good resistance to pests and diseases, low input costs -farmers can produce seeds by themselves, make use of food and fertilizers for animals and crops-.100% of interviewees still use native seeds and local varieties. (2) Changing crops and seasons; e.g., observing the sky, if seeing that rainbows appearance in the south at the beginning of the summer season, there will be a drought, do not transplant rice but switch to maize, beans (moldy green beans has tolerant to drought).

### 3.3.3. Indigenous knowledge of the Dao people

Khai Trung is a mountainous, purely agricultural commune located in the west of Luc Yen district, 18 km from the district center. The commune has streams such as Tat En, Giap Chay, Giap Cang, Khe Rang with short and steep features flowing from Nam Ru cave to Lam Thuong to provide water sources to serve production and people's life. Dao minority accounts for more than 60% of people in the commune; they are mainly living on halfway of the mountains and have experience in cultivating rice and crops on terraced upland fields. They also have experience in weather forecasting by observing the sky or the trees. In particular, (1) Observation of the moon: if Lunar eclipse (heavenly dog swallows the moon), it will be rainy; if the moon appears very close and clear, there will be drought. (2) Observation of plants: If the palm tree has a lot of fruit: this year will be very cold. Notably, the Dao people apply indigenous knowledge and experience in soil selection and terracing fields. Accordingly, the Dao people live in halfway mountainous areas with high slopes, so land choice for cultivation is also different.

The area under rice cultivation on terraced fields and upland rice usually accounts for most of the total cultivated land area. The typical rice cultivating of Dao people is terraced fields. When working on terraced fields, the Dao often choose flat land since the slope is not too large and have a thick farming layer with the condition that water can be brought in or terraced fields can catch rainwater from the upper slope near the forest.

After selecting the land, the Dao people proceed to flatten the land by plowing by buffalo or hoe depending on the land use purpose (growing rice or planting crops). The Dao commune decides to bring water to the fields or not. In addition to the form of cultivation on terraced fields, the Dao also cultivate on upland fields. Often, they use slash-and-burn plowing for cultivation. In the process of using land, especially upland fields, the Dao people also has a lot of experience in classifying different land, based on which suitable crops for each type of land were proposed. With the fields under cultivation, appearance of all kinds of thatched grass or May grass, means that such soil has been degraded (high laboring in weeding and low yield). If seeing wormwood and flying vegetables means that the soil is good for cultivation. The process of upland cultivation is followed by a closed process such as: clearing -> burning -> making soil -> poking holes -> seeding -> planting -> weeding -> fertilizing -> harvesting -> preservation.

The Dao people live on mountains, and their livelihoods depend on the upland field, mainly using rainfall in summer. Intercropping can help Dao people optimizing the use of their land in a short time of summer. The Dao people have different cultivating strategies based on the high level of their upland fields: (1) in the lower parts they will grow vegetables or Dao taro intercropping with local melon or corn grow together with cinnamon. (2) in the higher regions they plant bamboo and local bean, which is tolerant of drought. In addition, Dao people have their own local variety of pigs (named Lon Man) which has black hair and could suffer from cold. When pigs have diarrhea, people will pick guava leaf to make juice to treat the pigs. The Dao people use papaya flowers soaked in lime water to make juice for ill chicken.

### 3.3.4. Indigenous knowledge of the Hmong people

Long He Commune (Son La Province) is one of the remote and extremely difficult communes. The people are mainly from Hmong minority whose economic development is primarily based on upland fields (upland rice, corn and pumpkin cultivation). Due to shifting cultivation habits of the Hmong, many varieties of crops, including rice and corn, are rotated or intercropped according to their lifestyle. The value of indigenous crops has been eroded in the village with just fruit trees or vegetables in the home garden. New varieties have gradually replaced upland rice or local maize with a higher yield than the local ones.

Vegetables in the garden are mainly pumpkin, beans and ginger. The primary source of forest vegetables is bamboo shoots and some leaves used as herbs. The IK is actually the necessary foundation for the people's self-sufficiency, helping people less dependent on the outside to reduce vulnerability in the community due to climate change. However, this is gradually disappearing in the communities.

The Hmong people have a long experience in land use and upland cultivation techniques. The clearing of an upland field begins with the selection of the places, followed by the release and burning of trees. Through these three stages, it is considered that there is already a field for production. According to the people's experience, the suitable land for cultivation must be located where there are plenty of trees. After burning, dense trees will be a rich source of fertilizer for the soil, the more trees, the larger the amount of ash and the better the soil. The land with less steep is the more favorable for the farming process, the erosion power of rainwater is less, so the amount of humus is retained and the process of traveling during cultivation is more straightforward.

The outstanding characteristics in the upland cultivation techniques among the Hmong people are the intercropping and rotation crops. This takes advantage of the summer-autumn weather and increases the rotation coefficient of cultivated land, increasing land use's coefficient to ensure the demand for food. In one upland field, people can grow corn, vegetables, beans and pumpkin. With this approach and despite the yield of crops is not high, the cultivated area's total income is increased, meeting the demand for food. Also, this method is suitable for the natural conditions of the local people. Intercropping is a scientific measure to take advantage of the weather and preventing erosion in sloping areas.

Hmong farming practices are mainly cultivating on sloping land and depend on rainfall (only in summer). The Hmong people take advantage of intercropping to increase productivity in agroforestry such as green leaf Hmong kale intercropped with corn or Hmong melon intercropped with upland rice or ginger. They also use their indigenous knowledge in using land (e.g., in the highest areas they plant big trees such as Hmong apple or bamboo intercropped with *Amomum Villosum* (Sa Nhan)). In the middle parts, they grow fruit trees (e.g., mango and longan) intercropped with corn or upland rice, and in the lower parts, they grow beans or peanut intercropped with vegetable or corn. The use of intercropping in agroforestry by the Hmong people helps them to increase their productivity and reduces the risks caused by climate change. Hmong have good knowledge of raising cows. Their local cow variety is named Hmong cow. When their cows have foot and mouth disease, they use water from pickled bamboo shoots. During winter, they use crushed ginger with wine applying for swollen feet diseases in cows and buffalo.

## 4. Conclusion

The weather in the NMR has significantly changed the quantity of rainfall and average temperature derived in irregular temperature fluctuations. Higher temperatures and rainfall volumes cause either drought or flash flooding, affecting their production heavily. It also strongly impacts agricultural production and the livelihood of people in the region. The appearance of diseases happens more often due to climate change leading to the local people's increasing production cost.

Natural hazards have affected heavily agricultural practices of local people. In response to the changing climate, local people have different activities such as using local crops and livestock varieties which have a good tolerance to irregular climate. Additionally, various techniques to prepare and use land are adapted to climate change. They also have local knowledge of livestock disease treatment. We support the views that there should be a combination of local knowledge and the introduction of new scientific technologies in the most effective way. Our findings may be instrumental in future adaptation planning and policies regarding climate change, helping to increase the awareness regarding CC.

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