

Ethnic Minority Farmers' Perceptions of Climate Change and Its Effects on Crop Production in Northwest Vietnam: A Case Study of H'mong Farmers in Pa Lau Commune, Tram Tau District, Yen Bai Province

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Abstract

This study aimed to assess the perception of H'mong farmers in the northwest mountainous region on climate change, its impacts on crop production, and their adaptation strategies. Reports on natural disaster events and their damages for the period ranging from 2012-2021, together with meteorological data including daily temperature and precipitation for 1991-2021, were collected. Fifty households among the H'mong farmers were randomly selected from four villages of Pa Lau commune for interviews based on structured questionnaires. The results showed that most H'mong farmers know that the climate is changing. However, their perceptions of the trends of these changes in terms of rainfall, temperature, and extreme weather events were not consistent with the analysis of meteorological data. The results also revealed that this is because the farmers evaluated the changes mainly based on their observations of short-term climate changes and the associated impacts that directly affect their livelihoods. The farmers perceived that soil erosion and hot and extreme cold weather have tended to increase their impacts on the production of some major local crops. Other types of natural disasters such as droughts, floods, landslides, pests, and strong winds have tended to have more or less impacts depending on the crop type. Adaptation measures taken by farmers to mitigate the effects of climate change are mainly simple, flexible, seasonal and low-cost measures. This study provides basic information for authorities at all levels to mitigate the negative impacts of climate change.

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Keywords

Climate change perception, climate change impacts, adaptation

Introduction

Vietnam is one of the countries being heavily affected by climate change. The average annual temperature in Vietnam from 1958-2018 increased by 0.89°C and is forecasted to have an increase compared to the climate baseline (1986-2005) of 1.2-1.7°C under the RCP4.5 scenario and 1.7-2.3°C under the RCP8.5 scenario by the middle of this century. In addition, rainfall across the country is predicted to increase by 10-15% throughout much of the country by the middle of this century (MONRE, 2022). According to the global climate risk, Vietnam is ranked in the top six for countries most affected by extreme weather events in the period of 1999-2018, with its Climate Risk Index at 29.83. It suffered 226 extreme events during this period, with a death toll of 285 and losses of more than \$2 billion per year (Eckstein *et al.*, 2020). Any fluctuations in temperature and rainfall affect crop yields, crop growth, and food quality (Kang *et al.*, 2009). Extreme weather events tend to increase both in occurrence and intensity, negatively impacting agricultural production in Vietnam (Trinh *et al.*, 2021). Climate change has different impacts depending on the type of crop and ecoregion. However, most have been shown to be impacted in the direction of reducing crop yields (Vien, 2013; Yen *et al.*, 2017; Thuy *et al.*, 2021; Trinh *et al.*, 2021; Nguyen & Scrimgeour, 2022). The Northwest is considered one of the most vulnerable areas in Vietnam due to its mountainous terrain conditions, and this region is home to mostly ethnic minorities with high poverty rates, low education levels, and livelihoods that are mainly dependent on agriculture (Huong *et al.*, 2019; Yen & Leisz, 2021; Trinh *et al.*, 2021). In addition, Nguyen & Scrimgeour (2022) also indicated that the northwest will be more severely affected by climate change in the future due to low temperatures.

Farmers' experiences and perceptions of climate change-related issues impact their vulnerability to climate change and therefore play a crucial role in adaptation planning in the agricultural sector (Karki *et al.*, 2020). Furthermore, it is considered a two-step process – the first is to be aware of and understand how

the climate is changing. The second step is to respond to the impacts of that change through adaptation measures (Deressa *et al.*, 2010). According to Sen *et al.* (2021), the more climate change-aware farmers are, the more adaptable they will be. Farmers' perceptions of climate change vary greatly depending on socio-economic and environmental factors such as education degree, age, gender, ethnic background, income, geographical location, etc. (Deressa *et al.*, 2010; Karki *et al.*, 2020).

Farmers' perceptions of climate change have been increasingly studied but mainly concentrated in Africa, India, and China (Karki *et al.*, 2020). There have been several studies on this topic in Vietnam, such as the studies by Son Tran *et al.* (2015), Huong *et al.* (2017), Trinh (2018), and Sen *et al.* (2021). However, very little research has been conducted in the Northwest, especially with ethnic minorities. The H'mong ethnic group has been rated as one of the most vulnerable groups of people to climate change in Vietnam due to their isolation living in high mountainous areas, low education levels, and high poverty rates (Nguyen & Leisz, 2021). This study aimed to assess how H'mong farmers perceive climate change and its impact on agricultural production and adaptation strategies in Northwest Vietnam.

Methodology

Study area

Pa Lau commune was selected as the study area for the current research study, and is located in the Northern area of Tram Tau district (**Figure 1**). The topography conditions in Pa Lau can be classified as upland features with mountainous land areas, sloping hills, and increasing elevation heights from east to west. The climatic and weather conditions are characterized by a tropical monsoon climate with different climatic seasons. The average temperature is often below 15 to 17°C during the winter and spring, with the coldest month being January; and the temperature goes up during the summer and autumn, with hot, dry winds, and the hottest month being July. The annual average temperature is from 25 to 27°C. The annual

average precipitation is around 1,719.4mm reaching the maximum of 2,349.5mm (in 2008) and dropping to the minimum of 1158.4mm (in 2011). The precipitation varies in different seasons over the year. Heavy rains typically occur during June and August of each year,

affecting local farmers agricultural production (**Figure 2**). The total land area of Pa Lau is 2,179 ha, in which agricultural land covers an area of 1,857ha, non-agricultural land area is 778ha, and unused land is 244ha. The only ethnic minority in Pa Lau is the H'mong people, who have

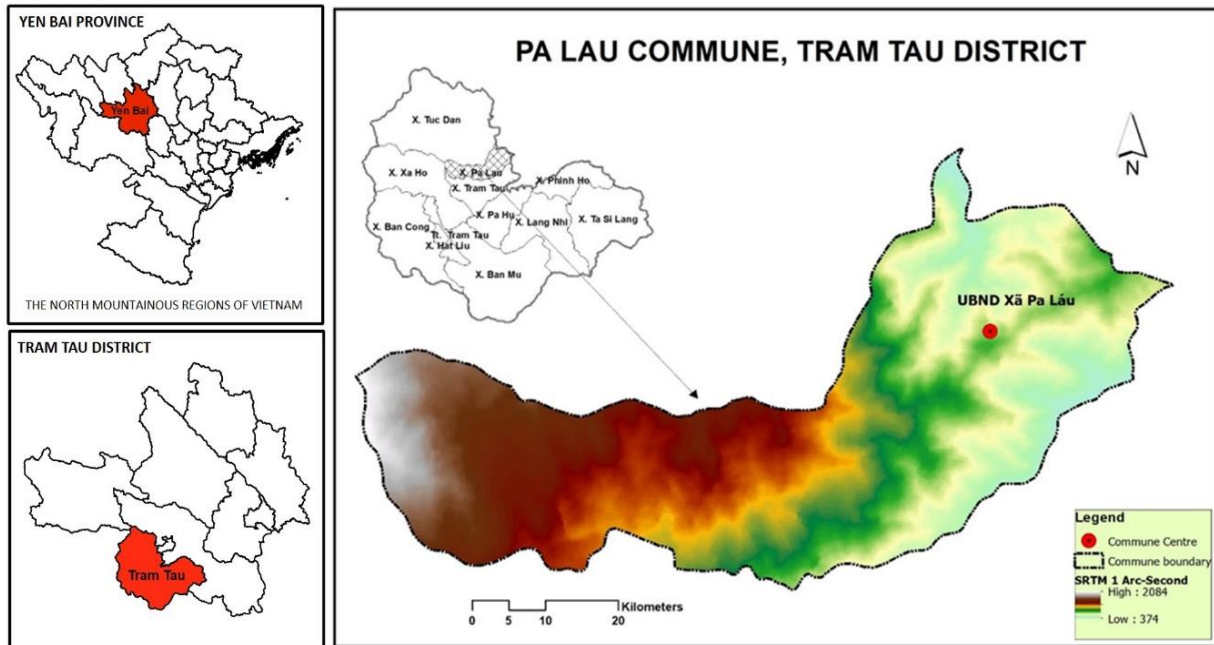


Figure 1. Map of the study area

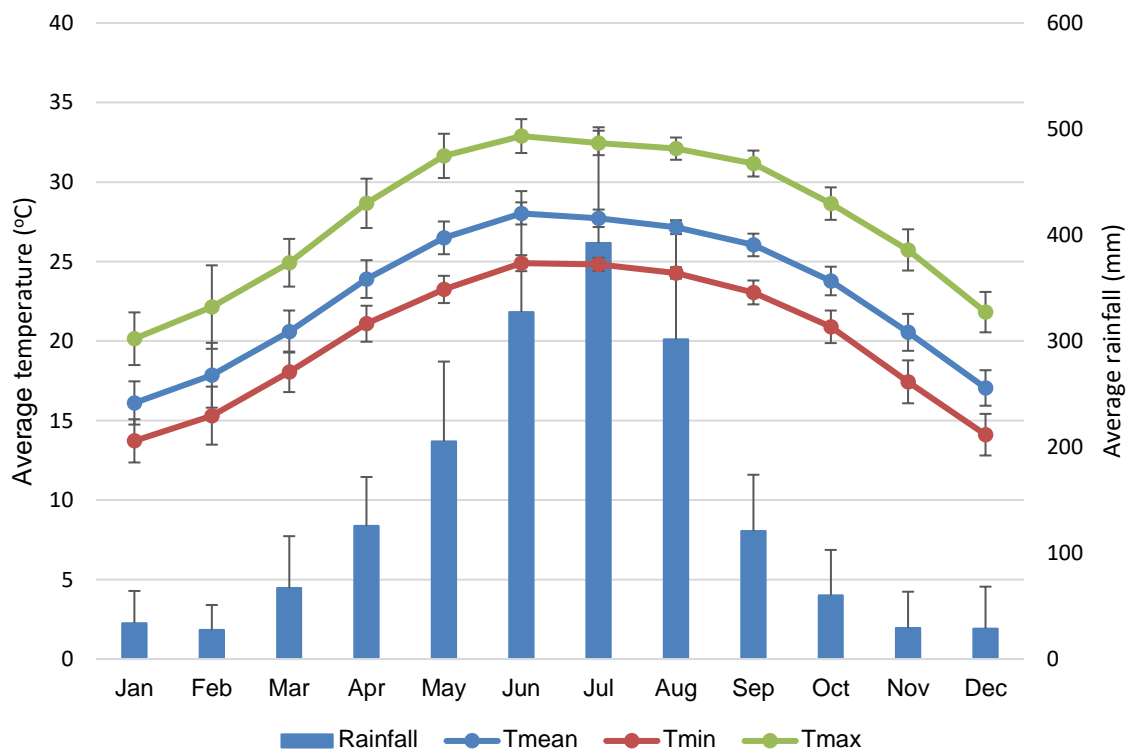


Figure 2. Average monthly temperature and rainfall in the study area during the period of 1991-2021

rich traditional knowledge for agricultural production. There are four hamlets in the commune. The total population in 2021 was 1,610 people, with 318 households and a population density of 74 people per square kilometer. Four major agricultural crops, namely paddy rice, maize, cinnamon, and cardamom, are commonly grown in Pa Lau. Rice and maize are the annual essential food crops. The latter two are permanent crops, which are important sources of income for the households in the study area. In recent decades, Pa Lau has experienced increased trends in extreme climatic and weather events, which have affected crop production in the local area.

Data collection

We collected information on the natural and socio-economic aspects of agricultural production from local government departments. In addition, reports on extreme climate event damage during the last ten years (2012-2021) were also collected. Since no meteorological station is located in Tram Tau district, daily temperature and precipitation data were obtained from Van Chan station, which is the nearest station and located in the same climate sub-region as Tram Tau district.

Household interviews with structured questionnaires were conducted randomly for 50 households from four villages of Pa Lau commune to collect information on how farmers perceived climate change during the last 20 years and their views on the impacts of climate change on the production of major crops and adaptation strategies. The four crops of paddy rice, corn, cinnamon, and cardamom are the principal crops in the study area. These crops' productions generate high economic value for local agricultural production. However, in recent years, these major crops' production areas and productivity have been affected by changes in climatic trends and in the frequencies of extreme weather events.

Data analysis

We used the Excel template software MAKESENS (Salmi *et al.*, 2002) to detect the trend statistics for the monthly, crop seasonal, and annual temperature and rainfall from 1991 through 2021. In addition, the statistical

significances of the trends of annual extreme climate events were also assessed. The software was developed based on the nonparametric Mann-Kendall test for the trend (Mann, 1945; Kendall, 1975) and nonparametric Theil-Sen's method for the magnitude of the trend (Sen, 1968; Theil, 1992). The Mann-Kendall test has been widely used in many publications concerning climate change such as Asrat & Simane, (2018), Esayas & Volume (2019), Chhogyel *et al.* (2020), Bien (2022), Phuong *et al.* (2022), and Shrestha *et al.* (2022). The trends for crop seasons were assessed for spring rice (February to June) and summer rice (July to October).

SPSS software was used to calculate the descriptive statistics concerning the farmers' perceptions of climate change, main information sources on climate change, the impacts of climate change on crop production, and their adaptation strategies.

Results and Discussion

Trends of temperature and rainfall in the study area based on meteorological data

Trends of average rainfall, and minimum, maximum, and mean temperatures according to month, year, spring rice, and summer rice

The Mann-Kendall (MK) test analysis resulted in the trends of rainfall, minimum temperature, maximum temperature, and average daily temperature according to the monthly mean as presented in Table 1, and by year and spring and summer rice crops in **Figure 2**.

In terms of rainfall, the analysis showed that the statistically significant changes in the trends occurred only in January ($P < 0.1$) and April ($P < 0.05$). In both of these months, rainfall tended to increase. Although not statistically reliable, the results also showed that rainfall tended to decrease centrally in the spring (February and March) and the beginning of the summer season (May, June, and July). Meanwhile, rainfall tended to increase at the end of the summer and winter seasons (except for November) (**Table 1**). This led to a decreasing trend in rainfall in the spring rice crop (February-June), while rainfall

in the summer rice crop (July–November) tended to increase (**Table 2**). The average annual rainfall tended to increase at a rate of 111 mm/decade and was statistically significant ($P < 0.05$). This result was also similar to the assessment of annual rainfall changes in recent decades in the northern climates of Vietnam, including Yen Bai (Le *et al.*, 2020; Phuong *et al.*, 2022). Rainfall tended to increase towards the end of the year, possibly due to an increase in tropical depressions and typhoons at this time (MONRE, 2022)

Unlike rainfall’s trend, the minimum, maximum, and average annual temperatures by year, and by spring and summer crops all statistically tended to increase (except for the average maximum temperature for the summer cropping season $P > 0.1$) (**Figure 3**). The increased rates for the annual mean values were 0.31°C, 0.23°C, and 0.29°C per decade for the minimum, maximum, and average temperatures, respectively. Similar results were found by MONRE (2022) and Phuong *et al.* (2022) when assessing the average annual temperature change rates for the Northwest in the past three to four decades. The highest temperature increase rate was found in spring crops with a maximum temperature increase of 0.51°C per decade and an

average temperature increase of 0.4°C per decade. The maximum temperature for the summer rice crop increased slower than the minimum temperature and was not statistically significant (0.17°C vs. 0.28°C per decade). The results from **Table 1** show an increasing trend in the spring crop temperature, which mainly falls in May and June, for both the minimum and maximum temperatures. Meanwhile, changes during the summer crop temperature were mainly due to an increase in the minimum temperature (the temperature at night), which occurred from September to November. This is also a critical stage that determines rice yield (booting, flowering, and grain filling). The study of Peng *et al.* (2004) showed that rice yield decreased by 10% when the night temperature (minimum temperature) increased by 1°C.

Trend of annual extreme weather events

The results of the analysis of trends in changes in extreme weather events related to rainfall and temperature are presented in **Table 2**. The results showed that the number of days with heavy rain (≥ 50 mm/day) and the largest amount of rainfall in one day of the year tended to increase, while the number of days with very

Table 1. Mann-Kendall test and Sen’s slope estimates for the trends of monthly rainfall, Tmax, Tmin, and Tmean in the study site (1991–2021)

Month	Rainfall		Tmin		Tmax		Tmean	
	MKZ	Sen’s slope (mm/yr)	MKZ	Sen’s slope (°C/yr)	MKZ	Sen’s slope (°C/yr)	MKZ	Sen’s slope (°C/yr)
Jan	1.92	0.59+	0.10	0.01	0.00	0.00	0.19	0.01
Feb	-0.07	-0.02	1.46	0.05	0.93	0.05	1.09	0.05
Mar	-1.38	-0.85	1.84	0.04+	1.77	0.04+	2.40	0.06*
Apr	2.14	1.31*	0.37	0.01	0.41	0.01	0.17	0.01
May	-1.16	-1.12	2.58	0.04**	2.11	0.07*	2.24	0.06*
Jun	0.00	-0.01	2.70	0.03**	2.96	0.06**	3.03	0.04**
Jul	-0.24	-0.77	1.67	0.02+	1.63	0.03	1.84	0.02+
Aug	1.50	3.86	2.33	0.02*	1.02	0.01	1.67	0.01+
Sep	0.68	0.79	2.91	0.05**	1.70	0.02+	2.60	0.04**
Oct	0.61	0.90	1.84	0.04+	0.00	0.00	1.02	0.02
Nov	-0.75	-0.27	2.48	0.07*	0.37	0.02	2.01	0.05*
Dec	0.02	0.00	0.20	0.00	-1.26	-0.04	-0.39	-0.01

Note: + significant at $P < 0.1$; *significant at $P < 0.05$; **significant at $P < 0.01$.

Table 2. Mann-Kendall test and Sen's slope estimates for the trend of annual extreme weather parameters in the study site (1991-2021)

Parameters	MKZ	Sen's slope
Number of days with heavy rainfall ($\geq 50\text{mm}$ per day)	2.13	0.11
Number of days with extremely heavy rainfall ($\geq 100\text{mm}$ per day)	1.13	0.00
Maximum 1-day precipitation (mm)	1.05	0.72
Number of cold nights ($T_{\text{min}} \leq 15^\circ\text{C}$)	-2.78	-0.6**
Number of extremely cold nights ($T_{\text{min}} \leq 13^\circ\text{C}$)	-1.45	-0.36
Minimum value of daily minimum temperature	-0.20	-0.01
Number of hot days ($T_{\text{max}} \geq 33^\circ\text{C}$)	3.67	1.33***
Number of extremely hot days ($T_{\text{max}} \geq 35^\circ\text{C}$)	3.11	0.64**
Maximum value of daily maximum temperature	1.79	0.05+

Note: + significant at $P < 0.1$; *significant at $P < 0.05$; **significant at $P < 0.01$; ***significant at $P < 0.001$.

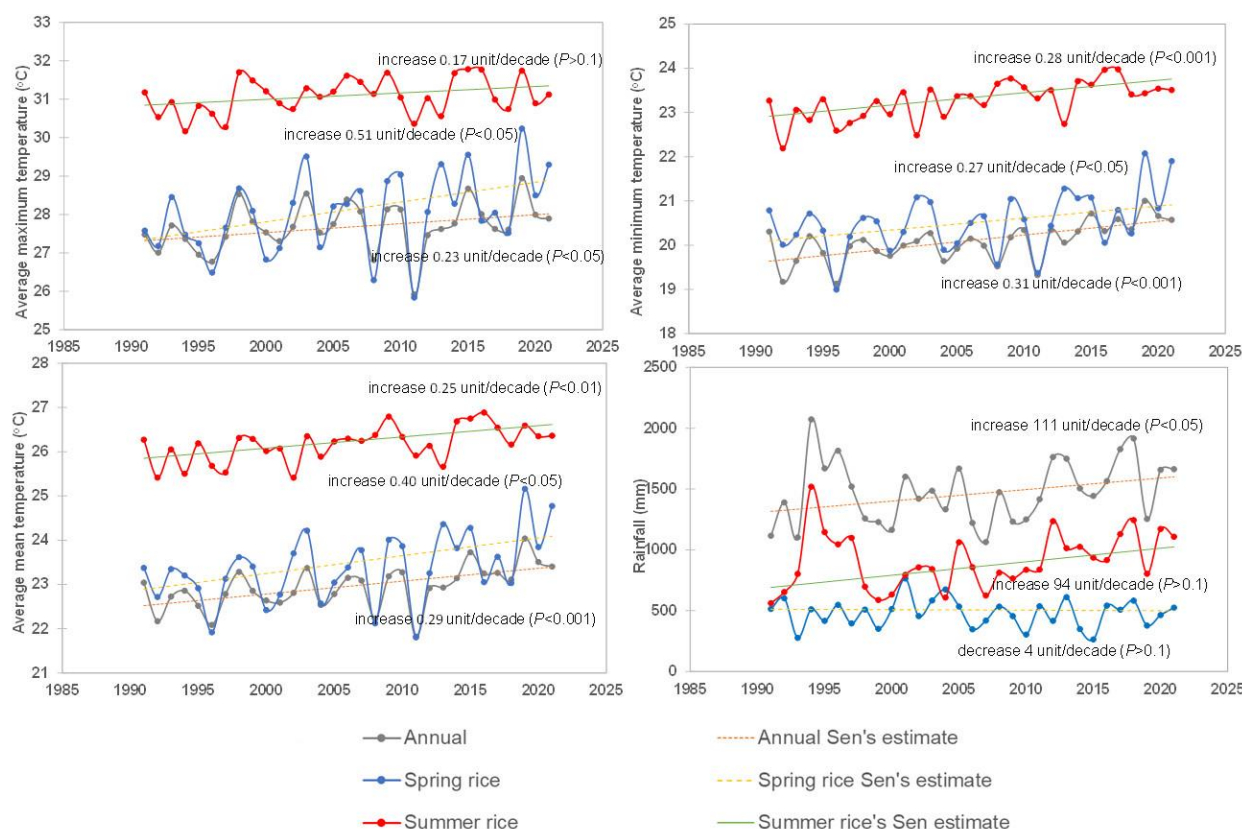


Figure 3. Trends of average T_{min} , T_{max} , T_{mean} , and rainfall according to year, spring rice, and summer rice in the study area (1991-2021)

heavy rain (≥ 100 mm/day) did not change during the period from 1991-2021. However, these trends were not statistically significant. Concerning temperature, the number of days with cold night temperatures ($\leq 15^\circ\text{C}$) tended to decrease. In contrast, the number of hot ($\geq 33^\circ\text{C}$)

and extremely hot days ($\geq 35^\circ\text{C}$) tended to increase with high statistical reliability; in which the number of hot days increased rapidly (13.3 days/decade). The annual absolute maximum temperature value also tended to increase at a rate of $0.5^\circ\text{C}/\text{decade}$ with $P < 0.1$. This result was

consistent with the analysis results of the extreme weather change trends by MONRE (2022).

Farmers' perception of climate change and meteorological data

Rainfall

As for the rain-related indicators, farmers generally had relatively different perceptions (**Figure 3**). More than 40% of the respondents believed that the average annual spring crop rainfall and the number of days with heavy rain tended to decrease. Meanwhile, the rainfall for summer crops was assessed as increasing, decreasing, and unchanged with almost the same percentages of interviewees, at 32%, 32%, and 34%, respectively. Most farmers believed there were no changes in the numbers of flash floods or droughts in their local area.

Contrary to the farmer's views, the analysis of meteorological data showed that the average annual rainfall and the number of days with heavy rain tended to increase (**Figure 2** and **Table 1**). However, there was an agreement between the farmers' perceptions and meteorological data on the changing trend of spring crop rainfall (decreasing trend). The spring crop lasts from February to June, and often experienced less rainfall during the year (**Figure 2**). This is probably why farmers paid more attention to the change in rainfall in this season, which led to their perception being closer to the actual rainfall change. Furthermore, as analyzed in the previous section, rainfall changes were not statistically significant due to huge variations in rainfall over the years. This may also be why the farmers' perceptions were not close to the recorded rainfall data, as they had different views on changes in the indicators related to rainfall. Previous studies have also shown that people often judge climate change trends based on recent fluctuations rather than long-term changes (Son Tran *et al.*, 2015; Fierros-González & López-Feldman, 2021).

Temperature

Very few farmers interviewed said that temperatures have not changed over the past 20 years (4-8%) (**Figure 3**). However, the farmers'

perceptions of temperature changes in most of the indicators were inconsistent. Indicators such as average annual temperature, summer crop temperature, spring crop temperature, daytime temperature, night temperature, and the number of hot days in the year were believed to have either increased or decreased by nearly all or more than half of the interviewees who thought that the temperature had changed. The proportion of farmers who thought that the number of cold days and days with frost in the year tended to decrease was higher than the number of farmers who thought that these indicators tended to increase (40 and 48% vs. 32 and 24%, respectively). However, a significant proportion of farmers believed that these indicators have not changed (26%) in the last 20 years. A study by Huong *et al.* (2017) also showed that Northwest mountain farmers had different views on temperature change trends. Many people assumed that winter temperatures tended to be colder.

Analysis of the meteorological data showed that the average annual temperatures, summer and spring crop temperatures, maximum temperatures (daytime temperatures), and minimum temperatures (night temperatures) all tended to increase with statistically high confidence (except for the maximum temperatures) (**Figure 4**). The number of hot and extremely hot days also increased markedly, while the number of days with extremely cold nights tended to decrease with high statistical significance (**Table 2**). Thus, it can be concluded that about half of the interviewees' perceptions of the changing temperature trends were not close to the actual monitoring data. Pá Lau commune is in a mountainous area with relatively low winter temperatures. The average annual temperature from December to February of the year was below 20°C, and the minimum temperature in these months was below 15°C (**Figure 2**). In 2020 and 2021, the average minimum temperature also tended to decrease (**Figure 3**). Maybe this is why many farmers thought that the number of cold days did not change or tended to increase during the last 20 years. Other studies evaluating farmers' perceptions of climate change, such as those of

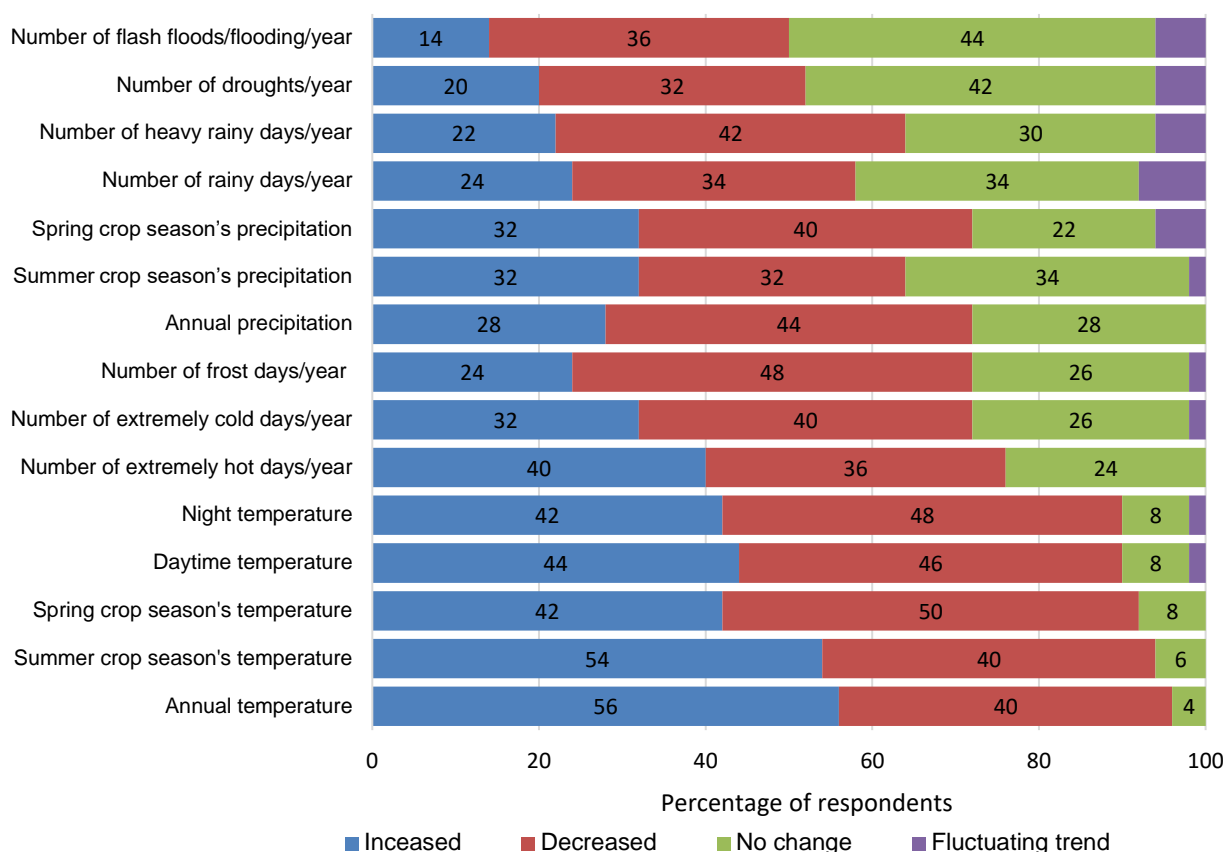


Figure 4. Farmers' perceptions of climate change in relation to different indicators of temperature and rainfall (spring crop season lasts from February to June; summer crop season lasts from July to November)

Son Tran *et al.* (2015), Esayas & Volume (2019), and Fierros-González & López-Feldman (2021), have found similar results.

Many different factors influence a farmer's perception of climate change. Karki *et al.* (2020) have reviewed many studies on this issue and have shown that among the influencing factors, education is the most commonly mentioned factor, followed by access to information, experience, extension services, income, gender, cultivation areas, agro-ecological conditions, household size, altitude, and location. The degree of influence of these factors may vary depending on socio-economic conditions, cultural characteristics, and geographical and political conditions. Understanding the influencing factors will help researchers and officials propose more specific solutions to raise people's awareness about climate change. Due to the lack of data, we did not evaluate the factors affecting

the perception of climate change among the H'mong at the study site in this study.

Information sources on climate change

As can be seen from **Figure 5**, the interview results showed that the primary sources for information on climate change rankings came from the local farmers' self-reflection, media-telecommunications, and the local authorities/council, of which nearly 80% of the interviewees agreed they could observe climate changes by themselves. Interestingly, less information about climate change came from people outside the commune.

The H'mong ethnic community lives in the high mountains and is considered one of the poorest ethnic minority communities in Vietnam. The facilities for telecommunication in households are limited. Moreover, the percentage of local people who do not attend

school is high; the majority still mainly use their ethnic languages (Yen & Leisz, 2021). Therefore, access to information sources, including information on climate change, is still difficult. This may also explain why many interviewees believed there has been no change in the indicators related to climate change or that their assessments were mainly short-term and not close to the long-term meteorological data.

Farmers’ perceptions of the effects of climate change on crop production

Global warming has led to changes in rainfall and extreme weather events such as droughts, floods, heat, severe cold, and wind intensity. The extent of landslides, soil erosion, and the occurrences of pests and diseases are impacted by changes in rainfall and temperature. All types of these natural disasters appear at the study site. The farmers' perceptions on the trends of the impacts of these natural disasters on some major local crops are shown in **Figure 5**. The interviewed farmers thought that soil erosion and extremely hot and cold weather increasingly affected all four major local crops (rice, corn, cinnamon, and cardamom). The increase in the effects of extremely cold weather was the highest, with an average score ranging from 3.6

to 3.9. Only rice tended to be affected by droughts and floods, while the other three tended to be mostly unchanged. Landslides and pests tended to have increased impacts on rice and maize. Strong winds tended to increasingly affect rice, cinnamon, and cardamom.

Although temperatures tended to rise significantly (**Figure 3**), extremely cold temperatures and frost remain critical natural disasters affecting agricultural production in the Pa Lau commune. Extreme cold was listed five times on the list of natural disasters that have caused the most significant damage in the last 10 years (2012-2021) (**Table 3**). Rice and cardamom suffered the most. Especially, the severe cold in February 2021 dramatically affected cardamom. This explains why farmers thought that severe cold has tended to significantly increase its impact on agricultural production in the local area (**Figure 6**). Other types of natural disasters, mainly related to heavy rains, flash floods, and strong winds, also frequently occur and significantly affect agricultural production. However, the hot weather and lack of irrigation water seriously affected agricultural production only once during the same 10-year period (in 2017).

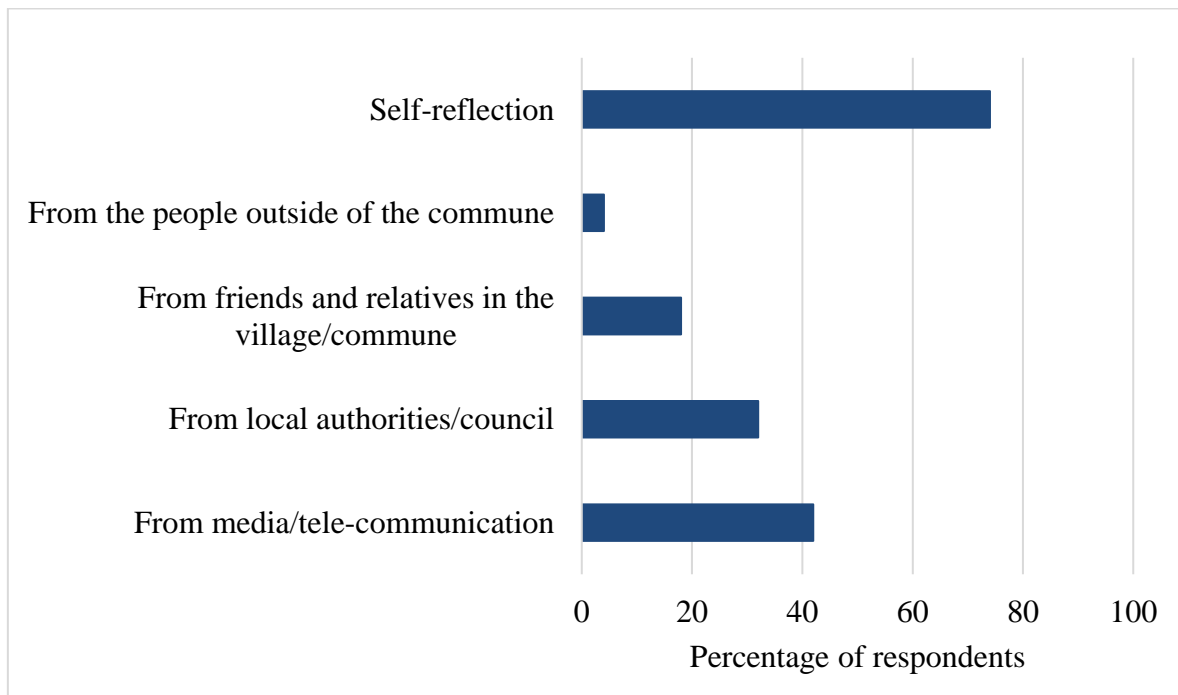


Figure 5. Sources for information on climate change from the farmers' perceptions

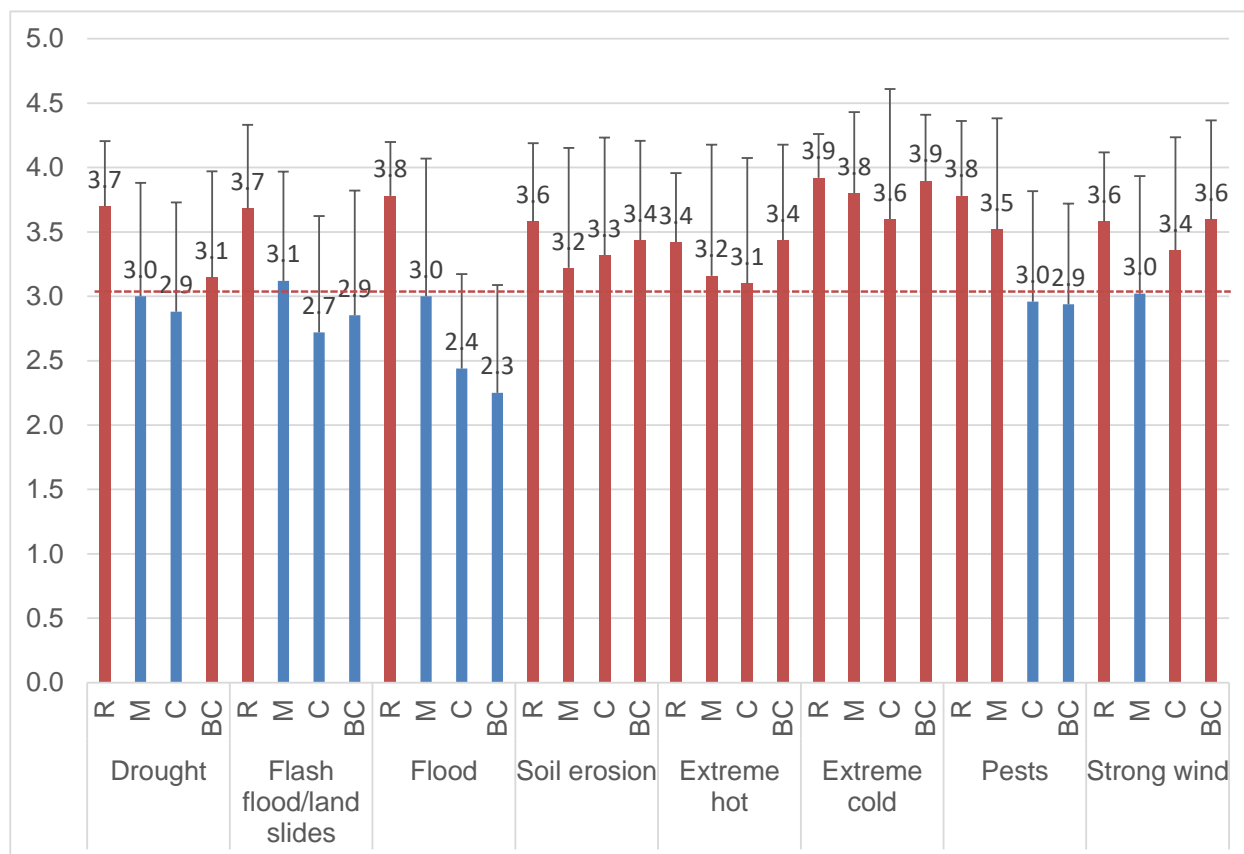


Figure 6. Farmers' perceptions of the trends of impacts of natural disasters on the production of rice (R), maize (M), cinnamon (C), and black cardamom (BC) (The number above each bar is the average score, of which 1 = Significantly reduced impacts; 2 = Reduced impacts; 3 = No change; 4 = Increased impacts; 5 = Significantly increased impacts; the error bar indicates the standard deviation)

Table 3. Natural disasters and their impacts on agricultural production in Pa Lau commune in the period of 2012-2021

Year	Extreme weather events/Natural disasters	Loss of productivity and cultivated land areas
2012	Flash floods	Lost about 10 hectares of arable land
2013	Extremely cold from January to February	Reduced crop yield, especially for rice, maize, and cardamom
2014	Strong winds and heavy rains in September	Strong winds knocked down 15 hectares of rice and maize, reducing crop yields
2015	Extremely cold in December	Greatly affected the yield of cardamom and killed 3 hectares of cinnamon trees
2016	Frost in December	Killed 5 hectares of cardamom and reduced yield for all crops, especially rice and cardamom
2017	Heavy rains, flash floods, and landslides in October	Floods washed away more than 35 hectares of productive land (20 hectares of rice land, 7 ha of corn land, and 8 ha of cardamom)
2018	Extremely hot in May and June	Lack of irrigation water sources caused yield reductions of rice, corn, and cardamom
2019	Extremely cold and frost	Reduced the yield of crops, especially cardamom
2020	Heavy rain and strong winds	Killed 7 cattle, damaged over 9 hectares of rice and nearly 1 hectare of maize, and damaged many intercommunal and inter-village roads
2021	Extremely cold in February and heavy rains in May	Killed 7 hectares of cardamom, reducing the yield of cardamom Floodwaters washed away 12 hectares of rice and maize fields

Farmers’ strategies to cope with climate change in crop production

Measures used by local farmers to adapt to climate change included increasing pest control, adjusting planting times accordingly, changing plant varieties, intercropping, applying more fertilizer, using supplemental irrigation, and protecting soil from erosion (Figure 7). However, the degree of application of these measures varied depending on the crop type. For example, rice and maize are two essential food crops in the locality, so almost all respondents said that they had applied all the stated measures (except for intercropping for rice crops). On the other hand, for cinnamon trees, people mainly applied measures to change the planting time, use intercropping, and protect the soil from erosion. Measures to adjust the planting time, add fertilizers, and change the plant varieties were applied mainly to cardamom.

These adaptation measures are all simple and familiar to the farmers and can be changed seasonally and cheaply. For example, farmers said they regularly visited their fields for timely detection to prevent pests and diseases better. Farmers can choose short-duration rice varieties

and later transplanting times to ensure healthy rice growth and high yields when the temperature drops too low in the early spring.

Conclusions

The analysis results showed that the majority of the H’mong farmers in the Northwest mountains had incorrect perceptions in comparison with the historical meteorological data about the changes of some indicators related to rainfall and temperature. For example, according to the statistical analysis, the average annual rainfall and the number of days of heavy rain have tended to increase. However, more than 40% of the farmers interviewed thought these indicators tended to decrease. Similarly, for temperature, nearly half of the interviewees felt that the average annual temperature, the number of hot days, daytime temperature, and night temperature have tended to decrease. At the same time, the results of the meteorological data analysis showed that these indicators have tended to increase with high statistical significance. This is because the farmers judged changes based primarily on short-term climate changes. Moreover, most of the farmers’ knowledge

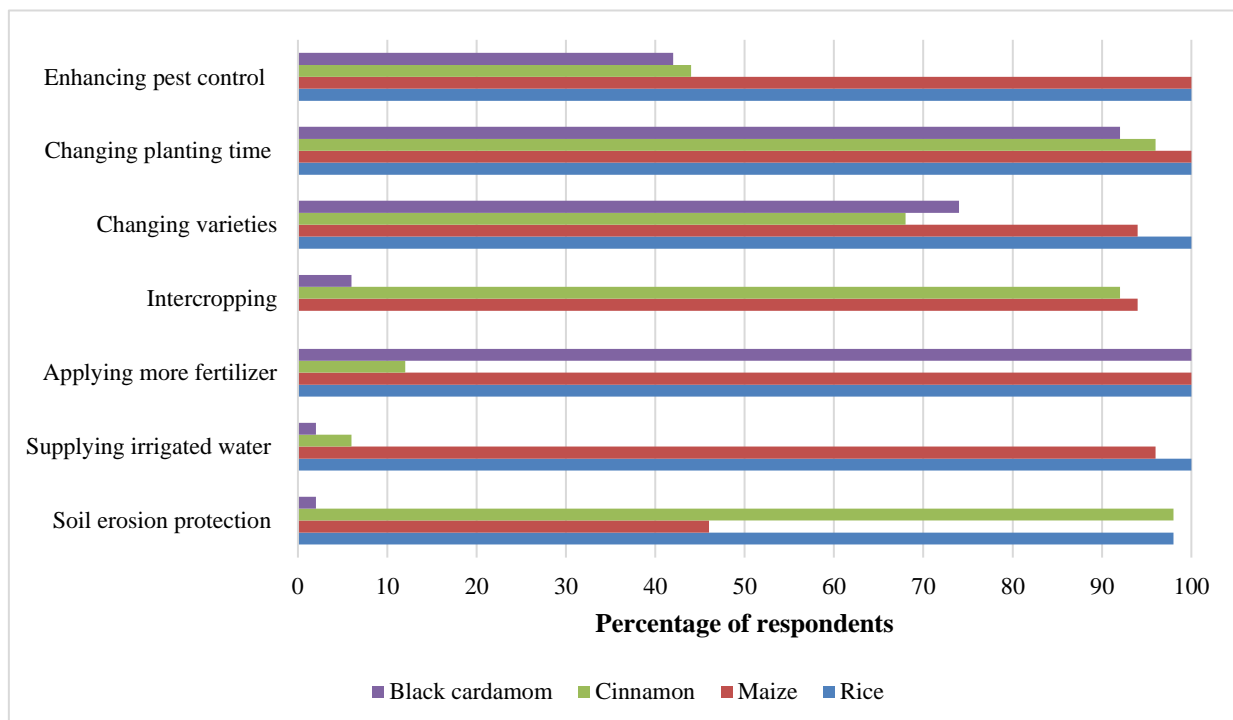


Figure 7. Adaptation strategies applied by farmers in Pa Lau commune

(80%) about climate change was based mainly on self-reflection.

The H'mong farmers believed that soil erosion and hot and extremely cold weather increasingly affected all four major crops of rice, corn, cinnamon, and cardamom. Other types of natural disasters, such as droughts, floods, landslides, pests, and strong winds, have tended to increase their influence differentially depending on the type of crop. Adaptation measures taken by farmers to mitigate the effects of climate change were mainly simple, flexible, and low-cost measures.

The results of this study show that there is a need for policies to raise awareness among the H'mong ethnic farmers about climate change. This study also provides essential information for agencies at all levels to mitigate the negative impacts of climate change. However, the limitation of this study is the sample size and scope. Therefore, it is suggested to carry out further studies at a larger scale to understand the factors influencing the farmers' perceptions of climate change. Based on this, it is possible to propose concrete solutions to enhance the farmers' awareness of climate change. Future studies should also focus on solutions to improve the farmers' adaptive capacities to climate change in agricultural production to ensure food security and reduce climate change vulnerability in the Northwest Region of Vietnam.

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