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Original Research

Understanding the Attributes Related to Climate Change Perceptions among Rural Households in Highlands: The case of Northern Thailand

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Abstract

There remains a scarcity of evidence regarding perceptions of climate change occurrences and their impacts among people highly involved in monocropping systems in highland areas, especially in Southeast Asia. This paper assessed villagers' climate change perceptions and socioeconomic attributes in Northern Thailand using primary data collected from 252 households, including farmers and non-farmers, based on stratified random sampling from eight villages in the highlands of Nan province, which were analyzed using descriptive statistics and probit regression. The result indicates that climate change perceptions were primarily influenced by individual attributes rather than household characteristics. One such attribute was the main occupation. Non-farmers were more likely to perceive climate change phenomena such as increased drought, higher temperature, and change in the number of rainy days, while farmers tended to perceive more climate change impacts such as pest and disease outbreaks and losses in crop yields. Other significant attributes were gender and age. Men and younger people were more likely to perceive climate change phenomena. Residential location, education, household size, household income from agriculture, household income from non-agriculture, household debt, number of farm plots, and landholding size were associated with some aspects of climate change and its impacts.

Keywords: climate change, highland agriculture, monocropping, perceptions of climate change, probit, household survey

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Introduction

Climate change, a major global concern, progressively harms natural and human systems in many countries. Its impacts include ecosystem degradation, food insecurity, migration, livelihood changes, health and security risks, and increased inequality [1]. A rise in Global Mean Surface Temperature by 2.0ºC may reduce crop yields (maize, rice, wheat, etc.) in tropical regions such as Southeast Asia, sub-Saharan Africa, and Central/South America more than the 1.5ºC increase scenario [2]. At the same time, agriculture continues to play a vital role in sustaining the economy and ensuring food and nutritional security. While soil under cultivation is one of the key sources of greenhouse gas emissions, it is necessary to increase staple crop production to serve the growing population [3].

Climate change impacts on agriculture are especially salient in mountainous rainfed areas. Alterations in weather and climatic patterns have depleted soil fertility and water resources, affected agricultural productivity, and subsequently threatened the well-being of highland communities [4, 5]. For example, rainfed farmers in the highlands of East Africa faced the problems of severe water scarcity, drought, flood, land degradation, and associated yield loss [6]. For instance, farmers in the highlands of Tanzania face the impacts of climate change, such as increased pest and disease outbreaks, losses in yield, and delayed harvesting [7]. Highland areas tend to suffer from their innate challenges such as soil erosion, environmental degradation, food insecurity, poverty, and disaster risks [8]. Urgent actions are needed to save the highlander and ecosystem services [9]. Climate research has been conducted across various regions, exploring various aspects of phenomena and their impacts. However, while substantial literature has studied climate change perceptions, there is scarce evidence as to local people involved in intensive monocropping systems with non-food crops in highland areas prone to soil erosion. Existing research in highlands has primarily focused on farmers' adaptation to climate change [10-13], their perception of climate change without associating it with their attributes [14-16], or communities without analyzing non-farmers [17-19].

The objective of this research is to investigate climate change perceptions and related attributes among residents in the highlands of northern Thailand. The outcomes are expected to contribute to climate change adaptation strategies and the literature on how local people practicing monocropping systems in highlands perceive climatic stresses.

Literature Review

Over the past few decades, climate change has negatively influenced agricultural yields in rainfed farming areas worldwide [20]. Temperature and precipitation are the primary climatic variables affecting crop yields [21]. Smallholder farmers in Asia and Africa are the main contributors to global agricultural production, which is impacted by extreme climatic events. Even though agriculture is a key driver of economic growth in most developing countries, government support to enhance farmers' resilience has been insufficient [17].

Agriculture is the backbone of Thailand's economy, with agricultural exports valued at USD 43 billion in 2021, primarily consisting of fruits, tapioca starch, natural rubber, sugar, rice, chicken meat, and fish [22]. The change in temperature during summer and rainy days is projected to cause a substantial drop in farmland values, ranging from USD 24 to 94 billion from 2040 to 2049 [23]. While highland agriculture is practiced in many countries, the definitions of highland differ. In 2005, the Highland Research and Development Institute in Thailand defined a highland as a mountainous area, an area five hundred meters or more above sea level, or an area between highland areas [24]. Accordingly, 20 out of the 76 provinces are covered by this definition. The highlands in the northern region contend with climate change and a heightened occurrence of natural disasters, including floods, droughts, and landslides. These events have caused fatalities, displacement, and significant economic setbacks [25]. The northern region is the largest maize-producing area in Thailand [26], where farmers rely on income from selling rubber and maize for livestock feed markets. However, their income is unstable and stagnant, due to intensive monocropping systems and climatic stresses [27, 14].

Personal experiences with climate change play a crucial role in shaping climate change perceptions and motivating individuals to engage in climate action [28, 29]. Direct exposure to climatic stresses influences local villagers' concerns through daily interactions with the environment [25]. At the same time, the implementation of adaptation measures can be constrained by obstacles such as insufficient climate literacy [30]. Individuals who perceive climate change tend to support policies on climate change adaptation [31]. Therefore, understanding their perception is essential in developing effective adaptation plans to improve livelihoods and ensure food security.

Perceptions of climate change have been the subject of research in different parts of the world. Several studies revealed how individuals worldwide face climate change and its livelihood impacts. Uprety et al. [32] conducted a study in three districts in the highlands of Nepal and found that the highlanders recognized alterations in local climatic conditions, the majority noting rising temperatures, an earlier onset of the summer season, and a shortened winter compared to 15-20 years before. An increased frequency of floods and landslides was also observed, as well as an uptick in pests and insects. On the other hand, their research left an analysis of factors for future research. Tofu [17] identified the climate change perceptions among smallholder farmers

in the Oromia regional state of Ethiopia. The result revealed that the most common change perceived by farmers was rising temperature, followed by a shift in the onset of the rainy season, a decrease in total precipitation, and an increase in drought occurrences. Age, access to extension services, access to climate information, soil fertility, and residential location were the main factors influencing perceptions of climate change and variability.

Similar results were obtained by Abid et al. [18], who examined farmers' perceptions of climate change in the semi-arid lowland area of Punjab province, Pakistan. The results revealed that most farmers perceived an increase in temperature and a decrease in rainfall during both the summer and winter periods over the past 20 years. Their perceptions were correlated with several factors, such as education, landholding size, land ownership status, cooperation among farmers, and the agroecological zone.

Roco et al. [33] investigated climate change perceptions of farmers and the factors influencing them in four rural municipalities in central Chile. The finding indicated that the majority of farmers perceived an increase in average temperature, a decrease in precipitation, and a higher frequency of droughts over the past 24 years. The probit analysis unveiled that younger, better-educated producers and landlords typically had a more discerning perception of climate change.

Furthermore, Manandhar et al. [25] showed in the mountainous areas of northern Thailand that 45% of the rural households perceived climate change in terms of rising total rainfall, reduction in the number of rainy days over the past two decades, and delayed rainfall in recent years. However, no significant relations were found between household characteristics and the perceptions of climate change.

Materials and Methods

Data Collection

Primary data and secondary data were collected for this research. The primary data were gathered through a questionnaire survey, while the secondary data were collected through open-access publications. During a reconnaissance visit, key informants were interviewed, and the study area was observed to understand the local context and become familiar with local people.

The study site is the Buayai sub-district, Nanoi district, Nan province, Thailand. The area was selected based on the following criteria: (a) hill farming area; (b) monocropping is widely practiced; (c) rainfed environment; and (d) accessible through an ongoing project [34]. Buayai sub-district comprises eight villages, i.e., Ban Aoi, Ban Maimongkhon, Ban Nahan, Ban Tupman, Ban Nakai, Ban Tonmueang, Ban Sanpayorm, and Ban Nongha. The total area of the sub-district is 131.1 square kilometers, all in the reserved forest. The geographical features of the area consist of flat land (4.8%), foothill slopes (19.0%), and mountainous terrains (76.2%) [35]. Around 95% of Buayai villagers engage in agriculture, producing maize for feed, rice, rubber, fruit trees, and livestock [36].

The sub-district has a population of 1,346 households. Proportionate stratified random sampling was employed to select households from each of the villages, where randomization was based on the lottery method. The total sample size was 252 households.

One respondent represented each household and answered questions about the household characteristics (e.g., household size, household income) and the respondent's profile. Subsequently, the respondents were asked about their perceptions of climate change and its impacts on their livelihoods, using multiple-choice questions. The different types of climate change phenomena defined and covered in this research are increased drought, increased floods, rising temperatures, changes in the number of rainy days, changes in the onset of the wet season, and more intense storms. Besides, uncertainty in crop yields, increased pest and disease outbreaks, more people leaving the village for cities, and uncertainty in annual income from agriculture, as caused by climate change phenomena, are defined as climate change impacts.

These indicators were selected based on the literature. Rising temperatures are the most direct consequence of the increasing greenhouse gas emissions [37]. Changing temperatures can lead to changing the number of rainy days [38, 39] and altering the onset of the wet season due to interactions within climatological systems [37, 38]. Extreme events as part of climate change are often represented in the forms of drought [37, 40, 41], flood [37, 40], and storm [40], among others. In terms of climate change impacts, the loss of agricultural productivity is a major indicator, as climatic conditions are direct inputs to crop growth [17, 41, 42]. In addition, pest and disease outbreaks are correlated with rising temperatures and shifts in rainfall patterns [39, 41]. Uncertainty in income increases as the main source of livelihood in rural areas is affected [37]. Moreover, population movement is another socioeconomic impact of climate change [40].

Analysis

The survey data were statistically analyzed using STATA 17. Descriptive statistics were employed to outline the variables included in the regression analysis. The probit regression was applied to identify the attributes associated with the perception of climate change expressed in a set of ten dummy variables. Probit is estimated using the standard maximum likelihood procedure and is suitable for analyzing the effects of independent variables on a binary dependent variable. As this research employed binary response variables, probit regression was appropriate [43, 44]. In addition,

marginal effects on the probability of observing one of the binary outcomes were estimated and presented in the result tables. Gender, education, main livelihood, and residential location were represented as dummy variables, while age and household characteristics were represented as numerical variables. The variables analyzed in the probit regressions are described in Table 1.

Results

Descriptive Statistics

Tables 2 and 3 present descriptive statistics of key variables. The majority of local people perceived increasing drought and rising temperature. Similarly, more than half of the respondents perceived changes in the number of rainy days and a shift in the onset of

Table 1. The variables included in the probit regression analysis.

Variable	Type	Definition
Dependent		
Climate change phenomena		
Increased drought	D	1 if the respondent perceived it, 0 otherwise
Increased floods	D	1 if the respondent perceived it, 0 otherwise
Higher temperature	D	1 if the respondent perceived it, 0 otherwise
Change in the number of rainy days	D	1 if the respondent perceived it, 0 otherwise
Change in the beginning of the wet season	D	1 if the respondent perceived it, 0 otherwise
More intense storms	D	1 if the respondent perceived it, 0 otherwise
Climate change impacts		
More pests and diseases	D	1 if the respondent perceived it, 0 otherwise
Lower crop yields	D	1 if the respondent perceived it, 0 otherwise
Uncertainty in own annual income	D	1 if the respondent perceived it, 0 otherwise
Villagers' migration to cities	D	1 if the respondent perceived it, 0 otherwise
Independent		
Individual characteristics		
Age	N	Age of the respondent (years)
Gender	D	1 if female, 0 otherwise
Education	D	1 if higher than primary, 0 otherwise
Main livelihood	D	1 if agriculture, 0 otherwise
Permanent residence at this home	D	1 if permanent, 0 otherwise
Household characteristics		
Household size	N	Number of family members
Total Income	N	Total income the household earned in the last 12 months (12/2020 – 21/2021) (thousand baht)
Non-agricultural income	N	Non-agriculture income earned in the last 12 months (12/2020 – 21/2021) (thousand baht)
Agricultural income	N	Agriculture income earned in the last 12 months (12/2020 – 21/2021) (thousand baht)
Household debt	N	Outstanding debt balance of the household from all sources including BACC and money lenders (thousand baht)
Number of own farm plots and land parcels	N	Number of farm plots or land parcels the household owned (including the land rented out)
Land holding size	N	Size of farm plots or land parcels the household owned (including the land rented out) (hectares)

N: numerical variable, D: dummy variable

Table 2. The mean values of the binary variables.

Variable	Mean
Increased drought	0.62
Increased floods	0.02
Higher temperature	0.62
Change in the number of rainy days	0.61
Change in the beginning of the wet season	0.56
More intense storms	0.08
More pests and diseases	0.39
Lower crop yields	0.29
Uncertainty in own annual income	0.18
Villagers' migration to cities	0.00
Gender (1 if female)	0.27
Education (1 if higher than primary)	0.25
Main livelihood (1 if agriculture)	0.72
Permanent residence at this home	0.99

the wet season. In terms of individual characteristics, on average, the respondents were over 60 years old and engaged in agriculture as their main livelihood. Most of the respondents were male, with primary school as their highest formal educational, while almost everyone resided in the studied villages as their primary residence. The average household size was 3.4 members. The annual household income was around 244 thousand baht per annum, with agriculture contributing 159 thousand and non-agricultural activities contributing 84 thousand. The household debt balance totaled around 232 thousand baht. On average, households owned 2.5 plots of land, totaling 4.0 hectares.

Probit Analysis

Table 4 summarizes the results of the probit analysis. A perceived increase in drought was significantly associated with main livelihood, residency, and income from agriculture. Non-farmers were 16.7% points more likely to perceive increased drought than farmers. Permanent residency in the village had a strong negative relation with the perception of increased drought, indicating that those with a permanent residence in the village were much less likely to perceive an increase in drought. A hundred-thousand baht increase in household income from agricultural sources will increase the probability of perceiving increased drought by 3.8% while holding other factors constant.

Perceiving increased floods was found to be significantly associated with gender, residency, and the number of landholdings. Men were much more likely to perceive increased floods as a climate change phenomenon than women, as shown by the perfect prediction. Permanent residency in the village showed a strong positive association with perceiving increased floods, which implies that those with a permanent residence in the village were much more likely to perceive increased floods. A one-plot increase in the number of owned land parcels raised the probability of perceiving increased floods by 0.9% on average, holding other variables constant.

Perceiving rising temperature was significantly associated with gender and main livelihood, but not with any other variables. Men were 22.4% points more likely to perceive a higher temperature than women. Non-farmers were 17.3% points more likely to perceive increased temperature than farmers.

Perceiving a change at the number of rainy days was significantly associated with age, gender, and main livelihood. As age became one year younger, the probability of perceiving a change in the number of rainy days increased by 0.9% on average, with other factors remaining unchanged. Men were 31.1% points more likely to perceive a change in the number of rainy days than women. Non-farmers were 22.5% points more

Table 3. Add a descriptive label of the table here.

Variable	Unit	Mean	Median	SD
Age	Year	60.4	61	11.1
Household size	Person	3.37	3	1.38
Annual household income	Thousand baht	244	172	265
Non-agricultural income	Thousand baht	84	16	167
Agricultural income	Thousand baht	159	106	188
Household debt	Thousand baht	232	100	319
Number of own farm plots and land parcels	Plot	2.49	2	1.59
Landholding size	Hectare	3.98	3.28	3.44

Table 4. Attributes associated with perceived climate change phenomena and impacts: Marginal effects on probability estimated by Probit.

Dependent variables: Perceived climate change phenomena and impacts (1 if the respondent perceived it, 0 otherwise)									
	Increased drought	Increased floods	Higher temperature	Change in the number of rainy days	Change in the beginning of the wet season	More intense storms	More pests and diseases	Lower crop yields	Uncertainty in own annual income
Individual characteristics of respondents									
Age (year)	–0.002	–0.001	–0.002	–0.009**	–0.008**	–0.003*	–0.001	–0.002	0.000
Gender (1 if female, 0 if male)	–0.090	–*** 1)	–0.224***	–0.311***	–0.293***	–0.014	–0.119	0.039	0.001
Education (1 if higher than primary)	–0.038	0.007	–0.082	0.000	–0.046	-0.001	–0.016	0.043	0.125**
Main livelihood (1 if farmer, 0 otherwise)	–0.167*	–0.050	–0.173**	–0.225***	–0.008	–0.019	0.188**	0.230***	0.099
Living permanently in this village	–*** 1)	+*** 1)	–0.047	0.187	0.230	+*** 1)	+*** 1)	+*** 1)	+*** 1)
Household characteristics									
Household size	0.038	0.006	–0.030	0.001	0.005	–0.000	–0.044*	–0.026	–0.017
Household income from non-agriculture	0.011	–0.003	0.020	0.020	0.015	0.005	0.028	0.045**	0.018
Household income from agriculture	0.038*	0.002	0.002	–0.004	0.000	0.014	–0.019	0.004	–0.001
Household debt	0.014	–0.001	0.008	0.003	0.002	–0.014**	0.023**	0.010	0.005
Number of farm plots and land parcels owned	–0.030	0.009**	0.014	0.040	0.018	0.008	0.044*	0.047*	0.044**
Landholding size (ha)	–0.011	–0.005	–0.018	–0.015	–0.014	–0.016*	–0.006	–0.011	–0.008
n	242	176	245	245	245	242	242	242	242
LR test	16.45*	9.89	19.97**	26.57***	22.64**	12.76	24.49***	31.18***	18.46**
Pseudo R^2	0.051	0.218	0.062	0.082	0.068	0.096	0.075	0.107	0.082

1) The independent variable was dropped due to its perfect prediction of the dependent variable, resulting in infinite marginal effects. The negative sign indicates the negative infinity, while the positive sign indicates the positive infinity.

2) *** stands for $p<0.01$, ** <0.05, and * <0.10.

3) The variable representing villagers' migration to cities was not included in the model because of no variance as seen in Table 2.

likely to perceive a change in the number of rainy days than farmers.

Perceiving a change in the beginning of the wet season showed a significant association with age and gender, but not with any other attributes. A one-year decrease in age increased the probability of perceiving a shift in the onset of the rainy season by 0.8% on average, holding other factors constant. Men were 29.3% points more likely to perceive a shift in the onset of the rainy season than women.

Perceiving intensity of storms was significantly associated with age, residency, household debt, and total landholding size. A one-year decrease in age increased the probability of perceiving a more intense storm by 0.3% on average, with other factors remaining unchanged. Permanent residency in the village had a strong positive relation with the perceived intensity of storms, as shown by the perfection prediction. A hundred-thousand baht increase in household debt increased the probability of perceiving a more intense storm by 1.4% on average. A one-hectare increase in landholding size increased the probability of perceiving the intensity of storms by 1.6%.

In terms of the impact of climate change on their livelihoods, perceiving increased outbreaks of pests and diseases was found to be significantly associated with main livelihood, residency, household size, household debt, and the number of land plots. On average, farmers were 18.8% points more likely to perceive increased pests and diseases than non-farmers, holding other variables constant. Permanent residency in the village had a strong positive relation with perceiving increased pests and diseases, as shown by the perfect prediction. A one-person decrease in family members increased the probability of perceiving increased pest and disease outbreaks by 4.4% on average. A hundred-thousand baht increase in household debt increased the probability of perceiving increased pest and disease outbreaks by 2.3%. A one-plot increase in landholding increased the probability of perceiving increased pest and disease outbreaks by 4.4%.

Furthermore, perceiving lower crop yields as the impact of climate change was significantly associated with main livelihood, residency, household income from non-agriculture, and the number of land plots. On average, farmers were 23.0% points more likely to perceive lower crop yields than non-farmers, other variables being unchanged. Permanent residency in the village had a strong positive relation with perceiving lower crop yields, as shown by the perfect prediction. A hundred-thousand baht increase in household income from non-agricultural sources increased the probability of perceiving lower crop yields by 4.5% on average. A one-plot increase in the number of land parcels increased the probability of perceived lower crop yields by 4.7%.

Lastly, perceiving uncertainty in own annual income was found to be significantly associated with education, residency, and the number of land parcels. On average, villagers with education beyond primary school were 12.5% points more likely to perceive uncertainty in annual income than those who had primary school as their highest formal education, holding covariates unchanged. Permanent residency in the village had a strong positive relation with perceived uncertainty in annual income, as shown by the perfect prediction. A one-plot increase in the number of land parcels increased the probability of perceiving uncertainty in own annual income by 4.4% on average.

Discussions

The results indicate that local people in highland areas tend to perceive changes in climate, especially increasing incidences of drought, rising temperature, and a change in the number of rainy days. On the other hand, most of them did not perceive a change in incidences of floods or the intensity of storms. These findings are in line with other research on local perceptions of climate change in highland areas. Dorji et al. [4], Uprety et al. [32], and Ali et al. [45] found that rising temperature was noted by residents. Changes in the timing of rainfall were observed according to Dorji et al. [4] and Manandhar et al. [25]. In addition, increased incidences of drought were observed by the local community, as highlighted by Manandhar et al. [25] and Uprety et al. [32].

Albeit not a majority, some of the villagers perceived climate change impacts, namely increased pests and diseases, lower crop yields, and uncertainty in income. These findings are consistent with Dorji et al. [4], who revealed that people in highland communities of Bhutan perceived impacts of climate change on the quality and yield of caterpillar fungi production, their main source of income, through changes in rangeland ecosystems, as well as the emergence of mosquitoes, potentially leading to the spread of vector-borne diseases.

While perceiving changes in climate was associated with both individual characteristics and household characteristics, it was primarily influenced by individual attributes (age, gender, education, main livelihood, and residential location) rather than household characteristics. This observation agrees with Sanogo et al. [46], who revealed that farmers' perceptions of climate change were affected by age, education level, farm size, and gender. Yet, Uddin et al. [47] found that some household characteristics (family size, farm size, family income) influenced farmers' perception of climate change.

This study noted that younger locals perceived a change in the number of rainy days, a change in the beginning of the wet season, and the heightened intensity of storms than older locals. This is in line with Roco et al. [33], who found that younger farmers tended to have higher awareness of changes in climate than aged ones. In contrast, those with higher education were more likely to perceive uncertainty in income

as an impact of climate change, compared to those with lower education levels. This finding is in line with Poortinga et al. [48], who found that people who had higher education were more likely to perceive the negative impacts of climate change. On the other hand, the finding contrasts with Odewumi et al. [49], who found that education had no influence on farmers' perceptions of climate change impacts on agriculture.

The probit analysis revealed that men perceived more of climate change phenomena than women. This is consistent with Sanogo et al. [46], who found in southern Mali a significant gender gap in climate change perception. They reported that male farmers tended to observe changes in drought, floods, temperature, number of hot days, wind, dust, and rainfall more than female farmers.

Non-farmers tended to perceive increased drought, higher temperature, and a change in the number of rainy days more than farmers. On the other hand, farmers were more likely to observe increased pests and diseases and lower crop yields as the impacts of climate change. This is not surprising since farmers observe these changes through their daily activities. Moreover, residential location had both negative and positive impacts on the perception of climate change. Local-specific differences in perceived climate change were also reported by Abid et al. [18], Tofu [17], and Akano et al. [19].

Greater income from agriculture led to a higher perception of increased drought, while higher non-agricultural income led to a higher likelihood of reduced crop yields due to climate change. This finding is consistent with Uddin et al. [47], who found that household income level was related to perception of climate change.

Perception of increased pests and diseases was positively linked to household debt level and negatively affected by household size. The finding is aligned with Uddin et al. [47], who reported that larger families had a lower likelihood of perceiving climate change because they attended less training on climate change. On the other hand, the finding contrasts with Mairura et al. [50], who found that household size had no effect on climate change perception. Farm size had negative effects on perceiving the heightened intensity of storms, which is again consistent with Uddin et al. [47].

Conclusion

There is scarce evidence regarding perceptions of climate change occurrence and impacts among marginalized populations engaged in monocropping systems in highland areas, especially in Southeast Asia. This research identified climate change perceptions and related attributes among local residents in the highlands of northern Thailand through primary data and statistical analyses.

The descriptive analyses indicated that the residents in the study areas perceived increased drought, rising temperature, and a change in the number of rainy days, though most of them did not perceive a change in the frequency of floods or intensity of storms. Some of them perceived impacts of climate change, such as increased plant pests and diseases, lower crop yields, and uncertainty in income.

The probit analyses revealed that perceiving climate change was associated more with individual characteristics than with household characteristics. Main occupation and residential location were the two main individual variables associated with climate change perceptions and impacts, while education level showed the least association. Among the household variables, the number of owned farm plots and land parcels was the most significant factor associated with climate change perception and impacts. More specifically, non-farmers were more likely to perceive climate change phenomena such as increased drought, higher temperature, and change in the number of rainy days, while farmers tended to perceive more climate change impacts such as pest and disease outbreaks, as well as losses in crop yields. Being a woman and residing primarily inside the village were associated with perceiving fewer climate change phenomena.

Men and younger people were more likely to perceive climate change phenomena. Residential location, education, household size, household income from agriculture, household income from non-agriculture, household debt, number of farm plots, and landholding size were associated with some aspects of climate change and its impacts.

The findings would inform policy development in prioritizing and identifying adaptation strategies for residents in marginalized highlands exposed to unsustainable agriculture. First, as villagers perceive rising temperatures and changing precipitation patterns, policymakers should consider supporting adaptation practices, especially providing training on efficient water usage. Second, as older residents perceive climate change less than younger residents, collaboration should be fostered among the local communities to strengthen social networks through knowledge exchange and sensitization, particularly among older residents. Third, as farmers tend to perceive increasing pest and disease outbreaks, increasing uncertainty in income, and decreasing crop yields, support for farm-gate prices and measures for pest management are needed.

This research is not free from limitations. First, the scope is limited to highland areas in northern Thailand. The implications may be less applicable to midland and lowland areas, as well as highland areas in other countries. Second, the research employed a questionnaire survey, which might have overlooked some qualitative aspects of perceptions of climate change phenomena and impacts. Lastly, some of the respondents were not household heads. Household variables, such as household income, might have suffered inaccuracy during the analysis.

Future research may consider covering other geographies, employing in-depth elicitations, and triangulating some of the critical information.

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Conflict of Interest

The authors declare no conflict of interest.

Ethical Clearance

This study was assessed and approved by the Research Ethics Review Committee at the Asian Institute of Technology with the reference code: RERC 2021/016.

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