Climate Change Awareness and Adaptation: A Case Study of Smallholder Farmers in the Coastal Area, Phu Vang District, Vietnam

University of Tsukuba   Vo Hoang Ha

University of Tsukuba   Takeshi Mizunoya

In Vietnam, agriculture plays a crucial role in the economy, contributing significantly to poverty reduction, food security, and socio-political stability. Agriculture contributed 15.34% to GDP and created the working environment for about 40.3% of the total workforce in 2017 (GSO, 2017).

However, the effectiveness of agricultural production in recent decades has seriously threatened by the changing of climate. In that context, agricultural productions are encouraged to develop their own strategies for minimizing adverse effects from climate-related issues. Hence, understanding the determinants of household adaptation is indispensable to promptly propose appropriate support policies.

The study was conducted in Phu Vang district, Thua Thien Hue province, Central of Vietnam, where is characterized by small-scale farmers and has experienced many extreme weather events in the recent years. Thus, the perception of such farmers regarding the change of climate, farming adjustment and barriers to adaptation are high priorities.

The objectives are (1) Examine farmers' perspective and awareness of climate change in the recent decade, (2) Identify household adaptive strategy under the pressures of climate change, (3) Clarify the factors that affecting households' adaptability to climate change, and (4) Suggest the relevant solution to strengthen farmers' adaptability to climate change in the local context.

The findings indicated that the changes in climate-related aspects were identified by the local farmers. Most interviewees (89.1%) reflected certain changes in the frequency of extreme weather events. Besides, changes in rainfall and temperature were also perceived by the participants, with 69.1% and 80.9% respectively.

Regarding the adaptive strategy, of the 110 respondents, there are 51 farmers (46.4%) adopted at least one adaptive method. In addition, the binary logistic regression model further confirmed that the households' adaptation was influenced by the household-head gender, educational qualifications, agricultural experience, number of labors, household's average income, the proportion of non-agricultural income, and participation in social organizations. Households' adaptation was positively affected by most of the above factors, except for the proportion of non-agricultural income. Meanwhile, there was no linkage between accessing credit and the implementation of adaptation measures.

Based on the result of the study, several solutions were suggested to enhance farmers' capacity to cope up with the negative impacts of climate change in Phu Vang district.

Keywords: Climate change, Agriculture, Awareness, Adaptation, Smallholder farmer, Phu Vang district, Vietnam, Coastal area.

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1. Introduction

Climate change is one of the major concerns worldwide in the recent decades. Due to a long coastal line nearly 3,260 km and 3,000 islands, Vietnam becomes a very vulnerable country with affected seriously by climate change, with strong fluctuations of meteorological and hydrology phenomena, regarding the report of the World Bank 2009 (World Bank, 2009).

In Vietnam, agriculture plays a crucial role in the economy, contributing significantly to poverty reduction, food security, and socio-political stability. Agriculture contributed 15.34% to total GDP and 40.3% for employment in 2017 (GSO, 2017). Rising the agricultural production at the national level leads to improve overall economic growth and development (FAO, 2002). The agriculture in Vietnam is dependent significantly on natural conditions especially depend on the climate that is one of the most important factors decide to rice production (Miguel, 2013). Or in other words, climate change is the biggest damage to agriculture, agricultural production and food security.

The study was conducted in Phu Vang district, Thua Thien Hue province, Central of Vietnam, where is characterized by small-scale farmers and has experienced many extreme weather events in the recent years. Furthermore, Phu Vang district is popular among small-scale farmers, and their livelihoods rely largely on agricultural activities who have limited or no financial reserves.

The objectives of the research are (1) Examine farmers' perspective and awareness of climate change in the recent decade, (2) Identify household adaptive strategy under the pressures of climate change, (3) Clarify the factors that affecting households' adaptability to climate change, (4) Propose suitable policy-related recommendations to improve household adaptability to climate change.

The coastal areas have been affecting significantly due to climate change. Therefore, consideration of farmers' perceptions and adaptation to climate change, as well as adaptive barriers are urgent. For those reasons, the research is conducted to determine impact factors related to the issues.

2. Material and Methodologies

2.1. Study area

The area where the study took place in Phu Vang district, Thua Thien Hue province, central coast of Vietnam (from 16°20′N 107°35′E). Phu Vang district is a coastal plain district belong to a downstream of Huong river that is characterized a high vulnerability affects significantly by climate change with 35 km of coastline and 6,800 ha of lagoons. Regarding to the Statistical yearbook 2017, Phu Vang district has a population of 184,927 residing in a 278.24 km^2 and the rate of poverty was 1.7% (Phu Vang Statistical Office,2017). Besides, the climate in Phu Vang district is inherited all the climate characteristics of Thua Thien Hue province. The main incomes of local people in Phu Vang district are largely relied on three sectors: fishing, agriculture, and aquaculture. In recent years, erratic changes in climate have been causing significant impacts on the lives of local people (Suu et al,. 2010). Therefore, the survey was carried out in three communes in Phu Vang district that engaged in agriculture production include Vinh Xuan, Phu Luong and, Phu Da.

2.2. Data collection and Sampling selection

The secondary data was accumulated from the Departments, the People committees from province, district and commune level. Furthermore, the climate data was collected from the Centre for Hydro-Meteorological Forecasting of Thua Thien Hue province from 2007 to 2017.

The primary data was collected from 110 smallholder farmers belonging three agriculture communes by using the questionnaire in the production period 2017/2018. For the household interview, the questionnaire clarified about the household characteristic, how householders perceive climate change,

farming adaptations to cope up with the adverse impact of climate change, and the barriers to their adaptation. The survey data was analyzed by using Excel and Statistical Package for the Social Sciences Software (SPSS 22). The research applied the descriptive and inference analysis for investigate the perception on climate change. The logistic model was used to determine factors influencing the farmers' decision to adapt climate change. The binary logistic model is generally given by the equation below:

$$\hat{Y} = \beta o + \beta 1 * X1 + \beta 2 * X2 + \beta 3 * X3 + \beta 4 * X4 + \beta 5 * X5 + \ldots\ldots + \beta n * Xn$$

Of which:

Y = 0   Household did not apply any adaption measures to adapt to climate change.

Y = 1   Household applied adaptation measures to adapt to climate change.

X1 to Xn   Independent factors selected for testing.

β   Coefficients.

Table 1: Description of independent variables

Variety	Description independent variety	Expected sign
X1	Gender of householder (Binary variable: Male = 1; Female = 0)	+
X2	Education level of householder (continuous variable)	+
X3	Farm experience of house holder (continuous variable)	+
X4	The number of labor (continuous variable)	+
X5	Per capital income (continuous variable)	+
X6	The non-farming income (continuous variable)	-
X7	Access to credit (Binary variable: Yes = 1; No = 0)	+
X8	Cooperative organizations' member (Binary variable: Yes = 1; No = 0)	+

3. Result and Discussions

3.1. Socio-demographic characteristics of respondents

Table 2: Socio-demographic characteristics of householders (N=110)

| No	Variable	Category	Frequency	Percentage
1	Gender	Female	36	32.7
		Male	74	67.3
2	Civil status	Single	29	26.4
		Married	76	69.1
		Widow	5	4.5
3	Age	24 - 30	9	8.2
		31 - 55	72	65.5
		56 – 70	26	23.6
		71 and above	3	2.7
4	Monthly income /capital	Low (< 3 million VND)*	17	15.5
		Middle (3 million VND – 5 million VND)	69	62.7
		High (above 5 million VND)	24	21.8
5	Level of education	Illiterate	8	7.3
		Primary school (grades 1-5)	34	30.9
		Secondary (grades 6-9)	21	19.1
		High school (grades 10-12)	32	29.1
		Intermediate	15	13.6
6	Experience in agricultural	≤ 10 years	2	1.8
		11 - 30 years	71	64.5
		31 years and above	37	33.6

(*) The 2018 exchange rate: 1,000 VND = 0.04 USD   (Source: Household interview by Author, 2018)

The table 2 provides the basic information about the socio demographic characteristic of surveyed households in Phu Vang district. Out of the 110 respondents interviewed, most of household heads are

male (67.3%). 65.5% of respondents were in their middle age from 31 to 55 years old, and 69.1% were married. More than that the education level of the respondents in study area was high with 92.7% had achieved primary education and out of that 48.2% are secondary and high school graduates. In addition, the highest educational attainment of respondents was intermediate with 15 respondents (13.6%). Most of the respondents have been involved in agriculture for a long time, with 64.5% of farmers having 11 – 30 years of agricultural experience.

3.2. Farmer's perception about climate change in Phu Vang district

In this research, the farmers were interviewed about whether they have realized the changing in temperature, rainfall and the weather phenomenon from 2007 to 2017 in Phu Vang district. To understand well about the change of climate and variability of local community perception, the study will explore how the famers perceive about the change of climate, and then analyze the scientific data on the trend and variability of climate in Phu Vang district to test these perceptions.
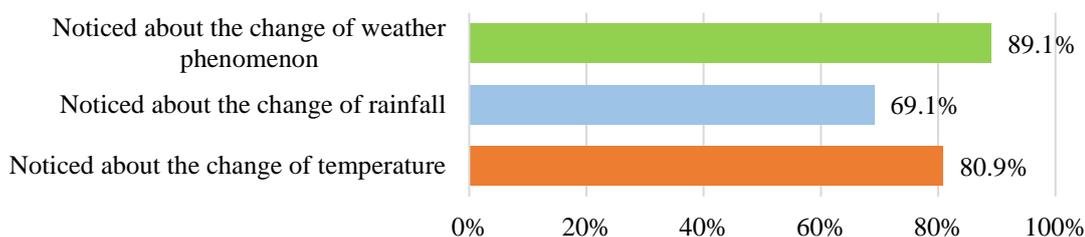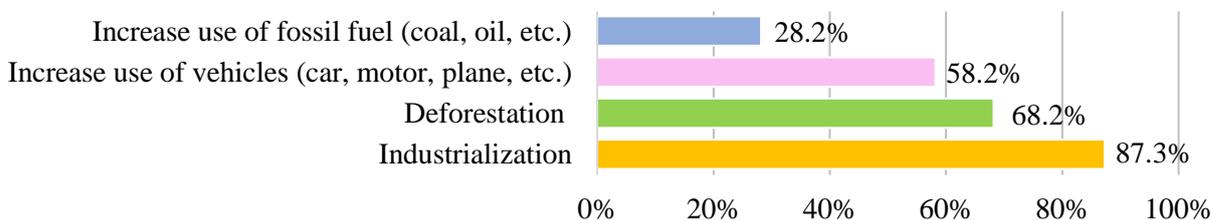

Figure 1: Farmers' awareness about the change of climate in Phu Vang district (N=110)
(Multiple choices were allowed - Source: Household interview by Author, 2018)

The Figure 1 illustrates the awareness of farmers about the change of climate generally in the study area. The changes in weather patterns were perceived clearly by most respondents. In which, 80.9% and 69.1% of informants notice the changes in temperature and rainfall respectively, while up to 89.1% of respondents realize at least one change regarding weather phenomena through their personal experiences.

3.3. Farmers' perceptions about the cause of climate changes

Being aware of the direction of climate change is crucial for implementing appropriate adaptation measures. As it is evident from the Figure 2 that "the industrialization process" is attributed to the main cause of climate change with the approval of most interviewees (87.3%). Besides, the "deforestation" is seen as also the major causes of climate change indicated by 68.2% of respondents. The increasing popularity of modern vehicles such as cars, motorbike, which lead to the increasing consumption of fossil fuels, were also perceived as a reason causing the change of weather with the consensus of 28.2% and 58.2% of informants respectively.


Figure 2: Farmers' awareness about the cause of climate change in Phu Vang district (N=110)
(Multiple choices were allowed – Source: Household interview by Author, 2018)

Majority of the farmers had a good awareness about the different causes of climate change include increasing use the fossil fuel, deforestation, industrialization, and increase use vehicles. The indicate is observed by respondents may be due to the fact because the study area being peri-urban so the farmers can observe and get the information easily about the adverse effect of pollution from industrialization, deforestation, increasing use fossil fuel and vehicle.

3.4. Adaptive methods of farmers in the context of changing the climate in Phu Vang district

Aiming at minimizing the adverse impacts of climate change on agriculture, the farmers in Phu Vang district have been implementing suitable adaptive measures. Of the 110 respondents, there are 51 farmers (46.4%) adopted at least one adaptive method, whilst 53.6% of respondents stated that nothing was operated for climate change adaptation. Based on the farmers' response those adaptation measures were (1) changing the rice varieties, (2) changing transplanting time, (3) diversification of crop productions, (4) diversification of livestock productions, (5) soil conservation and (6) apply irrigation measures actively (pump), the findings is shown in Figure 3.
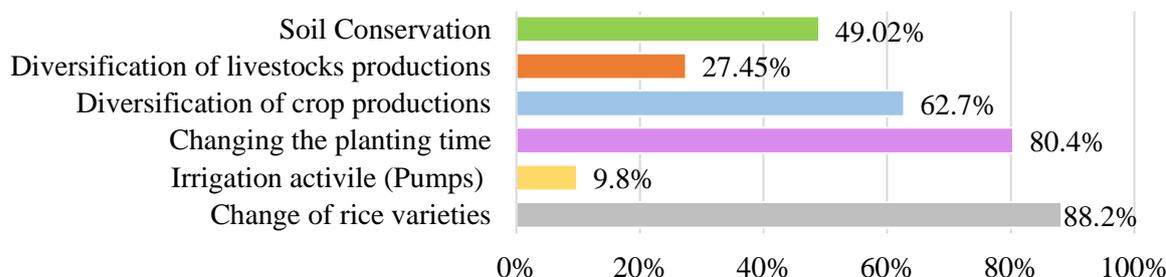
Figure 3: Farmers' adaptation measures to climate change in Phu Vang district (N=51)
(Multiple choices were allowed - Source: The household interview by Author 2018)

3.5. Factors influencing to farmers' adaptation measures to climate change in Phu Vang district

Firstly, the goodness of fit test in the Table 3, the p-value is low (< 0.001). And the observed of the chi-square value is 81.121 greater than the critical table chi-square values ($X^2_{0.1;7} = 12.017$ and $X^2_{0.05;7} = 14.067$) so the decision is to reject the null hypothesis. Moreover, with 69.7% of the Nagelkerde R2 that the logistic model explained 69.7 proportions of the distribution of the dependent variable.

The findings given in the Table 3 revealed that the logistic model predicted correctly 53 farmers out of 59 respondents not adopting adaptation measures. The rate of non-occurrences predicted correctly is $\frac{53}{59} = 89.8\%$. In addition, a total of 51 respondent adopting adaptation measures, the model estimated the wrong 10 farmers. It means the prediction rate if occurrences correctly are $\frac{41}{51} = 80.4\%$. The overall success rate of the logistic model is high, namely, $\frac{94}{110} = 85.5\%$. In other words, the model allows accurate forecasting in 85.5% including 89.8% of non-adaptive measures and 80.4% of adaptation measures implemented. Accordingly, the statistical testing results proved that using logistic regression model in this study is completely suitable.

Table 3: The classification table

Classification Table*					
			Predicted		
	Observed		**Adaptation**		**Percentage Correct**
Step 1			0	1	
	Adaptation	0	53	6	89.8
		1	10	41	80.4
	Overall Percentage				85.5

* The cut value is .500 — Source: Data processed by author, 2018

Secondly, as can be observed in Table 4 the results of the Logistic model indicated that the adaptation process is driven by some factors. Out of eight independent variables selected to find the relationship with adaptation to climate change, the six variables had a positive and significant relationship to the adoption of climate change adaptation measures. The six positive variables in the study are gender, education level, the farming experience of the household head, several farming laborers, per capita income, and members of social organization. While the ratio of non-agricultural income variable had negatively influences. Besides, the variable of access credit had no significant relationship with the

adaptation to climate change of household head. Consequently, the logistic model indicated that the adaption process is driven some factors as follow:

$$\hat{Y} = -5.699 + 1.319 * X1 + 0.172 * X2 + 0.075 * X3 + 0.538 * X4 + 0.552 * X5 - 0.073 * X6 + 1.9 * X7$$

Table 4: Variables in the Equation

|		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1a	Gender**	1.319	.716	3.393	1	.065	3.740
	Level _of_ education*	.172	.079	4.694	1	.030	1.188
	Agricultural_ experience*	.075	.037	4.165	1	.041	1.078
	Number _of_ labor*	.538	.228	5.593	1	.018	1.713
	Income_ per_ capital*	.552	.242	5.204	1	.023	1.737
	Ratio_ non-agricultural_ income*	-.073	.028	6.976	1	.008	.930
	Access_ credit	-.569	.680	.700	1	.403	.566
	Member_ of_ social_ organization*	1.900	.844	5.070	1	.024	6.685
	Constant	-5.699	2.288	6.201	1	.013	.003
2 – Log Likelihood		70.789a					
Cox & Snell R Square		.522					
Nagelkerke R Square		.697					
Chi-square		81.121					
Sig		0.001					

Source: Data processed by author, 2018

a. Variable(s) entered on step 1: Gender, Level_ of_ education, Agricultural_ experience, Number_ of_ labor, Income_ per-capital, Ratio_ non-agricultural_ income, Access_ credit, Member_ of_ social_ organization.

* Significant at 5% level
** Significant at 10% level

3.6. Barriers to climate change adaptation of smallholder farmers in Phu Vang district

In this research, the farmers were asked the follow-up question about the adaptation barriers to climate change in Phu Vang district to identify the constraints to farmers implement adaptation measures. Regarding the surveyed data, of the 110 respondents, there were 51 surveyed farmers (46.4%) who adopted one or more climate change methods, whilst 54.6% of respondents stated that not to have applied any adaptation measures.
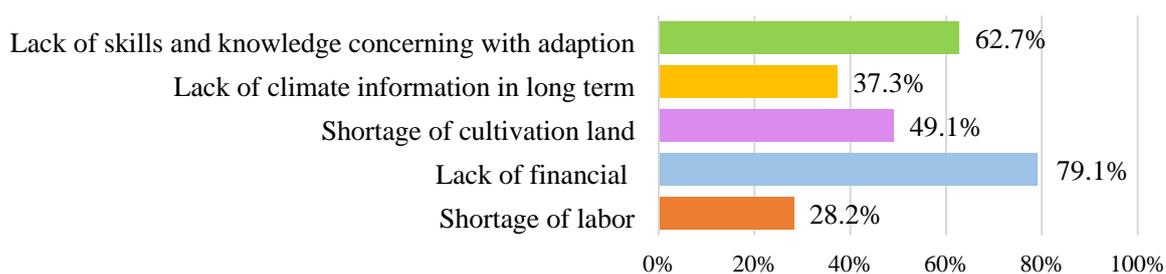
Figure 4: Barriers to climate change adaptation in Phu Vang district (N=110)

(Multiple choices were allowed - Source: The household interview by Author 2018)

Findings presented in Figure 4 reveals that the major barriers related to farmers' adaptation capacity in Phu Vang district were: (1) shortage of labors, (2) lack of financial, (3) shortage of cultivation land, (4) lack of climate information in long term, and (5) lack of skill and knowledge concerning with adaptation. Determinant the barriers which explain why farmers did not take all or any adaptation measures, therefore could suggest solutions to improve the farmers' adaptive capacity and reduce the impact of climate change.

4. Conclusion and Recommendations

In recent decades, farmers have been suffering numerous problems related to climate change to agriculture in Phu Vang district. The research has attempted to understand about smallholder farmers' perception and adaptation measures to cope up with the adverse impact of climate change in Phu Vang district. The findings of the study revealed that the changes in weather patterns were perceived clearly by most respondents from 20017 to 2017 in study area. Regarding the results obtained, suitable policy-related recommendations are proposed to enhancing farmers' adaptive capacity to climate change.

Firstly, regarding the finding results, the financial problem is seen as the worst barrier for farmers in applying adaptation measures. Until now, the Government has been issuing the policies related to financial supporting for the agricultural sector. However, the process of capital furnishing to farmers is limited because the loans with large amounts for farmers who have low income to expand production is still confined. Besides, the process of accessing loans/credits still faces many arduous problems. Therefore, to encourage farmers to develop agricultural productivity, the Government and local Government should give emphasis to support farmers financial, especially small-scale farmers.

The proposed measures include increasing the lending amount focus on agricultural development for farmers, facilitating farmers to access credits or loans with the low or no interest rate. In addition, the local agencies need to speed up and simplify the legal procedures for granting land use right and property certificates to access the loan processes.

Secondly, improving knowledge and skills about natural disaster risk prevention for farmers to enhance awareness and adaptation capacity. Specifically, raising awareness of government officials and local people in reducing and adapting to climate change in agriculture and rural development. Furthermore, ensuring for organizations, communities and all individuals could participate in the training classes or programs to improve farmers' awareness and adaptive capacity to climate change.

Thirdly, the social-physical infrastructures and media related to climate information should be improved to strengthen the adaptability as well as the ability to access climate information in the long term of farmers. Such as, set up/build early cautionary systems or weather forecast for crop productions and resident communities in the emergency situations. Construction the system of ponds and embankments steadily, plant trees along the coastal areas for prevention of floods as well as control corrosion.

Fourthly, the Government should invest capital and human resources in disseminating appropriate ecological friendly technologies and invented the new crop varieties with high resilient to the changing of climate conditions and ensure that all farmers could be approached easily.

Finally, propagating widely for farmers to implement the GAP (Good Agricultural Practices) process in cultivation. Encourage farmers follows the degrees and regulations related to sustainable agricultural development strictly such as implementing the crop rotation system, using the cultivation with saving the fertilizers and pesticides to limit the methane emission, using water for irrigation economically, soil conservation minimizes. Besides, the local Government and the relevant agencies should create the good agricultural markets to consume and rescue for agricultural products to improve farmers' income level.

[References]

General office statistics (GSO), (2017), Statistical yearbook of Vietnam 2017, Vietnam General Statistical office Publisher.

Lam Thi Thu Suu, Pham Thi Dieu My, Philip Bubeck, A. D. (2010), Community-based Adaptation Strategies for Enhancing Resilience to Climate Change in the Huong River Basin. Hanoi, Vietnam.

Miguel, D.-G, (2013), Identifying Institutional Factors That are Barriers to Climate Change Adaptation in Vietnam. Uppsala University, Sweden.

Phu Vang Statistical Office, (2017), Statistical Yearbook 2017.

The Food and Agricultural Organization of the United Nations - (FAO), (2002), The Role of Agriculture in the Development of Least-Developed Countries and their Integration into the World Economy.

World Bank, (2009), The World Bank Annual Report 2009 Year in Review operational summary.