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Stakeholders' perceptions and responses to climate change impacts on agricultural sector in mountainous areas of Thua Thien Hue province

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Abstract:

This study aims to analyse stakeholder perceptions and responses on climate change (CC) impacts on agricultural sector in the mountainous areas of Thua Thien Hue province. Data was collected by surveying 462 farmers in Nam Dong and A Luoi districts with a structure questionnaire; in-depth interviews of 29 agricultural officials; 12 agricultural input suppliers, and representatives of 18 community organizations. The research results show that stakeholders have very different perceptions regarding the causes, impacts, and responses to CC (P value <.00). Most stakeholders believe that CC has many causes of which deforestation and too much waste were the two main factors. However, more than 45% of farmers believe that CC is due to God. Regarding CC impacts, a large percentage (81.4%) of interviewed farmers were most concerned about drought due to its increased intensity and widespread effects. Meanwhile, agricultural officials were focused on foreseen and shocked extreme events such as landslides and flash floods, which occur only at particular sites along the streams. Agricultural enterprises are often proactive and aware of people's concerns to provide related services such as resistant seeds, irrigation facilities, and fertilizers. However, very few (8.44%) farm households in the region have access to these services because of limited financial capacity.

Keywords: **climate change, impacts, mountainous, perceptions, responses, Thua Thien Hue.**

Classification number: **4.4**

Introduction

Vietnam is a country with a large proportion of agricultural laborers and agriculture plays a very important role in the country's economy. The strong development of agriculture is a solid premise for other economic sectors to develop [1]. Over the past decade, under the impact of CC, the frequency and intensity of natural disasters has increased causing serious damage to mankind, property, economy, culture, and society [2]. According to some CC scenarios [3], temperatures in Thua Thien Hue will increase by 0.5°C in 2020, 1.4°C in 2050, and 2.6°C in 2100. The average annual rainfall will increase by 3.7% in 2050 and 6.8% in 2100 with a decreasing trend in the dry season and an increase in the rainy season. In the last 20 years, under the impact of CC, the number of floods increased by 26% and the peak of floods increased by 11% [4]. People in mountainous areas of Thua Thien Hue are faced with many livelihood risks due to the impact of CC [5].

Faced with these challenges, the government as well as domestic and foreign agencies and

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organizations have implemented numerous policies, programs, and projects to improve the capacity to respond to adverse impacts of CC on the environment. To minimize losses in agricultural production as well as human lives, programs such as the National Target Program to respond to CC 2008, 2016; action plan to respond to CC of Thua Thien Hue province 2016-2020; Green growth strategy 2012; smart agriculture (GACSA) have been introduced. However, the capacity of people in mountainous areas to respond to CC is still low [6] and one of the main reasons for this is limited awareness and understanding of the local residents about CC causes and impacts responses [7] This situation is consistent with the results of many previous studies indicating the decisive role of "perceptions and attitudes on CC impacts and responses of the people and stakeholders" in building CC resilience for farmers and communities [8, 9]. To have a scientific foundation for proposing solutions that improve the adaptive capacity and ensure livelihoods of people in mountainous areas in Thua Thien Hue province, this study analyses the perception of related stakeholders on CC causes, impacts, and the existing response strategies in agricultural production of local communities.

Methodology

Study site

The four mountainous communes of Thua Thien Hue province selected for the study include the Thuong Long and Thuong Quang communes in the Nam Dong district and the Hong Ha and A Roang communes in the A Luoi district. The field survey lasted from April 2019 to March 2020. These communes were representative for the whole studied districts in terms of typical livelihood activities, ethnicity, and poverty rate. In addition, the natural conditions of the communes were also representative for the districts in terms of typical extreme weather conditions.

Data collection

Secondary information includes data on extreme weather events; reports on the socio-economic situation of the communes in the period of 2015-2019; data on agricultural production of each commune and related studies in the two districts have been collected from international and national journals, reports from related departments and statistical offices.

Primary data was collected through interviews with 462 farm households; 29 agricultural officers at the four studied communes, Nam Dong and A Luoi districts, Thua Thien Hue province; 12 owners of agricultural input suppliers (AISs); and 11 individuals who were representatives of community-based organizations (CBOs) in the two studied districts. Households were randomly selected from the list of farm households provided by the commune people's committee. Based on time and budget availability, 120 households from each commune were selected for the study. Random sampling was conducted without repetition, and one household from every 5 was selected for the survey until the sample size was sufficient. The total number of households interviewed was 480, however, 18 households were removed due to inadequate information or incomplete survey questionnaires. The sample size, thus, contained 462 farm households. Community based organizations include

agricultural extension clubs, livestock groups, agricultural production cooperation groups, and forest protection groups. The content of the questionnaire focused on farmers' level of awareness about CC and concern about weather extreme events; impacts of CC on agricultural production in the locality; their perspectives on the response strategies that have been implemented; and the results.

Data analysis

Descriptive statistics was the main method used to analyse the data collected from the household survey. Mean, frequency, and percentage were applied to analyse all variables related to households' CC awareness and perception about impacts and response strategies. Besides, the study employed the Chi-squared test (X^2) to compare the related indicators among stakeholder groups including farm households, agricultural officials (commune, district, province), AISs, and CBOs.

Results and discussion

Major socio-economic characteristics of the study area

The mountainous region of the Thua Thien Hue province covers a total area of about 1,256 km^2, which belongs to 5 districts including Phong Dien, Huong Tra, A Luoi, Nam Dong, and Phu Loc. Nam Dong and A Luoi are two districts that have their entire land area within the mountainous area of the province. Ethnic minorities occupy a very high proportion with over 46% and 76% of the total population of the Nam Dong and A Luoi district, respectively (Table 1). Ethnic minorities include Ta Oi, Pako, Bru Van Kieu, Co Tu, and Pa Hy. They have been living in the same territory for many decades. With collective livelihood activities

Table 1. Major socio-economic characteristics of the study area in the year 2020.

Socio-economic characteristics	Unit	Nam Dong district	A Luoi district
Population	Person	28,267	49,611
Households	Household	6,809	13,448
Kinh households	Household	3,887	3,103
Ethnic households	Household	2,922	10,345
Poor households	%	10.16	25.94
Near poor households	%	7.10	13.14
Income structure			
- Agriculture-fishery	%	45.5	44.8
- Industry-handicraft	%	28.8	33.4
- Services	%	25.7	21.8
Total land area	ha	64,777.90	122,521.21
Agriland	ha	4,897.68	6,194.84
Forestland	ha	55,305.67	109,591.9
Non-agricultural land	ha	2,181.53	5,335.22

Source: Nam Dong and A Luoi people's committee, 2020.

and intermarriage among the ethnic groups, the boundaries of culture and customs have, thus, gradually disappeared or become eliminated.

Table 1 also shows that the percentage of poor and near-poor households in the two districts in 2020 was still very high. The average poverty rate of the whole district in 2020 of Nam Dong was 10.16% and of A Luoi was 25.94%. However, in some communes of the two districts, the poverty rate was extremely high with over 24% in Thuong Long commune, Nam Dong district, and over 35% in the A Roang, A Dot communes, A Luoi district. Besides, the rate of near-poor households was also more than 7% in Nam Dong and 13% in A Luoi. The high poverty rate in this area is possibly because the majority of households are ethnic minorities and their livelihoods heavily depend on natural resources, especially forest resources that have been exhausted. In addition, due to the implementation of "closing forests" policies[1] in the study area, the forest exploitation activities - a key income source of the majority ethnic households in the two districts - has become strictly controlled. As a consequence, livelihoods of most households in the two districts have been significantly affected. Agriculture fishery production makes up a large proportion of household income (45.5% in Nam Dong district and 44.8% in A Luoi district) and has been becoming more important for local people's livelihoods due to the reduction of income from forest exploitation activities. However, agricultural land is limited compared to forestland (4,897.68 ha compared to 55,305.67 in Nam Dong district and 6,194.84 ha compared to 109,591.9 ha in A Luoi) and has been reduced over time due to CC impacts, particularly, drought and landslides [6, 10]. Upland rice, casava, and maize are three dominant crops while cows and local pigs are dominant house animals in the two districts. The majority forest land in the two districts is covered by acacia and rubber plantation.

Stakeholders' perceptions about CC impacts

The level of awareness about CC plays a decisive role in building a household's resilience and limiting damages caused by CC impacts. The higher the awareness level, the more people become concerned while looking for effective solutions, and they will be more willing to adapt [11]. Data in Table 2 shows that most of the interviewed farmers and stakeholders have heard about CC and shared others their opinion that CC occurs due to many causes in which deforestation and excessive waste discharged to the environment are two key causes. These findings are consistent with many previous research efforts [12, 13]. However, a significant proportion (over 50%) of the respondents have heard about CC but do not understand or clearly understand its causes and potential impacts. More than 45% of people still believe that the main cause of changes in weather and increasingly climate extreme events is the naturedly decision of God.

Understanding causes and potential impacts of CC on agricultural production and livelihoods is key to motivate farmers and stakeholders to

[1]Decision No 07/2012/QD-TTg dated 08/02/2012 of the Prime Minister promulgating a number of policies to strengthen forest protection, including policies to promote socialization, to attract economic sectors, social organizations and residents to participate in forest protection, create jobs, increase income, contribute to poverty reduction and improve living standards for local communities.

Table 2. Stakeholder's perception about climate extreme events and causes (% respondents).

Perception	Farmers (n=462)	Agricultural officers (n=29)	AISs (n=12)	CBOs (n=18)	X^2	P value
Have heard about CC	71.0	100	100	100	23.4	.00
CC causes						
Ozone depletion	4.8	100	100	100	356.2	.00
Urbanization	22.1	100	100	100	148.8	.00
Deforestation	74.0	100	100	100	19.9	.00
Industrialisation	32.3	100	100	100	100.1	.00
Overpopulation	9.7	24.1	2,5	5.5	9.0	.03
Discharging too much waste into the environment	66.9	100	100	100	27.7	.00
Due to God	45.0	1.0	100	11.1	23.9	.00
Weather extreme events have greatest impact on agricultural production in mountainous areas of Thua Thien Hue province						
Drought and heat stress	81.4	37.9	66.7	72.2	22.8	.00
Abnormal weather	27.9	3.4	8.3	16.7	11.4	.01
Heavy rain	2.6	0	66.7	0	132.1	.00
Flash floods, landslides	19.5	55.2	16.7	11.1	21.8	.00
Tornadoes, storms	1.5	0	0	0	.9	.00

Source: Field surveys, 2020.

search for and adopt effective response solutions [13]. Table 2 shows that the perception about CC causes and impacts significantly varied among stakeholders (P value <.00). Over 71% of interviewed farmers considered heat stress and drought to be the extreme event that has the most serious impact on agricultural production and their livelihoods. A majority of interviewed AISs (66.7%), as well as representatives of CBOs (72.2%), shared the same views on CC impacts as local farmers. Meanwhile, over 55% of the agricultural staff indicated landslides and flash floods as the most critical natural disasters. The interview results showed that up to 10 out of 12 officials at the provincial and district levels believed that landslides and flash floods were the key problems of agricultural production and the livelihoods of the people in the mountainous areas. The differences in the identification of risks in agricultural production caused by CC may significantly affect the decision on responses as well as the effectiveness and sustainability of response strategies [14, 15].

Stakeholder concerns about impacts of CC on agricultural production in the study area

Results in Table 3 show that the concerns regarding responses to CC impacts in agricultural production significantly varied

Table 3. Stakeholder concerns about CC response in agricultural production (% of respondents).

Criteria	Farmers (n=462)	Agricultural officers (n=29)	AISs (n=12)	CBOs (n=18)	X^2	P value
Regularly seek information about CC, discuss and share with other individuals	79.4	44.8	0.75	100	24.4	.00
Worried about impacts of CC on agricultural production	79.4	37.9	66.7	100	37.1	.00
More accurate predictions of CC and impacts are needed	80.5	100	100	100	14.1	.00
Interested in accessing knowledge and technologies to cope with CC	45.9	100	100	100	61.4	.00
Need to raise awareness about CC impacts	80.5	100	100	100	114.9	.00
It is necessary to have a plan to respond to CC in the field of agricultural production	28.6	100	100	100	14.1	.00

Source: Field surveys, 2020.

among stakeholders (P.value<.00). The majority of farmers (nearly 80%) and representatives of CBOs (100%) were worried about negative impacts of CC and regularly seek related information to share with others. They were also very interested in accessing information on CC responses in the agriculture sector. However, around 20% of interviewed farmers did not care or did not recognise the need to raise awareness or to have CC response plans. Most of them were farmers who still believe that CC is caused by God.

AIS representatives were very interested in accessing information on CC. However, their concerns and worries were about the accessibility and ability of farmers to pay for their services due to negative impacts of CC. Many of them mentioned the cases of serious storms in 2015 and 2016 that greatly damaged the acacia and rubber plantation in the mountainous region of the province. The effect was that households could not afford to pay for fertilizer and other supplies they purchased. Similarly, the severe drought during the 2018-

2019 crop resulted in many rice fields in A Luoi having no harvest, and, as a consequence, farmers could not afford to buy rice new seeds for replanting.

Results of the field survey also indicate that all interviewed agricultural officers were interested in learning about CC and expressed that it was very necessary to raise awareness about CC for farmers and all related stakeholders as well as to develop CC response plan for mountainous areas of the province. However, they all confirmed that CC is not a single-top concern for agricultural departments, but it is an integrated issue that all sectors and related departments must consider integrating into their strategic plans. The agricultural development plans of the province deal with many issues and targets other than CC such as productivity, quality, biological systems, and market demand. Thus, funds to agriculture sector have been prioritised to respective items accordingly.

Stakeholders' strategies to respond to CC impacts in agriculture

Response approaches and satisfaction with existing response strategies partly reflect concerns and efforts of stakeholders to respond to CC impacts. The satisfaction level was measured by the average mean score of a 5-point Likert scale measurement. Table 4 shows that stakeholders had diverse approaches to respond to CC impacts in agriculture at their own position and roles in the sector. The level of satisfaction with their response strategies also varied significantly among strategies and groups of stakeholders. Most farmers learn from their neighbours, relatives, community organizations, or from experience of older generation to cope with CC impacts. Meanwhile, a very low percentage of farmers consult AISs (8.4%) or agricultural officials at any levels (11.5%) for coping strategies. Besides, the level of farmers' satisfaction with these two stakeholders was not high. It was explained that the AISs were good in that they are proactive in updating information and new technologies, but they only did their best for the regular clients. It is difficult for those who do not regularly purchase supplies from them to get consultations from AISs. In addition, their services were costly and thus not all farmers were able to afford AIS services. Regarding agricultural officials, almost all farmers expressed that it was difficult to contact them. Those who work at the commune were not capable, thus, farmers do not trust them. Those who work at higher levels (district and province) are more capable and strategic but difficult to contact to get a consultation. The consultations from CBOs, neighbours, and friends are mainly experience-based but were highly appreciated by the interviewed farmers for being flexible and understandable. This is particularly important to ethnic minority farmers that have characteristics of being hesitant in communication and have limited receptive capacity.

Table 4 also shows that all groups of stakeholders regularly seek information on weather, climate, and impacts of CC to share to others or to integrate into their short and long-term plans. CBOs and AISs are quite satisfied with what they have done to build farmers' resilience to CC impacts because their efforts have been, to some extent, appreciated by local farmers. Meanwhile, agricultural officials at all levels were not very satisfied with

Table 4. Stakeholders' responses to CC impacts on agriculture sector.

Stakeholders	Response strategies	Percentage of respondents agree (%)	Average mean score of satisfaction scale*
Farmers (n=462)	Self-change to cope with the situation	19.2	3.4
	Consult officials at all levels	11.5	3.0
	Consult AISs	8.4	3.4
	Consult CBOs	27.5	4.2
	Consult others	58.9	3.9
Agriculture officials (n=29)	Search for CC information to disseminate to farmers	100	3.5
	Communicate and provide trainings to raise farmers' awareness	13.8	2.7
	Do trials and demonstrate adaptive livelihood models	17.2	4.0
	Integrate CC into annual working plan	82.8	3.7
	Policy advocacy for climate responses in agriculture sector	20.7	2.6
AISs (n=12)	Search for CC information in the region	100	4.0
	Search for relevant adaptation models and related services	100	4.3
	Support demonstrating adaptive livelihood strategies	0	-
	Consult farmers and integrate CC adaptation in to their business plan	100	4.3
CBOs (n=18)	Seek and share CC related information for CBOs' members	90.9	4.5
	Share and exchange successful experience and adaptive cases	100	3.2
	Mobilise and support members to cope and build their resilience capacity	100	4.8

Source: Field survey, 2020.
*Satisfaction scale from 1 to 5 indicating lowest to highest level of satisfaction with the response strategy.

their activities of integration, consultation, communication, as well as policy advocacy to respond to CC particularly for the mountainous communities. The main reason for this is almost all officials indicated that it was the matter of a prioritized issue. Since CC is not prioritised and just an integration issue, there is no funding for this matter and not many officials have been formally educated, fully trained, or even assigned to take part in the related communication programs, trainings, or policy advocacy activities. This finding needs to be explored further because in order to meet other targets of the agriculture sector such as productivity, quality, biological sustainability, and profitability, climate must be among the key deciding factors in the long run [13]. In other words, finding ways to ensure productivity, quality, and profitability of agriculture production is the pathway to building farmers' adaptive capacity and vice versa [15]. Results in Table 4 also show that there was almost no collaboration among stakeholders in building farmer resilience to CC. This may be the key reason leading to the mismatch in identifying and prioritising extreme events and the respective coping solutions between farmers and related departments.

Conclusions and recommendation

CC is a major challenge for agricultural production in the mountainous areas of Thua Thien Hue province. However, the levels of awareness, perception, and concern of CC impacts and responses were significantly different among stakeholders (P value <.00). Most stakeholders have similar perceptions about the causes of CC, however, up to 45% of farmers still believed that CC is caused by God. This partly affects farmers' interest in seeking CC information as well as their willingness to change or respond. An important finding was the significant differences in perception of CC impacts of agricultural officials and local farmers. Agricultural officials have paid more attention and respond to flash floods and landslides, while farmers are more concerned about and prioritize drought responses. Lack of comprehensive analyses and communication programs could be the main reasons for this difference. The difference may create difficulties for the coordination of implementing agricultural development programs in the context of CC and livelihood of farmers. Therefore, to enhance the effectiveness of agriculture production and ensure livelihoods of farmers in the context of CC, relevant stakeholders need their knowledge and awareness on CC strengthened and should collaborate with other stakeholders to identify a common approach to support farmers effectively coping with CC. This research also suggests that related departments and institutions give priority to comprehensive assessments of CC impacts; build up a climate database and CC related information that accessible for stakeholders, particularly farmers and extension practitioners; and provide agriculture services suitable to the socio-economic conditions of the local communities.

COMPETING INTERESTS

The authors declare that there is no conflict of interest regarding the publication of this article.

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