An Analysis of Rice Farmers' Behavior in Response to Climate Change in the Mekong Delta of Vietnam: A Theory of Planned Behavior

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Abstract

This paper aims to investigate farmers' intention and behavior in response to climate change associated with salinity intrusion and drought in the Mekong Delta of Vietnam. The cross-section data were obtained from in-depth interviews with 361 rice farmers in the Mekong Delta, Vietnam. Structural equation modeling was employed to explore the relationship among the constructs in the theory of planned behavior which deals with individual intention and their behavior. The results indicate that rice farmers in the delta are more likely to intend to respond when they have a higher perception of climate change and perception of climate change adaptation. Perceived behavioral control, subjective norm, and trust in public adaptation are also found to significantly influence farmers' intention to perform climate change adaptation. Furthermore, the results show that not only the intention but also subjective norm significantly and directly motivate their behavior in response to climate change while those factors driving intention except for perceived behavioral control indirectly influence their behavior in response to climate change.

Key words: adaptive intention, behavior, climate change, Vietnamese rice farmers, structural equation modeling, theory of planned behavior

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1. Introduction

Climate change is defined as long-term (decades or longer) continuous changes (IPCC, 2001). It has been caused by global warming which is exacerbated by the greenhouse effect and has been recently exacerbated by human activities. Climate change accelerates the problems of change in temperature and precipitation, sea-level rise, as well as the frequency and severity of extreme weather events which have serious impacts on natural and human systems.

Vietnam is predicted to be one of the most vulnerable regions to climate change and sea-level rise in the world (Yusuf and Francisco, 2010). Climate variability concerning water scarcity from salinity intrusion and drought that not only jeopardize agricultural production but also destabilize rural livelihoods in most regions, especially in the Mekong Delta.

Climate change adaptation in agriculture is recognized as an essential response to reduce vulnerability to the adverse impacts of climate change, maintain rural livelihood in poor communities, and ensure the food security (Bryan et al., 2013). It is also recognized as an emergent response which can enhance the resilience of individuals and systems to climate change. According to IPCC (2014), adaptation is defined as adjustments in both natural systems and human behaviors in response to climate vulnerability for moderating adverse impacts or improving beneficial opportunities. Adaptation are undertaken throughout society from individuals, public, regional, national, and global settings. Adaptation conducted by public agencies are usually conscious or planned adaptation while those conducted by private individuals or community may be autonomous. In this study, we focus on the adaptation at individual level to explore the process of their intention and behavior in response to climate change.

The climate change adaptation among individual is considered an inherently social process that is constructed by socio-cultural characteristics of social systems to adjust natural systems and human behaviors (Wolf, 2011). Adaptation can be motivated not only by climate change risks but also by many factors involving protection of economic well-being or improvement of safety to meet their own individual or collective purposes. According to Adger et al. (2006), intentional adaptation was described as responses that are triggered by climate change and occur naturally without public interventions. Nevertheless, other adaptation can occur as a result of other non-climate related social or economic changes. Those unintentional adaptation may be not primarily motivated by climate change but rather than by social or economic benefits (Ho and Ubukata, 2018).

Considerable research is reported that farmers' adaptation responses to climate change can be affected by socio-economic factors and access to resources (Below et al., 2010; Below et al., 2012; Bryan et al., 2009; Deressa et al., 2009; Hassan and Nhemachena, 2008; Thomas et al., 2007). Especially, the role of perception in adaptation to climate change has been highlighted (Deressa et al., 2011; Mertz et al., 2009). Nevertheless, there is a very little study to address the role of social and psychological factors in adaptation, especially in Vietnam. Research on adaptive intention among rice farmers in the Mekong Delta from Dang et al. (2014) reported that risk perception of climate change, adaptation assessment, maladaptation, subjective norms, and disincentives significantly influence farmers' intention to adapt to climate change using the protection motivation theory. Therefore, this study attempts to confirm the role of psychological factors in not only the intention but also individual behavior in response to climate change associated with salinity intrusion and drought in the Mekong Delta of Vietnam based on the theory of planned behavior.

2. Theory of planned behavior

Researchers have widely applied the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1980) and the Theory of Planned Behavior (TPB) (Ajzen, 1991) to explain human behavior dealing with the psychological processes involved. The TRA proposed that an individual's behavioral intention, which depends on their attitude towards the behavior and subjective norm, is the key role in driving the actual behavior. The TPB as an extension of the TRA incorporates all the above constructs but includes the factor of perceived behavioral control to explain the combined effect on an individual's intention and behavior. There are five core constructs in the TPB: attitude toward behavior, subjective norm, perceived behavioral control, intention, and behavior (Figure 1).

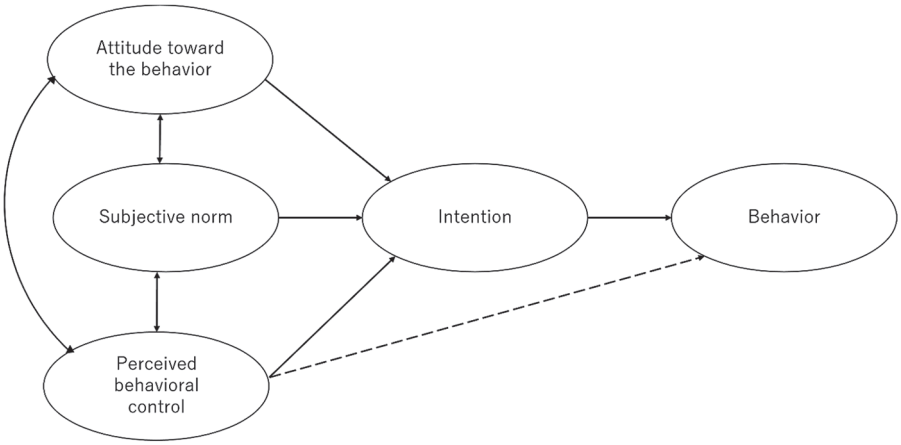

Figure 1 Theory of planned behavior

First, according to the TPB, attitudes serve as a key determinant of behavioral intentions. In this study, attitudes toward a behavior are considered as the degree of the individual to evaluate or perceive risks of climate change or coping strategies. The importance of these two cognitive factors involving perceived risks of climate change and perceived effectiveness of climate change adaptation has been demonstrated in interpreting intention (Dang et al., 2014) and behavior to climate change (Grothmann and Patt, 2005). Perception of climate change was measured by the perceived climate change risks to four dimensions of crop production, water resource, livelihood, and food security. Rice farmers were asked to what extent they perceived the severity to which climate change can affect each dimension, based on a five-point Likert scale. Therefore, this study hypothesizes the following:

H1. Perception of climate change positively influences adaptive intention

Additionally, perception of climate change adaptation was measured by the perceived effectiveness of four groups of climate change adaptations including crop management, water management, income diversification, and soil conservation. Farmers were asked to evaluate the effectiveness of each group, based on a five-point Likert scale. These private adaptations were initially implemented from literature (Bryan et al., 2013; Deressa et al., 2009; Dang et al., 2014) and then were adjusted and finalized by information from key informants and pre-test with ten farmers in the Mekong Delta. In this context, this study hypothesizes the following:

H2. Perception of climate change adaptation positively influences adaptive intention

Second, individual behavior or motivation is not only influenced by their physical benefit but also subjective norms and status. Subjective norm refers to how people perceive the social pressures from important referents for the individual concerned (i.e., relatives, friends, neighbors, and significant others) that he or she should or should not perform the behavior (Ajzen, 1991). Subjective norm has been recognized as a significant determinant of adaptive intention to climate change among rice farmers in the Mekong Delta of Vietnam (Dang et al., 2014). In this study, the subjective norm was measured by four factors based on a five-point Likert scale (based on a literature review of Dang et al. (2014)). Those factors were: "I believe that my friends, relatives, and neighbors want me to conduct adaptation strategy"; "I should conduct adaptation strategy because my friends, relatives, and neighbors want me to do that"; "I should conduct adaptation strategy because my friends, relatives, and neighbors do that"; "I must conduct adaptation strategy because my friends, relatives, and neighbors do that". On the other hand, Ho and Ubukata (2018) reported that a weak correlation between local climate change perceptions and individual behavior to perform their actual adaptation due to some gaps between their knowledge and actions (i.e., psychological factors) as well as other social effects (i.e., subjective norm). Therefore, this study hypothesizes the

following:

H3. Subjective norm positively influences adaptive intention

H4. Subjective norm positively motivates behavior

Third, perceived behavioral control is associated with an individual's perception of how difficulty in behavioral intention and performance of interest（Ajzen, 1991）. According to the TPB, perceived behavioral control, together with behavioral intention, can be used directly to predict individual behavior. The research from Bandura and his associates（Bandura et al., 1977, Bandura et al., 1980）showed that people's behavior is strongly influenced by their confidence in their ability to perform it（i.e., by perceived behavioral control）. In this study, perceived behavioral control was measured by asking farmers to rate the ease of performing each group of adaptation, based on a five-point Likert scale. Therefore, this study hypothesizes the following:

H5. Perceived behavioral control positively influences adaptive intention

H6. Perceived behavioral control positively motivates behavior.

Fourth, the intention is considered as the motivation factor that drives the behavior. An individual intention was measured by asking farmers to what extent they intended to conduct each adaptation group based on a five-point Likert scale. The four main groups of crop management, income diversification, water management, and soil conservation represented all nine climate change adaptations in the study sites. In this context, this study hypothesizes the following:

H7. Adaptive intention positively motivates behavior.

On the other hand, trust has been defined as "a state of perceived vulnerability or risk that is derived from individual uncertainty regarding the motives, intentions, and potential actions of others on whom they depend"（Kramer, 1999）. Cologna and Siegrist（2020）reported that trust in environmental groups and scientists are the measures that most strongly correlate with climate-friendly behaviors, while trust in institutions and other measures are only weakly associated with the analyzed behaviors. In this study, trust in public adaptation is measured by asking farmers to rate what extent they agreed with corresponding statements based on a five-point Likert scale: "Local government and institutions know what they have to do with climate change"; "Public adaptation strategies are well in advance implemented"; and "Public adaptation strategies are significantly effective". Therefore, this study hypothesizes the following:

H8. Trust in public adaptation positively influences adaptive intention.

Finally, the behavior was measured as a dummy variable with 1 denoting the actual performance of one or a combination of climate change responses regarding each group and 0 denoting the performance of no response.

In this study, there are seven constructs in the whole model: perception of climate change, perception of climate change adaptation, perceived behavioral control, subjective norm, trust in public adaptation, intention, and behavior. Those constructs are measures by a total of 27 observed factors（Table 1）.

Table 1 Description of all factors in the model

Factor	Description	Measurement
Perception of climate change		
PE1	Crop production	Measure how farmers perceived the adverse impacts of climate change on each dimension based on five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree)
PE2	Water resource	
PE3	Livelihood	
PE4	Food security	
Perception of climate change adaptation		
AA1	Crop management	Measure how farmers perceived efficacy to each group of adaptation, the scale ranges from 1 (ineffective) to 5 (effective)
AA2	Water management	
AA3	Income diversification	
AA4	Soil conservation	
Trust in public adaptation		
TR1	"Local government and institutions know what they have to do with climate change"	Measure based on five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree)
TR2	"Public adaptation strategies are well in advance implemented"	
TR3	"Public adaptation strategies are significantly effective"	
Perceived behavioral control		
PBC1	Crop management	Measure the ease or difficulty of performing each adaptation group, the scale ranges from 1 (very difficult) to 5 (very easy)
PBC2	Water management	
PBC3	Income diversification	
PBC4	Soil conservation	
Subjective norm		
N1	"I believe that my friends, relatives, and neighbors want me to conduct adaptation strategy"	Measure based on five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree)
N2	"I should conduct adaptation strategy because my friends, relatives, and neighbors want me to do that"	
N3	"I should conduct adaptation strategy because my friends, relatives, and neighbors do that"	
N4	"I must conduct adaptation strategy because my friends, relatives, and neighbors do that"	
Intention		
I1	Crop management	To what extent the adaptive intention, the scale ranges from 1 (not at all) to 5 (very large extent)
I2	Water management	
I3	Income diversification	
I4	Soil conservation	
Behavior		
B1	Crop management	To actual performance of climate change adaptation, 1 (adapting) and 0 (not adapting)
B2	Water management	
B3	Income diversification	
B4	Soil conservation	

Regarding the sample demographics, approximately 48.5 percent of local farmers had elementary school degree or lower, 37.6 percent had a junior high school, 12.5 percent had a high school, and 1.4 percent had college or university degree. Over 31.9 percent of local farmers were aged 50-60 years old and the next largest age groups were 40-50 years old (26.3 percent) and over 60 years old (26.3 percent), followed by 30-40 years old (14.7 percent) and below 30 years old (0.8 percent). In terms of experience in rice farming, the majority of farmers had 30-40 years (28.5 percent) and 20-30 years (28.3 percent), followed by groups of farmers had below 20 years (21.3 percent), 40-50 years (18.6 percent), and over 50 years (3.3 percent). Regarding the farm characteristics, the majority of farmers had a small scale of rice farming with the total farm size at and less than 1ha (67.9 percent), followed by the total farm size of 1-3ha (21 percent), the total farm size of over 3ha (11.1 percent). In terms of access to water sources, approximately 45.7 percent of farmers had their paddy field located at a short distance to the main river or main irrigation system; followed by farmers had their paddy field located at a medium distance which is defined as far from the main rivers or main irrigation systems, but relatively close to the secondary irrigation canals (43.8 percent); and farmers had their paddy field located at a long distance which is defined as far from both the main and secondary irrigation systems (10.5 percent).

3. Materials and methods

3.1. Study site and data collection

The study was carried out in the Mekong Delta, the major agricultural region of Vietnam. The delta has been reported as a significantly vulnerable region to climate change. Meteorological records from the Institute of Meteorology, Hydrology, and Environment (IMHEN, 2015) confirmed an average temperature rise of 0.5°C for 1955-2005 across Vietnam. Moreover, the problem of salinity intrusion, which is exacerbated by the rise of sea level and reduction of water flow caused by dam constructions both upstream and the lower on the Mekong River, has also increased in the delta. The 2006 serious salinity intrusion caused a remarkable reduction in total rice production in most regions of the delta (from 19.30 in 2005 to 18.23 million tons in 2006) (Figure 2).

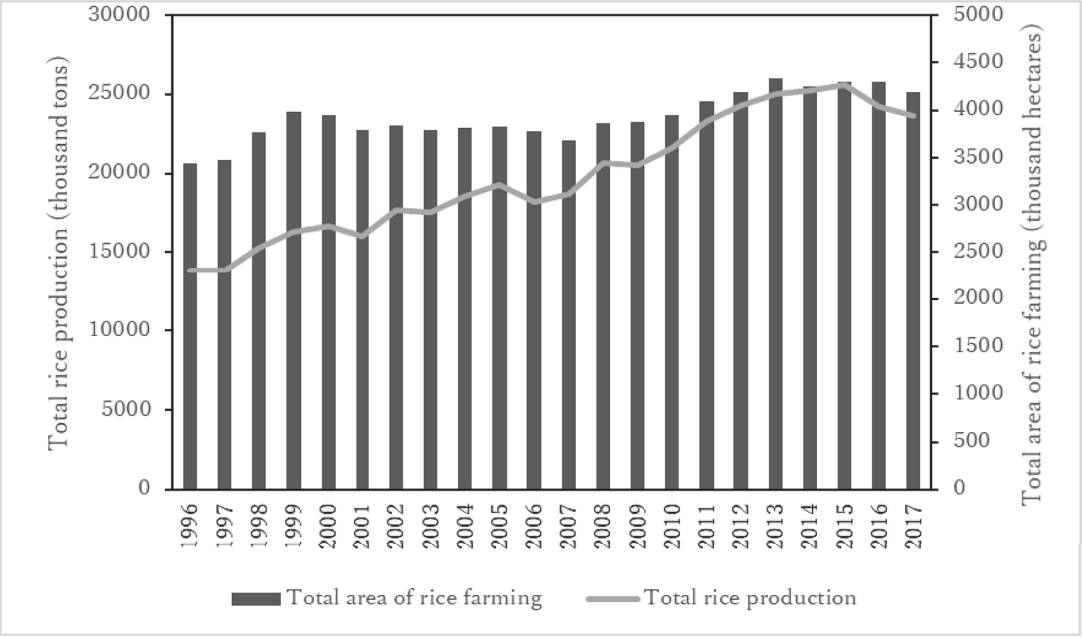

Figure 2 Rice production in the Mekong Delta of Vietnam during 1996-2017 (GSO, 2018)

According to the Mekong River Delta Climate Change Forum Report (2009), saltwater has continuously intruded further inland and adversely affected rice farming. Consequently, the total rice production slightly declined in 2009 (from 20.67 in 2008 to 20.52 million tons in 2009). In recent years, severe salinity intrusion and extreme drought have occurred and dramatically affected rice production, especially in 2016 and 2017 (decreased from 25.60 in 2015 to 24.23 in 2016 and continuously to 23.63 million tons in 2017).

To cope with climate change associated with salinity intrusion and drought, local rice farmers have employed a variety of climate change adaptations, which are categorized into four main groups: crop improvement practices (i.e., changing sowing or harvesting date, reducing the number of crop plantings, changing fertilizer and chemical use, changing rice varieties, diversifying crop), water management (i.e., changing irrigation schedule), income diversification (i.e., switching from rice farming to aquaculture, livestock, or off-farm activities partially or totally), and soil conservation (i.e., soil preparation, reducing the area of rice farming). More specifically, some practices related to diversifying farming systems including a combination of horticulture, annual and perennial trees with livestock, improving crop varieties (i.e. salinity or drought-tolerant varieties), integrating shrimp-rice farming have been introduced by local government and institutions, especially in Ben Tre and Tra Vinh provinces to cope with climate change issues, especially salinity intrusion and drought. Furthermore, the local government also provided a schedule of irrigation and sowing to rice farms to reduce risks of salinity intrusion and drought, especially in Long An province.

Thirteen provinces of the delta have been categorized into four groups of high, moderate, low, and lowest levels of vulnerability to climate change. The lowest vulnerability level in An Giang and Dong Thap provinces are not subjective to projected sea-level rise (Thuy and Anh, 2015). Therefore, the study aimed at choosing from the rest of the three groups. Long An, Ben Tre, and Tra Vinh province were randomly chosen from each of three groups of low, moderate, and high levels, respectively. Ben Tre province has a moderate vulnerability to climate change and is located near the coastal region, where water sources are often intruded upon by saline water, while Long An province has a low vulnerability to climate change and is located further inland, where water sources are only slightly affected by salinity intrusion. Tra Vinh province has a high vulnerability to climate change and is located in the coastal region where salinity intrusion becomes serious. In each province, two districts were randomly selected. Then two communes were continuously picked up from each district. The cross-sectional data of 361 households via face-to-face interviews with the structured questionnaire were collected through a field survey in February 2018.

3.2. Structural equation modeling

This study used structural equation modeling (SEM) to examine the interrelationship among constructs in the conceptual model. Structural equation models are a family of multivariate statistical models that allow the analyst to estimate the effect and relationships between multiple variables. It can be considered as a combination of factor analysis and path analysis.

First, the confirmatory factor analysis (CFA) was used to assess whether all indicator factors appropriately reflect their underlying constructs and whether the measurement model is valid. To check the measurement model validity, two criteria are required including construct validity and some indicators of Goodness-of-fit (GOF). For construct validity, standardized factor loadings and internal consistencies (i.e., Cronbach's alpha) greater than 0.7 (in some cases 0.5 for standardized factor loadings) are considered as good reliability (Fornell and Larcker 1981, Hair et al. 2006). Regarding GOF, some indices are commonly used namely the root-mean-squared error of approximation (RMSEA), comparative fit index (CFI), Chi-square (χ^2), and normed Chi-square (χ^2/df). RMSEA is a measure of the average of the residual variance and covariance; good models have RMSEA

values that are at or less than 0.08. CFI is an index that falls between 0 and 1, with values greater than 0.90 considered to be indicators of good fitting models. Its value from 0.8 to 0.9 is considered marginal levels (Hair et al., 1998). An acceptable normed Chi-square is equal to or less than 3.

Then, the SEM was used to investigate the relationships among the latent constructs and determine whether the model provides an acceptable fit to the data. Together with the same fit indices as in CFA, the structural equation fit (R^2), the direct, indirect, and total effects were also obtained in SEM. The structural model and hypotheses are tested by examining the standardized path coefficients. The explained variance in the dependent constructs (R^2 values) is assessed as an indication of the overall predictive power of the model.

4. Results and discussion

The overall quality of the measurement model was assessed using CFA to validate the seven model constructs. The goodness-of-fit for the measurement model was testing using several fit indices. The Chi-square $\chi^2 = 768.927$, df = 303, p = 0.000, CFI = 0.7886, RMSEA = 0.0654, and normed $\chi^2 = 2.538$ generally indicate an acceptable fit.

The results shown in Table 2 include the standardized factor loadings and Cronbach's alpha for evaluating the construct validity of the measurement model by CFA. According to Hair et al. (2010), the standardized factor loadings represent the association between the observed indicators and their constructs. That factors loadings should be at least 0.5 and statistically significant. In our model, all standardized factor loadings are statistically revealing that the indicators significantly and effectively reflect each underlying construct. Most standardized factor loadings are above 0.5, except for some values at marginal levels (Table 2).

On the other side, Cronbach's alpha is a measure of internal consistency, that is, how closely related a set of items are as a group. A Cronbach's alpha value of greater than 0.5 is acceptable, but lower than 0.35 must be rejected (Hair et al. 2006). In our model, the values of Cronbach's alpha for two constructs are higher than 0.7 including trust in public adaptation (0.89) and subjective norm (0.79) while the other five constructs are between 0.6 and 0.7 including the perception of climate change (0.67), perception of climate change adaptation (0.60), perceived behavioral control (0.69), adaptation intention (0.68), and behavior (0.63) (Table 2). The results show that all seven constructs express good internal consistency. Thus, these results suggest an acceptable reliability of the measurement model.

Table 3 reveals significant and positive correlations between adaptive intention and perception of climate change, perception of climate change adaptation, trust in public adaptation, perceived behavioral control, and subjective norm. Furthermore, a significant and positive correlation between behavior and intention, subjective norm, and perception of climate change adaptation. Perception of climate change is positively correlated with perceived behavioral control. Perception of climate change adaptation is positively correlated with trust in public adaptation, perceived behavioral control, and subjective norm. Finally, trust in public adaptation is correlated with subjective norm.

Table 2 Standardized factor loadings and Cronbach's Alpha

	Perception of climate change	Perception of CC response	Trust in public adaptation	Perceived behavioral control	Subjective norm	Intention	Behavior
PE1	0.5682[a]						
PE2	0.5112***						
PE3	0.9043***						
PE4	0.4043***						
AA1		0.6098[a]					
AA2		0.5504***					
AA3		0.5215***					
AA4		0.4192***					
TR1			0.7529[a]				
TR2			0.8752***				
TR3			0.9446***				
PBC1				0.4709[a]			
PBC2				0.8766***			
PBC3				0.6247***			
PBC4				0.4067***			
N1					0.8728[a]		
N2					0.8984***		
N3					0.4986***		
N4					0.5234***		
I1						0.6022[a]	
I2						0.7476***	
I3						0.5098***	
I4						0.4029***	
B1							0.5388[a]
B2							0.5614***
B3							0.6381***
B4							0.4488***
Cronbach's Alpha	0.6699	0.5978	0.8909	0.6872	0.7892	0.6779	0.6298

Note: *** significant at 1%. [a] means values were not calculated because factor loadings were set to 1.0 to control construct variance.

Table 3 Correlation for the measured constructs

	Perception of climate change	Perception of climate change adaptation	Trust in public adaptation	Perceived behavioral control	Subjective norm	Intention	Behavior
Perception of climate change	1						
Perception of climate change adaptation	0.0773	1					
Trust in public adaptation	0.0490	0.1289*	1				
Perceived behavioral control	0.1879**	0.3631***	-0.0239	1			
Subjective norm	0.0870	0.1323*	0.1724***	-0.0407	1		
Intention	0.4795***	0.3085***	0.1820***	0.2543***	0.2264***	1	
Behavior	0.0227	0.2891***	0.0164	-0.0753	0.1190*	0.2114***	1

Note: *, **, *** significant at 10%, 5%, and 1%.

The results for the structural model confirm an acceptable fit with Chi-square χ^2 = 907.859, df = 316, p = 0.000, CFI = 0.801, RMSEA = 0.07 (90% confidence interval for RMSEA from 0.065 to 0.078), normed χ^2 = 2.873. Furthermore, the structural model includes the estimation of the path coefficients and the R^2 values, which indicate how well the data support the hypothesis model. Path coefficients (standardized loadings and significance) indicate the effects of the independent variables on the dependent variable. Meanwhile, R^2 values represent the amount of variance explained by the independent variables or the overall explanatory power of the model. Figure 3 shows the results of standardized path coefficients of the structural model.

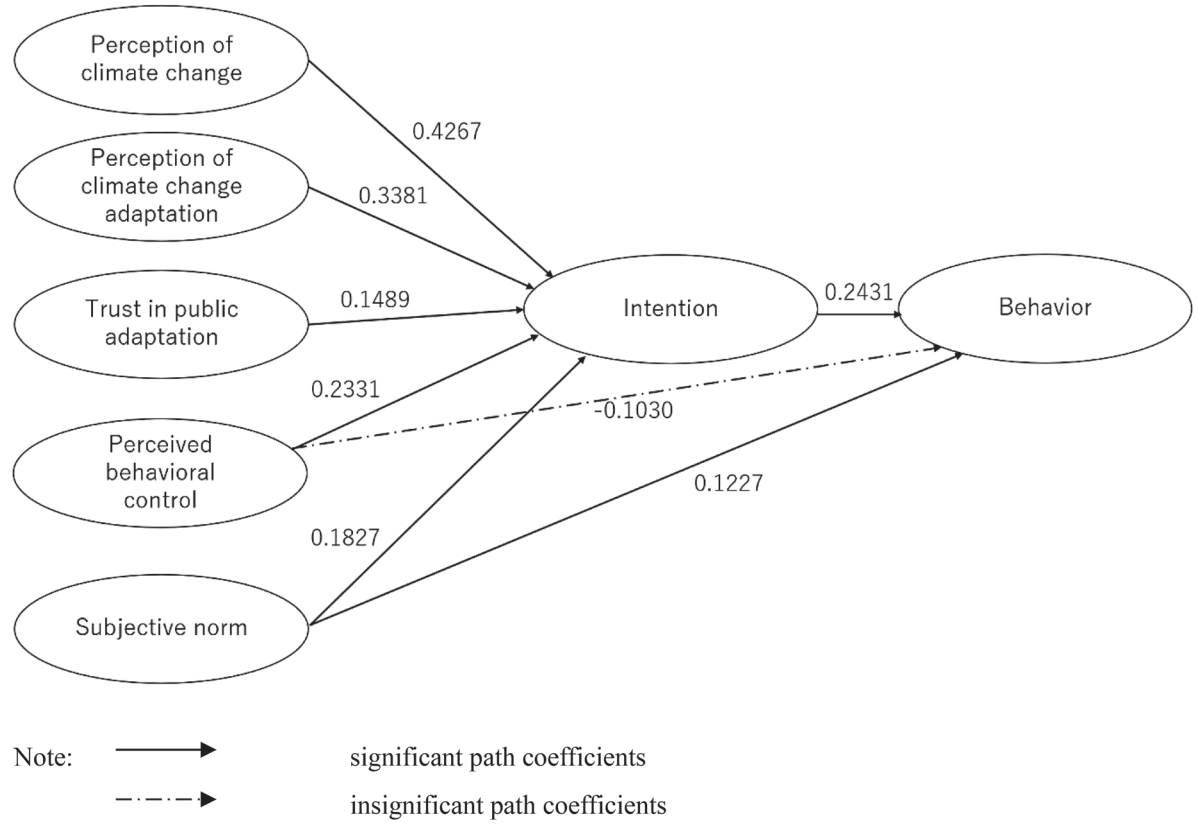

Figure 3 Structural model for adaptive intention and behavior (TPB)

The structural equation fit R^2 for the two targeted constructs: intention and behavior are 40.6% and 8.4%, respectively (Table 4). It means that over 40% variation of intention can be explained by significant factors such as the perception of climate change, perception of climate change adaptation, trust in public adaptation, perceived behavioral control, and subjective norm. Meanwhile, over 8% variation of behavior can be explained by two significant constructs: adaptive intention and subjective norm.

Table 4 Result of the structural equation model (Standardized parameter estimates)

Endogenous variables	Exogenous variables					Endogenous variables	Structural equation fit
	X_1	X_2	X_3	X_4	X_5	Y_1	(R^2)
Y_1	0.4267***	0.3381***	0.1489**	0.2331***	0.1827***	-	0.406
Y_2	-	-	-	-0.1030	0.1227*	0.2431***	0.084

Note: Y_1: Intention, Y_2: Behavior, X_1: Perception of climate change, X_2: Perception of climate change adaptation, X_3: Trust in public adaptation, X_4: Perceived behavioral control, X_5: Subjective norm. *, **, *** significant at 10%, 5%, and 1%.

The results shown in Table 5 demonstrated farmers' intention is directly and positively influenced by the perception of climate change (0.4267), perception of climate change adaptation (0.3381), and subjective norm (0.1827). That is consistent with the previous study of rice farmers in the Mekong Delta from Dang et al. (2014). Furthermore, the central construct of perceived behavioral control in the theory of planned behavior is found to be directly positive on motivating intention (0.2331). Adaptive intention is also directly affected by trust in public adaptation (0.1489). These results support *H1*, *H2*, *H3*, *H5*, and *H8*, respectively.

The results from the structural model also indicated that local rice farmers' behavior was directly affected by their intention (0.2431) and subjective norm (0.1227) but not perceived behavioral control. In detail, the total effects of the subjective norm (0.1671) are found to be significantly influencing behavior through a direct effect (0.1227) and an indirect effect via intention (0.2431*0.1489=0.0444). By contrast, the total effects of perceived behavioral control (-0.0463) are found to not affect behavior through a significant direct effect (-0.1030) and an insignificantly indirect effect via intention (0.2431*0.2331=0.0567). Thus, *H4* and *H7* are supported, but *H6* is not. On the other hand, behavior was indirectly affected by those factors driving intention except for perceived behavioral control (Table 5). More specifically, an individual behavior is indirectly affected by perception of climate change through intention (0.2431*0.4267=0.1037); perception of climate change adaptation through intention (0.2431*0.3381=0.0822); subjective norm through intention (0.2431*0.1489=0.0444); and trust in public adaptation through intention (0.2431*0.1489=0.0362).

Table 5 Total standardized effects in the structural model

	Direct effects		Indirect effects		Total effects	
	Intention	Behavior	Intention	Behavior	Intention	Behavior
Perception of climate change	0.4267***	-	-	0.1037**	0.4267***	0.1037**
Perception of climate change adaptation	0.3381***	-	-	0.0822**	0.3381***	0.0822**
Trust in public adaptation	0.1489**	-	-	0.0362*	0.1489**	0.0362*
Subjective norm	0.1827***	0.1227*	-	0.0444**	0.1827***	0.1671**
Perceived behavioral control	0.2331***	- 0.1030	-	0.0567**	0.2331***	- 0.0463
Intention	-	0.2431***	-	-	-	0.2431***

Note: *, **, *** significant at 10%, 5%, and 1%.

In general, farmers are more likely to have an intention to cope with climate change and then perform their behavior when they perceive the higher risks of climate change. Intention also increases when farmers perceive greater effectiveness of climate change adaptation, and this can lead to an increase in their behavior in response to climate change. Farmers who have higher trust in public adaptation are more likely to have an intention and then a motivation to perform their behavior to cope with climate change. Furthermore, subjective norm is found to be important in instructing farmers' behavior due to its direct influence on adaptive intention and behavior. It means that whether people around them conduct climate change adaptations significantly influences farmers' intention and directly motivates their behavior. Finally, the central factor of perceived behavioral control in the theory of planned behavior is found to be positively significant in driving farmers' intention but insignificant in motivating their behavior. Therefore, the TPB could be considered as a useful framework to investigate farmers' intentions and behavior in response to climate change.

Discussion

Perceptions of climate change and climate change adaptation are found to play crucial roles in intention and indirectly in behavior. On the other hand, perceptions of climate change impacts and perceptions of the effectiveness of climate change adaptation significantly depend on both informal and formal information (Ho, 2020). Therefore, it is essential to ensure the trustworthiness and timeliness of the information on both climate change and climate change adaptations through public media (i.e., television, radio), social networks based on formal networks or vertical linkages between local governments and farmers, and institutions (i.e., agricultural extension services) as well as informal networks or horizontal interactions (via friends, neighboring, or relatives). Regarding agricultural extension services, interviewed people (43 farmers) acknowledged some barriers to implement their adaptation including lack of technical extensions related to climate change and adaptive practices as well as information about those extensions or training in their communities. Also, lack of technology innovations (37 farmers), market access (i.e., they found no different price between improved and traditional rice varieties, or difficulty to sale their improved rice varieties to the middlemen (or wholesaler) who typically buys goods from farmers and resells them to a retailer/manufacturer within a traditional distribution channel) (29 farmers), lack of human capital in providing technological advice (21 farmers), are mentioned as following barriers to farmers' adaptive behavior.

Given the strong effect of subjective norm in motivating both adaptive intention and behavior in response to climate change, policymakers from local government and institutions should focus on promoting the benefits and accessibility of climate change adaptations to local community as well as encouraging collective action which can enhance cooperative behavior based in part on subjective norm (Ostrom, 2000).

Furthermore, to enhance the farmers' trust in public adaptation, the government not only needs to take the responsibility to introduce a variety of effective adaptation strategies suitable for specific institutional and cultural contexts but also needs to improve public infrastructures (i.e. salinity-control sluice gateway, irrigation canal system).

5. Conclusion and policy implications

This study attempted to investigate influencing factors motivating rice farmers' intention and behavior in response to climate change associated with salinity intrusion and drought in the Mekong Delta of Vietnam. Adaptive behavior is an emerging action in coping with climate change, and the findings have addressed the decision-making processes of farmers as well as psychological factors that influence their behavior.

The results from the structural equation model built on the TPB support that the perception of climate change, perception of climate change adaptation, perceived behavioral control, subjective norm, and trust in public adaptation play a mediating role in farmers' adaptive intention. Additionally, the findings of the study confirm that behavior in response to climate change is directly motivated by intention and subjective norm and indirectly influenced by those factors driving intention except for perceived behavioral control (i.e., perception of climate change, perception of climate change adaptation, trust in public adaptation). It means that the central factor of perceived behavioral control in the theory of planned behavior has a positive significance on motivating intention but insignificance on behavior.

Policies to promote farmers' behavior in response to climate change should emphasize the role of their intention. Since information plays a crucial role in shaping farmers' perceptions of climate change and climate change adaptation and then indirectly influence their intention and behavior, it is necessary to ensure the validity and credibility of information through social networks and agricultural extension services. Especially, agricultural

extension services should be more useful (i.e., supporting farmers with technical knowledge associated with adaptation practices) and easily accessible for local farmers. Human capital at local government and institutions in providing technological advice should be also considered for enhancing the role of extension services. Additionally, policymakers from local government and institutions should promote the benefits and accessibility of climate change adaptations to local community as well as encourage collective action. Moreover, it is necessary for the government not only to take the responsibility to introduce a variety of effective adaptation strategies suitable for specific institutional and cultural contexts, and economic incentives but also to improve public infrastructures.

The TPB demonstrated that some of the central concepts in the social and behavior sciences involving attitudes toward the behavior, subjective norm, and perceived behavioral control are useful to predict intention and behaviour. However, the study did not examine the role of past behavior in predicting either intention or behavior. Therefore, future research should incorporate additional relevant constructs to find out the climate change adaptation mechanism.

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