Farmers' Adaptive Responses to Climate Change: Evidence from the Small-Scale Rubber Sector in Southeast Vietnam

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Abstract

There is great need for research on climate change adaptation, especially for agricultural producers, including those involved in natural rubber production. Almost all of the traditional rubber growing areas in the world suffer from climate extremes, which have resulted from climate changes. The intensity of climate changes will vary across these areas, and it is difficult to anticipate exactly how these changes will occur in the future (RRII, 2010). In the meantime, the rubber industry is also highly vulnerable to market uncertainty (Viswanathan, 2008; Wijesuriya et al., 2007). These facts require special attention in formulating adaptation strategies (Wijesuriya & Dissanayake, 2009), and require rubber farmers to adapt (RRII, 2010). Many solutions through technologies and cultivation practices have been developed over time to offset losses caused by the negative effects of climate change on rubber plantations. They exist to improve latex yield and technical efficiency. These solutions are adopted in some regions, but not everywhere (Barlow & Muharminto, 1982). Assessment of the farm-level adoption of adaptation strategies available is crucial in order to provide information for the formulation of related policies (Charles & Rashid, 2007; Smit et al., 2001).

There is a gap in farming systems research in developing countries regarding the comprehensive assessment of climate change adaptation at the farm level. The comprehensive approach used in this study, in terms of methods of analysis of climate change, climate variability, their negative impacts on crop performance, perception, vulnerability, adaptation and logical mechanisms of farmer adaptation, is a methodological contribution beyond what has been done in previous studies. Developing and applying a comprehensive analytical framework will allow local decision makers as well as related stakeholders to manage climate change adaptation in farming systems.

The main purpose of this study is to investigate farmer households' adaptive responses, their preference patterns for climate change adaptation and the determinants of their adaptive responses. This knowledge is of great interest for designing climate change adaptation schemes; therefore, this research can assist local policy-makers to address the challenges of climate change and variability.

In this study, different farmer segments (classes) are assumed to have different preferences for numerous adaptive measures, with preferences being relatively homogeneous within finite segments but significantly varying between these segments. This clustering approach helps stakeholders to understand adaptive motivations of farmer segments rather than individual rubber farmers, thereby giving more scope for policy recommendations.

Several analytical models, based on heterogeneity of farmer households' preferences for adaptive attributes, are used to identify the propensity of different farmer segments to adopt particular adaptive responses. Based on site-specific and household-specific characteristics, the study differentiates one farmer segment from another. Focusing on a limited number of attributes of adaptive measures allows for a more general application of theory and empirical findings. Therefore, an approach that focuses on attributes is usually more meaningful than a conventional approach focusing on measures.

This study addresses a gap in research regarding the comprehensive assessment of climate change adaptation at the farm level. It starts by identifying potential impacts resulting from climate change and variability on agricultural production, with a focus on natural rubber production. There is considerable evidence of climate change and climate variability, and a statistically significant positive linear relationship exists between increases in total annual precipitation and increases in latex yield. Most rubber farmers in the survey strongly perceive climate change and climate variability. Farmers also perceive the vulnerability of their incomes to climate change and climate variability. This vulnerability provides a reason for farmer households to want to adapt. There is almost no evidence of an adaptive deficit. Farmer households' adaptations are locally specific and clearly seen at the farm level.

This study shows the heterogeneous preferences of different farmer segments, which implies that support for climate change adaptation at the farm level should not be based on homogeneous policies. Farmer households in this study have special interest in seven adaptive attributes which comprise four behaviour types based on responses that (i) increase drought resistance and heavy wind resistance of rubber trees; (ii) allow needs of skilled labour, time availability and investment capital to be met; (iii) allow required technical and economic efficiency to be attained; and (iv) result in early harvesting.

Ten farm-level determinants influence the probability of being members of a particular segment as follows: (i) certificate of land-use rights, (ii) farmer networks, (iii) hired labour, (iv) net profit per ha, (v) rubber land size, (vi) education level, (vii) household size, (viii) age of rubber trees, (ix) irrigation facilities, and (x) multiculture systems.

The findings of this study fit into, and add to, the existing literature on climate change adaptation at the farm level. This study shows that the needs of policy-makers are better served by investigating farmer segments rather than by analysing individual farmer practices, and by determining adaptive attributes rather than specifying adaptive measures in general. The analysis highlights the importance of research on heterogeneous preferences, and it contributes to the knowledge of how to apply the

LCM (the stated choice experiment method) in a farming context. This approach can be applied in a broader context for climate change adaptation in agriculture. The comprehensive approach used in this study provides guidance to conduct similar studies on other farming systems and design successful adaptation policies.

The scope of the study is limited to the case study of the small-scale rubber sector in Southeast Vietnam. The study provides detailed findings through a comprehensive consideration of climate change adaptation at the farm level. The case study application is used to demonstrate the methods and data required for such a comprehensive approach. This study is novel in the research context. Similar studies would need to be conducted in different study areas and in different farming systems, so that comparisons between research results could be obtained. Based on farmer households' preferences for adaptive attributes, this study also provides background for further research on cost-benefit analysis and/or cost-effectiveness analysis of each adaptive option available.

Candidate's Certification

I certify that the substance of this dissertation has not already been submitted for any degree and is not currently being submitted for any other degree or qualification.

I certify that any help received in preparing this dissertation and all sources used have been acknowledged in this dissertation.

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List of Abbreviations and Acronyms

ADF	Augmented Dickey Fuller
AGROINFO	The Information Center for Agriculture and Rural Development, MARD
ANOVA	Analysis of Variance
BIC	Bayesian Information Criterion
CAIC	Consistent Akaike Information Criterion
CIF	Cost Insurance and Freight
CMEA	The Council of Mutual Economic Assistance
coef.	Coefficients
*cons_*	Constant
diff.	Difference
DRC	Dry Rubber Content
DS	The Department of Statistics of Binh Phuoc, Dong Nai and Tay Ninh
F-test	*F*-statistic
FAO	The Food and Agriculture Organisation of the United Nations
FOB	Free on Board
GDP	Gross Domestic Product
GM	Genetically Modified
GSO	The General Statistics Office of Vietnam
ha	Hectare
HDI	Human Development Index
HS code	Harmonized Commodity Description and Coding System
IPCC	The Intergovernmental Panel on Climate Change
kg	Kilogram
km	Kilometre
km^2	Kilometre Squared
KMO	Kaiser-Meyer-Olkin Test
LCM	Latent Class Model
LLF	Log Likelihood Function
MARD	The Vietnam Ministry of Agriculture and Rural Development
MDG	Millennium Development Goal
mm	Millimetre
NAEC	The National Agriculture Extension Centre of Vietnam
MNL	Multinomial Logit Model

MNP	Multinomial Probit Model
MONRE	The Vietnam Ministry of Natural Resources and Environment
N	Number of Observations
NISF	The Vietnam National Institute of Soils and Fertilizers
Nparam	Number of Model Parameters
NTRA	Non-traditional Rubber Cultivation Area
°*C*	Degree Celsius
OLS	Ordinary Least Square Regression
p or (*p*-value)	Level of Statistical Significance
PDR	People's Democratic Republic
pH_{kcl}	Soil Acidity
QR	Quantile Regression
RRII	The Rubber Research Institute of India
RRIV	The Rubber Research Institute of Vietnam
RSS	Ribbed Smoked Sheets
SD	Standard Deviation
Std. Err.	Standard Error
t-value	*t*-statistic
t-var.	Trend (time) variable
tonne	Metric Tonne
TSNR	Technically Specified Natural Rubber
USD	United States Dollar
var.	Variable
VCCI	The Vietnam Chamber of Commerce and Industry
VIF	Variance Inflationary Factor
VNCHMF	The Vietnam National Centre for Hydro-Meteorological Forecasting
VND	Vietnamese Dong - the Currency of Vietnam
VRG	The Vietnam Rubber Group
WTO	The World Trade Organisation
z-value	*z*-statistic