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An Thinh Nguyen · Luc Hens

Human Ecology of Climate Change Hazards in Vietnam

Risks for Nature and Humans in Lowland and Upland Areas

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Prolegomena

When I got the invitation from the Editors to write a preface for a monograph studying human ecology of climate change hazards in Vietnam, I immediately expressed my interest in reading the essay. I found out that the selection of the place (Vietnam) to study risks for nature and the humans in a holistic way was so didactic and wisely chosen that I thought it could be used as a pilot study with applications in other parts of the world. The reasons have to do with the complex topography and the general geographic location of Vietnam in relation to the most dangerous extreme weather phenomena whose frequency and intensity have been increasing in the past few decades. In addition, human ecology in such a complex topography and climate indeed offers a unique opportunity toward original research of the physical and socioeconomic impacts of climate change to be applied both to the coastal and mountainous areas of Vietnam.

Professors An Thinh Nguyen and Luc Hens as Editors in Chief are providing to the scientific community a unique collection of original research papers and offer clarifications on the relationships between local communities and various environments subjected to climate change hazards. It is obvious to the reader that the aim of this monograph is to provide a holistic outlook on the impacts to the societies in Vietnam as affected at least partially by climate change. Human ecological principles have been applied to local communities concerning their response to a hazardous environment. The book provides an inspiring mosaic in a wide range of applications of human ecology. The diversity of biophysical, socioeconomic, and policy responses are interpreted in an easily readable way, and the monograph successfully provides information on the economic effects at the most affected areas of Vietnam.

It is interesting to note here that the selection of two types of Vietnamese landscapes, i.e., the dominant mountainous and the much smaller coastal lowland, can be used as local examples that other countries with similar topography can use on their own adaptation strategies to climate change hazards. It will be also extremely useful to Vietnam policies to cope according to the complexity of their landscape and the response of the society to extreme weather and environmental effects.

This book offers to the reader an interesting navigation in the effects of the most violent weather tropical storms, floods, and on longer time scales sea level rise and coastal erosion, highlighting the impacts on humans and their development prospects. Heavy rains, floods, and landslides and the biophysical and socioeconomic impacts at selected sites are impressively presented. Finally, the book provides useful recommendations toward resilient landscapes and improved green cities in Vietnam.

To conclude, this monograph is original, presents new results, and provides a new look in its conclusions clarifying relationships between local communities subjected to climate and weather hazards. Although it contains lots of useful information for this particularly vulnerable part of the world, the conclusions have significant global value embracing international interest to the reader. I am confident that the reader of this impressive monograph will find it as useful and as a pleasant exercise which applies also to other parts of the world similar to the Vietnam social and natural vulnerability to spectacular phenomena and to societies at complex topography. The authors and the Chief Editors should be very proud for the outcome of such a complex and difficult task that they have so successfully accomplished.

Athens, 5 July 2018

Christos Zerefos
President of the Hellenic Foundation
for Research and Innovation

Foreword

Over the last 25 years, the issue of climate change has left the confines of the scientific research community, and is now recognized as a major, global societal problem. Gradually and progressively, potential impacts on future generations are becoming understood, including essential aspects of the way society will produce energy and organize its mobility. These realizations have moved the debate from scientific uncertainty and its associated doubts, to concrete policy and societal actions.

Vietnam ranks among the countries most affected by climate change. Although there is a lot of variation in the country, which spans 15° latitude, temperatures have overall increased, rain regimes have changed, monsoon season has extended, and tropical storms have increased both in number and intensity.

These changes increasingly affect both the natural and the human environment. Storms cause erosion of the coastline and beaches which are necessary assets for the inhabitants of the dunes and for tourism. An increasing number of Vietnam's islands have already disappeared in the sea or are threatened by erosion. People living near the sea or in the lowland of the Red River delta and the Mekong delta face the consequences of the storms and inundations, and find their houses and the public infrastructure damaged or destroyed.

As a part of the United Nations Framework Convention on Climate Changes and in the context of its "green economy" shift, the Vietnamese government established a comprehensive climate change policy which is now being implemented by the provinces and the communes. Coastal cities such as Da Nang and Hai Phong have successfully implemented green innovations. They established a renewable energy policy, paid particular attention to the green patrimony of the city, and managed their ports effectively.

I particularly welcome this book because of its interdisciplinary character: It looks beyond the biophysical aspects of climate change and puts particular emphasis on people. It deals with their perception, their expectations, and their realizations adapting to the effects of climate change. It discusses the resilience and the innovation on the subject. As an economist, I particularly appreciate the sections on the monetary aspects of storms and natural disasters addressed by the book.

The book has a series of original aspects, not only its human targeted inspiration but also the human ecological approach. Combining different methods in original research frameworks is a strength which might provide inspiration to scientists worldwide. On its contents, the reader will find here not only an analysis of the already often addressed natural disaster problems along the coast, but also the less studied mountains which are frequently affected by storms.

This book deserves a wide reading audience. Although it is primarily a contribution to the human ecological science backing climate change, the content and the analysis are important for all of us concerned about sustainable development and the effects of the increasing frequency and intensity of the associated natural disasters. Allow me to strongly recommend this book not only to scientists but also to a wide range of societal actors.

Assoc. Prof. Dr. Nguyen Van Thanh
Vice-Minister Security, Vietnam

Acronyms

AHP	Analytic hierarchy process
ARIMA	Autoregressive integrated moving average model
CBA	Cost-benefit analysis
CCFSC	Central Committee for Flood and Storm Control
CI	Consistency index
CR	Consistency ratio
CRA	Community risk assessment
DEM	Digital elevation model
DPSIR	Driver-pressure-state-impact-response
EBM	Ecosystem-based management
EEA	European Environment Agency
EIA	Environmental impact assessment
EZ	Economic zone
FAO	Food and Agriculture Organization
FHZI	Flooding hazard zone index
GDP	Gross domestic product
GIS	Geographic information system
ICZM	Integrated coastal zone management
IMGG	Institute of Marine Geology and Geophysics (Vietnam)
IMHEN	Institute of Meteorology, Hydrology and Environment
IPCC	Intergovernmental Panel on Climate Change
ISPONRE	Institute of Strategy and Policy on Natural Resources and Environment
LHZI	Landslide hazard zone index
LULCC	Land use land cover change
MCDA	Multiple-criteria decision analysis
MONRE	Ministry of Natural Resources and Environment (Vietnam)
NPV	Net present value
NTP-CC	The National Target Program to Respond to Climate Change
OECD	The Organization for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
PTSD	Post-traumatic stress disorder

RCPs	Representative concentration pathways
RI	Random consistency index
SP-RCC	Support Program to Respond to Climate Change
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
WB	World Bank
wMean	Weighted mean

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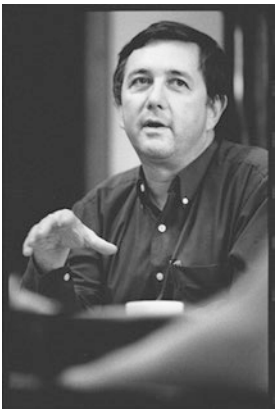
Short Bibliographical Note

Editors in Chief

An Thinh Nguyen acquired PhD with his focus on mountainous landscape ecology and geography at Vietnam National University, Hanoi, in 2007. He did his postdoctoral research on remote sensing and GIS at Kookmin University (Korea) during 2009–2010. In 2014, he was appointed as associate professor of geography and acted as the director of Research Institute for Resources and Climate Change (IRC), Hanoi University of Natural Resources and Environment (HUNRE), Vietnam. His research interests include geography of Vietnam, mountainous landscape ecology, and quantitative geography. An Thinh Nguyen is the Vice President of the International Association for Landscape Ecology in Vietnam (VN-IALE) and a member of the Vietnamese Association of Geographers (VAG).



Luc Hens graduated as a biologist and received his Ph.D. in Biology from the Vrije Universiteit Brussel (VUB), Belgium. Until 2010 he was a professor and chair of the human ecology department. He also lectures at the Technical University in Sofia (Bulgaria), the National and Kapodistrian University of Athens (Greece), the Sumy State University (Ukraine), and the Lisbon University (Portugal). He was a senior scientific adviser at the "Vlaamse Instelling voor Technologisch Onderzoek" (VITO), which is Belgium's biggest environmental research organization. He is currently retired as an emeritus professor. Professor Hens' specific area of research concerns the elucidation of interdisciplinary

instruments for sustainable development. In this framework, he acted as the promoter of over 50 research projects. Luc Hens acts as an expert in environmental policy on several councils in Belgium. He is the European editor for the *International Journal of Environment, Development and Sustainability*.

Introduction

General Theme and Subject

Worldwide, few countries exist where the effects associated with climate change are as pronounced as in Vietnam. Until now, most of the international attention on climate change hazards has been focused on the Vietnamese lowlands and the coast – the economically most productive part of the country. This is only fair, as the country experiences increasingly frequent and intense tropical storms as well as cyclones, floods, sea level rise, coastal erosions, droughts, and salinization. This affects local livelihoods, land use, and migration along the coast. Agriculture is pushed back toward the hinterland. The life of people is affected in such a dramatic way that they have to relocate. Forecasts of the effects all point to further worsening during the years to come. If by the end of this century the sea level rises by 1 meter, 10% of the population of Vietnam's coastal area would be directly affected, which reflects 80% of the country's GNP (MONRE 2016).

However, mountains cover over 75% of the total land of Vietnam (Le et al. 2012). They are also affected by climate change-associated events such as extreme weather conditions including tropical storms and heavy rainfall, which cause floods and landslides. This impairs small-scale agriculture, industry, tourism, infrastructure, livelihoods, and food security in an area shared by the Kinh with 54 other ethnic populations such as Tay, Thai, and Hmong minorities. Until now, much less attention has been paid to climate change-associated effects in these mountainous environments.

Understanding these complex climate change hazards, their impacts and adaptation, needs interdisciplinary frameworks. This book uses an inter- to transdisciplinary human ecological approach providing insight in the interrelations between changing land use, livelihoods, and migration in heavily affected areas along the Central Coast and in the northern mountains of the country.

A Human Ecological Approach

Complex problems of landscape change and environmental and social impacts and responses cannot be understood from a single, disciplinary perspective. This book adopts a human ecological approach which aims at understanding human-environment interactions in an interdisciplinary way. This allows integrating physical environmental effects with their impacts on livelihoods, culture, health, and perception, to mention just a few aspects. To this end, human ecology uses methods which combine and integrate scientific data. These methods stem from geosciences (GIS, remote sensing, spatial models), human sciences (Delphi survey, perception studies, interviews, local knowledge analysis, indicators), and applied sciences (environmental health and technology). A range of methods is applied in the studies documented in this book. This allows coming up with outcomes which go beyond disciplinary thinking about climate change and its associated effects.

Content

Research Areas

This book makes these general considerations in both regions of the country tangible. It offers a collection of original research papers on Ky Anh, the most southern district of the Ha Tinh province (along the coast of Central Vietnam, bordering the South China Sea), and on Van Chan, a mountain district of the Yen Bai province (in Vietnam's northern mountains). Both areas represent major landscapes of Vietnam: the lowland coast and the mountains. These latter cover over three-quarters of the country, while the lowland is the most important economic area.

The coastline of Ky Anh is perpendicular to the prevailing direction of the rising number of tropical storms, increasingly affecting the local inhabitants and counteracting their initiatives to build infrastructure and tourism development.

Van Chan is one of the centers of slope agriculture. This not only results in terraced rice fields, but this fragile environment is under increasing pressure toward higher yields and modernization. The region is equally in search of a sustainable model to handle increasing urbanization pressure. The protected forests and crop systems on the slopes of Van Chan are particularly important both locally and regionally. Van Chan and other mountains in the Vietnamese upland are the "sources" which directly affect the economy and the environment in the "sinks" of the Red River Delta. Therefore, in a global context of climate change, sustainable development in the mountains and the development of the lowlands are integrated and connected.

The chapters of this book clarify the relationships between local communities and environments subject to climate change hazards (or the coevolution between