



S. Niggol Seo

Micro-Behavioral Economics of Global Warming

Modeling Adaptation Strategies
in Agricultural and Natural Resource
Enterprises

Micro-Behavioral Economics of Global Warming

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S. Niggol Seo
School of Ecology and Environmental
Studies
Nalanda University
Rajgir, Nalanda
Bihar
India

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Preface

This book presents the foundation of the micro-behavioral economics of global warming. An empirical model, named the G-MAP model (geographically scaled microeconomic model of adapting portfolios in response to climatic changes and risks), is developed and applied to observed decisions of agricultural and natural resource enterprises in sub-Saharan Africa and South America. Major findings from the five versions of the G-MAP model are explained coherently throughout the book: the G-MAP animal species, the G-MAP agricultural systems, the G-MAP natural resource enterprises, the G-MAP climate risk, and the G-MAP public adaptations.

The micro-behavioral economics of global warming and the G-MAP models are evaluated against the three alternative modeling traditions each of which is known to have some level of limitations in capturing adaptation behaviors. The first is the Agro-Economic Models (AEMs) that are based on crop simulations or field experiments on selected crops under elevated CO₂ conditions. The second is a family of econometric studies of grain yield changes caused by yearly weather fluctuations. The third is the Agro-Ecological Zone (AEZ) methods in which the impacts of global warming are entirely hinged upon the AEZ classifications.

The author casts a fresh look at the traditional economics of global warming by unraveling a great array of adaptation strategies adopted by individuals who manage agricultural and natural resource enterprises in sub-Saharan Africa and South America. The book demonstrates the nature of the micro-behavioral economics as a cohesive dynamic integration of multiple disciplines, including economics, psychology, climate science, ecosystem studies, agronomy, and animal science, into the decision-making framework of one who makes decisions. The G-MAP models will provide a guide map of adaptation strategies to humanity's enduring journey of battling global climatic changes in this century and beyond.

The author began working with Prof. Robert Mendelsohn at Yale University in the summer of 2001, and the fundamentals of the micro-behavioral economics were established by May 2006 through the present author's PhD dissertation at Yale University titled "Modeling Farmer Responses to Climate Change:

Measuring Climate Change Impacts and Adaptations in Livestock Management in Africa” (Seo 2006). The empirical model of the micro-behavioral economics was later named the G-MAP model (Seo 2010).

For the development of the field this book engages, Prof. Robert Mendelsohn has been the primary intellectual force in the background. The seed of the micro-behavioral economics was sown when the highly influential Ricardian analysis was published two decades ago by him and his colleagues (Mendelsohn et al. 1994). Professor William Nordhaus, a frontiersman in the economics of global warming and a distinguished scholar of the economics of many big social issues (Nordhaus 1977, 1991), has given over the years not a few kind encouragements and critical comments. Like many scholars in the profession, I am grateful for his far-sighted guidance. The World Bank supported both projects of climate change in Africa and Latin America from which rural household surveys that are used for this book were collected. In particular, I am thankful to Prof. Ariel Dinar, lead economist at the World Bank then.

This book will turn out to be a thought-provoking treatise to those who are grappling with the unprecedented challenges posed by the advance of global warming. To many more contemplative readers, this book will come as a witty essay on how human beings should get along with natural beings, presented through the looking glass of global warming (Thoreau 1854, Leopold 1949, Carson 1962).

Dabo Hall, November 2014

S. Niggol Seo

Keywords Micro-behavioral economics of global warming • Adaptation to climate change • G-MAP model • Agricultural and natural resource enterprises • Sub-Saharan Africa • South America

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About the Author

S. Niggol Seo Professor is a natural resource economist who specializes in the study of global warming. Born in a remote rural village in South Korea in 1972, he studied at a doctoral degree program at the University of California at Berkeley and received a Ph.D. degree in Environmental and Natural Resource Economics from Yale University in May 2006 with a dissertation on micro-behavioral models of global warming. While at Yale, he learned from Robert Mendelsohn and William Nordhaus on the economics of global warming. Since 2003, he has worked with the World Bank on various climate change projects in Africa, Latin America, and Asia. He held faculty positions in the UK, Spain, and Australia since 2006. Currently, he is Professor of Environmental Studies at Nalanda University, the oldest University in the world and one of the most influential institutions in human history revived recently by the East Asian Summit. He can be reached at niggol.seo@aya.yale.edu.

Chapter 1

Introduction to the Micro-behavioral Economics of Global Warming

Abstract This chapter provides an introduction to the book which presents the Micro-Behavioral Economics of global warming with applications to adaptation decisions made by individuals who manage agricultural and natural resource enterprises in Sub-Saharan Africa and South America.

Keywords Global warming · Micro-behavioral economics · Adaptation · Sub-Saharan Africa · South America · Ecosystems

During the past half century, climate scientists have reported a steep increase in the atmosphere in the concentration of Carbon Dioxide, a major byproduct of burning fossil fuels for industrial activities and cutting forests (Keeling et al. 2005). During the same time span, global average temperature has risen gradually in an ups-and-downs fashion by about 0.6 °C from the 20th century average temperature (Hansen et al. 2006; IPCC 2014a). Concerns on the warming Planet have steadily increased over the past three decades as scientific knowledge have accumulated and been refined (IPCC 1990, 2001, 2014a).

Not far behind, policy efforts at the global level to contain the rising greenhouse gas emissions, including Carbon Dioxide, Methane, Nitrous Oxides, and Fluorinated Gases, from anthropogenic activities have gradually taken shapes and increasingly gained scientific and public supports (Nordhaus 1994, 2013; UNFCCC 1998, 2011a). While the world's citizens are still divided on how the humanity should meet the challenges from the warming Earth, concerned climate communities and policy circles have made arduous efforts to put together a global legal framework in which all the parties of the Convention take shared responsibilities in ensuring that the global temperature increase be kept under the 2 °C threshold while addressing justice concerns with regard to whom should bear the costs (UNFCCC 2011a).

Among the long list of concerns on the warming Earth, food security has remained to date at the very top of the list right from the twilight days marked by the establishments of the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Framework Convention on Climate Change (UNFCCC) (IPCC 1990, 2014a). Climate researchers as well as policy negotiators have

placed agricultural vulnerabilities, along with sea level rises, at the forefront of the discussions on how harmful global warming will turn out to be to the global economy and the Earth's ecosystems (Adams et al. 1990; Cline 1992; Downing 1992; Rosenberg 1992; Rosenzweig and Parry 1994; Mendelsohn et al. 1994; Darwin et al. 1995; Pearce et al. 1996; Reilly et al. 1996). The focal point placed on agriculture and food security in the early days mirrored that of the Rome Club report which had questioned the sustainability of economic growth, i.e., whether the world can continue to feed its citizens, issuing a dire warning on the future of economic growth (Meadows et al. 1972).

Unlike the impact studies on sea level rises which had few disagreements among the economists, early debates on agriculture and food security have intensified over time, attracting a large number of researchers to the field. The debates, often contentious, have given rise to numerous major research initiatives around the globe which aimed at tackling varied aspects of the debates and sometimes developing new concepts and methodologies that can help resolve outstanding points of disagreement (see, for major reviews, Reilly et al. 1996; Mendelsohn and Neuman 1998; Gitay et al. 2001; Easterling et al. 2007; Hillel and Rosenzweig 2010; Dinar and Mendelsohn 2011; IPCC 2014b).

Over this time period, political, institutional, and economic environments have changed rapidly. As the first commitment period of the Kyoto Protocol signed in 1998 kicked in with binding emissions targets among the Annex 1 countries in 2008 (UNFCCC 1998), regulatory and financial implications of the research findings have become clearer. As such, recently participations of the international policy organizations have significantly increased, not to mention regional and national agencies (see, for example, recent reports from CEEPA 2006; PROCISUR 2007; FAO 2009; ADB 2009; IFPRI 2010; CGIAR 2011; World Bank 2011, 2012; White House 2013). On the horizon, policy interventions in agriculture and natural resource sectors loom large at the global policy landscape through, for just one example, the Green Climate Fund (GCF) which has been promised to be as large as 100 billion US dollars annually (UNFCCC 2011b; UN 2014).

With this background, one of the goals that the present author hopes to achieve is to provide a timely review of the literature on climate change and agriculture and food security in a pertinent manner to the on-going policy discourses. Given a large number of articles and reports written and still being written on the topic, it is a daunting task to produce a fair and illuminating review of the field. At the same time, be reminded that there is still not a comprehensive review on the topic, after more than two decades of extensive research and contentious debates. This task is vitally important and urgent.

In approaching this task, the author deviates from the most reviews available in the market such as the IPCC reports which are heavily tilted to the experimental studies and devises an innovative approach to synthesize a large variety of distinct models and often incongruous findings. To be more specific, the author classifies the past economic studies into one of the three categories based on the capacity of each model in accounting for and capturing adaptation behaviors. As such, adaptation itself will turn out to be the key economic and policy decision variable in this