

Environmental Valuation in South Asia

Edited by

A. K. Enamul Haque

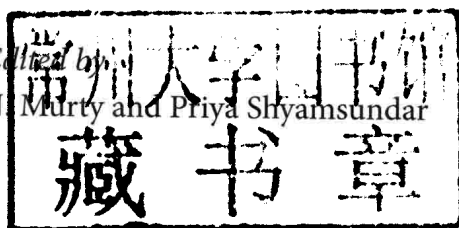
M. N. Murty

Priya Shyamsundar

CAMBRIDGE

Environmental Valuation in South Asia

Edited by A.K. Enamul Haque, M.N. Murty and Priya Shyamsundar



CAMBRIDGE
UNIVERSITY PRESS

CAMBRIDGE UNIVERSITY PRESS

Cambridge, New York, Melbourne, Madrid, Cape Town,
Singapore, São Paulo, Delhi, Tokyo, Mexico City

Cambridge University Press

4381/4, Ansari Road, Daryaganj, Delhi 110002, India

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org

Information on this title: www.cambridge.org/9781107007147

© A.K. Enamul Haque, M.N. Murty and Priya Shyamsundar 2011

This publication is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without the written
permission of Cambridge University Press.

First published 2011

Reprinted 2011

Printed in India at Replika Press Pvt. Ltd.

A catalogue record for this publication is available from the British Library.

Library of Congress Cataloguing in Publication data

Environmental valuation in South Asia / edited by A.K. Enamul Haque, M.N. Murty, and
Priya Shyamsundar.

p. cm.

Includes bibliographical references and index.

Summary: "Provides an overview of different environmental problems in South Asia
and examines how economic valuation techniques can be used to assess these
problems" -- Provided by publisher.

ISBN 978-1-107-00714-7 (hardback)

1. Environmental economics--Asia, South. 2. Environmental quality--Asia, South.

I. Haque, A. K. Enamul. II. Murty, M. N. (Maddipati Narasimha), 1942- III.
Shyamsundar, Priya, 1964- IV. Title.

HC430.6.Z9E5425 2011

333--dc22 2010040402

ISBN 978-1-107-00714-7 Hardback

Cambridge University Press has no responsibility for the persistence or
accuracy of URLs for external or third-party internet websites referred to in
this publication, and does not guarantee that any content on such websites is,
or will remain, accurate or appropriate.

List of Figures

- 2.1. Different Categories of Environment Values
- 3.1. Modeling an Environmental Improvement: Production Function
- 3.2. Valuing an Environmental Improvement: Production Function
- 3.3. Modeling an Environmental Improvement: Cost Function
- 3.4. Valuing an Environmental Improvement: Cost Function
- 3.5. Valuing an Environmental Improvement: Profit Function
- 3.6. Modeling Environmental Degradation: Production Function
- 3.7. Modeling Environmental Degradation: Cost Function
- 4.1. Externality Effect of a Decline in Soil Quality
- 6.1. Optimal Use of Pesticides
- 6.2. Impact of Pesticide on Yield Loss Reduction in a Production System
- 6.3. Average Amount of Pesticides Used on Cole Crops (gm a.i./ ha)
- 6.4. Resultant Damage Abatement Function of Pesticide
- 6.5. Pesticide Productivity Curve
- 6.6. Marginal Value Product of Pesticide Use in Cole Crop Production
- 7.1. Conceptual Framework
- 7.2. Intra-annual Variation in Rainfall near Baragi Village
- 7.3. Monthly Rainfall and Tank Level of Baragi Irrigation Tank for 1994–2005
- 7.4. Variation in 'Probability of Exceedance' of Rainfall Required to Fill Tank with variation in forested catchment runoff coefficient during the northeast monsoon (September–December)
- 8.1. Sea Elevations at Orissa Coast during 1999 Super Cyclone Landfall
- 10.1. Distribution of Visitors to the Sunderban
- 10.2. Projection of Revenue Collection with Varying Entry-Fee Rate
- 11.1. Monetary Valuation of Air pollution–Sick Days
- 12.1. Duration of Child Diarrhoea with a Recall period of 15 Days
- 12.2. Specification Test
- 13.1. Marginal Effect by Age
- 16.1. Average Concentrations of SPM, NO_x, SO₂ and the Exposure Index for 7 Monitoring Stations in Delhi for the Period October 2001 to March 2002

- 16.2. Average Concentrations of SPM, NO_x, SO₂ and the Exposure Index for 19 Monitoring Stations in Kolkata for the Period October 2001 to March 2002
- 16.3. Inverse Demand Function for Clean Air in Delhi
- 16.4. Inverse Demand Function for Clean Air in Kolkata
- 16.5. Inverse Demand Function for the Pooled Model of Delhi and Kolkata
- 17.1. Wage-Risk Trade-off
- 18.1. Household Demand for Improved Water Service in Sri Lanka

List of Tables

- 2.1. How to Evaluate Environmental Policy Changes
- 2.2. Valuation Techniques
- 3.1. Estimation of Cobb-Douglas Production Function for Irrigated Rice Farms in Tamil Nadu during Northeast Monsoon
- 3.2. Estimation of Profit Function for Irrigated Rice Farms in Tamil Nadu during Northeast Monsoon
- 4.1. Land Use and Cropping Characteristics of Paddy Villages
- 4.2. Soil Salinity during Pre-Shrimp Farming Period (1994–1995)
- 4.3. Range of EC Values for Poovam Soil Samples
- 4.4. Range of EC Values for Thiruvettakudy Soil Samples
- 4.5. Descriptive Statistics for Transplanted Paddy
- 4.6. Descriptive Statistics for Direct Sown Paddy
- 4.7. Estimated Log-Log Function of Salinity on Distance Parameters
- 4.8. Descriptive Statistics of Affected Farms
- 4.9. Descriptive Statistics of Unaffected Farms
- 4.10. Descriptive Statistics of Combined Sample
- 4.11. Estimates of Production Function for Paddy Farms
- 4.12. Estimates of Losses per Hectare from Increased Salinity Obtained Using Different Methods
- 5.1. Description of Variables
- 5.2. Descriptive Statistics of Variables
- 5.3. Estimated Shrimps Yield Function
- 5.4. Gains from Improving Water Quality to a Safe Level in the Dutch Canal
- 6.1. Pocket-wise Distribution of Cultivated and Cole crop area in Bhaktapur
- 6.2. Summary Statistics of the Variables
- 6.3. Results from the Non-linear Estimation of Various Production Functions
- 6.4. Computation of Damage Abatement and Yield Increment due to Pesticide Use

- 6.5. Cole Crop Production Using Different Level of Pesticides by Farmer
- 7.1. Landholding Classes among Tank Command Farmers
- 7.2. Estimated Production and Income in Entire Tank Command: Unirrigated kharif
- 7.3. Estimated Aggregate Production and Income in Entire Tank Command: Irrigated kharif
- 7.4. Estimated Aggregate Production, Income and Employment Generated in Entire Tank Command: Summer Paddy
- 7.5. Predicted Impact of Catchment Forest Regeneration on Gross Income of Baragi Tank Command Area Farmers
- 7.6. Predicted Impact of Catchment Forest Regeneration on the Net Income of Baragi Tank Command Area Farmers and Wage Employment Generated in the Command Area
- 8.1. List of Variables
- 8.2. Description and Sources of Data
- 8.3. Descriptive Statistics of House Damage Model
- 8.4. Ordinary Least Squares Estimates with Robust Std. Errors for Fully Collapsed Houses
- 8.5. Weighted Least Squares Estimates (weight = area) for Partially Collapsed Houses
- 8.6. Averted House Damages and Values
- 8.7. Storm Protection Values of Mangroves
- 9.1. Sample Respondents Interviewed in Different Seasons and Locations of the MHN Park
- 9.2. Explanatory Variables and Hypotheses
- 9.3. Descriptive Statistics of the Respondents
- 9.4. Visitor's Perceptions Regarding Improvements in two National Parks
- 9.5. Reasons for Visiting MHN Park by Sample Respondents
- 9.6. Estimated Results of Linear Regression Equations for Visitation
- 10.1. Types of Tours Packages: Seven Options in the Survey Questionnaire
- 10.2. Percentage of Multipoint Visitors Across Regions: Survey Estimate
- 10.3. Average Travel Cost and Per-capita Income Across Tour Packages
- 10.4. The Two-segment Split of the Recreational Market Used in the Study
- 10.5. Identification of Zones Used in Estimating TGF (excluding foreign nationals)
- 10.6. Zonal Data from Secondary Sources

- 10.7. Summary Statistics from Survey Data: Distribution of Visitors, Travel Cost and Per-capita Income across Zones, Durations and Market Segments
- 10.8. Variables Used for Estimating TGF
- 10.9. Regression Result for the Trip Generating Function
- 10.10. Distribution of Aggregate CS Across Zones, Segments and Durations (in Million INR)
 - 11.1. Descriptive Statistics
 - 11.2. Number of Sick Days (H): Poisson Estimates
 - 11.3. Tobit Equations of Mitigating Activities (M) Left Censored (0)
- 12.1. Cost of Child Diarrhoea per Child per Episode
- 12.2. Socio-Economic Conditions of Slum Households
- 12.3. Variable Explanations and Expected Sign
- 12.4. Descriptive Statistics
- 12.5. Negative Binomial-Logit Hurdle Regression of the Prevalence of Child Diarrhoea and Duration
- 12.6. Different Types of Cost of Child Diarrhoea (BDT) (15 days)
- 12.7. Sensitivity Analysis of the Cost of Child Diarrhoea (BDT) (15 days)
- 12.8. Probability of Diarrhoeal Attack for a Child
- 12.9. Yearly Cost of Child Diarrhoea
- 12.10. Yearly Expected Cost (BDT) of a Representative Child Diarrhoea
- 12.11. Yearly Expected Cost (BDT) of a Representative Household for Children
 - 13.1. Household Level Information
 - 13.2. Individual Level Information
 - 13.3. Distribution of Arsenic Related Diseases among Sick Households
 - 13.4. Estimating the Probability of Sickness (Probit Model)
 - 13.5. Estimating the Probability of Incurring Medical Costs (Probit Estimates)
 - 13.6. Calculation of Cost of Illness or Welfare Gain
 - 13.7. Lower Bound of Willingness to Pay to Avoid Arsenicosis
 - 13.8. Comparison of WTP from Other Studies
 - 13.9. Total WTP or Welfare Loss for Bangladesh
- 13.10. Unit Cost of Different Types of Arsenic Removal/Mitigating Technologies
 - 14.1. Sampling of Households for the Socio-economic Survey
 - 14.2. Air Pollution Levels within 3Km Distance of the Cement Factory, Puttalam District (National Building Research Organization)

- 14.3. General Characteristics of the Surveyed Households
- 14.4. Kitchen Characteristics (Indoor Air Pollution)
- 14.5. Respiratory and Related Diseases among Surveyed Households
- 14.6. Summary Statistics of the Regression Variables
- 14.7. Estimated Coefficients for Dose Response Functions for ARI, LRI and URI
- 14.8. Estimated Coefficients of the Mitigation Cost Functions for ARI, LRI and URI (Tobit Analysis)
- 14.9. Welfare Gain from Various Reductions in Current SPM levels per Annum
- 15.1. Household Characteristics: Descriptive Statistics
- 15.2. Characteristics of Intervention and Control Households
- 15.3. OLS and IV Regression results (Dependent Variable: CO level)
- 15.4. Symptoms of Illness in Main Cook (Woman) over 12 months Period
- 15.5. Symptoms of Illness in Children below Five Years over last 12 months Period
- 15.6. Probability of Reduction in Illness in Woman Cooks and Children below five years after Intervention
- 15.7. OLS, IV and Tobit Results (Dependent Variable: log of treatment cost)
- 15.8. Marginal Effects: Negative Binomial Estimates (Dependent Variable: Days lost due to illness)
- 15.9. Determinants of Firewood Consumption – OLS and IV estimates
- 15.10. Summary of Cost and Benefits (in Rs.)
- 15.11. CBA Analysis – the Results
- 16.1. Descriptive Statistics of Variables Used for Estimation of the Hedonic Property Value Model: Location Delhi
- 16.2. Descriptive Statistics of the Variables Used for Estimation of the Hedonic Property Value model: Location Kolkata
- 16.3. Estimates of Hedonic Price Equation for Delhi
- 16.4. Estimates of Marginal Willingness-to-pay Equation for Delhi
- 16.5. Estimates of Hedonic Price Equation for Kolkata
- 16.6. Estimates of Marginal Willingness-to-pay Equation for Kolkata
- 16.7. Estimates of Marginal Willingness-to-pay Equation for the Pooled Model
- 16.8. Estimates of Welfare Gains in INR to Urban Households in Delhi, Kolkata and for Pooled Model

- 17.1. Wages and Standard Benefit Rates
- 17.2. Risk Measures and Workers by Industry
- 17.3. Variable Definitions and Descriptive Statistics
- 17.4. Box-Cox Non-linear Regression Model Estimates of Wage Equations
- 17.5. OLS and WLS Estimates of Log Wage Equations
- 17.6. Regression Estimates of Job Risk Equations
- 17.7. Non linear Estimates of Log Wage Equation
- 17.8. Summary of Labour Market Studies on the Value of Life and Injury
- 17.9. Summary of (selected) Studies Estimating Implicit Discount Rates
- 18.1. Impact of Household Characteristics and Related Variables on Demand for Improved Piped Water Service-Probit regression
- 18.2. Predicted Uptake Rates of Improved WSS for Different Groups
- 18.3. WTP Estimates by Sub-groups with Connection Fees of Rs. 0 for Connected and Rs. 6000 for Unconnected Households
- 18.4. WTP Estimates by Sub-groups without Connection

List of Appendices

- 6.1. Empirical Finding from Pesticide Productivity Studies
- 8.8. Ordinary Least Squares Estimates with Robust Std. Errors for Fully Collapsed Houses with *Tahasildar* Dummies
- 8.9. Weighted Least Squares Estimates (weight = area) for Partially Collapsed Houses with *Tahasildar* Dummies
- 8.10. Ordinary Least Squares Estimates with Robust Std. Errors for the Ratio of Fully Collapsed to Partially Collapsed Houses

List of Contributors

M. Jahangir Alam

Department of Economics and
Social Sciences
BRAC University
Dhaka, Bangladesh

Shrinivas Badiger

Centre for Environment and
Development
Ashoka Trust for Research in
Ecology and the Environment,
Bangalore, India

Avishek Banerjee

Institute of Economic Growth
Delhi University Enclave
Delhi, India

Caroline van den Berg

World Bank
1818 H. Street NW
Washington DC, USA

Cyril Bogahawatte

Department of Agricultural
Economics
University of Peradeniya
Peradeniya, Sri Lanka

Saudamini Das

Institute of Economic Growth
University of Delhi Enclave
Delhi, India

Santadas Ghosh

Department of Economics and
Politics
Visva-Bharati
Santiniketan, West Bengal, India

Indrila Guha

Department of Economics
Vidyasagar College for Women
Kolkata, West Bengal, India

S.C. Gulati

Institute of Economic Growth
Delhi University Enclave
Delhi, India

Herath Gunatilake

South Asia Department
Asian Development Bank
6 ADB Avenue,
Mandaluyong City 1550,
Metro Manila, Philippines

Usha Gupta

Department of Business Economics
Bhim Rao Ambedkar College
University of Delhi
Main Wazirabad Road
Delhi, India

A.K. Enamul Haque

Department of Economics
United International University (UIU)
Satmasjid Road, Dhanmondi
Dhaka, Bangladesh

K. Omar Hattab

Department of Soil Science and
Agricultural Chemistry
Pandit Jawaharlal Nehru College of
Agriculture and Research Institute
Puducherry U.T., India

Janaranjana Herath

Department of Agricultural
Economics and Business
Management
Faculty of Agriculture
University of Peradeniya
Peradeniya, Sri Lanka

Md. Zakir Hossain

Transparency International
Bangladesh
Dhaka, Bangladesh

Ratna Kumar Jha

District Agriculture Development
Office, Bhaktapur
Department of Agriculture, Nepal

Himayatullah Khan

Institute of Development Studies

NWFP Agricultural University
Peshawar, Pakistan

Rajeeva Kumara

Sobaganahalli, Kothigere Post
Kunigal Taluk
Tumkur District, Karnataka, India

Sharachchandra Lele

Centre for Environment and
Development
Ashoka Trust for Research in
Ecology and the Environment
Bangalore, India.

S. Madheswaran

Centre for Economic Studies and
Policy
Institute for Social and Economic
Change
Bangalore, India

Ajit Menon

Madras Institute of Development
Studies
andhinagar, Adyar
Chennai
Tamil Nadu, India

M. N. Murty

Institute of Economic Growth
Delhi University Enclave
Delhi, India

P. Nasurudeen

Department of Agricultural
Economics and Extension
Pandit Jawaharlal Nehru College of
Agriculture and Research Institute

Karaikal
Puducherry U.T., India

Min Bikram Malla
Practical Action Nepal Office
Pandol Marg, Lazimpat
Kathmandu, Nepal

Iswaragouda Patil
Head Post Kunnur
Shiggaon Taluk
Haveri District
Karnataka, India

Subhrendu Pattanayak
Sanford School of Public Policy
and Nicholas School of the
Environment
Duke University
Durham, NC, USA

Adhrit Prasad Regmi
Centre for Rural Development
and Self-help
Dallu Residential Area, Chhuni
Kathmandu, Nepal

W.R. Rohita
No. 56, Darshanapura
Kundasale, Sri Lanka

K. R. Shanmugam
Madras School of Economics
Gandhi Manadapam Road, Kottur
Chennai, India

Priya Shyamsundar
South Asian Network for
Development and Environmental
Economics
32/25 Sukhumvit Soi 67
Bangkok, Thailand

P. Selvaraj
Fisheries College and Research
Institute
Chidambaranagar
Thoothukudi
Tamil Nadu, India

L. Umamaheswari
Department of Agricultural
Economics
Pandit Jawaharlal Nehru College of
Agriculture and Research Institute
Karaikal
Puducherry U.T., India

Jeffrey R. Vincent
Nicholas School of the
Environment
Duke University
Durham, NC, USA

Jui-Chen Yang
Research Triangle Institute (RTI)
Research Triangle Park, USA

Preface

Applied research in environmental economics has gained momentum in recent times and is viewed as a means to aid environmental management. The South Asian Network for Development Economics and Environment (SANDEE) has contributed to this momentum in South Asia, a region with a vast and growing ecological footprint. During the last ten years, SANDEE has sponsored research on several aspects of environment and development. It has also organized numerous workshops to meet training needs.

SANDEE uses innovative strategies to build capacity in environmental economics. Researchers and managers from universities, governments and NGOs are provided with repeated opportunities to improve their skills. The process for an economist to produce a useful piece of research is detailed. It involves his/her attending a teaching workshop, writing a research proposal related to an environmental problem in his/her country, presenting ongoing research to receive comments, receiving guidance from a SANDEE advisor and writing a manuscript. The final research output is peer-reviewed by an international expert. Thus, SANDEE research is grounded in the realities of local problems but benefits from the advice of scholars from around the world.

This book contains contributions from SANDEE researchers and advisors. The papers in the book are on environmental valuation in South Asia and provide information for designing sustainable development policies. They constitute detailed micro case studies of air, water, land and forest resources from the region.

The studies in this book have benefited from comments from many experts including Kenneth Arrow, Partha Dasgupta, Jean-Marie Baland, Kanchan Chopra, Herath Gunathilake, K. G. Maler, Subhrendu Pattanayak, E. Somanathan, Rehana Siddiqui and Jeff Vincent, to name a few. Many chapters have also been anonymously peer-reviewed. The editors have acted as advisors on specific projects and worked with several researchers from the beginning to the final culmination of this book.

The credit for producing the research presented in this book also goes to the highly motivated team at the SANDEE Secretariat. Manik Duggar, Pranab Mukhopadhyay, Kavita Shresta, and Anuradha Kafle, who were at SANDEE when these studies were done, have made the development of these projects possible. Current staff, including Mani Nepal and Krisha Shresta, has continued to work with the same spirit.

The task of preparing this book from SANDEE projects was entrusted to the Institute of Economic Growth (IEG) with M. N. Murty as coordinator. The IEG organized three book-related workshops and brought together contributors so that they could further develop their chapters. The former Director, Kanchan Chopra and several IEG faculty and staff provided intellectual and administrative support. We express our thanks to them.

Finally, we are thankful to SANDEE'S donors – IDRC (International Development Research Center), Sida (Swedish International Development Cooperation Agency), NORAD (Norwegian Agency for International Cooperation) and the World Bank for their financial assistance, and, to the staff who represent these agencies on SANDEE's Board for their advice and support.

Enamul Haque, M. N. Murty and Priya Shyamsundar

Contents

<i>List of Figures</i>	<i>ix</i>
<i>List of Tables</i>	<i>xi</i>
<i>List of Appendices</i>	<i>xvi</i>
<i>List of Contributors</i>	<i>xvii</i>
<i>Preface</i>	<i>xxi</i>
Chapter 1: Introduction	1
1.1. About the Book	1
1.2. Environmental Valuation in South Asia	2
1.3. Valuation Methods	4
1.4. Implementing Full Cost Pricing in Agrarian Settings	6
1.5. Accounting for Linked Ecological and Social Systems	8
1.6. Improved Health Outcomes	10
1.7. Micro to Macro: Valuation and Better Measures of Sustainable Development	12
1.8. Increasing Revenues through Better Valuation	13
1.9. Challenges to Environmental Valuation in Developing Countries	14
Chapter 2: Environmental Valuation: A Review of Methods	19
<i>A.K. Haque, M.N. Murty and P. Shyamsundar</i>	
2.1. Environmental Resources and Economic Valuation	19
2.2. Environmental Values	20
2.3. Measuring Environmental Values and Policy Changes	22
2.4. Valuation Methods	23
2.5. Conclusion	32
Chapter 3: Valuing the Environment as a Production Input	36
<i>Jeffrey R. Vincent</i>	36
3.1. Introduction	36
3.2. Production Function	38
3.3. Cost Function	46
3.4. Profit Function	54