

## **FINAL REPORT**

### **An Integrated Inter-temporal Analysis of Land Use Change in Forestry and Agriculture: An Assessment of the Influence of Technological Change on Carbon Sequestration and Land Use.**

Department of Energy Grant: DE-FG02-04ER63936

*Principal Investigator:* Brent Sohngen; Department of Agricultural, Environmental, and Development Economics; Ohio State University; 2120 Fyffe Rd.; Columbus, OH 43210; [Sohngen.1@osu.edu](mailto:Sohngen.1@osu.edu); 614-638-4640.

*Co-Principal Investigators:*

Tom Hertel, Purdue University, Department of Agricultural Economics  
Robert Mendelsohn, Yale School of Forestry and Environmental Studies  
Roger Sedjo, Resources For the Future

This project built a global land use model to examine the implications of land based carbon sequestration on land uses. The model also can be used to assess the costs of different land-based actions to reduce carbon emissions.

#### **The objectives of this research were to**

- (1) Develop baseline global land-use model
- (2) Integrate recent research on technological change in forestry and agricultural production into the model.
- (3) Baseline model results and scenario analysis
- (4) Analyze the influence of technological change on carbon sequestration costs.

#### **Results:**

To date, we have accomplished tasks 1 – 3. Papers are currently being written to provide information on the baseline model and the effects of technological change on baseline land uses. We were unable to finalize task 4 within the confines of this project, but continue work on the model, and will finalize this task within the next 6 months.

Along the way, we have utilized intermediate model results, developed as part of this research to produce policy relevant information. Some results have been published and some have been presented. A list of presentations and publications related to this work is given below.

The research funded several graduate students over a three year period (Bin Sun, Adam Daigneault, and Karl Meeusen), and a post-doctoral research assistant (Suk-won Choi) at Ohio State University. The research also funded one graduate student (Alla Golub) at Purdue University.

The forestry data used in the dynamic optimization model has been made available to the public on a website (see below). This data has been widely used by others in the literature, particularly those involved in the Stanford University Energy Modeling Forum. The forestry model is under revision and it will be posted on the website soon. The land use model will be posted on the website as soon as the first publication is accepted.

<http://aede.osu.edu/people/sohngen.1/forests/GTM/index.htm>

### **Presentations:**

- Sohngen, B. 2005. "Impacts and Adaptation in Forestry and Potential Carbon Sequestration." Invited Presentation at Symposium "Interfaces between Climate and Economic Dynamics." National Center for Competence in Research on Climate, Switzerland. Interlaken, Switzerland, March, 2005
- Sohngen, B. and R. Mendelsohn. "A Sensitivity Analysis of Forest Carbon Sequestration." Invited Presentation. Australian Bureau of Agricultural and Resource Economics. Canberra, Australia. August 8, 2005.
- Sohngen, B. "Carbon Sequestration and the Global Timber Market" Selected Paper. International Union of Forestry Research Organizations Conference. Brisbane, Australia. August 9 – 13, 2005.
- Sohngen, B. and B. Sun. 2006. "Optimal Set-Asides for Carbon Sequestration and Co-Benefits of Forestry." Selected Paper. Chinese Economics Association of North America session at the Annual Meetings of the Allied Social Sciences Association. Boston, MA. January 5, 2006.
- Sohngen, B. and R. Sedjo. "Carbon Sequestration Costs in Global Forests." Invited Presentation. Energy Modeling Forum meeting titled *Multigas Mitigation and Climate Change*. Washington, DC. January 31, 2006.
- Sohngen, B. "Approaches to Modeling Economics of Climate Change in Forestry and Agriculture." Invited Presentation at the University of Helsinki, Department of Forest Resources (Viikki Campus). Helsinki, Finland. March 15, 2006.
- Sohngen, B. "A Global Perspective on the Economics of Sequestering Carbon in Forests." Keynote Address at a workshop titled *Forest Ecosystem Carbon and its Economic Implications*. Finnish Forest Research Institute (METLA). Helsinki, Finland. March 16, 2006.
- Sohngen, B. "Cost and Potential for Generating Carbon Credits from Reduced Deforestation" Invited Presentation at the conference *Reducing Emissions from Deforestation in Developing Countries: A workshop to discuss methodological and policy issues*. Bad Blumau, Austria May 10-12, 2006
- Sohngen, B, S. Choi, T. Hertel, A. Golub, M. Tavoni. "Global Forestry and Agricultural Model." Energy Modeling Forum. Tsukuba, Japan. December 12-14, 2006.

- Sohnngen, B. and R. Beach. 2007. " Avoided Deforestation as a Greenhouse Gas Mitigation Tool: Economic Issues for Consideration." Invited Presentation. Coalition for Rainforest Nations Workshop on Avoided Deforestation. Columbia University, New York, NY. January 15, 2007.
- Sohnngen, B. M. Tavoni, and V. Bosetti. 2007. " The Potential Role of Forests and Wood in Meeting Carbon Stabilization Targets." Presentation at the conference *Workshop on environmental performance of using wood*. University of Washington, Seattle, WA. January 24-25, 2007
- Sohnngen, B. M. Tavoni, and V. Bosetti. 2007. " Forestry and the Carbon Market Response to Stabilize Climate." Presentation at the Department of Rural Economics, University of Alberta, Edmonton, AB. February 15, 2007
- Sohnngen, B. and R. Beach. 2007. "Modeling Economic Opportunities for Avoided Deforestation ." Presentation at the Forestry and Agricultural Greenhouse Gas Modeling Forum. Sheperdstown, WV, March 6-8, 2007.
- Sohnngen, B. 2007. " How Much Potential Afforestation, Forest Management, and Avoided Deforestation Is There? Where, When, and \$\$\$." Invited presentation for US Environmental Protection Agency. Washington, DC. April 23, 2007.
- Hertel, T, H-L Lee, S. Rose, and B. Sohnngen (presenter). 2007. " The role of global land use in determining greenhouse gas mitigation costs." Selected Paper. Workshop on Carbon Sequestration in Agriculture and Forestry. Thessaloniki, Greece, June, 2007.
- Tavoni, M., B. Sohnngen (presenter), and V. Bosetti. 2007. "Forestry and the carbon market response to stabilize climate." Selected Paper. Annual meetings of the European Association of Environmental and Resource Economists. Thessaloniki, Greece, June 2007.
- Sohnngen, B. and B. Sun. 2007. "Optimal Set-Asides for Carbon Sequestration and Co-Benefits of Forestry." Invited Presentation at Conference titled *Conference on Climate Change and Sustainable Development*. Hosted by Fundacione Eni Enrico Mattei (FEEM). Sardinia, Italy, September 27-28, 2007.
- Sohnngen, B., M. Tavoni, and V. Bosetti. 2007. "Forests as a Transition Tool in Climate Mitigation." Invited Presentation at *Resources For the Future*. Washington, D.C. October 4, 2007.
- Sohnngen, B., R. Beach, and K. Andrasko. 2007. " Assessing Comparative Advantage and Leakage in Emission Reductions from Deforestation." Presentation at Forest Day at the United Nations Conference of Parties, Bali, Indonesia. December 8, 2007.
- Sohnngen, B., M. Tavoni, and V. Bosetti. 2007. " Forestry and the Carbon Market Response to Stabilize Climate." Invited Presentation at National Taiwan University, Department of Agricultural Economics. Taipei, Taiwan. December 14, 2007.

#### **Publications:**

- Sohnngen, B and R. Sedjo. 2006. "Carbon Sequestration in Global Forests Under Different Carbon Price Regimes." *Energy Journal*, 27:109-126.
- Tavoni, M., B Sohnngen, and V. Bosetti. 2007. " Forestry and the carbon market response to stabilize climate." *Energy Policy*. 35(11): 5346-5353.
- Kindermann, G., M. Obersteiner, B. Sohnngen J. Sathaye, K. Andrasko, E. Rametsteiner, B. Schlamadinger, S. Wunder, R. Beach. 2008. "Global cost estimates of reducing

carbon emissions through avoided deforestation." *Proceedings of the National Academy of Sciences*. 105(30): 10302–10307.

Hertel, T., H.-L. Lee, S. Rose and B. Sohngen. 2006. "The Role of Global Land Use in Determining Greenhouse Gases Mitigation Costs." GTAP Working Paper No. 36. West Lafayette, IN: Global Trade and Analysis Project, Purdue University.

Sohngen, B. and R. Mendelsohn. 2007. "A Sensitivity Analysis of Carbon Sequestration." Chapter 19 in *Human-Induced Climate Change: An Interdisciplinary Assessment*. Edited by M. Schlesinger, H.S. Kheshgi, J. Smith, F.C. de la Chesnaye, J.M. Reilly, T. Wilson, and C. Kolstad. Cambridge: Cambridge University Press.