

University of Wyoming
College of Business
Department of Economics and Finance

Economics 5410-01
Seminar in Advanced Resource and Environmental Economics
MW 09:35 – 10:50 AM, Ross Hall, Room 135
Fall 2008

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Course Description: This course explores recent theoretical and empirical advances in natural resource and environmental economics. The lectures and seminars will be organized around the following key topics: land use and soil erosion, forestry for timber and non-timber benefits, valuing non-market ecological functions, trade and resource use, resource management under uncertainty, and sustainable development.

Prerequisites: ECON 4400 and ECON 5020 or consent of instructor.

Course Objectives: The main aim of this course is to encourage students to become familiar with recent advances in selected areas of natural resource and environmental economics through learning to read, critically evaluate, and hopefully begin developing, analytical contributions to these areas. The first part of the course will involve the instructor introducing the students to the topics through selecting key articles and readings to critically evaluate. This will take place through both lectures and group discussion. The final part of the course will involve student-led seminars based on the course topics. Each seminar will consist of both a paper presentation as well as a group discussion of the material presented.

Grading and Course Requirements: The academic requirements of this course consist of a final examination at the end of the semester and two seminar papers and presentations. **The exam will count for 40% of your final grade, and each seminar paper and presentation will count for 30%** (20% for the paper and 10% for the presentation). All grading will be done on a standard point system and not curved.

The final examination will be based on the required reading indicated under each topic, and in particular the material introduced in class during the first part of the course.

For the first seminar presentation and paper, each student will have to choose a published paper relevant to any one of the course topics, explain the methodology and

results, critically evaluate the modeling approach of the paper, and finally, suggest briefly a possible extension or reformulation of the model. For the second seminar presentation and paper, the student will attempt to develop further the suggested extension or reformulation of the model into his or her own paper on the selected topic, and explain the possible contribution of this approach to the literature.

The distribution of seminar topics among students will be agreed by **September 10**. Although not all topics need to be covered, a broad spectrum of seminar topics will be the aim.

On the day of the student's first seminar the student should hand out to the class a version of the first paper. However, the deadline for all students to submit a final version of the first seminar paper is **November 17** at the latest. The student should also be prepared to hand out a version of their second paper on the day of that seminar. However, the deadline for all students to submit a final version of the second seminar paper is **December 3** at the latest.

The final examination is scheduled for **Monday December 8 at 10:15 AM-12:15 PM**.

Attendance Policy: Students are expected to attend all classes, including seminars given by other students. If a student is unable to attend a class, then he or she should either seek the permission of the instructor in advance or provide a legitimate reason (e.g. illness, family or University obligation) for missing the class. Any student who misses a class is responsible for obtaining from other students the relevant material (e.g. handouts, notes) for that class.

Any student who fails to turn in the required seminar paper by the above designated due dates will receive automatically a 20 percent reduction in the grade that the paper would otherwise have earned. Extensions to paper deadlines and a make-up exam for the final examination will only be awarded under rare circumstances, and will require some supporting evidence (e.g. verified evidence of a medical or family emergency). The instructor may also need to consult other departmental or College colleagues before granting an extension or make-up exam.

Academic Dishonesty: Also known as "cheating" academic dishonesty will not be tolerated in this class. Cases of academic dishonesty will be prosecuted in accordance with UNIREG 802 Rev.2. Cheating in this course can result in an "F" final grade. In this course, academic dishonesty includes (but is not limited to) unapproved assistance on examinations, copying the work of other students, plagiarism or other use of published materials without complete citations, or fabrication of referenced information, including purchasing and/or downloading from the internet others' work without acknowledging this source.

Group Work Guidelines: Although substantial group discussion will take place within classes, no group work is anticipated in this course. However, the student is encouraged to discuss his or her ideas on the two seminar papers with other students,

and to seek their advice and comments on earlier drafts of the papers. The student should acknowledge any substantial advice and comments by other students in the papers, if appropriate.

Course Calendar: A calendar for the course will be distributed, as soon as the schedule for seminars is finalized.

Disclaimer: The instructor may need to modify the above course requirements, grading standards and calendar during the teaching of the course this semester. If so, the instructor will notify all students in class of any changes and confirm these changes in a written memo, handout and/or email.

Course Readings and Outline

Although there is no required text for the course, the following two texts are recommended:

Hartwick, J. and N. Olewiler. 1998. *The Economics of Natural Resource Use*, 2nd ed., Addison-Wesley, New York.

Conrad, J.M. 1999. *Resource Economics*, Cambridge University Press, New York.

Students should obtain copies of both these two texts, especially if they plan to pursue further graduate studies in the ENR field.

The following book is supplementary; it will be particularly useful for those students interested in natural resource economics applied to a developing country context:

Barbier, E.B. 2005. *Natural Resources and Economic Development*. Cambridge University Press, Cambridge.

The following topics form the basis of the course. Under each topic is a list of **core readings** that each student is required to read. The lectures and group discussions in the first part of this course will be drawn from these readings. Students should have read these course readings in advance and be prepared to discuss them in class.

The **suggested readings** under each topic indicate the type of papers that each student might select for the first seminar paper and presentation. The student does not have to choose one of these papers, but is encouraged to pick a paper that is related to this literature. Any paper chosen for a student's seminar that is not on this list needs to be approved in advance by the instructor.

0 Natural Resource Applications of Dynamic Optimization

Core readings:

Chapters 1-2 in J.M. Conrad. 1999. *Resource Economics*, Cambridge University Press, New York.

Chapter 1 in Conrad, J.M. and C.W. Clark. 1987. *Natural Resource Economics: Notes and Problems*. Cambridge University Press, New York.

I Land Use, Land Value and Soil Erosion

Core Readings:

"The Valuation and Use of Land and Water", pp. 57-75. Chapter 3 in Hartwick, J. and N. Olewiler. 1998. *The Economics of Natural Resource Use*. Addison-Wesley, New York.

McConnell, K.E. 1983. "An Economic Model of Soil Conservation." *American Journal of Agricultural Economics* 65(1):83-89.

Kiker, C. and G. Lynne. 1986. "An Economic Model of Soil Conservation: Comment." *American Journal of Agricultural Economics* 68(3):739-742.

McConnell, K.E. 1986. "An Economic Model of Soil Conservation: A Reply." *American Journal of Agricultural Economics* 68(3):743-744.

Barbier, E.B. 1990. "The Farm-Level Economics of Soil Conservation: The Uplands of Java." *Land Economics* 66(2):199-211.

Suggested Readings:

Albers, H.J., M.J. Goldbach and D.T. Kaffine. 2006. "Implications of Agricultural Policy for Species Invasion in Shifting Cultivation Systems." *Environment and Development Economics* 11:429-452.

Ardila, S. and R. Innes. 1993. "Risk, Risk Aversion, and On-Farm Soil Depletion." *Journal of Environmental Economics and Management* 25:27-45.

Beaumont, P.M. and R.T. Walker. 1996. "Land Degradation and Property Regimes." *Ecological Economics* 18:55-66.

Bekele, W. 2005. "Stochastic Dominance Analysis of Soil and Water Conservation in Subsistence Crop Production in the Eastern Ethiopian Highlands: The Case of the Hunde-Lafto Area." *Environmental and Resource Economics* 32(4): 533-550.

Besley, T. 1995. "Property Rights and Investment Incentives." *Journal of Political Economy* 103(5):903-937.

Carter, M.R. and P. Olinto. 2003. "Getting Institutions 'Right' for Whom? Credit Constraints and the Impacts of Property Rights on the Quantity and Composition of Investment." *American Journal of Agricultural Economics* 85(1):173-186.

- Coxhead, I. G. Shively and X. Shuai. 2002. "Development Policies, Resource Constraints, and Agricultural Expansion on the Philippine Land Frontier." *Environment and Development Economics* 7(2):341-364.
- Grepperud, S. 1996. "Population Pressure and Land Degradation: The Case of Ethiopia." *Journal of Environmental Economics and Management* 30:18-33.
- Grepperud, S. 1997. "Soil Conservation as an Investment in Land." *Journal of Development Economics* 54:455-467.
- Grepperud, S. 2000. "Optimal Soil Depletion with Output and Price Uncertainty." *Environment and Development Economics* 5(3):221-240.
- Grossman, H.I. 1994. "Production, Appropriation and Land Reform." *American Economic Review* 84(3):705-712.
- Innes, R. 2003. "Stop and Go Policies with a Land Market." *American Journal of Agricultural Economics* 85(1):198-215.
- López, R. 1997. "Environmental Externalities in Traditional Agriculture and the Impact of Trade Liberalization: The Case of Ghana." *Journal of Development Economics* 53:17-39.
- Pascual, U. and E.B. Barbier. 2006. "Deprived Land-Use Intensification in Shifting Cultivation: The Population Pressure Hypothesis Revisited." *Agricultural Economics* 34:155-165.
- Pascual, U. and E.B. Barbier. 2007. "On Price Liberalization, Poverty and Shifting Cultivation: An Example from Mexico." *Land Economics* 83(2):192-216.
- Place, F. and K. Otsuka. 2001. "Population, Tenure, and Natural Resource Management: The Case of Customary Land Area in Malawi." *Journal of Environmental Economics and Management* 41(1):13-32.
- Robalino, J.A. 2007. "Land Conservation Policies and Income Distribution: Who Bears the Burden of Our Environmental Efforts?" *Environment and Development Economics* 12(4):521-534.
- Shively, G.E. 2001. "Agricultural Change, Rural Labor Markets, and Forest Clearing: An Illustrative Case from the Philippines." *Land Economics* 77(2):268-284.
- Tachibana, T., T.M. Nguyen and K. Otsuka. 2001. "Agricultural Intensification versus Extensification: A Case Study of Deforestation in the Northern-Hill Region of Vietnam." *Journal of Environmental Economics and Management* 41(1):44-69.
- Takasaki, Y. 2007. "Dynamic Household Models of Forest Clearing under Distinct Land and Labor Market Institutions: Can Agricultural Policies Reduce Tropical Deforestation?" *Environment and Development Economics* 12(3):423-444.
- Van den Berg, M. 2002. "Do Public Works Decrease Farmers' Soil Degradation? Labour Income and the Use of Fertilisers in India." *Environment and Development Economics* 7(3):487-506.

II Forestry for Timber and Non-Timber Benefits

Core Readings:

"Forest Use". Chapter 10 in Hartwick, J. and N. Olewiler. 1998. *The Economics of Natural Resource Use*, 2nd ed., Addison-Wesley, New York.

"The Economics of Forestry". Chapter 4 in Conrad, J. 1999. *Resource Economics*, Cambridge University Press, New York.

Samuelson, P.A. 1976. "Economics of Forestry in an Evolving Society." *Economic Inquiry* 14:466-492.

Hartman, R. 1976. "The Harvesting Decision When the Standing Forest Has Value." *Economic Inquiry* 14:52-58.

Suggested Readings:

Akpalu, W. and P.J. Parks. 2007. "Natural Resource Use Conflict: Gold Mining in Tropical Rainforest in Ghana." *Environment and Development Economics* 12(1):55-72.

Alaouze, C.M. 2004. "The Effect of Conservation Value on the Optimal Forest Rotation." *Land Economics* 80(2):209-223.

Albers, H.J. 1996. "Modeling Ecological Constraints on Tropical Forest Management: Spatial Interdependence, Irreversibility and Uncertainty." *Journal of Environmental Economics and Management* 30:73-94.

Amacher, G.S., E. Koskela and M. Ollikainen. 2002. "Optimal Forest Policies in an Overlapping Generations Economy with Timber and Money Bequests." *Journal of Environmental Economics and Management* 44(2):346-369.

Barbier, E.B. 2002. "Institutional Constraints and Deforestation: An Application to Mexico." *Economic Inquiry* 40(3):508-519.

Barbier, E.B. and J.C. Burgess. 2001, "Tropical Deforestation, Tenure Insecurity and Unsustainability," *Forest Science* 47(4):497-509..

Boscolo, M. and J.R. Vincent. 2003. "Nonconvexities in the Production of Timber, Biodiversity and Carbon Sequestration." *Journal of Environmental Economics and Management* 46:251-268.

Boscolo, M. and J.R. Vincent. 2007. "Area Fees and Logging in Tropical Timber Concessions." *Environment and Development Economics* 12(4):505-520.

Chang, S.J. 1998. "A Generalized Faustmann for the Determination of Optimal Harvest Age." *Canadian Journal of Forestry Research* 28:652-659.

- Conrad, J.M. and D. Ludwig. 1994. "Forest Land Policy: The Optimal Stock of Old-Growth Forest." *Natural Resource Modelling* 8:27-45.
- Conrad, R.F., M. Gillis and E. Mercer. 2005. "Tropical Forest Harvesting and Taxation: A Dynamic Model of Harvesting Behavior under Selective Extraction Systems." *Environment and Development Economics* 10(5):689-709.
- Crépin, A-S. 2003. "Multi-Species Boreal Forests – What Faustmann Missed." *Environmental and Resource Economics* 26(4):625-646.
- Eerola, E. 2004. "Forest Conservation – Too Much or Too Little? A Political Economy Model." *Environmental and Resource Economics* 27:391-407.
- Englin J, and P. Boxall. 1996. "Optimal rotation of multiple use forests in the presence of fire risk." *American Journal of Agricultural Economics* 78(5):398-1408.
- Koskela, E. and M. Ollikainen. 2001. "Optimal Private and Public Harvesting under Spatial and Temporal Interdependence." *Forest Science* 47(4):484-496.
- Mitra, T. and H.Y. Wan, Jr. 1985. "Some Theoretical Results on the Economics of Forestry." *Review of Economic Studies* 52(2):263-282.
- Mitra, T. and H.Y. Wan, Jr. 1986. "On the Faustmann Solution to the Forest Management Problem." *Journal of Economic Theory* 40:229-249.
- D.J. Nalle, C.A. Montgomery, J.L. Arthus, S. Polasky and N.H. Schumaker. 2004. "Modeling Joint Production of Wildlife and Timber." *Journal of Environmental Economics and Management* 48:997-1017.
- Ollikainen, M. 1998. "Sustainable Forestry: Timber Bequests, Future Generations and Optimal Tax Policy." *Environmental and Resource Economics* 12(3):255-273.
- Peltola, J. and K.C. Knapp. 2001. "Recursive Preferences in Forest Management." *Forest Science* 47(4):455-465.
- Reed W.J.1993. "The decision to conserve or harvest old-growth forest." *Ecological Economics* 8(1):45–69.
- Salo, S. and O. Tahvonen. 2003. "On the Economics of Forest Vintages." *Journal of Economic Dynamics and Control* 27(8):1411-1435.
- Satake A. and T.K. Rudel. 2007. Modelling the forest transition: forest scarcity and ecosystem service hypotheses. *Ecological Applications* 17: 2024-2036.
- Stavins, R.N. and A.B. Jaffe. 1990. "Unintended Impacts of Public Investments on Private Decisions to Deplete Forested Wetlands." *American Economic Review* 80(3):337-352
- Termansen, M. 2007. "Economies of Scale and the Optimality of Rotational Dynamics in Forestry." *Environmental and Resource Economics* 37(4): 643-659.

Van Kooten, G.C. , C.S. Binkley and G. Delcourt. 1995. "Effect of Carbon Taxes and Subsidies on Optimal Forest Rotation Age and Supply of Carbon Services." *American Journal of Agricultural Economics* 77(May):365-374.

III Valuing Non-Market Ecological Functions

Core Readings:

Barbier, E.B. 2007. "Valuing Ecosystem Services as Productive Inputs" *Economic Policy* 22 (49): 177–229.

Suggested Readings:

Barbier, E.B. 2007. "Land Conversion, Interspecific Competition and Bioinvasion in a Tropical Ecosystem." *Journal of Agricultural & Applied Economics* 39(October):133-147.

Batabyal, A.A., J.R. Kahn and R.V. O'Neill. 2003. "On the Scarcity Value of Ecosystem Services." *Journal of Environmental Economics and Management* 46(2):334-352.

Boncour, J., F. Alban and O.G. Ifremer. 2002. "Fish, Fishers, Seals and Tourists: Economic Consequences of Creating A Marine Reserve in a Multi-Species, Multi-Activity Context." *Natural Resource Modeling* 15(4):387-411.

Brock, W. and A. Xepapadeas. 2002. "Optimal Ecosystem Management when Species Compete for Limiting Resources." *Journal of Environmental Economics and Management* 44(2):189-220.

Brock, W.A. and D. Starrett. 2003. "Managing Systems with Non-convex Positive Feedback." *Environmental and Resource Economics* 26:575-602.

Eichner, T. and R. Pethig. 2006. "Economic Land Use, Ecosystem Services and Microfounded Species Dynamics." *Journal of Environmental Economics and Management* 52(3):707-720.

Eiswerth, M.E. and W.S. Johnson. 2003. "Managing Nonindigenous Invasive Species: Insights from Dynamic Analysis." *Environmental and Resource Economics* 23:319-342.

Finnoff, D. and J. Tschirhart. 2003. "Protecting a Species While Harvesting its Prey in a General Equilibrium Ecosystem Model." *Land Economics* 79(2):160-180.

Kaiser, B. and J. Roumasset. 2002. "Valuing Indirect Ecosystem Services: The Case of Tropical Watersheds." *Environment and Development Economics* 7(4):701-714.

Knowler, D. and E.B. Barbier. 2005. "Managing the Black Sea Anchovy Fishery with Nutrient Enrichment and a Biological Invader". *Marine Resource Economics* 20(3): 263-285.

Knowler, D. and E.B. Barbier. 2005. "Importing Exotic Plants and the Risk of Invasion: Are Market-Based Instruments Adequate?" *Ecological Economics* 52:341-354.

Rodwell, L.D. E.B. Barbier, C.M. Roberts, and T.R. McClanahan. "A Model of Tropical Marine Reserve-Fishery Linkages" *Natural Resource Modeling* 15.4 (2002): 453-486.

Sanchirico, J.N. 2005. "Additivity Properties in Metapopulation Models: Implications for the Assessment of Marine Reserves." *Journal of Environmental Economics and Management* 49:1-25.

Smith, Martin D. 2007. "Generating Value in Habitat-Dependent Fisheries: The Importance of Fishery Management Institutions." *Land Economics* 83(1):59-73.

Sanchirico, J.N. and J.E. Wilen. 2001. "A Bioeconomic Model of Marine Reserve Creation." *Journal of Environmental Economics and Management* 42(3):257-276.

Swallow, S.K. 1994. "Renewable and Nonrenewable Resource Theory Applied to Coastal Agriculture, Forest, Wetland, and Fishery Linkages." *Marine Resource Economics* 9:291-310.

Tilman, D., S. Polasky and C. Lehman. 2005. "Diversity, Productivity and Temporal Stability in the Economics of Humans and Nature." *Journal of Environmental Economics and Management* 49:405-426.

Tschirhart, J. 2004. "A New Adaptive System Approach to Predator-Prey Modeling," *Ecological Modelling* 176:255-276.

IV Trade and Resource Use

Core Readings:

Barbier, E.B. 2005. "Natural Resource-Based Economic Development in History". *World Economics* 6(3):103-152

Brander, J.A. and M.S. Taylor. 1998. "The Simple Economics of Easter Island: A Ricardo-Malthus Model of Renewable Resource Use." *American Economic Review* 88:119-138.

Brander, J.A. and M.S. Taylor. 1997. "International Trade and Open-Access Renewable Resources: The Small Open Economy Case." *Canadian Journal of Economics* 30:526-552.

Bulte, E.H. and E.B. Barbier. 2005. "Trade and Renewable Resources in a Second-Best World: An Overview." *Environmental and Resource Economics* 30(4):423-463.

Suggested Readings:

Antweiler, W., B.R. Copeland and M.S. Taylor. 2001. "Is Free Trade Good for the Environment?". *American Economic Review* 91(4):877-908.

Barbier, E.B., R. Damania and D. Léonard. 2005. "Corruption, Trade and Resource Conversion" *Journal of Environmental Economics and Management* 50:276-299.

Barbier, E.B. and C.E. Schulz. 1997. "Wildlife, Biodiversity and Trade", *Environment and Development Economics* 2(2):145-172.

Brander, J.A. and M.S. Taylor. 1998. "Open Access Renewable Resources: Trade and Trade Policy in a Two-Country Model." *Journal of International Economics* 44:181-209.

Bulte E.H. and G.C. van Kooten, 1999. The Ivory Trade Ban and Elephant Numbers: Theory and Application to Zambia, *American Journal of Agricultural Economics* 81: 453-466.

Chichilinsky, G. 1994. "North-South Trade and the Global Environment." *American Economic Review* 84:851-874.

Copeland, B.R. and M.S. Taylor. 2005. "Free Trade and Global Warming: A Trade Theory View of the Kyoto Protocol." *Journal of Environmental Economics and Management* 49:205-234.

Costello, C. and C. McAusland. 2003. "Protectionism, Trade, and Measures of Damage from Exotic Species Introductions." *American Journal of Agricultural Economics* 85(4):964-975.

Hartwick, J., N. Van Long and H. Tian. 2001. "Deforestation and Development in a Small Open Economy." *Journal of Environmental Economics and Management* 41(3):235-251.

Hotte, L., N. van Long and H. Tian, 2000. International Trade with Endogenous Enforcement of Property Rights, *Journal of Development Economics* 62: 25-54

Kremer, M. and C. Morcom, 2000. Elephants, *American Economic Review* 90: 212-34.

López, R. 2000. "Trade Reform and Environmental Externalities in General Equilibrium: Analysis for an Archetype Poor Tropical Country." *Environment and Development Economics* 5:337-404.

McAusland, C. 2005. "Learning By Doing in the Presence of an Open Access Renewable Resource: Is Growth Sustainable?" *Natural Resource Modeling* 18(1):41-68.

McAusland, C. and C. Costello. 2004. "Avoiding Invasives: Trade-Related Policies for Controlling Unintentional Exotic Species Introductions." *Journal of Environmental Economics and Management* 48(2):954-977.

Polasky, S., C. Costello and C. McAusland. 2004. "On Trade, Land-Use, and Biodiversity." *Journal of Environmental Economics and Management* 48(2):911-925.

Smulders, S., D. van Soest and C. Withagen. 2004. "International Trade, Species Diversity, and Habitat Conservation." *Journal of Environmental Economics and Management* 48(2):891-910.

V Resource Management under Uncertainty

Core Readings:

"Option Value and Risky Development". Chapter 7 in Conrad, J. 1999. *Resource Economics*, Cambridge University Press, New York.

Pindyck, R.S. 1980. "Uncertainty and Exhaustible Resource Markets." *Journal of Political Economy* 88:1203-1225.

Conrad, J.M. 1997. "On the Option Value of Old-Growth Forest." *Ecological Economics* 22:97-102.

Suggested Readings:

- Barbier, E.B. and J.F. Shogren. 2004. "Growth with Endogenous Risk of Bioinvasion." *Economic Inquiry* 42(4):587-601.
- Butterfield, D.W. 2003. "Resource Depletion under Uncertainty: Implications for Mine Depletion, Hartwick's Rule and National Accounting." *Resource and Energy Economics* 25(3):219-238.
- Clarke, H.R. and W.J. Reed. 1990. "Applications of Optimal Stopping Rules in Resource Economics." *Economic Record* 66:254-265.
- Clarke, H.R. and W.J. Reed. 1989. "The Tree Cutting Problem in a Stochastic Environment." *Journal of Economic Dynamics and Control* 13:569-595.
- Conrad, J.M. 1997. "Global Warming: When to Bite the Bullet." *Land Economics* 73:164-173.
- Costello, C. and S. Polasky. 2004. "Dynamic Reserve Site Selection." *Resource and Energy Economics* 26(2): 157-174.
- Costello, C. and S. Polasky. 2008. "Optimal Harvesting of Stochastic Spatial Resources." *Journal of Environmental Economics and Management* 56(1):1-18.
- Eiswerth, M.E. and G.C. van Kooten. 2002. "Uncertainty, Economics and the Spread of an Invasive Species." *American Journal of Agricultural Economics* 84(5):1317-1322.
- Fernandez, L. 2005. "A Diversified Portfolio: Joint Management of Non-Renewable and Renewable Resources Off-Shore." *Resource and Energy Economics* 27:65-82.
- Hannesson, R. 2002. "The Economics of Marine Reserves." *Natural Resource Modeling* 15(3):273-290.
- Horan, R.D. and F. Lupi. 2005. "Tradeable Risk Permits to Prevent Future Introductions of Invasive Alien Species into the Great Lakes." *Ecological Economics* 52:289-304.
- Isley, M. 2002. "A Real Options Approach to the Valuation of a Forest Investment." *Journal of Environmental Economics and Management* 44(3):471-492.
- Just, R.E., S. Netanyahu and L. Olson. 2005. "Depletion of Natural Resources, Technological Uncertainty, and the Adoption of Substitutes." *Resource and Energy Economics* 27:91-108.
- Kassar, I. and P. Lasserre. 2004. "Species Preservation and Biodiversity Value: A Real Options Approach." *Journal of Environmental Economics and Management* 48(2):857-879.
- Mason, C.F. 2001. "Non-Renewable Resources with Switching Costs." *Journal of Environmental Economics and Management* 42(1):65-81.
- Newell, R.G. and W.A. Pizer. 2003. "Regulating Stock Externalities under Uncertainty." *Journal of Environmental Economics and Management* 45(2S):416-432.
- Nøstbakken, L. 2006. "Regime Switching in a Fishery with Stochastic Stock and Price." *Journal of Environmental Economics and Management* 51(2):231-241.
- Pindyck, R.S. 1984. "Uncertainty in the Theory of Renewable Resource Markets." *Review of Economic Studies* 51:289-303.

Reed, W.J. 1993. "The Decision to Conserve or Harvest Old-Growth Forest." *Ecological Economics* 8:45-69.

Saphores, J-D. M. and J.F. Shogren. 2005. "Managing Exotic Pests under Uncertainty: Optimal Control Actions and Bioeconomic Investigations." *Ecological Economics* 52:327-339.

VI Sustainable Development

Core Readings:

"Sustainability and Natural Resource Scarcity" and "The Economics of Sustainability". Chapters 2 and 12 in Hartwick, J. and N. Olewiler. 1998. *The Economics of Natural Resource Use*, 2nd ed., Addison-Wesley, New York.

"Sustainable Development". Chapter 8 in Conrad, J. 1999. *Resource Economics*, Cambridge University Press, New York.

Hartwick, J.M. 1977. "Intergenerational Equity and the Investing of Rents from Exhaustible Resources." *American Economic Review* 67:972-974.

Solow, R.M. 1986. "On the Intergenerational Allocation of Resources." *Scandinavian Journal of Economics* 88:1441-1449.

Suggested Readings:

Andreoni, J. and A. Levinson. 2001. "The Simple Analytics of the Environmental Kuznets Curve." *Journal of Public Economics* 80:269-286.

Arrow, K.J., P. Dasgupta and K-G. Mäler. 2003. "Evaluating Projects and Assessing Sustainable Development in Imperfect Economies." *Environmental and Resource Economics* 26:647-685.

Asheim, G. 2007. "Can NNP Be Used for Welfare Comparisons?" *Environment and Development Economics* 12(1):11-32.

Barbier, E.B. and A. Markandya. 1990. "The Conditions for Achieving Environmentally Sustainable Development", *European Economic Review*, 34:659-669.

Cairns, R.D. 2002. "Green Accounting Using Imperfect, Current Prices." *Environment and Development Economics* 7(2):207-214.

Cairns, R.D. and N. Van Long. 2006. "Maximin: A Direct Approach to Sustainability." *Environment and Development Economics* 11:275-300.

Chavas, J-P. 2004. "On Impatience, Economic Growth and the Environmental Kuznets Curve: A Dynamic Analysis of Resource Management." *Environmental and Resource Economics* 28:123-152.

Chichilinsky, G. 1997. "What is Sustainable Development?" *Land Economics* 73: 123-135.

- Common, M. and C. Perrings. 1992. "Towards an Ecological Economics of Sustainability." *Ecological Economics* 6:7-34.
- Eriksson, C. and J. Persson. 2003. "Economic Growth, Inequality, Democratization, and the Environment." *Environmental and Resource Economics* 25:1-16.
- Hartwick, J.M. 1995. "Constant Consumption Paths in Open Economies with Exhaustible Resources." *Review of International Economics* 3:275-283.
- Howarth, R.B. and R.B. Norgaard. 1992. "Environmental Valuation Under Sustainable Development." *American Economic Review* 82:473-477.
- John, A. and R. Pecchenino. 1994. "An Overlapping Generations Model of Growth and the Environment." *Economic Journal* 104:1393-1410.
- Lieb, C.M. 2002. "The Environmental Kuznets Curve and Satiation: A Simple Static Model." *Environment and Development Economics* 7(3):429-448.
- López, R. 1994. "The Environment as a Factor of Production: The Effects of Economic Growth and Trade Liberalization." *Journal of Environmental Economics and Management* 27:163-184.
- López, R. and S. Mitra. 2000. "Corruption, Pollution, and the Kuznets Environmental Curve." *Journal of Environmental Economics and Management* 40(2):137-150.
- López, R., G. Anríquez and S. Gulati. 2007. "Structural Change and Sustainable Development." *Journal of Environmental Economics and Management* 53:307-322.
- Ono, T. and Y. Maeda. 2002. "Sustainable Development in an Aging Economy." *Environment and Development Economics* 7:9-22.
- Stokey, N.L. 1998. "Are There Limits to Growth?" *International Economic Review* 39:1-31.
- Torvik, R., 2002. Natural Resources Rent Seeking and Welfare, *Journal of Development Economics* 67: 455-70.
- Weitzman, M.L. and K. Löfgren. 1997. "On the Welfare Significance of Green Accounting as Taught by Parable." *Journal of Environmental Economics and Management* 32:139-153.