University of Minnesota
Department of Applied Economics

Economics of Natural Resource and Environmental Policy
APEC 5651
Spring Semester 2016
Tu/Th 3-4:15 pm; McGrath 6

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OVERVIEW

Economic thinking, methods, and data permeate virtually all conservation, environmental, and natural resource policy and management issues. What is the value of conservation, environmental protection, and natural resources? Who benefits and by how much? What are the costs of various management and policy alternatives and who pays? What are cost-effective ways of achieving environmental goals? How can policies be structured to provide incentives for conservation and environmental protection and to avoid unintended consequences? Is enough being done to protect future generations and achieve sustainable outcomes?

In this course we will cover a range of conservation, environmental, and natural resource topics including externalities and public goods, environmental policies to internalize externalities and provide public goods such as pollution taxes and cap-and-trade, benefit-cost analysis, valuing environmental improvement, renewable and non-renewable resources, common property resources and overcoming the tragedy of the commons, climate change, biodiversity conservation, ecosystem services, discounting, and sustainable development.

Who should take this course?

This course is designed with three main audiences in mind:

1) Students studying economics who wish to learn about environmental and resource issues and the application of economic theory and empirical analysis to these issues
2) Students studying public policy who wish to learn about environmental and resource issues and how to apply economic theory and empirical analysis to shed light on policy and management debates and gain a deeper understanding of environmental policy
3) Students studying conservation biology, natural resource science and management, water resources, or other environmental and resource science fields who wish to learn more about economics, policy and management of the environment and resources

This course will be somewhat different from a standard economics course largely because of the varied disciplinary background and experience of the students. I view this as a great opportunity for mutual learning. The course is designed to facilitate having students in the class help each other learn about the areas in which they have greater background and experience. I expect the

natural science students to help others learn the important science underpinnings of the environmental and resource issues; the public policy students to help others learn about policy, politics, and institutions; and the economics students help others learn about economic theory and methods and how these apply to environmental and resource issues.

For those students who do not have much of an economics background, I will hold several "Econ 101" sessions to offer additional help in economics for those parts of the course where the economic content is a bit heavier. I will also hold help sessions prior to due dates for problem sets. My goal is to de-mystify economics so that everyone who completes the class will understand how to apply economic reasoning and methods to environmental and resource policy and management questions, and to gain an appreciation of the strengths and limitations of economic approaches. For all topics covered in the course, we will discuss a mix of economic theory, data, and application, the underlying natural science and institutional contexts, and current policy debates.

Course Content and Objectives
This course has three main objectives:

- To acquaint you with major conservation, environmental, and natural resource issues and current policy debates.
- To show how economic analysis can shed light on these issues and debates and allow you to gain proficiency in the use of economic methods applied to these issues.
- To become a discerning critic of the use of economic methods in public policy debates on conservation, environmental, and natural resource issues.

Prerequisites
Desired: Intermediate Microeconomics (APEC 3001, Econ 3101, or equivalent)
Minimum: Background in conservation, environmental or natural resource science, policy or management and a willingness to learn economics applied to environmental and resource issues.

COURSE REQUIREMENTS AND GRADING

Class participation	10%
Daily questions	10%
Economic issues brief 1	10%
Economic issues brief 2	10%
Problem sets (4 – each worth 5%)	20%
Midterm 1	20%
Midterm 2	20%

We will read and discuss a mix of textbook material, journal articles and popular press articles that cover conservation, environmental, and natural resource economics from a range of perspectives. In addition to assigned material, we will often use the first few minutes of class to discuss topics currently in the news. Please bring up interesting current events and topics that you run across during the semester.

Class time will be devoted partly to lecture and partly to discussion and active exploration of

topics. Asking questions and being prepared to engage in discussion will make the class more rewarding and enjoyable for all. Please come to class prepared to engage in discussion of the material for that particular class session.

The class participation grade will depend on the quality of your contributions to class discussion. Asking good questions and supplying insightful comments are the types of contributions I am most looking for and will count most heavily in the class participation grade. I will give one grade for class participation based on your contributions over the semester.

On days when there is not another assignment due, you will be responsible for posting a "Daily Question," which is a short question or comment about the readings or topic for the following class session (suggested length: from a couple of sentences up to half a page). Daily Questions should be posted to the Moodle website for the class by 6 pm the day before class (Monday or Wednesday evening). Daily Questions should focus on something that you find most interesting or are having trouble understanding. Daily Questions help me to get a sense of what topics are of most interest and where you may be having difficulty understanding material. I will use your Daily Questions to adjust the focus of the lecture and discussion. I will often use a particularly good question or comment as the place to start the discussion in class. Daily questions will be graded on a 3 point scale with "3" representing a very thoughtful question or insight, "2" representing a reasonable question or insight that shows familiarity with the material, and "1" representing minimal effort and insight that does not demonstrate much familiarity with the material. Daily Question scores will be aggregated and turned into a letter grade at the end of the semester (as a rough guide, an average of 2 will put you roughly at the borderline between an A- and a B+) .

You will write two "Economic Issues Briefs" during the semester. Each Economic Issue Brief will focus on a specific conservation, environmental, or natural resource policy or management issue and use economic analysis to discuss good policy or management choices for addressing the issue. Each brief will be 800 – 1000 words in length (not including references). Briefs will be given a letter grade. More details on Economic Issues Briefs will be supplied later in the semester.

There will be four problem sets. The best way to learn environmental and natural resource economics (or any branch of economics) is to solve problems that ask you to apply concepts to particular issues. The problem sets will be mostly analytical but will also include some numerical problems. The latter type may involve the use of *Excel*. I encourage you to work together on problem sets but each of you must hand in your own assignment. Problem sets will be given a numerical score. I will translate numerical scores into letter grades based on the difficulty of the assignment.

There will be two take-home exams, one at midterm time and the other at the end of the course. Part of the exam will ask you to solve problems (similar to what you will be asked to do on problem sets) and part of the exam will ask you to synthesize what you have learned to discuss important conservation, environmental, and resource topics. Exams will be given a letter grade.

TEXTS

Recommended texts:

- Goodstein and Polasky. 2014. *Environmental Economics*, 7th Edition.
- Hanley, Shogren, and White. 2007. *Environmental Economics: In Theory & Practice*, 2nd Edition.

Course readings will primarily come from journal articles and other readings. The two recommended textbooks will be used primarily as background reading. It would be a good idea to have one (or both) books, especially if your economics background is not strong. But it is not essential to buy either book. Goodstein and Polasky is primarily targeted to undergraduates but provides useful and clear discussions of many issues. It is a bit broader and more sympathetic to critics of standard economic arguments than most economics textbooks. Hanley, Shogren, and White is targeted at advanced undergraduates and graduate students and covers core material in environmental and resource economics.

Optional texts: You may find these texts useful to supply an alternative explanation of material or for greater depth in some areas.

Conrad. 2010. *Resource Economics*, 2nd Edition.
Fisher, Naidoo and Ricketts. 2015. *A Field Guide to Economics for Conservationists*.
Freeman. 2003. *The Measurement of Environmental and Resource Values*, 2nd edition.
Keohane and Olmstead. 2007. *Markets and the Environment*.
Kolstad. 2010. *Environmental Economics*, 2nd Edition.
Oates (editor). 2006. *The RFF Reader in Environmental and Resource Policy*, 2nd Edition.
Stavins (editor). 2012. *Economics of the Environment: Selected Readings*, 6th Edition.
Tietenberg and Lewis. 2014. *Environmental and Natural Resource Economics*, 10th Edition.

POLICIES

Missing or Late Assignments

Assignments are due at the beginning of class on the due date (or the evening before in the case of Daily Questions). If you have extenuating circumstances that will prevent you from turning in an assignment on time please arrange for an extension ahead of time. I will give you plenty of time to complete the assignment between handing out an assignment and its due date. Putting off assignments until the very end and then having a last minute crisis is your problem not mine. Students who turn in assignments after the due date without a valid excuse will have their grades reduced by one grade (e.g. A- to B+) for each day the assignment is late. Missing an assignment will result in getting a 0 for the assignment. An incomplete will be granted for the course only in extenuating circumstances.

Academic Dishonesty and Plagiarism

The University of Minnesota defines academic dishonesty as "Submission of false records of academic achievement; cheating on assignments or examinations; plagiarizing; altering, forging, or misusing a University academic record; taking, acquiring, or using test materials without faculty permission; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement" (University of Minnesota's

Board of Regents Student Conduct Code). Plagiarism is the "use the words or ideas of another person as if they were your own words or ideas" (Merriam Webster Dictionary). If you want to use the exact wording from a previously published work in your own work you must put the wording in quotation marks and cite the source (as shown by example in the prior sentence). If you use ideas or specific facts from a source but do not use the exact words then you still must cite the source of the original ideas or facts. Evidence of academic dishonesty will be forwarded to the Student Scholastic Conduct Committee. TurnItIn is used to check for plagiarism on written assignments.

Students with Disabilities

The University of Minnesota is committed to providing equitable access to learning opportunities for all students. Disability Services (DS) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations. If you have, or think you may have, a disability (e.g., mental health, attentional, learning, chronic health, sensory, or physical), please contact DS at 612-626-1333 to arrange a confidential discussion regarding equitable access and reasonable accommodations. If you are registered with DS and have a current letter requesting reasonable accommodations, please let me know early in the semester so we can agree on accommodations that will be applied in the course.

Students with Mental Health Issues

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating, and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce your ability to participate in daily activities. University of Minnesota services are available to assist you with addressing these and other concerns you may be experiencing. You can learn more about the broad range of confidential mental health services available on campus via www.mentalhealth.umn.edu.

COURSE SCHEDULE, READINGS, AND ASSIGNMENT DUE DATES

Tuesday January 19: Course overview and introduction. Discussion of three current issues – climate change, mining, water quality

Readings: Goodstein and Polasky, Chapter 1

Thursday January 21: A brief overview and comparison of environmental economics, natural resource economics, and ecological economics

Readings: Pearce, D. 2002. An intellectual history of environmental economics. *Annual Reviews of Energy and Environment* 27: 57–81.

Optional: Hanley, Shogren, and White Chapter 1

Assignment: Daily Question

Tuesday January 26: Markets and efficiency

Readings: Heal, G. 2001. Basic economics. In *Nature and the Marketplace: Capturing the Value of Ecosystem Services*.

Assignment: Daily Question

Thursday January 28: Market failure: externalities and public goods

Readings: Goodstein and Polasky, Chapter 3
OR
Hanley, Shogren, and White, Chapter 3

Assignment: Daily Question

Tuesday February 2: Policy approaches to internalize externalities

Readings: Heal, G. 2001. Policies and institutions. In *Nature and the Marketplace: Capturing the Value of Ecosystem Services*. Island Press.

Optional: Goodstein and Polasky, Chapters 4 and 15
Hanley, Shogren, and White, Chapter 4

Assignment: Daily Question

Thursday February 4: Cap-and-trade: applications to SO_2 and CO_2

Readings: Schmalensee, R. and R. Stavins. 2015. Lessons learned from three decades of experience with cap-and-trade. NBER Working Paper No. 21742.

Optional: Hanley, Shogren, and White, Chapter 5

Assignment: Daily Question

Tuesday February 9: Voluntary approaches: property rights and the Coase solution; Certification and information

Readings: Coase, R. 1960. The problem of social cost. *Journal of Law and Economics* 3: 1 – 44. (Read pages 1 – 8)

Kotchen, M. 2013. Voluntary- and information-based approaches to environmental management: A public economics perspective. *Review of Environmental Economics and Policy* 7 (2): 276-295.

Assignment: Problem set 1

Thursday February 11: Setting environmental policy: health and safety standards or economic efficiency?

Readings: Goodstein and Polasky, Chapter 7

Assignment: Daily Question

Tuesday February 16: Benefit-cost analysis

Readings: Arrow, K. et al. 1995. Is there a role for benefit-cost analysis in environmental, health, safety regulation? *Science* 272: 221-222.

Sandel, M. 2012. Incentives. In *What Money Can't Buy: The Moral Limits of Markets*.

Assignment: Daily Question

Thursday February 18: Valuing the environment: Measuring non-market benefits

Readings: Flores, N. 2003. Conceptual framework for non-market valuation. In *A Primer on Non-Market Valuation*, P. Champ, K.J. Boyle, and T.C. Brown (eds). Springer.

Optional: Goodstein and Polasky Chapter 5
Hanley, Shogren, and White Chapter 11

Assignment: Daily Question

Tuesday February 23: Revealed preference methods

Readings: Boyle, K.J. 2003. An introduction to revealed preferences methods. In *A Primer on Non-Market Valuation*, P. Champ, K.J. Boyle, and T.C. Brown

(eds). Springer.

Mahan, B. et al. 2000. Valuing urban wetlands: a property price approach. *Land Economics* 76: 100-113.

Assignment: Economics Issue Brief 1

Thursday February 25: Stated preference methods

Readings: Symposium on Contingent Valuation, *Journal of Economic Perspectives* Vol. 26, No. 4, Fall 2012

Kling, C.L., D.J. Phaneuf, and J. Zhao. From Exxon to BP: Has some number become better than no number? (pp. 3-26)

Carson, R.T. Contingent valuation: A practical alternative when prices aren't available. (pp. 27-42)

Hausman, J. Contingent valuation: From dubious to hopeless. (pp. 43-56)

Assignment: Daily Question

Tuesday March 1: Behavioral economics and the environment

Readings: Carlsson, F., and O. Johansson-Stenman. 2012. Behavioral economics and environmental policy. *Annual Review of Resource Economics* 4: 75-99.

Falk, A. & Szech, N. 2013. Morals and markets. *Science* 340: 707-711.

Optional: Goodstein and Polasky Chapter 11

Assignment: Problem Set 2

Thursday March 3: Uncertainty

Readings: Polasky. 2016. Notes on optimal choice of environmental policy under uncertainty.

Optional: Weitzman, M. 1974. Prices vs. quantities. *Review of Economic Studies* 41: 477-91.

Hanley, Shogren and White Chapter 12

Assignments: Daily Question

Tuesday March 8: Spatial issues

Readings: Polasky, S. et al. 2014. Implementing the optimal provision of ecosystem services. *Proceedings of the National Academy of Sciences* 111: 6248-53.

Kolstad, C.D. 1987. Uniformity versus differentiation in regulating externalities. *Journal of Environmental Economics and Management* 14(4): 386-399.

Assignment: Daily Question

Thursday March 10: Case study: Electric power generation resource planning

Reading: Goodkind, A. and S. Polasky. 2013. Health and environmental costs of electricity generation in Minnesota.

Assignments: Daily Question

Friday March 11: Midterm 1 is due by 5 pm

SPRING BREAK

Tuesday March 22: Intertemporal choice, sustainability, and discounting

Readings: Goodstein and Polasky, Chapter 8

Assignment: Daily Question

Thursday March 24: Sustainable development

Readings: Steffen, W., P.J. Crutzen, and J.R. McNeill. 2007. The anthropocene: Are humans now overwhelming the great forces of nature. *AMBIO: A Journal of the Human Environment* 36(8): 614-621.

Rockstrom, J. et al. 2009. A safe operating space for humanity. *Nature* 461: 472-475.

Optional: Hanley, Shogren, and White Chapter 2

Assignment: Daily Question

Tuesday March 29: Renewable resources

Readings: Clark, C. 1990. Elementary dynamics of exploited populations. Chapter 1 in *Mathematical Bioeconomics*. Wiley Inter-Science.

Clark, C. 1990. Economic models of renewable-resource harvesting. Chapter 2 in *Mathematical Bioeconomics*. Wiley Inter-Science.

Polasky, S. 2015. Notes on optimal harvesting.

Optional: Hanley, Shogren and White Chapters 9 & 10
Goodstein and Polasky Chapter 10.4-10.5

Assignment: Daily Question

Thursday March 31: Common property resources

Readings: Hardin, G. 1968. The tragedy of the commons. *Science* 162: 1243-48.

Dietz, T., et al. 2003. The struggle to govern the commons. *Science* 302: 1907-1912.

Assignment: Daily Question

Tuesday April 5: Exhaustible resources

Readings: Goodstein and Polasky Chapter 10.0-10.3
OR
Hanley, Shogren and White Chapters 7 & 8

Assignment: Problem Set 3

Thursday April 7: Energy

Readings: Goodstein and Polasky Chapter 18

Assignment: Daily Question

Tuesday April 12: Biodiversity conservation

Readings: Ando, A. et al. 1998. Species distributions, land values, and efficient conservation. *Science* 279: 2126-2128.

Polasky, S. et al. 2008. Where to put things? Spatial land management to sustain biodiversity and economic returns. *Biological Conservation* 141: 1505-24.

Assignment: Daily Question

Thursday April 14: Ecosystem services

Readings: Millennium Ecosystem Assessment. 2005. Summary for policy-makers. *Ecosystems and Human Well-being: Synthesis.*

Polasky, S. and K. Segerson. 2009. Integrating ecology and economics in the study of ecosystem services: some lessons learned. *Annual Review of Resource Economics* 1: 409-434.

Assignment: Economics Issue Brief 2

Tuesday April 19: Land use

Readings: Nelson, E. et al. 2009. Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Frontiers in Ecology and the Environment* 7: 4–11.

Lawler, J. et al. 2014. Projected land-use change impacts on ecosystem services in the U.S. *Proceedings of the National Academy of Sciences* 111(20): 7492-7497.

Assignment: Daily Question

Thursday April 21: InVEST modeling exercise

Reading: InVEST User's Guide. http://www.naturalcapitalproject.org/invest/

Assignment: Daily question

Tuesday April 26: Managing for sustainability: uncertainty and resilience

Readings: Ludwig, D. et al. 1993. Uncertainty, resource exploitation, and conservation: lessons from history. *Science* 260: 17, 36.

Polasky, S. et al. 2011. Decision-making under great uncertainty: environmental management in an era of global change. *Trends in Ecology & Evolution* 26: 398-404. Ecosystem services

Assignment: Problem Set 4

Thursday April 28: Inclusive Wealth

Readings: Polasky, S., B. Bryant, P. Hawthorne, J. Johnson, B. Keeler, and D. Pennington. 2015. Inclusive wealth as a metric of sustainable development. *Annual Review of Environment and Resources* 40: 6.1–6.22.

Optional: Goodstein and Polasky Chapter 9

Assignment: Daily Question

Tuesday May 3: Climate change

Readings: Stern, N. 2008. The economics of climate change. *American Economic Review* 98: 1-37.

Nordhaus, W. 2010. Economic aspects of global warming in a post-Copenhagen environment. *Proceedings of the National Academy of Sciences* 107: 11721-26.

Optional: Goodstein and Polasky Chapter 21

Assignment: Daily Question

Thursday May 5: Climate change

Readings: Aldy, J., A.J. Krupnick, R.G. Newell, I.W.H. Parry, and W.A. Pizer. 2010. Designing climate change policy. *Journal of Economic Literature* 47(4): 903-936.

Optional: Hanley, Shogren and White Chapter 6

Assignment: Daily Question

Friday May 13: Midterm 2 is due by 5 pm