

**UNIVERSITY OF COLORADO AT BOULDER, FALL 2006**  
**NATURAL RESOURCE ECONOMICS, Econ 4535-001**  
Lectures: MWF 10:00 a.m. to 10:50 a.m. @ ECON 119

**Instructor: Vijaya R. Sharma, Ph.D.**

Office Hours: MWF 9:00 a.m.-10:00 a.m. @ Econ 4A

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**Course Introduction**

This course presents theories of efficient utilization of natural resources and discusses issues related to current practices of use of resources. It also discusses issues of sustainability, conservation, and preservation. The course extensively uses graphical analyses and some mathematical models. It also assigns a number of readings. Courses on intermediate microeconomics (Econ 3070) and mathematical economics (Econ 1070 or 1080) are prerequisites for this course.

**Textbook and Assignments**

1. **Optional:** Environmental and Natural Resource Economics, by Frank A. Ward, Pearson Prentice Hall
2. Twelve assignments are prescribed in the course and are listed in the course outline. Some assignments require you to prepare a summary of the readings assigned; you can access the readings from the instructor's web site.
3. Within the first two weeks of classes, each student chooses a presentation topic from among those listed in the course outline, conducts the necessary research and study, and presents the findings to the class on the day scheduled for the topic (see the course outline).
4. Some notes on the course materials prepared by the instructor are available on the instructor's web site, but they may differ from actual lectures in some details and may even be incomplete or nonexistent for some topics.

**Examinations and Grading**

The course grade will base on performances in two midterms (20 points each), one presentation/write-up (20 points), fulfillment of 10 of 12 assignments (10 points), and the cumulative final exam (30 points). No makeup midterm or exam shall be given. If you miss a midterm or presentation, the final exam shall count 50 points.

Midterms (Sep 25 and Nov 1)	40
Presentation/Write-up	20
Assignments	10
Final Exam (Dec 10 at 1:30 p.m.)	30

**Course Outline and Tentative Schedule**

1. Course Introduction and Economics Approach to Use of Resources (Aug 28, 30, Sep 1)  
Introduction to course, syllabus, and grading policy  
Resource Taxonomy – Resource Flows, Natural Resources (Renewable and Non-renewable), Environmental Resources  
Reasons of Studying Natural Resource Economics – involves inter-temporal decisions, pervasive market failure, potential irreversible consequences, and multidisciplinary knowledge  
Broad Issues – Efficient utilization, Sustainability, Resource Scarcity and Economic Growth  
Economics Approach of weighing benefits and costs and the problem of interpersonal comparison  
**Assignment #1 due on Sep 1 (write a summary of the following reading):**  
**The Cost of Fur (news piece published in the Economist of March 1, 2001)**
2. Inter-temporal Decisions and Related Concepts (Sep 6, 8)  
Rate of time preference, concept of discounting, inter-temporal optimal allocation rule (graphical model), marginal user cost and scarcity rent
3. Hotelling Model of Optimal Rate of Depletion of Nonrenewable Resources (Sep 11, 13, 15, 18, 20, 22)  
Reserve Taxonomy – Current Reserves, Potential Reserves, and Total Resource Endowment  
Two Markets – Asset Market and Flow Market  
Hotelling Model – Mathematical Derivation, Graphical Explanations, Equilibrium Conditions

Best Reserve First, Path of efficient prices and scarcity rent under Zero MEC, Constant MEC, Increasing MEC, Impacts of changes in discount rate, Price of substitute, Stock, MEC, and Demand, Extraction under Monopoly, Negative externality, Effect of Price Ceiling, Effect of Recycling  
**Assignment #2 due on Sep 20 (mathematically derive and interpret the equilibrium condition of Hotelling model and describe with the help of a graph the effect on price path from any one case of a change in parameter or market failure discussed in the following reading):**  
**The Economics of Resources or the Resources of Economics, by Robert Solow** (from American Economic Review, vol. 64, no.2, May 1974, pp. 1-14; or from Economics of the Environment, Selected Readings, 3<sup>rd</sup> edition, edited by R. Dorfman and N. Dorfman, W.W. Norton & Company, New York, 1993, pp.162-178)

**Exam 1 on the above materials on September 25, 2006, Monday**

4. Equi-Marginal Principle of Allocating Surface Water and Benefit-Cost Analysis (Sep 27, 29, Oct 2, 4)  
 Safe Yield Use Principle of maintaining water table in aquifers, optimal rate of depletion of aquifers  
 Equi-marginal principle of allocating surface water – mathematical derivation, scarcity rent of water, marginal user cost, and marginal cost pricing of water  
 Benefit-cost analysis of water development projects – B/C ratio, NPV, IRR, incremental analysis  
**Assignment #3 due on Oct 6 (mathematically derive the equi-marginal principle and interpret)**
5. Timber Harvesting Model (Oct 6, 9, 11, 13)  
 Growth characteristics of timber, stumpage value, Net present value from timber harvesting, the MAI rule of harvesting  
 Optimal timber harvesting period (single crop vs. infinite cycles of rotation) – mathematical derivation and interpretations  
**Assignment #4 due on Oct 16 (mathematically derive and interpret the single crop timber harvesting rule and discuss the change in this rule when infinite rotation is allowed)**
6. Fishery Sustainable Yield Model (Oct 16, 18, 20, 23)  
 Fishery growth characteristics, Minimum threshold stock, Maximum sustainable stock, Physical relationship between stock and yield, Concept of Maximum Sustainable Yield (MSY)  
 Economic model (graphical presentation) – assumptions, fishing effort, relationship between fishing effort and sustainable yield, Revenue and Cost graph, Optimum sustainable stock and yield, interpretations  
**Assignment #5 due on Oct 25 (clearly draw the graphical model, label the axes, show the optimum sustainable harvesting point, and interpret)**
7. Use versus Non-use values of resources and measurement techniques (Oct 25, 27, 30)  
 Basis for Option, Discovery and Existence Values: Uncertainty, Lack of Information and Possible Irreversible Consequences (Measures of Caution)  
 Reasons for Higher Value of Resources in Future: Asymmetry of Technological Progress and Inability of technology to reproduce unique resources (supply side reason) and Changing Preferences in Favor of Natural Resources – learning by doing (demand side reason)  
 Non-human value – the difference between economic value and environmental value  
**Assignment #6 due on Nov 1 (write a summary of the following reading):**  
**Economic Assessment of Biodiversity and Protected Species, from Environmental Economics, Theory, Application, and Policy, by Duane Chapman, Addison Wesley Longman, 2000, pp. 273-281**

**Exam 2 on the above materials on November 1, 2006, Wednesday**

8. Discussion on Energy Resources (Nov 3, 6, 8)  
**Assignment #7 due on Nov 3 (write a summary of the following reading):**  
**Energy Resources - Cornucopia or Empty Barrel? by Peter McCabe, the American Association of Petroleum Geologists, 1998**  
 Warehouse concept of reserves, Resource Pyramid, Closed model and Open model, Theoretical production and price trends  
**Presentation by students on recent trend of oil prices, reasons, and interpretations on Nov 8**

9. Discussion on Municipal water scarcity (Nov 10, 13, 15)  
**Assignment #8 due on March 20 (write a summary of the following two readings):**  
 (a) **Is Water Different?** by R. Miller, D. Benjamin, and D. North, from **The Economics of Public Issues**, by the same authors, 10<sup>th</sup> edition, 1996, pp. 37-41  
 (b) **Economic Analysis of Groundwater Use in Douglas County**, by Paul Flack, 2005  
 Average cost pricing vs. marginal cost pricing, Practice of tap fees, Price vs. watering restrictions for conservation of water  
**Presentation by students on water rights markets on Nov 15**
10. Discussion on Forestry Resources (Nov 17, 27, 29)  
**Assignment #9 due on April 5 (write a summary of the following reading):**  
**Free Market Forestry**, by Mark Muro, from the **Denver Rocky Mountain News**, Sunday, June 1, 1997, pp. 1B  
 Below-cost timber sales, allowing participation of environmental activist organizations in bidding for clear-cutting of forests, roadless forest initiative, forest services strategic plan 2004-2008  
**Presentation by students on roadless forest initiative on Nov 29**
11. Discussion on Problems of Open Access (Dec 1, 4, 6)  
**Assignment #10 due on April 12 (write a summary of the following two readings):**  
 (a) **Individual Fishing Quotas**, by Lauren Fluken, 2005  
 (b) **Economic Incentives and Poaching of the One-Horned Indian Rhinoceros in Nepal**, from the **Poverty Reduction and Environmental Management No. 1**, Jan 2005  
 Coase theorem, applicability, issues with privatization, alternative ways of resolving open access problem  
**Presentation by students on Issues with Privatization on Dec 8**
12. Population, Environment, Trends of Resource Scarcity, and Sustainability (Dec 8, 11, 13, 15)  
 Neo-Malthusian Perspective on Population, Economic model of family size, Modern theory of demographic transition, Mutual relationship between economic growth and population growth, Ecological perspectives and Ecological Economics  
 Trends of Economic Scarcity – Price, marginal extraction cost, and rent, Factors Mitigating Scarcity, Findings in the literature  
**Assignment #11 due on Dec 11 (write a summary of the following reading):**  
**Trend of Natural Resource Commodity Prices**, by Margaret Slade, from **Journal of Environmental Economics and Management**  
 John Rawl's sustainability principle of nondeclining welfare, Solow-Hartwick sustainability rule of nondeclining capital, Issue of Substitutability of Natural Capital with Manmade Capital, Weak Measure of Sustainable Development, Strong Measure of Sustainable Development, Empirical Findings on Sustainable Development in Selected Countries, Safe Minimum Standard of Use (SMS), Daly's Steady-State Principles  
**Assignment #12 due on Dec 15 (write a summary of the following reading):**  
**Sustainability - An Economist's Perspective**, by Robert Solow, from **Economics of the Environment, Selected Readings**, 3<sup>rd</sup> edition, edited by R. Dorfman and N. Dorfman, W.W. Norton & company, 1993, pp. 179-187

**Exam 3 (cumulative): December 20, 2006, Wednesday, 1:30 p.m.**

#### **Accommodations for Students with Documented Disability**

If you qualify for accommodations because of a disability, please submit a letter to me from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact 303-492-8671, Willard 322, or [www.Colorado.EDU/disabilityservices](http://www.Colorado.EDU/disabilityservices).

#### **Absences due to Religious Observances**

Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. If you have any such conflict, please inform the instructor at least two weeks in advance to make a reasonable arrangement or adjustment according to the University policy, which can be seen at [http://www.colorado.edu/policies/fac\\_relig.html](http://www.colorado.edu/policies/fac_relig.html).

**Classroom Behavior Policy**

Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which students express opinions. See policies at <http://www.colorado.edu/policies/classbehavior.html> and at [http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student\\_code](http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code).

**Honor Code**

All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council ([honor@colorado.edu](mailto:honor@colorado.edu); 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Additional information on the Honor Code can be found at <http://www.colorado.edu/policies/honor.html> and at <http://www.colorado.edu/academic/honorcode>.