昆山杜克大学
DUKE KUNSHAN UNIVERSITY

SUBJECT AND COURSE NO.

Ecosystems, Resource Management and Sustainability

ENVIRON 590K; Fall 2016

Dates / contact hours:	300 contact minutes per week for seven weeks
Academic Credit:	1 course
Areas of Knowledge:	NS (Natural Sciences)
Modes of Inquiry:	STS (Science, Technology, & Society)
Course format:	lecture and discussion sections, student team-based analyses of regional resource management in critical areas of Asia, learning modules based on text excerpts and videos, oral and poster presentations

Instructor's Information

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Prerequisite(s)

None; the course is planned to accommodate students with diverse backgrounds

Course Description

The natural resources of our biosphere are used by MAN to obtain what are termed ecosystem services. With global change during the anthropocene (e.g., during our recent past where MAN has become the factor which dominates functioning of our ecosystems), over-exploitation of ecosystem services threatens the long-term sustainable use of our natural resource heritage. Thus, environmental scientists attempt to explain how resource management in complex social-ecological-systems (SESs – systems governed simultaneously by natural processes but also human social interactions) can be understood and can be carried out within a sustainable framework.

This course focuses, on the one hand, on theoretical principles related to key competencies required in order to carry out problem-solving in social-ecological systems (SESs). The first of these, system thinking competence, relates to achieving understanding of the SES under study (information on ecosystem function along with sensitivities and knowledge about the influences of social system drivers). Anticipatory competence refers to developing the ability to examine future alternatives with a variety of established and newly developing approaches. Strategic competence involves the selection of a vision for success, considering potentials but also societal norms and social preferences, and establishing a roadmap for accomplishing desired goals via backcasting, i.e., identification of strategic steps and actions that will move

the SES toward desired goals. Further essential is the communication of this roadmap along with alternative measures and consequences to those involved in governance.

The second very important focus of the course is on so-called LEARNING BY DOING. Comprehending the complexities related to resource management in regional studies requires insight with respect to historical trajectories of change, ecological processes at different scales, the competing interests of local actors or stakeholders, management concepts and initiatives of government agencies, and potentials in flexibility that will determine future change. These are different and also difficult to comprehend for every regional system. In this course, student teams (4 to 6 persons) will investigate these dimensions for selected regional Asian SESs, will attempt to establish suggested guidelines for future management, and will report on their findings in oral and poster presentations. The following questions, for example, might provide themes for examinations by the student groups: 1) What social and natural science driving factors have determined historical management decisions and the trajectory of change in South-North water transfers and links in China? 2) What is the vision for potential agricultural production from a „restored" arid loess plateau region in China; how might it be complemented and implemented? 3) What international differences and desires among stakeholders in the Greater Mekong Subregion impact cross-border exchanges as well as the local ecosystem services in specific countries? 4) How can one optimally manage ecosystem services from the tropical resort paradise of Hainan Island? Alternatively, the groups themselves will define a regional management theme of common interest and study the identified SES together.

Course Goals and Objectives

The objectives of this course are to develop students' ability to:

- Appreciate the complex interactions between natural and man-determined drivers of global change that impact our lives
- Understand the links between regional social-ecological-system (SES) descriptions, methods for projecting future trends in ecosystem services, and communication with management agencies
- Relate in terms of complex interactions the factors influencing the gain in ecosystem services in a regional social-ecological system (student group project with individual contributions)
- Effectively present the ideas of the regional resource management projects in text (poster) and oral forms

Students must understand basic concepts from the assigned text chapters; read, comprehend, and evaluate literature which is provided along with lectures; integrate material from different sources and think synthetically; and present material clearly in oral and written formats.

Required Text Resources

Reading assignments and discussion materials will be selected from the following references:

1. China's Environmental Challenges, 2016 Second Edition, Judith Shapiro, Polity Press, Malden, Maine, pp. 228
2. Principles of Ecosystem Stewardship, 2009, F. Stuart Chapin III, Gary Kofinas and Carl Folke eds., Springer Science+Business Media, LLC, 233 Spring Street, New York, pp. 401
3. China: Its Environment and History, 2012, Robert B. Marks, Rowman & Littlefield Publishers, Inc., Lanham, Maryland, pp. 438

Optional Resources Discussed in the Course

The content of these additional materials will be discussed as they relate to the basics of the course as learned during the first four weeks (see week 5 of the time schedule below).

1. The Ecosystem Approach, 2008, David Waltner-Toews, James Kay and Nina Listere eds. , Columbia University Press, New York, pp. 383
2. Plows, Plagues, and Petroleum: How Humans Took Control of Climate, 2005, William Ruddiman, Princeton University Press, Princeton, New Jersey, pp. 226
3. Aldo Leopold and the Ecological Conscience, 2002, Richard Knight and Suzanne Riedel eds., Oxford University Press, New York, pp. 190
4. The Human Impact on the Natural Environment: Past, Present and Future, 2013 7th Edition, Andrew Goudie, John Wiley & Sons, Inc., Chichester, U.K.
5. The Challenge for Africa, 2009, Wangari Maathai, Random House, Inc. (Anchor Books), New York, pp. 319
6. Integrating Hydrology, Ecosystem Dynamics, and Biogeochemistry in Complex Landscapes, 1999, John Tenhunen and Pavel Kabat eds., John Wiley and Sons Ltd, Chichester, England, pp. 367
7. Principles of Conservation Biology, 2006 Third Edition, Martha J. Groom, Gary K. Meffe, and C. Ronald Carroll, Sinauer Associates, Inc., Sunderland, Massachusetts, pp. 779
8. Asian Change in the Context of Global Climate Change: Impact of natural and anthropogenic changes in Asia on global biogeochemical cycles, 1998, James Galloway and Jerry Mellilo (eds.), Cambridge University Press, Cambridge, pp.363
9. Man's Role in Changing the Face of the Earth, 1956, William L. Thomas (ed.), Chicago University Press, Chicago, Illinois, pp. 1193
10. Publications of Issues in Ecology: http://www.esa.org/esa/science/issues/

Needed Materials

Laptops with Word, Powerpoint and Adobe Reader and for Internet Access

Course Requirements

1. On time attendance at lectures and discussions.
2. Participation in discussions which review weekly material and prepare for quizzes. Quizzes will focus on short answers or definitions that demonstrate knowledge of concepts and terminology discussed in the assigned chapters and as discussed in lectures.
3. Preparation of an outline related to an individual component of the student group projects – on the analysis of complex drivers for ecosystem services in a selected regional system, the trade-offs or management problems that arise, alternative management approaches, and recommended strategic management that will allow sustained achievement of selected services.
   There is no set formula for preparation of the individual projects, since every management problem is a special case. The main intention and important goal here is to encourage strongly each student to grapple with system complexity, competing interests and needs, and to work toward understanding trade-offs and compromises. In evaluating the results and success of

these projects (summarized in posters), the background of individuals will be considered, and the effort made in gaining a new systems view is the main issue of concern (also in grading of the projects).

4. Oral presentation of the individual project described above

Detailed rubrics for the individual projects explaining the expectations and technical considerations will be provided to students in agreement with the time schedule. Explanation of the assigned readings, assigned video viewing, and quiz procedures will be provided in weekly sessions.

Technology Considerations

Lecture slides and additional pdf materials will be distributed to students via Sakai. Laptops are required for assembling the final poster presentations.

Assessment Information and Grading

Grading will be based on a 100 point scale, where points are accumulated based on performance with respect to the following items (see also Time Schedule below):

Participation in Class Discussions	10%
2 Quizzes on Ecosystem and SES Concepts	30%
Protocols on Reading and Video Viewing	10%
Final Individual Poster Project	25%
Linking of Individual Poster with Posters of Study Group	10%
Presentation of Poster on Regional Resource Management	15%

Diversity and Intercultural Learning

The course is particularly suited to cultural diversity. Decisions with respect to management of social-ecological systems vary according to cultural preferences and practices. This will become apparent and will be illustrated in case studies that are discussed by myself and by the students. Selection of student projects that relate to their home environments will be encouraged, and the comparison of approaches and attitudes toward resource management taken by individuals coming from different geographic locations and backgrounds will enrich the experience of participants in this course.

Course Policies and Guidelines

Attendance is required at all sessions. Failure to attend must be justified with documentation.

Use of laptops for note taking and following the materials provided is encouraged. Surfing and use of cell phones during sessions is prohibited.

Duke University holds its students to the highest standards of academic integrity and honesty. Academic dishonesty of any kind is not tolerated and might result in failure of the assignment, and/or course, and/or expulsion from the university. Plagiarism on written assignments will result in a zero for the assignment and might result in further disciplinary action through the university. As a Duke student you pledge to uphold the Duke Community Standard:

- I will not lie, cheat, or steal in my academic endeavors;
- I will conduct myself honorably in all my endeavors; and
- I will act if the Standard is compromised.

For more information on academic integrity and the Duke Community Standard see:
http://judicial.studentaffairs.duke.edu/resources/community_standard/cs_more.html

Course Outline and Time Schedule

In addition to the following listing of topics and concepts with discussion during scheduled class time, optional review sessions will be offered once a week. These will be „open-ended", i.e., the discussion will continue until most persons are satisfied with their understanding.

Week 1 – 3 x 100 minutes (lectures and discussions)
Assignments for Independent Study: Selected pages from Shapiro text on "Drivers of Change"; Video viewing on ecosystem degradation and restoration (Loess Plateau, Tropical Forest in Rwanda, Desertification, etc.)
Main Focus: Ecosystem Components and the Provision of Ecosystem Services
Natural system dynamics (atmosphere, geosphere, biosphere) – What are ecosystems? – water cycle – carbon and nutrient cycles – evolution of diversity – disturbance regimes, thresholds and restoration– ecosystem services–systems thinking competence

Week 2 – 3 x 100 minutes (lectures and discussion; quiz on themes "Ecosystems and Drivers of Change")
Assignments for Independent Study: Selected pages from Chapin et al. for each individual student for terminology discussions
Main Focus: Understanding the Impacts of Global Change
MAN as an ecological factor – the Anthropocene – taking stock in the Millenium Assessment – categorizing ecosystem service outputs – livelihoods and human well-being – defining well being: material well-being – health – security – generating social support of ecosystem and resource stewardship
Historical environmental change in China – interrelationships in social-ecological systems – transdisciplinarity – terminology applied with respect to integrated social-ecological frameworks

Week 3 – 3 x 100 minutes (lectures and student-led discussions of terminology; group project planning)
Assignments for Independent Study: Selected pages from Shapiro text on "State-Led Environmentalism" and "Public Participation and Civil Society"
Main Focus: Ecosystem and Watershed Approaches to Regional Resource Management
the TERRECO regional study of resource management in Korea – a watershed-oriented SES framework – social-ecological drivers of change and time trajectories – trade-offs in services – spatial scales and

management – competing stakeholder interests – sustainability and sustainable management – resilience based stewardship

Initial Definition of Student Group Projects on Asian Case Studies to Foster Systems Thinking, Anticipatory Competence and Strategic Competence (see Course Description above) – initial choice of individual topics, election of a group coordinator, accessing source materials

Week 4 – 3 x 100 minutes (lectures and discussion; quiz on themes "Social-Ecological Systems and Integration Approaches"; internal discussion and review of the group projects)

Assignment for Independent Study: Selected pages from Shapiro text on "Environmental Justice and the Displacement of Environmental Harm"

Focus 1: Case Studies on the Challenges of Ecosystem and Resource Stewardship

Case study examinations by the instructor as permitted by time: subsistence agriculture, erosion, fuel wood and reforestation as competing needs in Nzoia River Basin Kenya, payments for forest improvement to maintain Hoa Binh watershed power production and water supply in Vietnam, high fertilization and plastic mulching practices in relation to crop production in Northern China

Focus 2: Developmental History of Resource Management Concepts

Historical resource management – past conservation orientation – protected parks, landscapes, biosphere reserves – short-term versus long-term goals – current global programs on sustainable resource management

Week 5 - 3 x 100 minutes (reports on final themes and topic selections from the group project coordinators; overview presentation about the optional resource materials and important literature sources; lectures and discussions)

Assignments for Independent Study: Selected pages from Shapiro text on "The BIG Picture" and "Prospects for the Future"; Video viewing of Al Gore presentation "The case for optimism on climate change"

Main Focus: Conceptualizing and Implementing Ecosystem and Resource Stewardship

Approaches to social-ecological governance – anticipatory and strategic competence – backcasting – challenges in transformation of governance systems (pitfalls, their recognition and required management strategies) – role of communication across disciplines and community sectors – conflict resolution - examples of successful co-management – normative competence

Week 6 – 3 x 100 minutes (workshop format - review and discussion of individual student projects and preparation of posters)

Week 7 – 3 x 100 minutes (student presentations of case studies with discussions as final exam)

Main Focus: Case Studies on the Challenges of Ecosystem and Resource Stewardship (Developing Interpersonal Competence)

Case study examinations by students (structured depending on number) on regional resource management

Oral presentations of poster materials and discussion in a seminar context

Appendix

Ecosystems, Resource Management and Sustainability

The need to recognize the significance of *Man* as an ecological factor and to link management of natural ecosystems with those modified by *Man* has been an issue in ecosystem science for more than half a century (Currie 2011). But the study of social systems has not become an integrated component of training in ecology and environmental sciences. Davidson-Hunt and Berkes (2003) summarize the state of affairs in the following way:

"With the Age of Enlightenment humans were extracted from the environment. The separation of nature and society became a foundational principle of Western thought and provided the organizational structure for academic departments. Since that time, Western thought has oscillated between positions in which nature and society were treated as distinct entities, and one in which articulations between the two were examined."

Nevertheless, studies carried out during the first global program in ecosystem science, the International Biological Program (IBP), clearly demonstrated the increasing pervasiveness of human impacts. In summarizing results from IBP studies, Eugene Odum (1969) stated that:

"*until recently mankind has more or less taken for granted the gas-exchange, water-purification, nutrient-cycling, and other protective functions of self-maintaining ecosystems, chiefly because neither his numbers nor his environmental manipulations have been great enough to affect regional and global balances."*

Further, he proposed that:

"society needs, and must find as quickly as possible a way to deal with the landscape as a whole, so that manipulative skills (that is, technology) will not run too far ahead of our understanding of the impact of change."

With perceptive foresight, Aldo Leopold wrote in Berlin in 1935 (see Knight and Riedel 2002) that:

"One of the anomalies of modern ecology is the creation of two groups, each of which seems barely aware of the existence of the other. One studies the human community, almost as if it were a separate entity, and calls its findings sociology, economics and history. The other studies the plant and animal community and comfortably relegates the hodge-podge of politics to the liberal arts. The inevitable fusion of these two lines of thought will constitute the outstanding advance of the . . . . century."

While the fusion did not occur in the 20th century, it is clear that developments in ecosystem science are currently leading to such a change (Waltner-Toews et al. 2008, Currie 2011, Carpenter et al. 2012). Within this trend, a new structuring of education is needed.

The course on Ecosystems, Resource Management and Sustainability is viewed as a contribution to this much broader international effort. The components included in this course are illustrated in Figure 1. The diagram is modified from Waltner-Toews and Kay (2005). Three foci may be recognized in the figure: 1) a quantification of the social-ecological-system under study, 2) the study of scenario outputs via visioneering and backcasting, and 3) communication of the resulting information to governing institutions with the intent to promote adaptive monitoring and management. Critical competencies (green ovals, Wiek et al. 2011) will be examined with respect to these three foci in a systematic manner. General examples of this

linkage between competencies and research will be elaborated on the basis of international case studies, which have been successful in completing the framework shown. A major component of the course is to involve students in group projects that require them to confront, examine and develop these key competencies.

The first of these, system thinking competence, relates to achieving understanding of the SES under study (information on ecosystem function along with sensitivities and knowledge about the influences of social system drivers). Anticipatory competence refers to developing the ability to examine future alternatives with a variety of established and newly developing approaches. Strategic competence involves the selection of a vision for success, considering potentials but also societal norms and social preferences, and establishing a roadmap for accomplishing desired goals via backcasting, i.e., identification of strategic steps and actions that will move the SES toward desired goals. Further essential is the communication of this roadmap along with alternative measures and consequences to those involved in governance. Normative competence addresses "key issues of sustainability including socio-ecological systems integrity, along with intra- and intergenerational equity."[1] It includes "concepts of justice, equity, social-ecological integrity, and ethics (e.g., to know which practices can be transformed or discarded and which must be maintained to sustain viability of life-supporting systems)." Thus, normative competence is related to a valuation of the overall problem, examining the current system and problems in terms of selecting justified compromises for long-term management. "Interpersonal competence is the ability to motivate, enable, and facilitate collaborative and participatory sustainability research and problem solving."[2] Communication skills and clarity of presenting options are abilities that vary with each individual, but which play a critical role in linking science to governance. It must be examined from the theoretical side in the course, as well as practiced in seminar presentations, and will hopefully be used by some students later in international conferences and in their chosen career.

Literature Cited

Carpenter SR, Folke C, Norström A, Olsson O, Schultz L, Agarwal B, Balvanera P, Campbell B, Castilla JC, Cramer W, DeFries R, Eyzaguirre P, Hughes TP, Polasky S, Sanusi Z, Scholes R, Spierenburg M 2012 Program on ecosystem change and society: an international research strategy for integrated social-ecological systems. Current Opinion in Environmental Sustainability 4:134-138

Currie WS 2011 Units of nature or processes across scales? The ecosystem concept at age 75. New Phytologist 10.1111/j.1469-8137.2011.03646.x

Davidson-Hunt IJ, Berkes F 2003 Nature and society through the lens of resilience: toward a human-in-ecosystem perspective. In: Berkes F, Colding J, Folke C eds, Navigating social-ecological systems – Building resilience for complexity and change. Cambridge University Press, Cambridge, UK, pp 53-82

Knight RL, Riedel S (eds) 2002 Aldo Leopold and the ecological conscience. Oxford University Press, Oxford, UK, pp 190

Odum E 1969 The strategy of ecosystem development. Science 164:262-270

Waltner-Toews D, Kay J 2005 The evolution of an ecosystem approach: the diamond schematic and an adaptive methodology for ecosystem sustainability and health. Ecology and Society 10(1):38

Waltner-Toews D, Kay J, Listner NE 2008 The ecosystem approach: complexity, uncertainty, and managing for sustainability. Columbia University Press

Wiek A, Withycombe L, Redman CL 2011 Key competencies in sustainability: a reference framework for academic program development. Sustainability Science 6:203-218

[1] Wiek et al. 2011, p. 209
[2] Wiek et al. 2011, p. 211

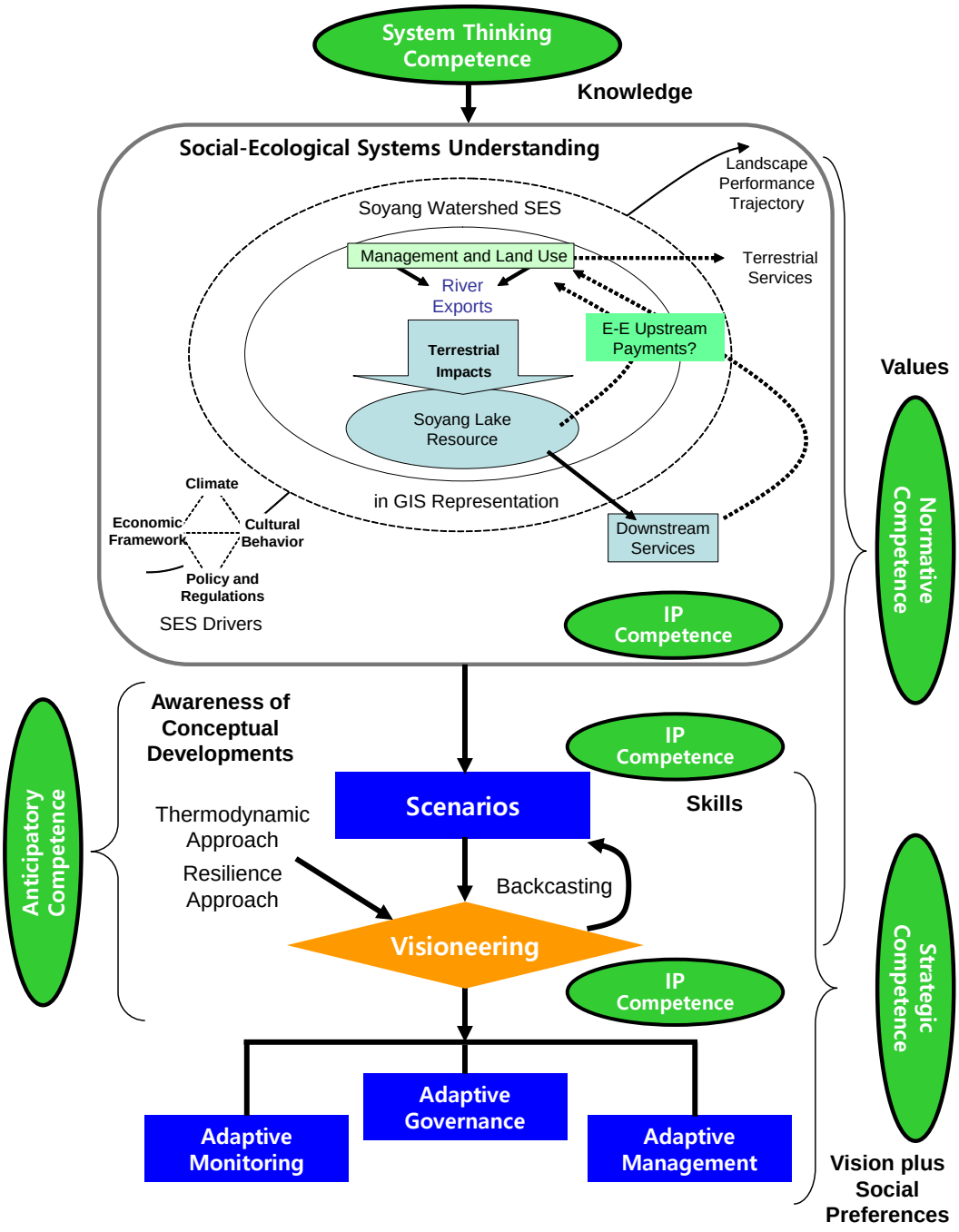

Figure 1. Components of the course "Ecosystems, Resource Management and Sustainability." Green ovals indicate the 5 key competencies that are required in sustainability research (Wiek et al. 2011). These key competencies are fundamental to an integrated research and problem-solving framework (*sensu* Waltner-Toews and Kay 2005). The SES shown is illustrated for Soyang Watershed in South Korea, but similar examples are available for Hoa Binh Watershed near Hanoi, Vietnam, and for Nzoia River Watershed in Western Kenya, and others. An important emphasis in the course will be on linking to governance by communicating strategic goals through visioneering. IP=Interpersonal.