THE UNIVERSITY OF BRITISH COLUMBIA

LWS/SOIL 517 - Land and Water Resources Evaluation

Instructor:

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127 – 2357 Main Mall
H.R. MacMillan Building

Winter Term 1
Credits: 3

Class Time: ***Mon Wed 9:00 – 10:30 am***

Room: MCML 358

Description

This course focuses on a "systems" approach to assessing and evaluating land and water resources. It provides guidance in critical reading, methods and approaches to assessing and interpreting information based on different values and governance systems. The aim is to provide students the opportunity to develop processes and experiences by which they can facilitate their academic disciplinary experience into a more holistic framework. The outcome will be to aid student learning on how to integrate academic information from across disciplines and focus that integration into credible arguments for effective oral and written communication.

Prerequisites and/or Co-requisites

Must be a graduate student enrolled in the MLWS or Soil Science programs. Other graduate or upper level undergraduate students, from similar programs at UBC, may take the course with permission from the instructors and, if deemed beneficial, an interview.

Course Structure

LWS/SOIL 517 is a lecture and discussion format offering, with lectures by course instructor or invited speaker to address a major theme, followed by a student-led discussion session.

There will be assigned readings posted in Canvas (www.canvas.ubc.ca) each week prior to the lectures (see course schedule below). The lectures will highlight a particular land and water issue or theme.

Learning Objectives

By the end of this course, learners will be able to:

- discuss different approaches to "systems" thinking in the land and water context,

- describe the land-water-energy nexus and its implications for natural resource management,
- ask the right questions to address science versus management challenges in land and water systems,
- evaluate a range of different information resources (ranging from biophysical to socioeconomic) through critical reading,
- understand the role of various levels of government regulations and how they interrelate in land and water management decision-making, and
- integrate academic information from across disciplines and focus it into a holistic framework to facilitate the development and delivery of credible arguments for assessing and evaluating land and water systems.

Course Expectations

Students are expected to attend all class sessions, complete their assignments on time and prepare and actively participate in class discussions. This will help to ensure your success in this course.

Student-Led Discussions

Discussion topics will be shared with the class, with associated questions. Student discussion groups of 3-5 students will be assigned to prepare a brief synopsis of the topic and present their responses to the class, followed by an open discussion.

The groups will have 20-30 minutes to discuss the topic. Each group will select a “chair” for the discussion, and every student will act as the chair (at least) once. The chair will provide a short (~5 minutes) report, summarizing their group’s responses to the discussion questions, followed by a class Q & A. It is anticipated that there will be 4-5 discussion group sessions in the term.

Each student will prepare a paragraph (~250-300 words) on their conclusions of the group and the class discussions. These will be submitted via Connect, no later than the beginning of the next class.

This will provide the experience of identifying and assessing critical concerns central to the understanding of, and effective communication regarding, the land and water system sector.

Evaluation Criteria and Grading

In-class participation, involvement in discussions, and effectiveness as the “chair” (Participation 25%, Chair 5%)	30%
Midterm exam – Short answer, in-class (60 minutes)	20%
Final Examination (take home) – (Term Paper - Systems Analysis on a land and water issue related to student’s interest)	50%

Academic Integrity

The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work.

Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

Course Schedule

* *May be subject to change without notice.*

Period	**Date**	**Unit**
Week 1	Sept 5	Review Syllabus, Connect & Introduction; Assign readings
Week 2	Sept 10, 12	Systems analysis, system dynamics, and adaptive systems
Week 3	Sept 17, 19	Historic themes, Evolution of human relations with the land (soil/water/ecology) Guest lecture
Week 4	Sept 24, 26	Guest lecture Guest lecture
Week 5	Oct 1, 3	**Oct. 1 - Student discussion #1 (Future discussions TBA)** Land-Water Nexus; Transdisciplinary and Interdisciplinary approaches to natural resource management
Week 6	Oct 8 *(Thanksgiving – no class)* Oct 10	Critical reading; interpreting role of science and societal values (traditional, cultural, economic) in management decisions
Week 7	Oct 15, 17	**Midterm Exam Oct. 17 (in class)**
Week 8	Oct 22, 24	Return and discuss midterm Asking the right questions; Role of science and management, processes of interpreting scientific "facts" to formulate understandable information
Week 9	Oct 29, 31	Understanding the objectives, assumptions and limitations of information on land-water systems – review various types of assessments and reports
Week 10	Nov 5, 7	Environmental Institutions – government vs. governance; jurisdictions and interpretations

Week 11	Nov 12 (*Remembrance Day stat holiday – no class*) Nov 14	Integrating indigenous and traditional knowledge in environmental decisions; community participation
Week 12	Nov 19, 21	Review of techniques in land and water resource evaluation: Remote sensing, GIS
Week 13	Nov 26, 28	Summary & Review **Final Examination (take home)**

Course Outline and Readings

**Reading required and will be assigned prior to class. Readings are posted in Canvas.*

1. **Introduction:**
   a. The land and water system as a holistic ecological system, reviewing Earth's resource cycles
   b. Introduction to systems analysis, system dynamics, and adaptive systems

   Readings:

   *Arnold, R.D. and J. P. Wade. 2015. A definition of systems thinking: A systems approach. *Proc. Comp. Sci.,* 44: 669-678.

   *Falkowski, P. et al. 2000. The global carbon cycle: a test of our knowledge of earth as a system. *Science,* 290(5490): 291–296.

   Kuchment, L.S. 2004. The hydrological cycle and human impact on it. *In* Arjen Y. Hoekstra, and Hubert H.G. Savenije, Eds. *Encyclopedia of Life Support Systems (EOLSS)*. Developed under the Auspices of the UNESCO, Oxford: UK.

   Lewis, H., D. Macgregor and H.M. Jones. 2006. Critical Reading. https://www.york.ac.uk/media/biology/documents/careers/critical_reading_handout.pdf

   Stern, P.C. 2005. Deliberate methods for understanding environmental systems. *Biosciences*, 55: 976-982.

2. **Historic and emergent themes:**
   a. Evolution of human relations with the land (soil/water/ecology) based on different value systems
   b. Emergent concepts and challenges

   Readings:

   Barbier, E.B. 1989. The contribution of environmental and resource economics to the economics of sustainable development. *Development and Change (SAGE)*, 20: 429-459.

   *Callicott, J.B. 1987. The conceptual foundations of the land ethic. Companion to a Sand County Almanac, Madison Wisc. Press.

   Flood, R.L. 2010. The relationship of 'systems thinking' to action research. *Syst Pract Action Res*, 23: 269-284.

   *Hardin, G. 1968. The tragedy of the commons. *Science,* 162: 1243-1248.

Leopold, A. 1948. Ecocentrism: The land ethic. *A Sand County Almanac: And Essays on Conservation from Round River*. 119-126.

*Røpke, I. 2004. Analysis: The early history of modern ecological economics. Ecol. Econ. 50: 293-314.

*UN Permanent Forum on Indigenous Issues. (2007). Indigenous Peoples – Land Territories and Natural Resources. http://www.un.org/esa/socdev/unpfii/documents/6_session_factsheet1.pdf

* White, L. 1967. The historic roots of our ecological crisis. *Science,* 155: 1203-1207.

3. The land-water nexus:

a. Introduction of the “nexus” concept in human and environmental systems.
b. Transdisciplinary and interdisciplinary approaches to natural resource management.

Readings:

*Andrews-Speed, P., et al. 2012. The global resource nexus: the struggles for land, energy, food, water, and minerals. *Transatlantic Academy Publication.* pp. 1 – 13; 55-63.

Bazilian, M. et al. 2011. Considering the energy, water and food nexus: Towards an integrated modelling approach. *Energy Policy,* 39: 7896-7906.

*Polk. 2014. Achieving the promise of transdisciplinarity: A critical exploration of the relationship between transdisciplinary research and societal problem solving. *Sustain. Sci.,* 9: 439-451.

*Ringler, C., A. Bhaduri and R. Lawford. 2013. The nexus across water, energy, land and food (WELF): Potential for improved resource use efficiency. *Current Opin. Environ. Sustain.,* 5: 617-624.

4. The role of science and management:

a. Processes of interpreting scientific “facts” to formulate understandable information
b. Including critical reading, evaluation of information sources and the interpreting the role of societal values in understanding the land-water system and nexus

Readings:

*Bridgman, P. 1955. The operational character of scientific concepts. *The logic of modern physics*. Reprinted in Ch. 2, Boyd, R., P. Gasper and J.D. Trout (Eds.), *The Philosophy of Science.* A Bradforth Book, MIT Press, Cambridge: USA. pp. 57-69.

*Kleidon, A. and M. Renner. 2013. Thermodynamic limits of hydrologic cycling within the Earth system: concepts, estimates and implications. *Hydrol Earth Sci,* 17: 2873-2892.

*Ostrom, E. 2009. A general framework for analyzing sustainability of social-ecological systems. *Science*, 325: 419-422.

Partelow, S. 2015. Coevolving Ostrom’s socio-ecological systems (SES) framework and sustainability science: four key co-benefits. *Sustain. Sci.*, 11: 399-410.

Warren, W.A. 2005. Hierarchy theory in sociology, ecology and resource management: A conceptual model for natural resource or environmental sociology and socioecological systems. *Soc. Natur. Resour.,* 18: 447-466.

5. Asking the right questions:

a. Science vs management questions
b. The role of science in the management of resources

c. Citizen science

Readings:

*Berkes, F. and H. Ross. 2016. Panarchy and community resilience: Sustainability science and policy implications. *Enviro. Sci. Policy*, 61: 185-193.

Holling, C.S. 2001. Understanding the complexity of economic, ecological and social systems. Ecosystems 4: 390-405.

*Kirchner, J.W. 2006. Getting the right answers for the right reasons: Linking measurements, analyses, and models to advance the science of hydrology. *Water Resour. Res.,* 42, W03S04, doi:10.1029/2005WR004362.

*Riesch, H. and C. Potter. 2014. Citizen science as seen by scientists: Methodological, epistemological and ethical dimensions. *Public Understanding of Science,* 23: 107-120.

6. Understanding the objectives, assumptions and limitations of information on land-water systems:

a. Review various natural resources assessments and reports (i.e., geological, soil, ecological, hydrological, capability, suitability, vulnerability maps and disciplinary approaches)
b. Introduce methods of developing integrated information and evaluations

Readings:

*Dumanski, J., P.S. Bindraban, W.W. Pettapiece, P. Bullock, R.J.A. Jones and A. Thomasson. 2002. Land classification, sustainable land management and ecosystem health. Encyc. Life Support. Syst., Oxford: UK. EOLSS Publ.

FAO, 2007. Land evaluation: Towards a revised framework. Land and Water Discussion paper 6. Rome: Italy.

Guo, L. and H. Lin. 2016. Critical zone research and observatories: Current status and future perspectives. *Vadose Zone J.,* 15: 1-14.

*O'Neill, R.V. 2000. Ecosystems on the landscape: The role of space in ecosystem theory. In, Jorgensen, S.E. and F. Muller (Eds.), *Handbook of Ecosystem Theories and Management*. Lewis Publ., CRC Press, Boca Raton: USA. pp. 447-465.

7. Environmental institutions

a. Governance vs government
b. Federal, provincial, municipal jurisdictions and interpretations
c. Environmental risk assessment
d. Challenges for integrating indigenous and traditional knowledge

Readings:

*Black, K. and E. McBean. 2016. Increased indigenous participation in environmental decision making: A policy analysis for the improvement of indigenous health. *Intern. Indigenous Policy J.*, 7: 1-23.

Ellis, S.C. 2005. Meaningful consideration? A review of traditional knowledge in environmental decision making. *Arctic*, 58: 66-77.

*Snyder, L. 2015. Democratic governance: the Constitution and Canada's branches of government. Available from: http://www.lawnow.org/democratic-governance-the-constitution-and-canadas-branches-of-government

Plus abstracts or executive summaries of:

Canadian Environmental Protection Act, 1999. https://www.ec.gc.ca/lcpe-cepa/default.asp?lang=En&n=26A03BFA-1

Fisheries Act (Canada) – https://www.ec.gc.ca/pollution/default.asp?lang=En&n=072416B9-1

Agricultural Land Commission Act – http://www.alc.gov.bc.ca/alc/content/legislation-regulation/the-alc-act-and-alr-regulation

Water Sustainability Act (BC) – http://www2.gov.bc.ca/gov/content/environment/air-land-water/water/laws-rules/water-sustainability-act

Province of BC Environmental Protection & Sustainability Services http://www2.gov.bc.ca/gov/content/environment

8. **Review of techniques in land and water resource evaluation (advantages and limitations):**
    a. Remote sensing, inventories, mapping and Geographic Information Systems (GIS), simulation models

Readings (Foundational):

Berry, J.K. 1991. GIS in island resource planning: A case study in map analysis. Chapter 55

Martin, P.H. et al. 2005. Interfacing GIS with water resource models: A state-of-the-art review. *J. Am. Water Resour. Assoc.*, 41: 1471-1487.

Mason, M. 2017. Principles and applications of geographic information systems (GIS). http://www.environmentalscience.org/principles-applications-gis

*Munn, L.C. 1986. The Canada Land Inventory. In, F.T. Last et al., (Eds) *Land and its Uses - Actual and Potential*, Plenum Press. New York: USA. pp 391- 407.

*Woodcock, C., A.H. Strahler and J. Franklin. 1983. Remote sensing for land management and planning. *Environ. Mang't.,* 7: 223-237.

Wilson, J.P., H. Mitasova and D.J. Wright. 2000. Water resource applications of geographic information systems. *URISA Journ.*, 12: 61-79.

9. **Future directions and perceived needs and challenges for land and water resources evaluation.**

Additional References

Barbut, M. 2014. Land, water and people. Cascading effects to integrated flood and drought responses. UNCCD Secretariat, Rome, Italy.

Belgrano, A. and C.W. Fowler. 2008. Ecology for management: pattern-based policy. In S.I. Munoz (ed.). Ecology research progress, pp. 5–31. Nova Science Publishers, Hauppauge, NY.

Chapman, P.M. 2006. Determining when contamination is pollution – weight of evidence determinations for sediments and effluents. *Environ. Intern.* 33: 492-501.

Dumanski, J., W.W. Pettapiece, P. Bullock, R.J.A. Jones and A. Thomasson. 2002. Land classification, sustainable land management and ecosystem health. Encyc. Life Support. Syst., Oxford: UK. EOLSS Publ.

FAO. 1981. Land evaluation classifications. FAO Soils Bulletins 32, Rome: Italy.

Grant, W.E., E.K. Pedersen and S.L. Marin. Ecological modeling: systems analysis and simulation. In S.E. Jorgensen and F. Muller (Eds.), *Handbook of Ecosystem Theories and Management*. Lewis Publ. CRC Press, Boca Raton, USA. pp 103-112.

Howells, M. et al. 2013. Integrated analysis of climate change, energy and water strategies. *Nature Climate Change,* 3: 621-626.

Kirchner, J.W. 2006. Getting the right answers for the right reasons: linking measurements analyses and models to advance the science. *Water Res. Res*., 42: doi: 10.1029/2006JD008222.2007.

Lavkulich. L.M. 1980. Land - our threatened resource. In Nemetz, P.N. (Ed), Resource Policy: International Perspectives. J. Bus. Admin. 11: 265-276.

Vitousek, P.M., P.M. Ehrlich, A.H. Ehrlich and P.A. Matson, 1986. Human appropriation of the products of photosynthesis. *BioScience*, 34: 368-373.

Warren, W.A. 2005. Hierarchy theory in sociology, ecology and resources management: A conceptual model for natural resources or environmental systems. *Soc. Natur. Resour.,* 18: 447-466.

Wohlwend, B.J. 2001. Equitable utilization and the allocation of water rights to shared water resources. http://www.bjwconsult.com