THE UNIVERSITY OF BRITISH COLUMBIA

Master of Land and Water Systems
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LWS/SOIL 517 - Land and Water Resources Evaluation

Instructors:

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Winter Term 1, 3 credits

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.

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 reading each week prior to the lectures (see course schedule below). The lectures will highlight a particular land and water issue or theme.

Student discussion groups of 3-5 students will be assigned to prepare a brief synopsis of the issue and present their assessment, conclusions and recommendations to the class (~15 minutes), followed by an open discussion. It is anticipated that there will be 3-4 discussion group sessions per term. Each group will select their "chair" for the discussion, and every student will act as the chair at least once. 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 sectors.

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.

Evaluation Criteria and Grading

In-class participation, including reasonable attendance, involvement in discussions, and effectiveness as the "chair" (Participation 15%, Chair 5%)	20%
Assignments – Four short critical reviews (5% each)	20%
Term Paper - Systems Analysis on a land and water issue related to student's program	20%
Final Examination	40%

*Reading strongly encouraged prior to class.

Course Outline

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.

    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)
    b. Emergent concepts and challenges

Readings:

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

Flood, R.L. 2001. The relationship of systems thinking to action research. In, Reason, P. and H. Bradley (Eds.), *Handbook of Action Research: Participation, Inquiry and Practice.* Sage Publ., London: UK. pp. 133-144.

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

Leopold, Aldo, 1948. A Sand County Almanac. A Discussion Gude. 3-23.

* White, Lynn, 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.*

Brazilian, M. et al. 2011. Considering the energy, water and food nexus: towards an integrated modeling 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. 1985. The logic of modern physics. In, 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. 2016. 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 resources management: A conceptual model for natural resources or environmental 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: inking measurements analysis and models to advance the science. Water Res.42 doi:10.1029/2006JD008222.207

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

6. **Understanding the objectives, assumptions and limitations of published 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:

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

Guo, Li and Henry 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. In S.E. Jorgensen 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 traditional knowledge

Readings:

*Black, Kerry and Edward 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, Stephen 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 – https://www.ec.gc.ca/pollution/default.asp?=En&n-072416B9-1

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

Environmental Protection & Sustainability – http://www2.gov.bc.ca/gov/content/environment

Water Sustainability Act – http://www2.gov.bc.ca/gov/content/environment/air-land-water/laws-rules/water-sust

8. **Techniques in land and water systems evaluation:**
    a. Remote sensing, mapping and Geographic Information Systems (GIS), simulation models

Readings:

*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.

9. **Examples of successes and failures of land water programs, their environmental, ecological and human impacts**
    a. Example of an applied framework: Stephens, K.A. 2016. Sustainable Watershed Systems: primer on application of ecosystem-based understanding in the Georgia Basin. The Partnership for Water Sustainability in BC.
    b. Others to be selected in class.

10. **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.

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