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## CE 898.3

### Contemporary Topics at the Interface of Food and Water Security

Department of Civil, Geological, and Environmental Engineering  
T2 2024-2025

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#### Land Acknowledgement

I would like to acknowledge that the Saskatoon campus of the University of Saskatchewan is on *Treaty Six Territory* and the *Homeland of the Métis*. We pay our respect to the First Nation and Métis ancestors of this place and reaffirm our relationship with one another. I would also like to recognize that some may be attending this course from other traditional Indigenous lands, and as part of the field trip, we will be visiting other traditional Indigenous lands. I ask that you take a moment to make your own Land Acknowledgement to the peoples of those lands. In doing so, we are actively participating in reconciliation as we navigate our time in this course, learning and supporting each other.

**Instructor:** Warren Helgason, Ph.D., P.Eng.  
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**Office Hours:** by appointment

**Course Delivery:** This course will be delivered as a hybrid synchronous in-person and online lectures & discussion periods. Group meetings will be Tuesdays 1:30-4:30 PM. Location 2C18 Engineering.

**Website:** <https://canvas.usask.ca/>

**Textbook:** N/A – all required background reading materials will be provided to the students.

**Assessment:** Participation (20%)  
Paper review submissions (60%)  
Leadership in group discussion (20%)

#### Prerequisites:

- Restricted\*\* to MSc and PhD students formally enrolled in the FWNET CREATE program. This is a mandatory training component which must be completed in the 1<sup>st</sup> or 2<sup>nd</sup> year of training.
- \*\* Students not formally enrolled in the FWNET program may be admitted under special circumstances. Permission from the instructor is required.

#### Enrollment Limit:

- Enrollment is limited to 10 students.

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## Course Description:

The purpose of this course is to introduce students in the Food-Water Nexus Education and Training (FWNET) program to relevant issues, challenges, and opportunities at the intersection of food and water security. The course examines, through a contemporary lens, examples of water development projects in Western North America, highlighting success and failures. Students are exposed to modern techniques for evaluating the sustainability of global food production systems. Major topics examined include: climate change, nutrient stewardship, production efficiencies, economics, and human nutrition and health.

## Course Content:

### Class Schedule

Date	Topic & Reading List
<b>Weeks 1-3</b> <b>(Jan 6-24)</b>	<b>Sustainability of irrigation water development projects &amp; competing water demands</b> Else, J., & Harrar, L. (Directors). (1997). <i>Cadillac Desert</i> [Film]. KTEH/San Jose; Trans Pacific Television. Borsato, E., Rosa, L., Marinello, F., Tarolli, P., & D'Odorico, P. (2020). Weak and Strong Sustainability of Irrigation: A Framework for Irrigation Practices Under Limited Water Availability. <i>Frontiers in Sustainable Food Systems</i> , 4, 17. <a href="https://doi.org/10.3389/fsufs.2020.00017">https://doi.org/10.3389/fsufs.2020.00017</a> Hsiao, T. C., Steduto, P., & Fereres, E. (2007). A systematic and quantitative approach to improve water use efficiency in agriculture. <i>Irrigation Science</i> , 25(3), 209–231. <a href="https://doi.org/10.1007/s00271-007-0063-2">https://doi.org/10.1007/s00271-007-0063-2</a> Grafton, R. Q., Williams, J., Perry, C. J., Molle, F., Ringler, C., Steduto, P., Udall, B., Wheeler, S. A., Wang, Y., Garrick, D., & Allen, R. G. (2018). The paradox of irrigation efficiency. <i>Science</i> , 361(6404), 748–750. <a href="https://doi.org/10.1126/science.aat9314">https://doi.org/10.1126/science.aat9314</a>
<b>Week 4</b> <b>(Jan 27-31)</b>	<b>Virtual water and water footprints of agricultural goods</b> Mialyk, O., Schyns, J. F., Booij, M. J., Su, H., Hogeboom, R. J., & Berger, M. (2024). Water footprints and crop water use of 175 individual crops for 1990–2019 simulated with a global crop model. <i>Scientific Data</i> , 11(1), 206. <a href="https://doi.org/10.1038/s41597-024-03051-3">https://doi.org/10.1038/s41597-024-03051-3</a> Hoekstra, A. Y., & Mekonnen, M. M. (2012). The water footprint of humanity. <i>Proceedings of the National Academy of Sciences</i> , 109(9), 3232–3237. <a href="https://doi.org/10.1073/pnas.1109936109">https://doi.org/10.1073/pnas.1109936109</a> Hoekstra, A. Y., & Hung, P. Q. (2005). Globalisation of water resources: International virtual water flows in relation to crop trade. <i>Global Environmental Change</i> , 15(1), 45–56. <a href="https://doi.org/10.1016/j.gloenvcha.2004.06.004">https://doi.org/10.1016/j.gloenvcha.2004.06.004</a>
<b>Weeks 5-6</b> <b>(Feb 3-14)</b>	<b>Climate change effects upon agriculture</b> Filho, W. L., Setti, A. F. F., Azeiteiro, U. M., Lokupitiya, E., Donkor, F. K., Etim, N. N., Matandirotya, N., Olooto, F. M., Sharifi, A., Nagy, G. J., & Djekic, I. (2022). An overview of the interactions between food production and climate change. <i>Science of The Total Environment</i> , 838, 156438. <a href="https://doi.org/10.1016/j.scitotenv.2022.156438">https://doi.org/10.1016/j.scitotenv.2022.156438</a> Elliott, J., Deryng, D., Müller, C., Frieler, K., Konzmann, M., Gerten, D., Glotter, M., Flörke, M., Wada, Y., Best, N., Eisner, S., Fekete, B. M., Folberth, C., Foster, I., Gosling, S. N., Haddeland, I., Khabarov, N., Ludwig, F., Masaki, Y., ... Wisser, D. (2014). Constraints and potentials of future irrigation water availability on agricultural production under climate change. <i>Proceedings of the National Academy of Sciences of the United States of America</i> , 111(9), 3239–3244. <a href="https://doi.org/10.1073/pnas.1222474110">https://doi.org/10.1073/pnas.1222474110</a>

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Gregory, P. J, Ingram, J. S. I, & Brklacich, M. (2005). Climate change and food security. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360(1463), 2139–2148. <https://doi.org/10.1098/rstb.2005.1745>

**Week 7**

**(Feb 17-21)**

**Mid-term break – no classes**

**Week 8-9**

**(Feb 24-Mar 7)**

**Stewardship of agricultural nutrients and chemicals**

Bijay-Singh, & Craswell, E. (2021). Fertilizers and nitrate pollution of surface and ground water: An increasingly pervasive global problem. *SN Applied Sciences*, 3(4), 518. <https://doi.org/10.1007/s42452-021-04521-8>

Lintern, A., McPhillips, L., Winfrey, B., Duncan, J., & Grady, C. (2020). Best Management Practices for Diffuse Nutrient Pollution: Wicked Problems Across Urban and Agricultural Watersheds. *Environmental Science & Technology*, 54(15), 9159–9174. <https://doi.org/10.1021/acs.est.9b07511>

Tang, F. H. M., Lenzen, M., McBratney, A., & Maggi, F. (2021). Risk of pesticide pollution at the global scale. *Nature Geoscience*, 14(4), 206–210. <https://doi.org/10.1038/s41561-021-00712-5>

**Week 10-11**

**(Mar 10-21)**

**Health impacts of water and food insecurity**

Raiten, D. J., & Aimone, A. M. (2017). The intersection of climate/environment, food, nutrition and health: Crisis and opportunity. *Current Opinion in Biotechnology*, 44, 52–62. <https://doi.org/10.1016/j.copbio.2016.10.006>

Miller, J. D., Workman, C. L., Panchang, S. V., Sneegas, G., Adams, E. A., Young, S. L., & Thompson, A. L. (2021). Water Security and Nutrition: Current Knowledge and Research Opportunities. *Advances in Nutrition*, 12(6), 2525–2539. <https://doi.org/10.1093/advances/nmab075>

Young, S. L., Bethancourt, H. J., Cafiero, C., Gaitán-Rossi, P., Koo-Oshima, S., McDonnell, R., Melgar-Quinonez, H., Neufeld, L. M., Oenema, S., Pérez-Escamilla, R., Viviani, S., & Frongillo, E. A. (2023). Acknowledging, measuring and acting on the importance of water for food and nutrition. *Nature Water*, 1(10), 825–828. <https://doi.org/10.1038/s44221-023-00146-w>

**Weeks 12-13**

**(Mar 24-Apr 4)**

**Economics of water-limited food production**

Arellano-Gonzalez, J., AghaKouchak, A., Levy, M. C., Qin, Y., Burney, J., Davis, S. J., & Moore, F. C. (2021). The adaptive benefits of agricultural water markets in California. *Environmental Research Letters*, 16(4), 044036. <https://doi.org/10.1088/1748-9326/abde5b>

Beltran-Peña, A., Rosa, L., & D’Odorico, P. (2020). Global food self-sufficiency in the 21st century under sustainable intensification of agriculture. *Environmental Research Letters*, 15(9), 095004. <https://doi.org/10.1088/1748-9326/ab9388>

D’Odorico, P., Chiarelli, D. D., Rosa, L., Bini, A., Zilberman, D., & Rulli, M. C. (2020). The global value of water in agriculture. *Proceedings of the National Academy of Sciences*, 117(36), 21985–21993. <https://doi.org/10.1073/pnas.2005835117>

Dolan, F., Lamontagne, J., Link, R., Hejazi, M., Reed, P., & Edmonds, J. (2021). Evaluating the economic impact of water scarcity in a changing world. *Nature Communications*, 12(1), 1915. <https://doi.org/10.1038/s41467-021-22194-0>

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**Learning Outcomes:**

At the end of this course, students will be able to:

- Demonstrate an awareness of issues that cause insecurity of food and water.

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- Describe the successes and failures of historical large-scale agricultural water projects in western North America and provide commentary on how modern approaches might result in a different outcome.
  - Explain how water is embodied in agricultural commodities, and how this relates to global food and water security.
  - Provide examples of how climate change might affect food production at local, regional, and global scales.
  - Provide examples of how environmental stewardship is related to food sustainability.
  - Articulate how their own research contributes to water and food security.

### **Assessment**

Students must receive a grade of 60% (master's students) or 70% (PhD students) to achieve a passing grade in this course.

**Participation (20%):** Students are expected to fully engage in the group discussion. Providing written and oral comments and viewpoints on reviewed material is expected.

**Leadership in group discussion (20%):** Each student will be expected to organize and lead one group discussion.

**Independent literature synthesis (60%):** For each of the 6 main topics in the course, students will be expected to provide a concise synthesis of a peer-reviewed journal article of their choice. The students will reflect on the quality of the research, how the ideas presented fit into the food-water nexus and articulate their own viewpoints about how these ideas relate to contemporary sustainability issues.

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The following describes the relationship between literal descriptors and percentage scores for courses in the College of Graduate Studies and Research:

### **90-100 Exceptional**

A superior performance with consistent strong evidence of

- a comprehensive, incisive grasp of subject matter;
- an ability to make insightful, critical evaluation of information;
- an exceptional capacity for original, creative and/or logical thinking;
- an exceptional ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently;
- an exceptional ability to analyze and solve difficult problems related to subject matter.

### **80-89 Very Good to Excellent**

A very good to excellent performance with strong evidence of

- a comprehensive grasp of subject matter;
- an ability to make sound critical evaluation of information;
- a very good to excellent capacity for original, creative and/or logical thinking;
- a very good to excellent ability to organize, to analyze, to synthesize, to integrate ideas, and to express thoughts fluently;
- a very good to excellent ability to analyze and solve difficult problems related to subject matter.

### **70-79 Satisfactory to Good**

A satisfactory to good performance with evidence of

- a substantial knowledge of subject matter;
- a satisfactory to good understanding of the relevant issues and satisfactory to good familiarity with the relevant literature and technology;
- a satisfactory to good capacity for logical thinking;
- some capacity for original and creative thinking;
- a satisfactory to good ability to organize, to analyze, and to examine the subject matter in a critical and constructive manner;
- a satisfactory to good ability to analyze and solve moderately difficult problems.

### **60-69 Poor**

A generally weak performance, but with some evidence of

- a basic grasp of the subject matter;
- some understanding of the basic issues;
- some familiarity with the relevant literature and techniques;
- some ability to develop solutions to moderately difficult problems related to the subject matter;
- some ability to examine the material in a critical and analytical manner.

### **<60 Failure**

An unacceptable performance.

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## Academic Dishonesty and Academic Appeals:

### **Policies on Academic Dishonesty, Academic Appeals and Course Delivery:**

Although the face of teaching and learning has changed due to covid-19, the rules and principles governing academic integrity remain the same. If you ever have questions about what may or may not be permitted, ask your instructor. Students have found it especially important to clarify rules related to exams administered remotely and to follow these carefully and completely.

Students are expected to undertake all aspects of their academic work in an ethical manner. Students are expected to submit their own individual work for academic credit, properly cite the work of others, and to follow all rules for examinations. Academic misconduct, plagiarism, and cheating will not be tolerated. Students are responsible for understanding the university's policies on academic integrity and academic misconduct. If any form of academic misconduct is discovered, appropriate disciplinary action will be taken.

For more information on what constitutes academic misconduct, please consult the University Council *Regulations on Student Academic Misconduct* (<https://secretariat.usask.ca/student-conduct-appeals/academic-misconduct.php>) as well as the Standard of Student Conduct in Non-Academic Matters and Procedures for Resolution of Complaints & Appeals (<https://secretariat.usask.ca/student-conduct-appeals/non-academic-misconduct.php>).

For information regarding appeals of a final grade or other academic matters, please consult the University Council document on *Student Appeals of Evaluation, Grading and Academic Standing* (<http://policies.usask.ca/policies/student-affairs-and-activities/student-appeals.php>).

Additional policies and procedures related to student conduct and appeals are provided on the University Secretariat website ([www.usask.ca/secretariat/student-conduct-appeals](http://www.usask.ca/secretariat/student-conduct-appeals)) and on the University website <http://www.usask.ca/integrity/>.

A summary of University of Saskatchewan policies relating to academic courses is provided in the document: *Academic Courses Policy on Class Delivery, Examinations, and Assessment of Student Learning* (<http://policies.usask.ca/policies/academic-affairs/academic-courses.php>).

### **Integrity Defined (from the Office of the University Secretary)**

The University of Saskatchewan is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect. Students are particularly urged to familiarize themselves with the provisions of the Student Conduct & Appeals section of the University Secretary Website and avoid any behavior that could potentially result in suspicions of cheating, plagiarism, misrepresentation of facts and/or participation in an offence. Academic dishonesty is a serious offence and can result in suspension or expulsion from the University.

For more information on what academic integrity means for students see the Academic Integrity section of the University Library Website at: <https://library.usask.ca/academic-integrity#Academicintegrity>

You are encouraged to complete the Academic Integrity Help session to understand the fundamental values of academic integrity and how to be a responsible scholar and member of the USask community - <https://library.usask.ca/academic-integrity.php#AcademicIntegrityHelp session>

### **Safety:**

Safety is of paramount importance. Students are expected to work in a safe and responsible manner, to follow all safety instructions, and use any specified personal protective equipment.

### **Recording Lectures:**

Video conference sessions in this course, including your participation, will be recorded and made available only to students in the course for viewing via Canvas/Blackboard after each session. This is done, in part, to

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ensure that students unable to join the session (due to, for example, issues with their internet connection) can view the session at a later time. This will also provide you the opportunity to review any material discussed.

Please remember that course recordings belong to your instructor, the University, and/or others (like a guest lecturer) depending on the circumstance of each session, and are protected by copyright. Do not download, copy, or share recordings without the explicit permission of the instructor.

For questions about recording and use of sessions in which you have participated, including any concerns related to your privacy, please contact your instructor. More information on class recordings can be found in the Academic Courses Policy <https://policies.usask.ca/policies/academic-affairs/academic-courses.php#5ClassRecordings>.

### **Copyright:**

Course materials are provided to students based on their registration in a class. Any materials created by course instructors is the intellectual property of the instructors. This includes exams, tests, PowerPoint/PDF slides and other course notes. Additionally, other copyright-protected materials created by textbook publishers and authors may be provided to students based on license terms and educational exceptions in the Canadian Copyright Act (see <http://laws-lois.justice.gc.ca/eng/acts/C-42/index.html>).

Before copying or distributing others' copyright-protected materials, students need to ensure that their use of materials is covered under the University's Fair Dealing Copyright Guidelines available at <http://www.usask.ca/copyright/basics/copyright-policy/fair-dealing-guidelines/index.php>. For example, posting others' copyright-protected materials on the internet is not covered under the University's Fair Dealing Copyright Guidelines; doing so requires permission from the copyright holder. For more information about copyright, please visit <http://www.usask.ca/copyright/students/rights/index.php> or contact the University's Copyright Coordinator at [copyright.coordinator@usask.ca](mailto:copyright.coordinator@usask.ca).

Students should be aware that a violation of the university's copyright policies could be an instance of non-academic misconduct. For example, the practice of uploading or posting copyright-protected materials to course-sharing websites, depositories, or "drop boxes", without the permission of the copyright holder, could result in a charge of non-academic misconduct under the university's "Standard of Student Conduct in Non-Academic Matters", found at the following location: <https://secretariat.usask.ca/student-conduct-appeals/non-academic-misconduct.php>.

### **Examinations with Access and Equity Services (AES)**

Students who have disabilities (learning, medical, physical, or mental health) are strongly encouraged to register with Access and Equity Services (AES) if they have not already done so. Students who suspect they may have disabilities should contact AES for advice and referrals. In order to access AES programs and supports, students must follow AES policy and procedures. For more information, check [www.students.usask.ca/aes](http://www.students.usask.ca/aes), or contact AES at 306-966-7273 or [aes@usask.ca](mailto:aes@usask.ca).

Students registered with AES may request alternative arrangements for mid-term and final examinations. Students must arrange such accommodations through AES by the stated deadlines. Instructors shall provide the examinations for students who are being accommodated by the deadlines established by AES.

### **Student Supports**

#### **Student Learning Services**

Student Learning Services (SLS) offers assistance to U of S undergrad and graduate students. For information on specific services, please see the SLS web site <http://library.usask.ca/studentlearning/>.

#### **Student and Enrolment Services Division**

The Student and Enrolment Services Division (SESD) focuses on providing developmental and support services and programs to students and the university community. For more information, see the students' web site <http://students.usask.ca>.

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**Financial Support**

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact Student Central (<https://students.usask.ca/student-central.php>).

**Aboriginal Students Centre**

The Aboriginal Students Centre (ASC) is dedicated to supporting Aboriginal student academic and personal success. The centre offers personal, social, cultural and some academic supports to Métis, First Nations, and Inuit students. The centre is also dedicated to intercultural education, bringing Aboriginal and non-Aboriginal students together to learn from, with and about one another in a respectful, inclusive and safe environment. Students are encouraged to visit the ASC's Facebook page (<https://www.facebook.com/aboriginalstudentscentre/>) to learn more.

**International Student and Study Abroad Centre**

The International Student and Study Abroad Centre (ISSAC) supports student success in their international education experiences at the U of S and abroad. ISSAC is here to assist all international undergraduate, graduate, exchange and English as a Second Language students and their families in their transition to the U of S and Saskatoon. ISSAC offers advising and support on all matters that affect international students and their families and on all matters related to studying abroad. Please visit [students.usask.ca](https://students.usask.ca) for more information.