**CIEE Global Institute – Copenhagen, Denmark**

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| **Course name:** | Sustainable Agriculture and Food Systems |
| **Course number:** | (GI) AGRI 3001 CPDK |
| **Programs offering course:** | Open Campus |
| **Open Campus Track:** | Sustainability and Environmental Sciences |
| **Language of instruction:** | English |
| **U.S. semester credits:** | 3 |
| **Contact hours:** | 45 |
| **Term:** | Spring 2019 |

## Course Description

This interdisciplinary course examines the environmental, social, and economic dimensions of agriculture, and relevant emerging challenges involving climate change and resource depletion and degradation. It treats the Green Revolution, capital-intensive/high-input practices, and corporate agriculture. Students will learn about the implications of "conventional" agriculture for the environmental protection, and food systems, security, and sovereignty. Additionally, students will explore the principles and practice of alternatives, including integrated crop and pest management, agroforestry, permaculture, plus organic, sustainable, and "climate smart" agriculture. Using a framework of "systems thinking", and drawing analogies between agricultural and ecological systems, the course explores the multiple drivers, inputs, and outputs of agricultural production and trade. Students will have firsthand, immersive experiences with production systems that are wide-ranging, and will explore the costs and benefits of each, through the lens the environment, economy, and society.

## Learning Objectives

Completing this course, students will:

- Have command over the concepts and terminology to explain the principles and practices of integrated crop and pest management, agroforestry, permaculture, organic, sustainable, and "climate smart" agriculture;
- Have mastery over the key debate points and controversies surrounding the Green Revolution, corporate agriculture, and alternatives to corporate agriculture;
- Possess an understanding of "systems thinking" as it relates to agricultural production and trade, and be cognizant of the complex synergisms between the system components;
- Acquire competencies in the quantitative and qualitative assessment of the sustainability of agricultural production and trade systems;

- Propose systems solutions for challenges and shortcomings in the realm of food systems, food security, and food sovereignty;
- Practice and expand communication skills (oral and written);
- Practice leadership and teamsmanship in group projects and assignments;
- Become an enlightened and engaged stakeholder in matters related to food systems and agriculture, at home and abroad.

**Course Prerequisites**
None.

**Methods of Instruction**
All topics will be treated through foundational lectures and required readings. Lessons will be complemented with classroom discussion, critical reading, writing, and discussion exercises. Excursions will immerse students in the appropriate context for experiencing agricultural production, distribution, and trade. Students may visit farms, markets, or agricultural extension services. Students will actively interact with critical actors, possibly including producers, agricultural extensionists, vendors, consumers, or land use managers.

**Assessment and Final Grade**

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| • Participation | 20% |
| • Discussion leader | 10% |
| • Final project, written report | 20% |
| • Final project, oral report | 10% |
| • Midterm exam | 20% |
| • Final exam | 20% |
| Total | 100% |

**Course Requirements**
**Participation**

Participation is valued as a meaningful contribution in the digital and tangible classroom, utilizing the resources and materials presented to students as part of the course. Meaningful contribution requires students to be prepared in advance of each class session and to have regular attendance. Students must clearly demonstrate they have engaged with the materials as directed, for example, through classroom discussions, online discussion boards, peer-to-peer feedback (after presentations), interaction with guest speakers, and attentiveness on co-curricular and outside-of-classroom activities.

**Discussion leader**

Each student, or group of 1-3 students, will take charge of a class discussion that centers on readings and a particular topic question. The student leader/s will be responsible for (1) supplying a brief synopsis of the article/s, (2) posing several thought- and discussion-provoking questions, and (3) facilitating the discussion to a meaningful analysis and conclusion. A grading rubric will be provided prior to the assignment.

**Final project, written report**
With input from the instructor, students will select a research question of interest and collect data and information during excursions to farms, etc., as well from online and print material. The information will be compiled into a final manuscript suitable for publication in a relevant journal (e.g., Journal of Sustainable Agriculture; Journal of Agroecology and Sustainable Food Systems, etc.). The content, format, and style will mimic the selected journal. A grading rubric for the manuscript submission will be provided prior to the assignment.

**Final report, oral presentation**
The student will present an 10-minute talk summarizing the results of the research presented in the manuscript. This will be presented in a format suitable for a professional society, including a question-answer period, during which the presenter will answers posed by peers and instructors. A grading rubric for the symposium talk will be provided prior to the assignment.

**Midterm exam**
Students take an 80-point exam consisting of short answer and short essay questions, covering lectures, readings, and materials covered on excursions during the first one-half of the block.

**Final exam**
Students take a comprehensive (cumulative) 80-point exam consisting of short answer and short essay questions, covering lectures, readings, and materials covered on excursions.

**Attendance Policy**

Regular class attendance is required throughout the program, and all unexcused absences will result in a lower participation grade for any affected CIEE course. Due to the intensive schedules for Open Campus and Short Term programs, unexcused absences that constitute more than 10% of the total course will result in a written warning.

Students who transfer from one CIEE class to another during the add/drop period will not be considered absent from the first session(s) of their new class, provided they were marked present for the first session(s) of their original class. Otherwise, the absence(s) from the original class carry over to the new class and count against the grade in that class.

For CIEE classes, excessively tardy (over 15 minutes late) students must be marked absent. Attendance policies also apply to any required co-curricular class excursion or event, as well as to Internship, Service Learning, or required field placement. Students who miss class for personal travel, including unforeseen delays that arise as a result of personal travel, will be marked as absent and unexcused. No make-up or re-sit opportunity will be provided.

Attendance policies also apply to any required class excursion, with the exception that some class excursions cannot accommodate any tardiness, and students risk being marked as absent if they fail to be present at the appointed time.

Unexcused absences will lead to the following penalties:

| *Percentage of Total Course Hours Missed* | *Equivalent Number of Open Campus Semester classes* | *Minimum Penalty* |
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| Up to 10% | 1 content classes, or up to 2 language classes | Participation graded as per class requirements |

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| 10 – 20% | 2 content classes, or<br>3-4 language classes | Participation graded as per class requirements; **written warning** |
| More than 20% | 3 content classes, or<br>5 language classes | Automatic **course failure**, and possible expulsion |

**Weekly Schedule**
NOTE: this schedule is subject to change at the discretion of the instructor to take advantage of current experiential learning opportunities.

**Week 1** **Introduction**

Class 1:1 Introduction to class
This session will form the introduction to the class.

We will review the syllabus, learning objectives, and assessment methods, including aspects of participation and engagement in class. This will be followed by the introduction to "systems thinking", sustainable agriculture, and food systems. Key concepts and definitions will be presented.

Readings:
Clapp (2010). *Food*. Chapters 1-5.
Meadows (2008). *Thinking in systems.* Chapters 1-5.

Online Resources:
Systems Thinking: A cautionary tale.
https://www.youtube.com/watch?v=17BP9n6g1F0
Food System Innovation.
https://www.youtube.com/watch?v=7o80ma2X7Y8

**Week 2**

Class 2.1 Introduction to the global food system
This session will have a lecture and discussion (graded).

Lecture: Unpacking the world food economy. Introduction to these topics: significance of food sales to global and national economies and

how it differs in industrialized versus nonindustrialized nations; the state-led expansion of industrial agriculture and international markets; the rise of transnational corporations; how the Green Revolution paved the way for agri-business; the commodification of food and agriculture; how food security and sovereignty can be impacted.

Following the lecture, there will be a student-led, graded, discussion on the reading by Barrett (2010). The discussion topic is "The meaning and measure of food security."

Readings:
Barrett (2010). Measuring food insecurity.

Class 2.2 Food security in a rapidly changing world, part 1.
This session will have a lecture and a discussion (graded).

Lecture: The Great Acceleration. Definitions and trends. Human population growth, the demographic transition, and global disparity in poverty and wealth. Consequences for food demand, food trade, human nutrition and health, and environmental sustainability. Estimates of food quantity needed to feed the world in 2050. The paramount significance of the "water-energy-food nexus".

Following the lecture, there will be a student-led, graded, discussion on the readings by Garnett and co-authors, and Tilman and co-authors. The discussion topic is "Connecting global diets, the environment, and human health."

Readings:
Bongaarts (2009). Human population growth and the demographic transition.
Garnett *et al.* (2013). Sustainable intensification in agriculture: premises and policies.
Pimentel (2011). Food for thought: a review of the role of energy in current and evolving agriculture.
Tilman *et al.* (2011) Global food demand and the sustainable intensification of agriculture.
Tilman & Clark (2014). Global diets link environmental sustainability and human health.

**Week 3**

Class 2.3 Food security in a rapidly changing world, part 1.
This session will have a lecture and a discussion (graded).

Lecture: Food production challenges under climate change and declining or degraded resources. Climate change predictions regarding agricultural production. Trends in water, nutrient, and arable land availability, disease/pest outbreaks, and soil erosion. Proximate cause for trends. Regions and economies impacted. Food-deficit countries: who they are, and their special vulnerabilities in a changing world. The intersection of climate change, resource depletion and degradation with human population growth, poverty, and wealth.

Following the lecture, there will be a student-led, graded, discussion on the articles by Hanjra & Qureshi. The discussion topic is, "How agriculture should respond to the impacts of water scarcity."

Readings:
Hanjra & Qureshi (2010). Global water crisis and future food security in an era of climate change.

Online Resources:
Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/x8200e/x8200e03.htm
Index Mundi. https://www.indexmundi.com/facts/indicators/SN.ITK.DFCT

Class 3.2 Think globally, eat locally: an activity
This session will include a lecture and an activity (market visits).

After an in-class orientation on the topic of "food miles", and the "locavore movement" by the instructor, the students will visit markets to compare information on the source of fresh and packaged fruits, grains, and meats. Markets will differ in pre-determined ways (for instance, farmer's markets, grocery store chains, family-owned general store, convenience stores, location in suburbs or inner city, etc.). The students will analyze and interpret their findings. The material will be covered on the midterm exam.

Class 3.3 The role of technology in food security
This session will include a lecture and a discussion (graded).

Lecture: The role of technology in western agricultural, from the Industrial Revolution to the present. Technological breakthroughs and disruptive technology in agriculture. Their social, economic and environmental impacts on agriculture's "hard boundaries", e.g.,

constraints related to space, soil availability, phosphorous and other nutrients, water, and genomics. GMOs, precision technology: a review and explanation of what they are and the controversies that surround them. Technology to the rescue for increasing food production? The limits of technology, technology transfer, and techno-fixes: When, where, and for whom does agro-tech work and when does it not work?

Following the lecture, there will be a student-led, graded, discussion on the articles by Vergragt & Brown. The discussion topic is: "Can sustainability reporting resolve the GMO controversies?"

Readings:
Fedoroff *et al.* (2010). Radically rethinking agriculture for the 21st century.
Vergragt & Brown (2008) Genetic engineering in agriculture: New approaches for risk management through sustainability reporting.

Online Resources:
Precision technology: Top ten technologies
https://www.therobotreport.com/top-10-technologies-in-precision-agriculture/

**Week 4**

Class 4.1 Sustainable food systems

This session will have a lecture and a discussion (graded).

Lecture: Intersection of sustainability and food systems. Concepts of sustainability; the three pillars of sustainability; inter- and intra-generational equity/justice; concept of food justice and food sovereignty. Concepts of resilience and adaptation; examples of resilience and adaptation in food systems; how to create or preserve agricultural resilience and adaptive potential; issues of scale (local, regional, international); the critical role of international aid and trade policies in resilience-and adaptation-planning. The concept of food sovereignty and the right to food and to food systems.

Following the lecture, there will be a lecture on the readings by the authors Patel, and Altieri and Toledo. The discussion topic is: "Does food sovereignty move us toward sustainable food systems?"

Readings
Patel, R. (2009) Food sovereignty.

Altieri & Toledo (2011). The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants.

Class 4.2 Midterm exam

Class 4.3 Principles of sustainable agriculture
This session will have a lecture and a discussion (graded).

Lecture: Sustainable agriculture, in principle and practice. Definitions and key concepts explained: economic viability, socially supportive, and ecologically sound. Natural ecosystems as models for nutrient, water and energy flow in an agricultural system; importance of public health and well-being and food economies in the conceptual framework; types of production systems that capture some of the elements of "sustainable agriculture": permaculture, organic agriculture; biodynamic agriculture; regenerative agriculture, etc. The intersection of sustainable agriculture with food sovereignty. How sustainable agriculture meets the goals of food security at different scales: local, regional, and international. The water-energy-food AND livelihoods nexus. Markets for sustainable agriculture.

Following the lecture, there will be a student-led (graded) discussion on the reading by Tomlinson. The title is, "Do we really need to increase food production?"

Readings
Biggs *et al.* (2015) Sustainable development and the water–energy–food nexus: A perspective on livelihoods.
Tomlinson (2013) Doubling food production to feed the 9 billion: a critical perspective on a key discourse of food security in the UK.
Wezel *et al.* (2014) Agroecological practices for sustainable agriculture. A review.

**Week 5**

Class 5.1 Sustainable alternatives in your neighborhood: an activity.
This session will include a lecture and an activity (market visits).

After an in-class orientation to the topic by the instructor, the students will visit a local agricultural production center. The students will collect information on methods of production, including water, nutrient, and energy inputs, as well as the use of technology, human labor, space

requirements, and production output. Students will model the system (components, inputs, outputs, feedback loops, synergistic interactions, etc.) and use that information for an environmental sustainability analysis. They will also address questions related to the scale-ability of the system: would the overall environmental sustainability increase, decrease, or not change if the scale of the operation were altered?

Class 5.2 Agro-forestry

This session will have a lecture and a discussion (graded).

Lecture: Principles and practice of agro-forestry. Characteristics of agro-forestry system; examples of agro-forestry from around the globe, with typical overstory trees and understory plants for food, fiber, medicinal, and biodiversity purposes. The role of livestock. Synergisms and interactions between components and their impacts on soil quality, soil erosion, pest control, water needs, and production levels (over different timescales). Contrast between soil quality, agrochemical load, and cost per unit production, as compared to intensive agriculture. Markets for agro-forestry products.

Following the lecture, there will be a student-led (graded) discussion on the reading by Meijer and co-authors. The title of the discussion is, “The social barriers that thwart change in agricultural practices.”

Readings

Herrero et al. (2010) Smart investments in sustainable food production: revisiting mixed crop-livestock systems

Meijer *et al.* (2015) The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa.

Class 5.3 Climate-smart agriculture

This session will have a lecture and a discussion (graded).

Lecture: The principles, practices, and goals of climate-smart agriculture (CSA): definitions and key concepts explained. Review of agriculture’s role in anthropogenic climate change. Review of changing climate: trends in temperature, water and atmospheric CO2. Mitigation versus adaptation; plant and animal adaptations to changing climatic variables; use and examples of technology to lower GHG emissions and facilitate genetic adaptation to climate change; examples of policies that enhance CSA approaches.

Following the lecture, there will be a student-led (graded) discussion on the reading by Clapp and co-authors. The title of the discussion is, "Climate-smart agriculture: More of the same or something radically different?"

Readings
Smith *et al.* (2007). Agriculture. In *Climate Change 2007: Mitigation*.
Clapp *et al.* (2018) The global political economy of climate change, agriculture and food systems.

Online Resources:
Happy cows help save the planet: Climate Smart Agriculture in Costa Rica. https://www.youtube.com/watch?v=59KvzvWkaVM

Due: Final project, written report

**Week 6**

Class 6.1 Agriculture for the future
This session will have a lecture and a discussion (graded).

Lecture: Agriculture for a hungry planet. A review of the hard boundaries that surround agriculture and the patterns of human population growth and food preference trends. Current global patterns of land use. The essential arguments for industrialized versus traditional agriculture, and for intensive versus low-intensity farming. What is at stake; concept of biodiversity and intact ecosystems; human livelihoods and cultural reservation; what ecologists think about agriculture. At the heart of the issue: the land-sparing vs land-sharing debate. Is one better than the other? When? And for whom?

Following the lecture, there will be a student-led (graded) discussion on the reading by Balmford, and Fischer and co-authors. The title of the discussion is, "Is Balmford right?"

Readings:
Balmford (2012) What conservationists need to know about farming.
Fischer *et al.* (2011). Conservation: limits of land sparing.

Class 6.2 Final project, oral reports

Class 6.3 Final Exam.

## Course Materials

### Course Textbooks

Clapp, J. (2010). *Food*. Cambridge: Polity Press.

Meadows, D. H. (2008). *Thinking in systems, A primer.* Sustainability Institute: White River Junction.

### Readings


Altieri, M. A., & Toledo, V. M. (2011). The agroecological revolution in Latin America: rescuing nature, ensuring food sovereignty and empowering peasants. *Journal of Peasant Studies*, *38*(3), 587-612

Balmford, A., Green, R., & Phalan, B. (2012). What conservationists need to know about farming. *Proceedings of the Royal Society of London B: Biological Sciences*, *279*(1739), 2714-2724.

Barrett, C. B. (2010). Measuring food insecurity. *Science*, *327*(5967), 825-828.

Biggs, E. M., Bruce, E., Boruff, B., Duncan, J. M., Horsley, J., Pauli, N., ... & Haworth, B. (2015). Sustainable development and the water–energy–food nexus: A perspective on livelihoods. *Environmental Science & Policy*, *54*, 389-397.

Bongaarts, J. (2009). Human population growth and the demographic transition. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *364*(1532), 2985-2990.

Clapp, J., Newell, P., & Brent, Z. W. (2018). The global political economy of climate change, agriculture and food systems. *The Journal of Peasant Studies*, *45*(1), 80-88.

Fedoroff, N. V., Battisti, D. S., Beachy, R. N., Cooper, P. J. M., Fischhoff, D. A., Hodges, C. N., ... & Reynolds, M. P. (2010). Radically rethinking agriculture for the 21st century. *Science*, *327*(5967), 833-834.

Fischer, J., Batáry, P., Bawa, K. S., Brussaard, L., Chappell, M. J., Clough, Y., ... & Klein, A. M. (2011). Conservation: limits of land sparing. *Science*, *334*(6056), 593-593.

Garnett, T., Appleby, M. C., Balmford, A., Bateman, I. J., Benton, T. G., Bloomer, P., ... & Herrero, M. (2013). Sustainable intensification in agriculture: premises and policies. *Science*, *341*(6141), 33-34.

Hanjra, M. A., & Qureshi, M. E. (2010). Global water crisis and future food security in an era of climate change. *Food Policy*, *35*(5), 365-377.

Herrero, M., Thornton, P. K., Notenbaert, A. M., Wood, S., Msangi, S., Freeman, H. A., ... & Lynam, J. (2010). Smart investments in sustainable food production: revisiting mixed crop-livestock systems. *Science*, *327*(5967), 822-825.

Meijer, S. S., Catacutan, D., Ajayi, O. C., Sileshi, G. W., & Nieuwenhuis, M. (2015). The role of knowledge, attitudes and perceptions in the uptake of agricultural and agroforestry innovations among smallholder farmers in sub-Saharan Africa. *International Journal of Agricultural Sustainability*, *13*(1), 40-54.

Patel, R. (2009) Food sovereignty. *The Journal of Peasant Studies, 36 (3),* 663-706, DOI: 10.1080/03066150903143079

Pimentel, D. (2011). Food for thought: a review of the role of energy in current and evolving agriculture. *Critical reviews in plant sciences*, *30*(1-2), 35-44.
Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, & Sirotenko, O. (2007). Agriculture. In *Climate Change 2007: Mitigation*. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer, eds., Cambridge University Press, Cambridge.
Tilman, D., Balzer, C., Hill, J., & Befort, B. L. (2011). Global food demand and the sustainable intensification of agriculture. *Proceedings of the National Academy of Sciences*, *108*(50), 20260-20264.
Tilman, D., & Clark, M. (2014). Global diets link environmental sustainability and human health. *Nature*, *515*(7528), 518-522.
Tomlinson, I. (2013). Doubling food production to feed the 9 billion: a critical perspective on a key discourse of food security in the UK. *Journal of rural studies*, *29*, 81-90.
Vergragt, P. J., & Brown, H. S. (2008). Genetic engineering in agriculture: New approaches for risk management through sustainability reporting. *Technological Forecasting and Social Change*, *75*(6), 783-798.
Wezel, A., Casagrande, M., Celette, F., Vian, J. F., Ferrer, A., & Peigné, J. (2014). Agroecological practices for sustainable agriculture. A review. *Agronomy for sustainable development*, *34*(1), 1-20.
Wittman, H. K., Desmarais, A. A., & Wiebe, N. (2010). *Reconnecting Food, Nature, and Community.* Food First Press.

## Online Resources

Food and Agriculture Organization of the United Nations. http://www.fao.org/docrep/x8200e/x8200e03.htm
Food System Innovation. https://www.youtube.com/watch?v=7o80ma2X7Y8
Happy cows help save the planet: Climate Smart Agriculture in Costa Rica. https://www.youtube.com/watch?v=59KvzvWkaVM

Index Mundi. https://www.indexmundi.com/facts/indicators/SN.ITK.DFCT

Precision technology: Top ten technologies. https://www.therobotreport.com/top-10-technologies-in-precision-agriculture/

Systems Thinking: A cautionary tale. https://www.youtube.com/watch?v=17BP9n6g1F0