This syllabus is subject to modification and exact lecture topics will be determined as we make progress through the course. However, this will provide for you an overview of what to expect.

COURSE DESCRIPTION AND OVERVIEW

Roughly 40% of our Earth’s land surface is devoted to agriculture. Grasslands have been plowed over for industrial sized farming operations; forests have been razed to make fuel and high-value commodities. The food we eat has a significant environmental impact, and, in turn, our food system stands to be tested with a changing environment. Food Production and Climate Change provides an overview of our current global food system embedded within larger environmental systems that it both impacts and depends on. We will explore the evolution of intensive food production, specifically in how humans have changed the land surface, and the environment, in order to meet increasing food demand. We will also learn how climate change, and the associated extreme events and variability, will challenge our ability to grow and harvest crops in a timely fashion to meet nutrition standards across the world. The impacts of climate change on food production vary largely across geographic, economic and even gender space. Finally, this course will review the environmental footprint of emerging food movements, their efficacy, and a host of alternative future food production trajectories that promise a range of environmental, socio-economic and nutritional impacts.
This course will require approximately 30-40 pages of reading per week, sometimes supplemented with web-based research and an occasional quantitative analysis. Readings will be a combination of peer-reviewed studies, popular articles, white and concept papers and book chapters. The variety of publication mediums is meant to serve a multi-fold purpose for you: it will familiarize you with the field’s cutting edge research; enable you to evaluate the public’s response to such research and how it is communicated; and allow you to understand more deeply the implications of such research on food producers, consumers and processors. Some of these readings, particularly those taken from scientific literature, will be dense and may prove initially challenging. In these cases, other materials will be supplied to help you gain a more full understanding of the findings and implications. You will also be required, and encouraged, to conduct literature searches to access more information and delve more deeply into weekly topics. Most of the required readings will be provided to you as pdfs on NYUClasses, or emailed out just after class.

**STUDENT EXPECTATIONS**

On-time attendance to Lecture and Participation  
Completion of ~30-40 pages of weekly readings  
Completion of weekly assignments  
One 15 page (minimum, excluding references) Final Term Paper

*It is NYU policy that all work is expected to be your own. Plagiarism of any kind will result in a failing grade for the class, and referral to an academic dean. Plagiarism includes: copying sentences or fragments from any source without quotes or*
references; not citing every source used in your papers; citing internet information without proper citation; presenting someone else’s work as your own; or copying verbatim from any source. You are subject to CAS’s guidelines for Academic Integrity: http://cas.nyu.edu/page/ug.academicintegrity

You will be expected to attend every class, as the readings will cover some of the topics we discuss in class in more detail, but not all topics. Your active listening in class will help you to create a more thorough response to some of the homework prompts, and those responses that receive full marks will incorporate this. This is college, and so I also expect that you will take initiative to look further into terms and topics you are unfamiliar with in the readings (this includes asking me). Active participation will be encouraged – it can behoove you to be a visible contributor in class. There will be many opportunities to do so, as an individual and as discussions questions posed to groups of students in class, so please be ready to take advantage of these opportunities. I also encourage out-of-class discussion on readings and response topics, and if several are you are pursuing similar lines of research for your final paper, I expect that you will discuss this amongst yourselves. However, at all times, all work should be your own.

PREREQUISITES

ENVST-UA 100 - Environmental Systems Science, or Permission of Instructor

GRADING CRITERIA

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<thead>
<tr>
<th>RESPONSIBILITY</th>
<th>PERCENT OF FINAL GRADE</th>
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<tr>
<td>Assignments</td>
<td>60</td>
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<tr>
<td>Term Paper</td>
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<tr>
<td>Total</td>
<td>100</td>
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ASSIGNMENTS

As you are about to learn about a dynamic, constantly changing field, the readings for this course are, likewise, being constantly being updated. As such, what you will actually be assigned to ready might deviate a bit from the readings listed here, although these are some key references in the field that should act as a guide. I will post all readings you are responsible for on NYUClasses – Resources, and it is your responsibility to check the NYUClasses course page regularly for updates, assignments, and readings. My main mode of communication with you will be through NYUClasses messaging service as well. You are, of course, free to email me for clarification at any time.

When assigned, you will have approximately one (1) week to complete each assignment. These will comprise of numerous (~4-10) questions designed to test
your comprehension and critical thinking of the assigned readings and issues discussed in class. The questions will generally ask you to summarize or describe various concepts in your own words, and then challenge you to apply these concepts in thinking about climate-agriculture interactions. The responses will most often be written, in short-answer or short-essay form. There will also be a few, general, quantitative questions relating to observed and projected trends in climate variables and agricultural production over time. These are given so that you can better understand the transient nature of global environmental change, and how such change may impact interactions between our food system, food security, and the environment.

The assignment will generally be posted Fridays directly following the week’s classes, and is due by 5:00 pm the following Friday. Assignments, along with all class correspondence, will be posted using the NYU Classes system. Assignments are expected to be typed using 12 pt font and spaced with either single of 1.5 spacing (double spacing is NOT acceptable). Assignments should either be emailed to me or uploaded via the NYU Classes webpage, or maybe submitted as a GoogleDoc (although this is the least preferred method). Please note: all assignments MUST have your last name in the filename. Assignments that do not have a name in the filename will automatically be deducted 10 points. The grading of each assignment will follow a point system out of 100. 10 points will be deducted for each day the assignment is late, and will not be accepted after the 5th day. If you have difficulty in complying with the above, or any other questions, please contact me as soon as possible.

TERM PAPER

Due Friday, May 13th. The term paper will be “open topic”, in that the student may choose any topic related to the themes discussed in class. Students will be required to submit a paper proposal and preliminary list of references to the instructor for approval. If the topic does not meet instructor approval, the student may seek the instructor’s guidance on how to construct a topic that is appropriate.

Disability Disclosure Statement:

Academic accommodations are available to any student with a chronic, psychological, visual, mobility, learning disability, or who is deaf or hard of hearing. Students should please register with the Moses Center for Students with Disabilities at 212-998-4980.

NYU’s Henry and Lucy Moses Center for Students with Disabilities
726 Broadway, 2nd Floor
New York, NY 10003-6675
Telephone: 212-998- 4980
Voice/TTY Fax: 212-995- 4114
Web site: http://www.nyu.edu/csd
GENERAL COURSE OUTLINE

Unit 1: Systems thinking  - What are the linkages between food production and the environment? What happens when we leave components out of the system?

Week 1 - Systems Thinking in Agriculture: Production and the Environment
i. What is “systems thinking”
   1. How does it apply to climate studies?
   2. How does it apply to our food system?
ii. Goal: Identify components of environmental and agricultural systems
   1. Determine how they function together
   2. Diagram the climate and agricultural systems
iii. Understand implications of leaving out system components
   1. The problem of “externalities” (as per climate change) – what is the cost of leaving components out of the system
iv. Apply systems thinking to the definition of FAO global food security
v. Review and understand course objectives
   1. Structure and Expectations for the course

Readings:

i. Combs et al., (2013) Thinking in Terms of Food Systems [www.css.cornell.edu/FoodSystems/Cnc96.html] (7 pg)
ii. TruCost report on pricing of externalities (Tables and Figures)
iv. FAO Introduction to Food Security (3 pg)

Unit 2: Our Current Climate and Food Production Systems

Week 2: Our Climate System and its Role in Agricultural Production
i. An overview of our Earth’s climate system
   1. Earth’s Energy Balance and the Greenhouse Effect
2. The role of Greenhouse Gases
   ii. Atmospheric temperature and variability, moisture and convection
   iii. General circulation – what drives the atmosphere?
      1. Atmospheric forces
      2. Climate zones (water limited versus energy limited regions)
      3. Monsoon regions
iv. Natural Climate Variability
   1. ENSO
   2. Paleoclimate temperature and CO₂ record
   3. Climate forcings and feedbacks
v. Climate and soils
   1. Cycling of important soil nutrients

Readings:
   i. IPCC TAR Chapter 1: An Overview of the Climate System (14 pages)
   ii. IPCC AR4 Chapter 1: Historical overview of Climate Change Science (36 pages)
   iii. Handbook of Climate Change and Agroecosystems Vol. 1, Chapter 1, eds. Rosenzweig and Hillel (11 pages)
   iv. NASA’s description of Earth’s Energy Balance:
       http://earthobservatory.nasa.gov/Features/EnergyBalance/page1.php
   v. IRI Primer on ENSO:
       http://iri.columbia.edu/climate/ENSO/background/basics.html
   vii. The Australian Bureau of Meteorology ENSO webpage:
   viii. NASA’s Primer on Soil Forming Factors:

Week 3: Current Agricultural Production
   i. Malthusian projections and meeting the worlds nutritional needs
      1. Why has food production seemingly kept up with population?
      2. What are the limits to production?
   ii. Soil Health and Fertility
      1. The Role of Carbon
      2. The Role of Nitrogen
      3. Soil ecosystems and nutrient balance
4. **Guest lecture: Angela Kong, soil scientist, NASA GISS**

   iii. The Green Revolution and Introduction to modern agriculture
   1. Land use change
   2. The introduction of High Yield Varieties (HYVs)
   3. The introduction of synthetic fertilizers
   4. Management and Irrigation

**Readings:**

4. The Green Revolution: Curse or Blessing? The International Food Policy Research Institute (4 pages)

**Weeks 4-5: Current Climate-Agriculture Interactions**

   i. Planetary Boundaries
      1. Carrying capacity
      2. Limits to resources use
   ii. Potential Production – what are the limits on agricultural production at the field level?
   iii. Defining and Evaluating Yield Gaps
iv. Natural climate variability and crop production
   1. Impact of El Niño events
   2. Food Shocks

v. Regional Perspectives of Modern Agriculture
   1. South Asia
   2. Africa
   3. South America
   4. USA

vi. The Dust Bowl: Causes and Implications

Readings:

For the Assignment following Lecture 12, you will be required to watch Ken Burns: The Dust Bowl, Episode 1. This is available through Netflix Instant Watch, at Bobst Library or for purchase on Amazon or iTunes. I will arrange an after class viewing for those of you who are interested as well.

i. Haggblade (2004) Building on Success in African Agriculture. IFPRI (14 pages)


iii. Ittersum et al (2013) Yield Gap analysis with local to global relevance – a review. Field Crops Research 143: 4-17 (14 pages)


v. Mueller et al (2012) Closing yield gaps through nutrient and water management. DOI:10.1038/nature11420 (4 pages)


ix. Barona et al. (2010) The role of pasture and soybean in deforestation of the Brazilian Amazon. Environ Res Lett. DOI: 10.1088/1748-9326/5/2/024002 (10 pages)


Readings (suggested):


xv. Information on modern agricultural inputs and how this affects soil and nutrient chemistry


xviii. USDA-ERS Primer on corn (and other crops) with figures of production and feed-use (hand-out, 5 pages plus data)


xxii. Then End of Cheap Food – The Economist

xxiii. Contradiction of the Green Revolution


xxv. Comments on the economics of industrial and highly mechanized agriculture and food processing (and implications for western diets)


Unit 3: The impact of climate change on food production

Weeks 6-7: The impact of climate change on food production

i. A primer on climate change – the scientific basis
   1. Tools used in climate change assessments (models, remote sensing, etc.)
2. Benefits and limitations of these methods

ii. Projected global changes and general agricultural vulnerabilities: a problem of scale and time
   1. Spatial and timescales of evaluation
   2. General global impacts on crop productivity
   3. Specific climatic impacts
      a. Extreme events
      b. Drought
      c. Rainfall variability
      d. Changes in mean temperature
      e. Water availability
      f. Coastal inundation

iii. Guest Lecture: Delphine Deryng – the impact of rising CO2 levels on crop production: interactions, implications, and uncertainties

iv. Brief Discussion integrated assessments of climate change on food: AgMIP and other coordinated activities – approach and generalizability

v. Regional perspectives on climate change impacts on agriculture
   1. South Asia
   2. Africa
   3. South America
   4. USA

vi. Characterization of uncertainties in climate and agricultural projections and responses

vii. Ongoing efforts to understand and mitigate vulnerability of agriculture due to climate change
   1. Pest and diseases
   2. Market interactions

viii. What are farmer options in various regions around the globe?
   1. Have we seen evidence yet of climate change impacting yields and food security? (See Chapt. 2 in Handbook)

Readings:

i. Lobell and Burke, Climate Change and Food Security, Chapter 1, (pages 3-11)

ii. IPCC AR4 Chapter 8 Climate Models (pages: 591-593; 600-601; 608-612; 623-625; 632, Box 8.1)

iii. IPCC AR4 Chapter 9 Understanding climate change (pages: 667-678; 696; 727-728)

iv. IPCC AR5 Summary for Policymakers (All, but emphasis on the highlighted gold/beige textboxes, 28 pages)


vii. Funk et al. (2008) Warming of the Indian Ocean threatens eastern and southern African food security but could be mitigated by agricultural development. PNAS. 105. (6 pages)


x. Lobell and Burke, Climate Change and Food Security, Chapter 1, (pages 136-152)


Readings (suggested):


1. Samples of the types of models and tools used


xvi. Jones J, Comparative Assessment of Agricultural uses of ENSO-based climate forecasts in Argentina, Costa Rica and Mexico. (28 pg)


Unit 4: Interactions between Food Production and the Environment. The contribution of our food system to environmental changes

Weeks 8-9: Ascertaining the global footprint of agriculture
i. Agriculture’s Carbon Footprint
   
   ii. Deforestation and land clearing
      1. Soil carbon contributions and exchanges

iii. Inputs-related emissions
iv. Production-related emissions
v. Distribution-related emissions
vi. Effect of diet on emissions
vii. Breakdown of the CGIAR agricultural emissions tables
viii. Energy and carbon efficiency of different foodstuffs
ix. Foodwaste

x. The regional/local footprint of agriculture
   1. South Asia
   2. Africa
   3. South America
   4. USA

xi. Soil and land degradation and the impact of industrial farming on regional environments: case studies

xii. Local changes in climate/circulation

xiii. Water resources (depletion, pollution and appropriation)

xiv. Impact on pollinators

xv. Impact of biofuel production on food crop production

xvi. Brief discussion of socio-economic implications of environmental degradation associated with agriculture
   1. Farmer consolidation, debt and impacts on gender inequality
   2. Implications for changes in cultural staples and nutritional profile
   3. The link between palate-development and intensive farming practices related to palate-appeasing crops
   4. Impact of biofuel production on food price volatility and shocks

Readings

i. Readings from the IPCC Fourth Assessment Report: Working Group 3, Chapter 8: Agriculture (44 pages)


vi. Gray JM et al (2014) Direct human influence on atmospheric CO₂ seasonality from increased cropland productivity. doi:10.1038/nature13957 (17 pages)

vii. WRI Food Security Report: Reducing Food Waste (pages 1-9)


Readings (suggested)

in agriculture. Agricultural Water Management 97:495-501 (7pg)

xix. Every Thirty Minutes: Farmer Suicides, Human Rights, and the Agrarian Crisis in India. Center for human rights and global justice. NYU Law (53 pg)

xx. Gender and climate change research in agriculture and food security for rural development. CGIAR, CCAFS, FAO

xxi. The state of food and agriculture – Women in agriculture. Closing the gender gap for development (2011) FAO, Rome, Italy


Unit 5: Interactions between Environmental, Food and Social Systems – specific crop examples.

Week 10: These examples will delve into the historical domestication, modern production, environmental impacts, susceptibility to climate change, social ramifications, supply/demand, and farmer options

i. Maize
ii. Coffee

Readings


Unit 6: Potential alternatives – does non-conventional agriculture (organic, bio-dynamic, etc.) preserve, conserve and reduce environmental damage? What are the roles of the various certifications and what components of the above systems do these certifications tackle (Fair Trade, USDA, Good Guide, etc.)? Are certifications a
band-aid or a means to an (sustainable) end? Is there climate change mitigation potential for agricultural lands?

**Week 11: What are the different forms of non-conventional agriculture?**

i. Precision Agriculture and Environmental Monitoring
   1. Are production methods getting “better”?
   2. Future for large-scale production
   3. How can advanced monitoring systems be useful in understanding agriculture-environment interactions?

ii. Organic Production and environmental benefits of alternatives

iii. Defining and Evaluating Conservation Agriculture
   1. Review major studies and initiatives in conservation agriculture
   2. What impact does conservation agriculture have on plant nutrient content?
      a. Soil health?
      b. Soil moisture content, etc?

iv. To employ these techniques, do we require more land area?
   1. Land sparing vs land sharing

v. What is the role of technology in agricultural adaptation to climate change?

vi. Studies showing impact of conservation agriculture on environment

vii. Studies showing impact of conservation agriculture on farmer livelihood

**Readings**

i. Readings from the IPCC Fourth Assessment Report: Working Group 3, Chapter 8: Agriculture (44 pages)


Field Trip – Optional visit to Farm (TBA)

Week 12: Certifications and ratings

i. Organic, Fair Trade, Rainforest Alliance, REDD etc.

ii. Review studies that comment on efficacy of ratings
   1. Have ratings contributed to environmental health in agriculture?
   2. Has it prompted preservation of lands that would otherwise be abused due to agriculture?

iii. What is the impact of these certifications on farmers? On consumers?

iv. How does increased demand for certified products impact global resource use?
   1. Who does conservation/responsible agriculture help (farmer perspective, consumer perspective)?

v. Quality and Nutrients
   1. Climate change impacts to food nutrient content
   2. Agricultural adaptation strategies and nutrition (how do climate adaptations contribute to all facets of food security)?
   3. Jeff Watts article on focus on quality

vi. Across groups – disagreement on how to move forward (scaling to large-holders)
   1. Does Fair Trade stay niche or become new norm?

vii. Food Sovereignty (short film on La Via Campesina)
   1. Fundamental basis
   2. Ongoing practice
   3. Efficacy to both environmental and ecosystems services and implications for farmer welfare and global food system
   4. Can we measure the impact of this movement on the environment?

Readings


iii. DeLind L (2011) Are local food and the local food movement taking us where we want to go? Or are we hitching our wagons to the wrong stars? Agric Hum Values 28:273-283 (11 pg)


vii. Access to opportunity: enabling smallholder and community participation in social and environmental certification standards. CCB Standards for Smallholder Initiative 2012. Rainforest Alliance

viii. Beyond forestry: why agriculture is key to the success of REDD+. IIED Briefing November 2010 (4 pages) www.iied.org/pubs/display.php?o=17086IIED


*Week 13 Guest Lecture* on farmer adaptation strategies to climate change in the developing world

*Suggested Additional Readings*


x. Kassam A, Friedrich T (2011 a,b) Conservation Agriculture: global perspectives and developments. FAO Regional conservation agriculture symposium 8-10 February. (33+)
xii. Michael Pollan. In Defense of Food (book)
xiii. FoodWorks Initiative by Speaker Christine Quinn’s office
xiv. UN Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD). Framework document 20 June 2008