

**Spring 2022 AOM 4932/6932**  
**Course title: Agricultural Intensification: Tradeoffs or Synergies with the Environment and Livelihoods**

**Instructor: Cheryl Palm Agricultural and Biological Engineering Department and Food Systems Institute**

COVID Response Statements For face to face courses a statement informing students of COVID related practices such as: We will have face-to-face instructional sessions to accomplish the student learning objectives of this course. In response to COVID-19, the following suggestions are in place to maintain your learning environment and to enhance the safety of our in-classroom interactions.

- It is recommended that you have a covid test before class begins.
- You are requested to wear approved face coverings at all times during class and within buildings. Following and enforcing these policies and requirements are all of our responsibility. Practice physical distancing to the extent possible when entering and exiting the classroom.
- If you are experiencing COVID-19 symptoms (Click here for guidance from the CDC on symptoms of coronavirus), please use the UF Health screening system and follow the instructions on whether you are able to attend class. Click here for UF Health guidance on what to do if you have been exposed to or are experiencing Covid-19 symptoms.
- Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work. Find more information in the university attendance policies.

**Course Description:** 2 credits. This interdisciplinary course is designed to teach students about the principles of sustainable agricultural intensification (SAI) and to explore the challenges to achieve SAI. We will begin with the history, science and impact of agricultural intensification, including the Green Revolution that doubled global food supplies between 1970 and 1995. We explore the effects of agricultural intensification on the environment (water quality, greenhouse gases, biodiversity), and human livelihoods (income, food security, nutrition). Though the focus is on developing countries the course will include temperate and regional comparisons for a broader understanding of the global food production system.

The course will combine readings and discussions sessions with occasional assignments. There is an opportunity to take an additional section on data analysis that includes a specific topic of interest to the student.

- 1. Pre-requisites and Co-requisites:** Students should have familiarity with agricultural production systems; however, the course will provide basic background and reading materials to cover the interdisciplinary areas of agricultural production, economics, environment, and livelihood considerations.

Those students selecting the lab section should be able to use Microsoft Excel. Experience with and/or some data analysis software including STATA, R, and such would be helpful but

not necessary. Working knowledge of geospatial tools would also be of interest for projects.

## 2. Course Objectives and specific Student Learning Outcomes (SLOs):

We begin with an overview of 1) the core bio-physical resources for food production: climate, soils, nutrients, water and biodiversity and 2) the socioeconomic conditions needed for agricultural intensification, and 3) the implications of agricultural intensification strategies to the environment (soils, water, air, carbon and biodiversity) and human livelihoods or human wellbeing (income, food security, nutrition). We will spend much of the semester examining the tradeoffs and synergies among agricultural intensification strategies with the impact on environment and ecosystems services as well as socioeconomics and human wellbeing. The focus is primarily on the tropics and subtropics, where rapid population growth and expansion and intensification of agriculture is occurring, but we will also explore examples from the temperate region. The overall question is how to meet local and global food and fuel requirements that do not harm the long-term integrity of the environment while providing equitable access to healthy, nutritious food for all.

The lab course will follow the lectures and will explore the various ways to explore datasets and calculate the various indicators within the five domains of sustainability. Tools for analyzing tradeoffs and synergies among those domains and indicators will also be explored. *The objectives and student learning outcomes for the lab are designated in italics.*

Those successfully completing this course will be able to:

1. Describe the differences between agricultural extensification and intensification and the driving forces determining which will prevail in a landscape.
2. Describe the different domains and indicators of sustainable intensification.
3. Describe and give examples of policies and institutions that can be used to negotiate tradeoffs and synergies.

**SLO1/2/3:** Students discuss papers that explore both agricultural intensification/extensification, explain the reasons why they have different outcome indicators and potential policies that could change those outcomes.

4. Compare and discuss the tradeoffs and synergies among the five domains of sustainability that are associated with different agricultural systems.

**SLO4:** Students select a case study of an agricultural system of their choice that explores the different domains of sustainability.

5. Learn to prepare and give oral presentations.

**SLO5:** Students present their case study to the class.

6. *(for the lab section) Learn to analyze, interpret, and compare (tradeoff and synergies) of different agriculture systems from a sustainable intensification perspective.*

**SLO6:** *Students assess tradeoffs and synergies among production, environment, economics, human and social domains for different farming systems or practices.*

## 3. Instructors contact information:

Dr. Cheryl Palm, Agricultural and Biological Engineering

Rogers Hall 223, Office: 352-392-1864 x223; [cpalm@ufl.edu](mailto:cpalm@ufl.edu)

Dr. Palm will return email messages within 24 hours. Do not expect messages to be returned over the weekend. Office hours can be made by scheduling appointments. Scheduling can be done by email or in person during class.

4. **Training Location: In person** Room 283 Frazier Rogers Hall.  
*Lab 283 Frazier Rogers Hall*  
***If needed due to covid testing*** virtual lectures will be held simultaneously to the in-person lecture via zoom.  
***Please advise the instructor if this is needed***
  5. **Meeting time:** Lecture section -Monday Periods 8-9 (3:00-4:55 p.m.)  
Lab section – Wednesday Periods 8-9 (3:00-4:55 p.m.)
  6. **Material and Supply Fees:** None.
  7. **Textbooks and Software Required:**  
No textbooks are required. All required reading material is available through websites or the UF library.
  8. **Recommended Readings:**  
Readings be assigned on a weekly basis. The core list is provided below within the lecture schedule.
  9. **Attendance and Expectations:** Students are expected to complete readings before class, actively participate in discussions, complete assignments, take exams and write a report on a specific case study.  
*Those taking the lab on data analysis will be expected to activity engage in the weekly lab work, write a short report, including data output and interpretations.*
- MORE DETAILS ARE PROVIDED BELOW UNDER GRADING**
10. **Grading:** The grade for the lecture course will be determined by:
    1. Participation (total 10 points) will be determined based on attendance in class (5 pts) and active participation in class and discussions of key reading assignments (5 pts). Those students who must participate virtually are expected to have their cameras on. If a student cannot attend class in person they must advise the instructor so alternatives can be set up.
    2. Oral presentation (5 points) students will each make a 5 minute oral presentation of an assigned reading.
    3. Exams (total 65 points): Four exams will be given; exams 1,2,3 are worth 15 points each, exam 4 is worth 20 points.

4. A case study report – 10 pp max (20 points). The case study will consist of applying the information learned from the class to a specific agricultural system and or commodity. Details will be provided midsemester.

**Assignments, exams, reports not handed in on time will receive a -1 point for each day the assignment is late.**

The grade for the lab will depend on participation (50 points) in weekly activities to develop specific sustainability indicators for a chosen farming system/country. A 5 page report (50 points) by each student that will be a compilation of indicators and tradeoff/synergies for their chosen farming system/country. The report will be presented as tables and figures along with a discussion and interpretation of the results.

Any work that is submitted should be the product of the student. Any assignments that are not the individual student’s work will be given a 0 grade and further disciplinary action per UF policy.

### 11. Grading Scale

Percent	Grade	Grade Points
92.0 - 100.0	A	4.00
90.0 – 91.9	A-	3.67
87.0-89.9	B+	3.33
83.0-86.9	B	3.00
80.0 – 82.9	B-	2.67
75.0 - 79.9	C+	2.33
74.9 – 70.0	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

### 12. Online Course Evaluation Process

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.”

### 13. Honesty Policy – Academic Honesty

As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: *“We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and*

*integrity.*" You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or implied: *"On my honor, I have neither given nor received unauthorized aid in doing this assignment."*

It is assumed that you will complete all work independently in each course unless the instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct to appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated. Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: <http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code>.

14. Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting [disability.ufl.edu/students/get-started](http://disability.ufl.edu/students/get-started). It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester

**14. Course Outline:** schedule, sequencing of topics may be changed with advanced notice. Readings with a \* are required readings for the week.

<b>Week (lab/lecture)</b>	<b>Activities</b>
Week 1 Jan. 5	<b>Lecture – holiday</b> <b>Lab:</b> Introduction to lab course. Overview of sustainability indicators and calculations, datasets
Week 2 Jan. 10, 12	<b>Lecture:</b> Introduction to course, discussion of agricultural extensification and intensification <b>Readings:</b> Godfray, H.C.J., Beddington, J.R., Crute, I.R., Haddad, L., Lawrence, D., Muir, J.F., Pretty, J., Robinson, S., Thomas, S.M. and Toulmin, C., 2010. Food security: the challenge of feeding 9 billion people. <i>Science</i> , 327(5967), pp.812-818.  *Foley JA, Defries R, Asner GP, Barford C, Bonan G, Carpenter SR, Chapin FS, Coe MT, Daily GC, Gibbs HK, Helkowski JH, Holloway T, Howard EA, Kucharik CJ, Monfreda C, Patz JA, Prentice IC, Ramankutty N, Snyder PK. 2005. Global consequences of land use. <i>Science</i> . 309(5734):570-4.

	<b>Lab:</b> Select two country, find statistics for production, yields (and potential yields), areas in production for 3 crops.
Week 3 Jan. 17 (holiday), 19	<b>Lecture - holiday</b> <b>Lab:</b> Continue with FAOStats;
Week 4 Jan. 24, 26	<b>Lecture:</b> Agricultural Intensification and Sustainability <b>Readings:</b> Pingali, P.L., 2012. Green Revolution: Impacts, limits, and the path ahead. Proceedings of the National Academy of Sciences, 109(31), pp.12302-12308. Tilman, D., Balzer, C., Hill, J. and Befort, B.L., 2011. Global food demand and the sustainable intensification of agriculture. Proceedings of the National Academy of Sciences, 108(50), pp.20260-20264. <b>Lab:</b> Learn to develop tradeoff diagrams (spidergrams)
Week 5 Jan. 31, Feb. 2	<b>Lecture:</b> Sustainable Intensification: Domain, Indicators, Tradeoffs and Synergies <b>Readings:</b> *Power, A. G., 2010. Ecosystem services and agriculture: tradeoffs and synergies. Philos. T. R. Soc. B. 365, 2959-2971. Musumba, M, Grabowski, P., Snapp, S, Palm, C. 2017; Guide for the Sustainable Intensification Assessment Framework. <a href="http://www.k-state.edu/siil/resources/framework/index.html">http://www.k-state.edu/siil/resources/framework/index.html</a> . <b>See example for indicator selection and tradeoff analysis.</b> <b>Discussion:</b> Tradeoffs and Synergies <b>Assignment:</b> Exam 1 <b>Lab:</b> compare data among countries Soil maps; find major soils in your selected study area
Week 6 Feb. 7, 9	<b>Lecture:</b> Soils, Nutrients, and Environment <b>Readings:</b> Palm, C.A., P.A. Sanchez, S. Ahmed, A. Awiti. 2007. Soils: A Contemporary Perspective. The Annual Review of Environment and Resources. 32: <b>only pp 99-1102 and 115-121.</b> Vitousek, Peter M., R. L. Naylor, T. Crews, M. B. David, L. E. Drinkwater, E. Holland, P. J. Johnes, J. Katzenberger, L. A. Martinelli, P. A. Matson, G. Nziguheba, D. Ojima, C. A. Palm, G. P. Robertson, P. A. Sanchez, A. R. <b>Lab:</b> Digital soil maps, Soil health

Week 7 Feb 14, 16	<p><b>Lecture:</b> Agriculture, Climate, Carbon</p> <p><b>Readings:</b></p> <p>Griscom et al. 2017. Natural climate solutions. PNAS 114: 11645-11650.</p> <p>Schlesinger, W.H. 2000. Carbon sequestration in soils: some cautions amidst optimism. Agriculture, Ecosystems, Environment 82: 121-127</p> <p><b>Lab:</b> Carbon stocks -soil and biomass, GHG values/IPCC carbon default values; partial nutrient balances</p>
Week 8 Feb. 21, 24	<p><b>Lecture:</b> Climate, Water, and Agriculture</p> <p><b>Readings:</b></p> <p>Gordon, L. J., C.M. Finlayson, M. Falkenmark. 2010. Managing water in agriculture for food production and other ecosystem services. Agricultural Water Management: doi: 10.1016/j.agwat.2009.03.017</p> <p><b>Lab:</b> Agroecological zones, Climate maps, irrigation maps</p>
Week 9 Feb. 28, Mar. 2	<p><b>Lecture:</b> Biodiversity and Intensification - Tradeoffs and Synergies; Land sharing/Land sparing</p> <p><b>Readings:</b></p> <p>*Grass, I., J. Loos, S. Baensch, P. Batary, F Libran-Embid, et al. 2018. Land-sharing/land-sparing connectivity landscapes for ecosystem services and biodiversity conservation. People and Nature 1:262-272.</p> <p>*Kremen, C. and A. M. Merenlender. 2018. Landscapes that work for biodiversity and people. Science 362</p> <p><b>General Discussion about production and environmental domains</b></p> <p><b>Readings:</b></p> <p>Springmann, M. et al. 2018. Options for keeping the food system within environmental limits. Nature 562: 519-525.</p> <p>Clark, M. and D. Tilman. 2017. Comparative analysis of environmental impacts of agricultural production systems, agricultural input efficiency, and food choice. Environmental Research Letters 12:111002</p> <p><b>Assignment:</b> Exam 2</p> <p><b>Lab:</b> Organize, compare, and discuss data to date</p>
Week 10 Mar. 7, 9	<p><b>Spring Break</b></p>
Week 11 Mar. 14, 16	<p><b>Lecture:</b> Agriculture as the Engine of Economic Growth: production and economic domains</p> <p><b>Readings:</b></p>

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	<p>Barrett, C.B., Carter, M.R. and Timmer, C.P., 2010. A century-long perspective on agricultural development. <i>American Journal of Agricultural Economics</i>, 92(2), pp.447-468.</p> <p>Jayne, T.S., S. Snapp, F. Place, N. Sitko. 2019. Sustainable agricultural intensification in an era of rural transformation in Africa. <i>Global Food Security</i> 20: 105-113..</p> <p><b>Lab:</b> Poverty and income</p>
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<p>Week 12 Mar. 21, 23</p>	<p><b>Lecture:</b> Agriculture as the Engine of Economic Growth: production and economic domains – continued</p> <p><b>Readings:</b></p> <p>Lee, D.R. 2005. Agricultural sustainability and technology adoption: Issues and policies for developing countries. <i>American Journal of Agricultural Economics</i> 87: 1325-1334.</p> <p>Lotte et al. 2014. Adoptability of sustainable intensification technologies – Drylands – West Africa</p> <p><b>Lab:</b> poverty and income continued</p>
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<p>Week 13 Mar. 28, 30</p>	<p><b>Lecture:</b> Food Security, Nutrition, and Health – Agriculture and Human Domains</p> <p><b>Readings:</b></p> <p>Barrett, C.B. 2020. Overcoming global food security challenges through science and solidarity. <i>Amer. J. Afr. Econ.</i></p> <p>Fravel, S. et al. (2019). Food access deficiencies in Sub-Saharan Africa: Prevalence and implications for agricultural interventions. <i>Frontiers in Sustainable Food Systems</i> 3.</p> <p>Webb, P. and Kennedy, E., 2014. Impacts of agriculture on nutrition: nature of the evidence and research gaps. <i>Food and nutrition bulletin</i>, 35(1), pp.126-132.</p> <p><b>Lab:</b> food security, nutrition</p>
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<p>Week 14 Apr. 4, 6</p>	<p><b>Lecture:</b> Food Security, Nutrition, and Health – continued</p> <p><b>Readings:</b></p> <p>Carletto, G., M. Ruel, P. Winters &amp; A. Zezza (2015) Farm-level Pathways to Improved Nutritional Status: Introduction to the Special Issue, <i>The Journal of Development Studies</i>, 51:8, 945-957, DOI: 10.1080/00220388.2015.1018908</p> <p>Webb, P. and Kennedy, E., 2014. Impacts of agriculture on nutrition: nature of the evidence and research gaps. <i>Food and nutrition bulletin</i>, 35(1), pp.126-132.</p> <p><b>Assignment:</b> Exam 3</p> <p><b>Lab:</b> food and nutrition security</p>
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<p>Week 15</p>	<p><b>Lecture:</b> Social Domain.</p>
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Apr. 11, 13	<p><b>Readings:</b></p> <p>Grootaert, C. et al. 2004. Measuring Social Capital: An integrated questionnaire. The World Bank Working Paper No. 18</p> <p>Alkire et al. 2015. The Women’s Empowerment in Agriculture Index. IFPRI</p> <p><b>Lab:</b> Social domain and summarize data</p>
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Week 16	<b>Wrap up:</b> Discussion of key papers:
Apr. 18, 20	<p><b>Readings:</b></p> <p>Adesogan, A., A. H. Havelaar, S. L. McCune, M. Eilitta. 2019? Animal source foods: Sustainability problem or malnutrition sustainability solution? Perspective matters. Global Food Security</p> <p>Clark, M. A., M. Springmann, J. Hill, D. Tilman. 2019. Multiple health and environmental impacts of foods. PNAS.</p> <p>Hilborn, R., J. Banobi, S. J. Hall, T. Pucylowski, T. E. Walsworth. 2018. The environmental cost of animal source foods. Frontiers in Ecology and Evolution doi:10.1002/fee.1822</p> <p><b>Discussion:</b> overview of key points of semester</p> <p><b>Assignment:</b> Exam 4 <b>(Due April 25)</b></p> <p><b>Assignment:</b> Hand in Case Study Report <b>(Due April 27)</b></p>

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### 15. Services for Students with Disabilities

Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)) by providing appropriate documentation. Once registered, students will receive an accommodation letter which must be presented to the instructor when requesting accommodation. Students with disabilities should follow this procedure as early as possible in the semester.

0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)

**16. Software Use** – All faculty, staff and student of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

### 17. Services for Students with Disabilities.

#### Services for Students with Disabilities

The Disability Resource Center coordinates the needed accommodations of students with disabilities. This includes registering disabilities, recommending academic accommodations

within the classroom, accessing special adaptive computer equipment, providing interpretation services and mediating faculty-student disability related issues. Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation

0001 Reid Hall, 352-392-8565, [www.dso.ufl.edu/drc/](http://www.dso.ufl.edu/drc/)

#### 18. Your well-being is important to the University of Florida.

##### Campus Helping Resources

Students experiencing crises or personal problems that interfere with their general well-being are encouraged to utilize the university's counseling resources. The Counseling & Wellness Center provides confidential counseling services at no cost for currently enrolled students. Resources are available on campus for students having personal problems or lacking clear career or academic goals, which interfere with their academic performance.

- University Counseling & Wellness Center, 3190 Radio Road, 352-392-1575, [www.counseling.ufl.edu](http://www.counseling.ufl.edu)

##### Counseling Services

##### Groups and Workshops

##### Outreach and Consultation

##### Self-Help Library

##### Wellness Coaching

- U Matter We Care, [www.umatter.ufl.edu/](http://www.umatter.ufl.edu/)

- Career Resource Center, First Floor JWRU, 392-1601, [www.crc.ufl.edu/next-level](http://www.crc.ufl.edu/next-level)

#### 19. Student Complaints:

- Residential Course: [https://www.dso.ufl.edu/documents/UF\\_Complaints\\_policy.pdf](https://www.dso.ufl.edu/documents/UF_Complaints_policy.pdf)
- Online Course: <http://www.distance.ufl.edu/student-complaint-process>