Readings for ISSST Agroecology Industrial Ecology Intersection

Thank you so much for participating in this programming at the ISSST Conference 2023!

Both of Agroecology and Industrial Ecology look to ecology for guidance about how to design systems and processes for our human lives, but with different methods and even foundational worldviews. There is a lot of opportunity and a lot of room for misinterpretation, as is true for most interdisciplinary endeavors.

These readings were selected to provide perspectives from Agroecology and Industrial Ecology and to support some of the specific goals stated in the proposal documents provided. There will not be a quiz, so enjoy and review with curiosity. Please feel free to add to the list at the end of this document.

In addition to the recommended readings below, please review:

- The USDA proposal to the Bioenergy, natural resources, and environment, Sustainable Bioeconomy through Biobased Products. A1414, which provided funding for travel and lodging of agroecologists and other scientists and engineers with a focus on agriculture it's production.
- The Penn State Rock Ethics Institute Seed Grant proposal which provided a scholarship and travel support to Farrah Dingal a Penn State M.S. student (and much more) to support the development of the Ethics Workshop.
- AE/IE Panel Discussion Working Draft

Background on Industrial Ecology and Agroecology.

International Society for Industrial Ecology. "What is Industrial Ecology?" https://is4ie.org/about/what-is-industrial-ecology

> "The idea is first to understand how the industrial system works, how it is regulated, and its interaction with the biosphere; then, on the basis of what we know about ecosystems, to determine how it could be restructured to make it compatible with the way natural ecosystems function." - Erkman (1997)

Agroecology is a broad and diverse field spanning science and social movements. In the global North, Agroecology research is often based in physical and ecological sciences, e.g., soil health, management. In the global South, Agroecology is often more of a social movement. This is a generally agreeable set of characteristics for Agroecology: https://www.agroecology-europe.org/the-13-principles-of-agroecology/

Please review:

- Wezel, A., S. Bellon, T. Dore, C. Francis, D. Vallod, C. David. 2009. Agroecology as a science, a movement and a practice. A review. *Agronomy for Sustainable Development*. 29:503-515.
- Erkman, S. 1997. Industrial Ecology: An historical view. *Journal of Cleaner Production*. 5(1-2):1-10.

These fields strive to learn from ecology in order to better manage systems to meet human needs with minimal harm to ecosystems. Both fields recognize that social institutions and relationships are critical. And, yet the foundations of our fields and the worldviews they were born in, as well as our individual experiences make it challenging to communicate and align toward common goals. The following readings aim to give more depth to considering how perspective influences our research activities and interpretations.

- Stojanovic, Milutin. 2019. Conceptualization of Ecological Management: Practice, Frameworks and Philosophy. *Journal of Agricultural and Environmental Ethics*. 32:431–446. https://doi.org/10.1007/s10806-019-09783-2
- Chamberlin, T.C. 1965. The Method of Multiple Working Hypotheses. *Science*. https://www.science.org/doi/10.1126/science.148.3671.754

There is considerable tension in this moment in time when there is a lot of focus on accounting for greenhouse gas emissions from land and the biosphere and bioproducts and arguably a lack of accounting for other important aspects of best management of land. There has been tremendous effort for decades to develop carbon accounting policies and market that people can agree with, thought to be fair this has largely occurred in the Energy and Fossil Fuel sectors. As attention is placed on Agricultural and Forestry, carbon-focused climate policy and the metrics that support it are meeting criticism from traditions and disciplines that have long been fighting for different ways to interact with land. We cannot unpack all of that, but below is a reading that outline a few of the key arguments and concerns.

The backbone of carbon accounting is Life Cycle Assessment. Carbon accounting is intended to hold industries accountable for their contribution to climate change and have largely been productive. Agriculture and Food Systems in particular are more complex and there is concern that too much focus on Carbon could miss other important aspects of these systems culturally and with regard to ecosystem impacts.

There are two related topics that we'll focus on at ISSST: (1) What is the state of our ability to accurately estimate GHG emissions at different geographic and temporal scales and (2) What other ecosystems services or impacts are important? There are many other questions related to equity, justice, culture and more that I hope will be brought up.

- EarthShift Global. “Carbon Footprint vs. Carbon Intensity.” https://earthshiftglobal.com/blog/carbon-footprint-vs.-carbon-intensity
- IPES-Food (International Panel of Experts on Sustainable Food Systems). 2022. Smoke and Mirrors: Examining competing framings of food system sustainability: agroecology, regenerative agriculture, and nature-based solutions. https://ipes-food.org/_img/upload/files/SmokeAndMirrors.pdf
- Berardy, A. T. Seager, C. Costello, and C. Wharton. 2020. Beyond Life Cycle Assessment: Towards Holistic Food Sustainability Evaluation. Journal of Agriculture, Food Systems, and Community Development. 9(4):1-19. https://doi.org/10.5304/jafscd.2020.094.009
- Valdivia, S. et al., 2021. Principles for the application of life cycle sustainability assessment. Int’l J of LCA. 26: 1900–1905. https://link.springer.com/article/10.1007/s11367-021-01958-2
- Englund, O., et al., 2020. Multifunctional perennial production systems for bioenergy: performance and progress. WIREs Energy & Environment. 9(5):Sept/Oct. 2020. https://doi.org/10.1002/wene.375
- Details on the Methods used by the U.S. Environmental Protection Agency to estimate GHG emissions in Agriculture, namely manure and soils. Note the comments on uncertainty, quite large. https://www.epa.gov/system/files/documents/2022-08/Chapter4-StateGHGI_Methodology_Report_Aug2022.pdf
    - Full report: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks
- An example of a detail relevant to GHG accounting and management to reduce emissions: Basche, A.D., F.E. Miguez, T.C. Kasper, and M.J. Castellano. 2014. Do cover crops increase or decrease nitrous oxide emissions? A meta-analysis. *Journal of Soil and Water Conservation 69(6):471-482. https://www.jswconline.org/content/69/6/471*

Optional/Supplemental

Prof. Braden Allenby, a keynote at ISSST 2023, has been a thought leader in the field of Industrial Ecology and introduced a concept he calls Earth Systems Engineering and Management. My sense has always been that the ESEM perspective doesn’t necessarily think that it’s good that humans have altered the Earth so significantly, rather that we have and it is our responsibility to do a better job. There was a bit of a back and forth with Keith, which I think exemplifies some of the difficulties with understanding each other, even when there is a shared goal.

- Allenby. 2000 Earth Systems Engineering and Management. https://ieeexplore.ieee.org/document/890078/authors#authors
- Keith, D.W. 2000. The Earth is not yet an artifact. https://ieeexplore.ieee.org/document/890079
- Allenby. 2000. Response to: "The Earth is Not Yet an Artifact," by David Keith, from Brad Allenby. https://ieeexplore.ieee.org/document/913200

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This document preceded "Smoke and Mirrors" and is critical of an effort to make an "IPCC of Food," because there are already a number of organizations that have been focused on food sustainability for some time.
https://www.ipes-food.org/_img/upload/files/UNSG_UNFSSOpenLetter.pdf

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Soil Conditions and Plant Growth (pg 22-48)
https://marwanbaloch.files.wordpress.com/2015/01/soil-conditions-and-plant-growth.pdf
Communities of plants capture and convert environmental resources into carbon-based products. Their absolute capture and conversion of resources will determine their total productivity (biomass) and, where a proportion of this biomass is useful to human beings, their harvestable yield. Their relative capture and conversion of resources will determine the suitability of one crop over others at any location and in any growing season. The principles of resource capture and conversion (hereafter, simply resource capture) can be considered as a framework for analysing the performance of crops and cropping systems. In this analysis, groups of plants (crops) act as vegetation 'factories' in which environmental resources are sequestered ('captured') and fixed ('converted') into chemical products. By using this physical analogy, we can apply concepts of 'work', 'energy' and 'efficiency' to the whole vegetation system and compare the performance of one vegetation system with another.

Raudsepp-Hearne, C. et al., 2010 Untangling the Environmentalist's Paradox: Why Is Human Well-being Increasing as Ecosystem Services Degrade? BioScience 60: 576–589. ISSN 0006-3568
Environmentalists have argued that ecological degradation will lead to declines in the well-being of people dependent on ecosystem services. The Millennium Ecosystem Assessment paradoxically found that human well-being has increased despite large global declines in most ecosystem services. We assess four explanations of these divergent trends: (1) We have measured well-being incorrectly; (2) well-being is dependent on food services, which are increasing, and not on other services that are declining; (3) technology has decoupled well-being from nature; (4) time lags may lead to future declines in well-being. Our findings discount the first hypothesis, but elements of the remaining three appear plausible. Although ecologists have convincingly documented ecological decline, science does not adequately

understand the implications of this decline for human well-being. Untangling how human well-being has increased as ecosystem conditions decline is critical to guiding future management of ecosystem services; we propose four research areas to help achieve this goal.

The Method of Multiple Working Hypotheses

Author(s): T. C. Chamberlin (1890)

https://webhome.auburn.edu/~tds0009/Articles/Chamberlain%201965.pdf

As methods of study constitute the leading theme of our session, I have chosen as a subject in measurable consonance the method of multiple working hypotheses in its application to investigation, instruction, and citizenship. There are two fundamental classes of study. The one consists in attempting to follow by close imitation the processes of previous thinkers, or to acquire by memorizing the results of their investigations. It is merely secondary, imitative, or acquisitive study. The other class is primary or creative study. In it the effort is to think independently, or at least individually, in the endeavor to discover new truth, or to make new combinations of truth, or at least to develop an individualized aggregation of truth. The endeavor is to think for one's self, whether the thinking lies wholly in the fields of previous thought or not. It is not necessary to this habit of study that the subject-material should be new; but the process of thought and its results must be individual and independent, not the mere following of previous lines of thought ending in predetermined results…As in the earlier days, so still, it is the habit of some too hastily conjure up an explanation for every new phenomenon that presents itself. Interpretation rushes to the forefront as the chief obligation pressing upon the putative wise man. Laudable as the effort at explanation is in itself, it is to be condemned when it runs before a serious inquiry into the phenomenon itself. A dominant disposition to find out what is, should precede and crowd aside the question, commendable at a later stage, "How came this so?" First full facts, then interpretations.

Who "Designs" the Agricultural Landscape? <attached>

ABSTRACT In the United States, the landscape most responsible for producing animal protein is the Upper Midwest "Corn Belt." Currently, this region is challenged by poor water quality, declining biological diversity, and decaying rural communities. It is also the region most responsible for the zone of hypoxia in the Gulf of Mexico. This paper examines the question of who has designed the current agricultural landscape in the Corn Belt, and how it might best be re-designed to better serve broader public interests. Several modeling studies indicate that the region would benefit both economically and ecologically from increased perennial cover on the landscape. However, farmers' options for meaningful land use change are significantly constrained by powerful market forces far removed from the region. Federal conservation programs have been poorly funded, and generally make minor improvements to conventional production systems, while commodity policy is heavily influenced by agribusiness interests. Metropolitan consumers can demand greater account- ability from the global agribusiness corporations responsible for the design of the Corn Belt and work for food and agricultural policy that supports ecosystem health, public health, and health of rural communities

Multifunctional perennial production systems forbioenergy: performance and progress (attached)

As the global population increases and becomes more affluent, biomass demands for food and biomaterials will increase. Demand growth is further accelerated by the implementation of climate policies and strategies to replace fossil resources with biomass. There are, however, concerns about the size of the prospective biomass demand and the environmental and social consequences of the corresponding resource mobilization, especially concerning impacts from the associated land-use change. Strategically integrating perennials into landscapes dominated by intensive agriculture can, for example, improve biodiversity, reduce soil erosion and nutrient emissions to water, increase soil carbon, enhance pollination, and avoid or mitigate flooding events. Such "multifunctional perennial production systems" can thus contribute to improving overall land-use sustainability, while maintaining or increasing overall biomass productivity in the landscape. Seven different cases in different world regions are here reviewed to exemplify and evaluate (a) multifunctional production systems that have been established to meet emerging bioenergy demands, and (b) efforts to identify locations where the establishment of perennial crops will be particularly beneficial. An important barrier towards wider implementation of multifunctional systems is the lack of markets, or policies, compensating producers for enhanced ecosystem services and other environmental benefits. This deficiency is particularly important since prices for fossil-based fuels are low relative to bioenergy production costs. Without such compensation, multifunctional perennial production systems will be unlikely to contribute to the development of a sustainable bioeconomy.