

Theory and Practice of an Interdisciplinary Food Systems Curriculum¹

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Abstract

Food production, consumption and trade are inextricably connected to health, livelihoods and the environment. In an increasingly globalized food system, commodity chains are complex and socio-cultural relations paramount. Conventional agriculture education programs and even non-traditional sustainable agriculture programs, do not always explicitly address food systems with global, structural and socio-cultural perspectives. As part of a three-year National Institute of Food and Agricultural postdoctoral research grant, I developed a curriculum for an undergraduate-level Sustainable Food Systems program. The program was comprised of six interdisciplinary courses that emphasize place-based learning, political ecology and agroecology. I created this curriculum through a case study at Fort Lewis College, a public liberal arts college in Durango, Colorado. Results from a survey of students at the college, interviews and surveys with food systems practitioners and literature review all combined to inform the direction of curriculum development. The developed courses are interdisciplinary, field-based, experiential and project-based. I piloted three of these courses and found that students established deep critical thinking skills around values-based controversial issues and were able to articulate solutions for complex place-based food systems problems.

Introduction

The study of food systems is inherently complex, including such varied topics as power dynamics along complex value chains (Alkon and Agyeman, 2011; Buck et al., 1997; Lind and Barham, 2004), health and the industrialized food system (Alston et al., 2008; Altieri, 2009), unequal institutional support for crops (Breggin and Myers, 2013; Spittler et al., 2011) and uneven impacts of food security (Sen, 1982; Trauger, 2014). Incorporation of these themes into a coherent food systems learning

program is challenging. A crucial question for educators is how to structure coursework around food systems such that they are viewed as objects of study at the human-environment nexus and not placed wholly on either end of that spectrum. Historically, programs dealing with food systems emerged from agricultural programs and institutions seeking to adapt to cultural and market shifts towards sustainable agriculture (Karsten and Risius, 2004; Keating et al., 2010). These programs emerged from production-oriented departments and institutions, meaning that the new alternative curricula were often still farm-scale in nature (Keating et al., 2010). However, in recent years, the study of food systems themselves as the object of inquiry has resulted in the development of food systems curricula, as opposed to sustainable agriculture curricula (LaCharite in press).

This paper presents an interdisciplinary series of courses for post-secondary learning about food systems that emphasizes place-based learning, political ecology and agroecology. The program emphasizes approaches to food systems curricula development derived from a previous literature review (Hilimire et al., 2014) in which we identified interdisciplinarity, systems-thinking and the experience-theory-skill complement as core theoretical and pedagogical concepts for effective food systems learning (Table 1). Interdisciplinary thinking incorporates multiple perspectives and systems-thinking uses multi-scalar relationships as the object of inquiry (Francis et al., 2011; Karsten and O'Connor, 2002), both of which allow for a more accurate analysis of food systems than disconnected, disciplinary approaches (Schneider et al., 2005). The experience-theory-skill complement is a three-pronged approach to food systems curricula development that blends experience-based learning, theoretical study and skills acquisition.

From the same literature review (Hilimire et al., 2014) we identified exposure first, case study learning

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Table 1. Concepts and goals for food systems curricula development, derived from Hilimire et al. (2014).

CONCEPT	EXPLANATION	GOALS
Core theoretical and pedagogical concepts		
Interdisciplinarity	Interdisciplinarity is a key concept for food systems curricula, both within individual courses and across an entire curriculum. Interdisciplinarity engages multiple perspectives, through both theory and method.	To effectively analyze food systems, which are inherently interdisciplinary.
Systems-thinking	Systems-thinking, in the context of food systems curricula, defines the object of inquiry as a system, allowing for engagement with the whole complexity of food systems.	To realistically define food systems as a series of complex, multi-scalar relationships.
Experience-theory-skill complement	The experience-theory-skill complement is an organizing principle for food systems curricula, suggesting that educators incorporate experience, theory, and skills acquisition into any curriculum. Experience-based learning can occur through events such as field trips, or participatory activities such as internships. Theoretical study can occur through engagement with the literature or debate. Skills refers to acquisition of accepted tools used for analysis and work in food systems.	To engage and delineate multiple modes for food systems learning. To foster civic engagement, critical thinking, and job-specific skills.
Techniques for building food systems curricula		
Exposure first	Exposure first, in the context of food systems, is a non-linear approach to learning that involves introducing learners to a food system early in a course or curriculum before tools of analysis or theoretical understanding are introduced, reinforced, or mastered.	To encourage curiosity and engagement among learners, as well as the ability to build contextual knowledge of food systems before theoretical concepts are mastered.
Case study learning	Case study learning connects students to real or imagined food systems scenarios, often asking learners to address or define problems. Case study learning can occur through many forms, such as written assignments, class discussion, and experience-based learning.	To link theoretical and practical concepts in the study of food systems, and to develop problem-solving skills.
Cooperative group learning	Cooperative learning includes team work and learning with practitioners.	To foster peer-to-peer learning and “communities of learners” (Ison 1990).

and cooperative learning as techniques for food systems curricula development (Table 1). Exposure first refers to the concept of immersing students in a complex food system scenario early in a course or curriculum. This represents a non-linear approach to learning whereby students gain investment in a topic and awareness of its complexities well before tools of analysis or theoretical understanding are introduced, reinforced, or mastered (Ison, 1990; Lieblein and Francis, 2007; Lieblein et al., 2007). Case study learning involves presenting learners with real or simulated food systems situations and then defining the problems or envisioning solutions for each case. Written assignments, class discussion and experience-based learning all serve case study learning well and allow students to link theory and practice to hone critical thinking and problem-solving skills. Finally, we found that cooperative learning, in which teams of study are comprised of peers and/or practitioners, allows for a participatory experience in learning about others’ personal experiences with food systems. This approach is particularly effective for a field such as food systems, where every learner is also a daily participant in the engagement with food.

After generating these food systems curricula development concepts and techniques, I sought to apply them in a postsecondary liberal arts context through development of a Sustainable Food Systems program, as presented in this paper. The presented program analyzes the social, political, economic, cultural and ecological domains of food and the associated pedagogy explicitly includes those fields that are sometimes left out of sustainable agriculture programs, such as human geography and political ecology. The objectives of this paper are to: (1) illustrate one approach for building a food systems program based on the above-described theoretical framework, (2) report on the piloted portions of this curriculum.

Methods

A National Institute of Food and Agriculture (NIFA) postdoctoral fellowship awarded in 2012 supported the development of pedagogy and curricula for what was originally titled an “Agroecology Certificate” at Fort Lewis College. Fort Lewis College is a public liberal arts postsecondary institution located in the rural southwestern region of Colorado in the city of Durango (population 17,500). In 2014, Fort Lewis College enrolled approximately 4,000 students in 30 majors. As a Native-American serving institution, Fort Lewis College enrolled students from 155 American Indian tribes and Native Alaskan villages in that time period (FLC n.d.). Historically, the school had a strong agricultural focus, with an agriculture program from 1925 to 2011 (FLC n.d.). In the 2000s, Fort Lewis left the land grant Colorado State University (CSU) system. While it had a liberal arts mission under land-grant CSU, following this shift, it became a stand-alone institution with a liberal arts focus. Eventually, formal agriculture science programs were removed from the college curriculum. Despite this departure, student interest in food systems studies remained high, with 87% of students in a 2013 survey indicating they were somewhat to very interested in more food systems coursework at Fort Lewis (Hilimire and McLaughlin in press). Under the NIFA grant, I proposed to create a curriculum for an Agroecology Certificate at Fort Lewis College. Throughout the course of this research, I retitled the curriculum as a “Sustainable Food Systems” program because the conceptual heft associated with the phrase sustainable food systems more accurately reflected the nature of the curriculum with its focus on political ecology, geography and ecological agriculture than did the term agroecology, which was often defined by students and colleagues as production-oriented.

To develop this series of courses, I completed a literature review (Hilimire et al., 2014), a survey of

Fort Lewis College students (Hilimire and McLaughlin in press), interviews and surveys with food systems practitioners, the preparation of the courses for the curriculum itself and piloting of courses. Key to the process of course creation was insight from practitioners (Niewolny et al., 2012). Through on-site visits, interviews and an online survey, I communicated with 18 food systems professionals in 2013 and 2014, found by contacting all farmers and ranchers listed as vendors at the Durango farmers market and in the Eat Local guide. I also networked with the local county extension agent and used word-of-mouth to identify additional food systems professionals. These food systems professionals represented the range of professions in food systems in the region of the college and included mixed vegetable farmers, orchard farmers, beef ranchers, food access and nutrition non-profit workers, policy advocates and the manager of a meat processing plant. These professionals offered insight for shaping the curriculum and became contacts for hosting field trips, giving guest lectures and offering internships. In this paper, I report on the results of developing and piloting the courses. Combining insight from the literature review, the student survey and practitioner interviews, I built six courses for the program, including course descriptions, teaching outlines and field-based program options. I piloted three of these courses. Following piloting, I evaluated courses through student feedback and refined them.

Results and Discussion

Six Food Systems Courses

Based on the pedagogical theory from the literature review; input from students given in the survey; and ideas from faculty, staff and food systems professionals, I built a series of six courses for a Sustainable Food Systems program (Table 2). Altogether, these courses form a cohesive, interdisciplinary food systems program with courses that can be taught by various faculty with related expertise. The goal in developing this curriculum was to create a program of courses, each one interdisciplinary, that cumulatively presented analytical tools for the assessment of the social, political, economic, cultural and ecological domains of food. This goal was informed by the need for learning programs tailored to systems-oriented scholars and professionals in the realm of food systems, as opposed to solely agriculture and was also driven by the need for curricula that fit well in a liberal arts context, as opposed to a land-grant context (Jacobsen et al., 2012; Parr et al., 2007). The presented Sustainable Food Systems program emphasizes the analysis of agricultural spaces as ecosys-

tems, proficiency in food policy and politics and engagement with social issues surrounding food systems.

Sustainable Food Systems of the Four Corners

The first course in the series was called “Sustainable Food Systems of the Four Corners region.” This interdisciplinary course aimed to engage students with food systems learning through the exposure first model, which entails engagement with complexity early in a food systems curriculum, rather than waiting until students master building block concepts, to involve them with complicated food systems analysis (Hilimire et al., 2014; Ison, 1990; Lieblein and Francis, 2007; Lieblein et al., 2007). Exposing students to complexity in food systems early in the curriculum can encourage investment in learning and synthesis.

I piloted this course during summer semester 2013. Learning modules for the class included a brief history of U.S. agriculture; defining key terms “food systems,” “livelihoods,” and “agroecology;” introduction to horticultural skills; meat and livestock; food security; and careers in food systems. These modules were particularly relevant to the region where the school was located for facilitation of experience-based learning. For the first module on the history of U.S. agriculture, students read and discussed the changes that have occurred primarily over the last 150 years in U.S. agriculture. We examined contemporary trends in U.S. food systems, focusing in-depth on the idea of “local foods.” Students read and debated various view points on local foods (Born and Purcell, 2006; DuPuis and Goodman, 2005; Pilgeram, 2011; Pollan, 2006), using an explicitly geographic lens. Specifically, the analysis of the rhetorical strategy around local foods served to highlight the importance of scalar analysis, as students learned that local foods could accommodate positive or negative environmental impacts, depending on the scale of analysis (Born and Purcell, 2006). For the horticultural skills part of the class, we visited four different mixed vegetable farms, with students learning and practicing specific skills for

Table 2. Courses for a sample sustainable food systems college curriculum.

Course title	Key course concepts
Sustainable Food Systems of the Four Corners	Study the food system local to the college to promote early engagement with the complexity of food systems through an exposure first model.
Political Ecology of Food	Use written case study responses to develop deductive reasoning skills. Cultivate inductive reasoning with student-developed team research projects, which also emphasize cooperative group learning. Utilize literature from geography, political ecology, and other social sciences to explicitly analyze the structural context of food systems at multiple scales.
Ecological Agriculture	Develop practical farm and/or garden management skills, using the experience-theory-skill complement to balance field trips to farms, literature study, and the cultivation of a campus garden. Emphasize literature from agroecology, ecology, and other natural sciences to apply the ecosystem concept to agriculture and to study organic farming methods.
Interdisciplinary Field Training in Food Systems	Build skills proficiency for food systems analysis through learning and practicing field methods. Build critical thinking skills by applying methods in real world settings on a variety of farms, food policy agencies, and food systems organizations.
Community Development of Food Systems	Analyze a specific food sovereignty case using tools from participatory action research.
Independent Field Experience	Form specific expertise in an area of food systems inquiry through a student-centered learning experience with a food systems professional organization, farm, or ranch.

soil management, irrigation, crop culture and pest management. These field days, combined with lecture and readings on agroecology, altogether served to provide students with a complement of experience, theory and skills in regards to horticulture. This focus on horticulture was introductory to the third course in the series, "Ecological Agriculture."

In the meat and livestock portion of the class, we compared confined animal feeding operations to grass-fed cattle grazing and small-scale supplemental feeding operations. This unit was highly relatable for students in Colorado, many of whom were in-state residents. Cattle are a common sight in the agricultural landscape and the open curiosity of students about this subject strongly supported learning. In this vein, I recommend that for this course to be adopted in another region that it be crafted to focus on case studies relevant to the region. In the pilot course, we visited a slaughterhouse and two ranches with distinct management styles. Students then wrote reflective essays comparing observations from the site visits and their readings on the different management styles.

This course also emphasized civic engagement through a community partnership for service learning, a strategy utilized by other food systems programs (Clark et al., 2013). In the pilot version of this course, I partnered with an anti-hunger non-profit with an office in the region of the college. Students read reports on regional food security and a coordinator from the organization facilitated a lecture and discussion with students. The class then worked on a series of homework assignments. The first was titled "Shopping on a Budget." Students were instructed to report on field research to provide dinner for a family of four using \$10 or less. After comparing costs and options at three different types of markets: a conventional grocery store, a convenience store and a farmer's market, students wrote reports detailing their findings. They compared meals on parameters of cost, total caloric intake per meal, nutritional and health values and environmental impact. For each parameter, students had to explain the values on which they based the comparisons. At the end of the paper, they described which meal they would serve and why.

In the second phase of the food security module of the course, I sought to connect the student research from the Shopping on a Budget activity with an activity designed to generate a useful product for the non-profit. Students were assigned the creation of recipes that could be used by clients of the non-profit to facilitate healthy, affordable cooking. The expectation for these recipes was that students would link concepts from the class to the assignment, proposing recipes with strong embedded environmental and social values, with ingredients totaling less than \$10 for a dinner for a family of four. On nearly all assignments, students fell short of the expectations and I believe that the assignment was given too early. Exposure first is intended to immerse students in the complexity of food systems to promote early engagement and investment

in learning. However, engagement and investment do not translate to proficiency, at least not without the analytical tools taught at later points in this curriculum. Instead of asking students to learn and implement new concepts so rapidly, this entry-level class should have focused on assignments in which students verbalized critical thinking, as opposed to demonstrating its results. In teaching this class again, I would instead emphasize work more like the Shopping on a Budget assignment. Such reflective assignments can support students to articulate questions, which may be more appropriate for an entry-level class.

Finally, this course included a lecture and discussion of careers in food systems. In evaluations of the course, students highlighted this as one of the most important units of the class. It was valuable to include this as a unit in the first course of a Sustainable Food Systems program such as this one, because future courses asked students to take a direct role in the choice of research topics and internships. Having an idea of what job-oriented direction they may pursue helped students to more carefully craft these student-centered options.

Political Ecology of Food

The second course in the series was called "Political Ecology of Food." In contrast to the regional concentration of the first course, this class emphasized the tension of the multiple scales of food systems, from local to global and highlighted analytical tools from the social sciences. The focus of this course was to apply theories from geography, political ecology and other social sciences to the multi-scalar analysis of food systems. I piloted this course in the spring semester of 2014, strongly emphasizing a combination of deductive and inductive case studies. Learning modules for the class included ethanol, food justice, commodity chain analysis, U.S. agricultural subsidies, free trade agreements, food and farm workers, pesticides, genetically modified organisms, food safety, fair trade and organic foods.

This course took a case study learning approach (Hilimire et al., 2014) by examining specific examples illustrative of larger themes in food systems studies. For these, I purposefully selected controversial topics for this course and provided students with readings that showed contrasting viewpoints. These encouraged students to enrich critical thinking skills and become comfortable with uncertainty in food systems research. For example, in a unit on quinoa, students read various articles, among which was a piece by (Jacobsen, 2011) and its response by Winkel et al. (2012). After reading these articles, students discussed the role that increased global quinoa consumption has played for food security and rural livelihoods in quinoa-producing regions. In another unit on genetically modified organisms, students read a book co-authored by a geneticist and an organic farmer (Ronald and Adamchak, 2008) about the potential benefits of genetically-modified organisms for organic-style agriculture. This book was intellectually challenging because it brought together two practices in

a complementary way that are often seen as competing. Students were surprised to learn the actual definition of genetic engineering and many struggled to separate the technical definition from the emotional associations with the term.

I incorporated case studies in several ways as homework assignments for this course. For several assignments, students responded to essay prompts for hypothetical situations. One essay prompt was:

The mayor of Our town is concerned about obesity. She puts forth a ban on all food products containing High Fructose Corn Syrup (HFCS) across the city. She is then taken to court by the Corn Refiners Association for targeting a specific agricultural commodity (corn). What is your take on the issue? How do you solve this problem?

Prompts like these served as deductive case studies (Hilimire et al., 2014). In these, students were given pre-identified problems and instructed to identify analytical tools and solutions. In this course, I also used an inductive case study learning approach, in which students were the ones to characterize the topic and problem. For an eight-week segment of the course, I assigned a student-selected, cooperative learning project. The prompt for the assignment instructed students to identify a food systems issue and study it, using a combination of literature and primary research. For the primary research, students were encouraged to use observation or interviews as their main tools. One group conducted a comparison of coffee at four local coffee shops. They conducted interviews and gathered evidence, comparing a small-sized coffee at each establishment on environmental parameters (organic, shade-grown, etc.), social parameters (Fair Trade or other direct sales channels) and economic parameters (cost per gram of ground coffee in the brew). Another group administered a two-minute interview in the downtown area, asking participants about values when food shopping. On student evaluations, this was one of the most successful tools for learning that emerged from this course, with students commenting on the value of teamwork and the importance of researching topics of personal interest to them. Similar to other research, students also commented on the social aspect of teamwork, indicating that working in small groups made the assignment more enjoyable (Trexler et al., 2003).

In addition to the controversial topics and case study learning, I sought to explicitly incorporate themes and analytical tools from geography and political ecology into this course. Geography, with its focus on the connection of humans and nature, is particularly well suited as a theoretical basis for the study of food systems (Duram and Oberholtzer, 2010). Furthermore, the emphasis on place and space at multiple scales, an important theme for geographers, helped students to parse the impacts of food systems change in a spatially meaningful way. One of the primary themes of this course was “beneficial in one place and time does not mean beneficial in all places and times.” Through this lens, students analyzed topics such as international food trade, learning to

identify winners and losers at multiple spatial and temporal scales.

Political ecology is a field that examines the environmental behavior of land-based actors, traditionally conceived of as peasants, in the context of political economy at multiple scales (Blaikie and Brookfield, 1987; Lawhon and Murphy, 2012; Walker, 2005). This course examined the land use decisions of agriculturalists in the contexts of local, regional, national and global political economies. Students used the multiples scales of political economy to distinguish land use behaviors of farmers. For example, students assessed private sector food safety regulations in California and their impacts on decisions to limit on-farm conservation practices (Beretti and Stuart, 2008; Stuart, 2009). They also examined the role of the “U.S. Farm Bill,” past and present, on the American landscape and assessed the cascading effects of international free trade agreements on land use, particularly with regards to corn in Mexico. From this, students were asked to comment on the ways in which agriculturalists are constrained in their environmental decision-making by intersecting scales of political economic relations (Lawhon and Murphy, 2012). In this course, this line of questioning led to a post-structural political ecology analysis of decision-making and in the second half of the course students examined the role of the moral economy in further constraining or empowering agriculturalist actors, assessing social and market movements such as organics, fair trade and local. In this, students were exposed to actor-network-theory (Murdoch et al., 2000) and the importance of examining power shifts that derive from social movements around food systems.

Ecological Agriculture

The third course in the series was called “Ecological Agriculture.” The goal of this course was to explore the ecosystem concept as it related to food. I piloted the course twice during the summer semesters of 2014 and 2015. The course immersed students in approaches to garden and farm management compatible with ecosystem function and environmental conservation. Ecological topics such as nutrient cycling, population dynamics, species interactions and adaptation were analyzed from an agroecological perspective. The course covered specific horticultural techniques for soil quality, irrigation management, crop rotations and integrated approaches to pest and weed management. Ecological Agriculture was a very skills-centric class. Students learned to assess soils in the field, interpret soil tests and build soil management plans. In another unit, students identified crops by botanical family and studied principles of crop rotation, intercropping and cover crops. Skills were tested throughout the semester in a series of in-class quizzes and take-home tests. Finally, for the capstone assignment of the course, students produced three-year cropping plans for a garden, including winter cover crops, summer season successions, intercrops and an articulated soil management plan.

Theory and Practice of an

The decision to include many hands-on skills in this course was informed by a student survey (Hilimire and McLaughlin in press) administered at Fort Lewis College that found a strong demand among students for acquisition of horticultural skills such as composting, gardening and sustainable farming techniques. In that survey, we also found that students sought experience-based learning opportunities, requesting that courses involve work on a farm or ranch. This course used the experience-theory-skill complement to integrate field trips to local farms, lectures and literature and work in the campus garden. One of the greatest strengths of the class was a cross-campus collaboration centered around the campus garden. The course was taught in the late spring (April-May) as an intensive and students tilled and amended the campus garden in preparation for the summer growing season. They also planted seeds and seedlings into the garden and built shade structures and trellises. At the conclusion of the course, two students assumed garden management as "Food Fellows," a program developed by the campus's student-run Environmental Center. The program offered a stipend to students for maintenance of several food-related campus projects. The collaboration with the Food Fellow program during the piloting of this course proved to be very successful; after the course concluded, the Fellows cared for and harvested the crops planted by the class. In addition, the Fellows worked closely with the cafeteria management to create a campus-grown model for using the garden crops as ingredients in the cafeteria.

Summary

The presented Sustainable Food Systems program incorporated multiple scales and perspectives through interdisciplinarity and systems thinking. The curriculum embodied the exposure first model with the first course in the sequence, in which students jumped into place-based case studies to build engagement and critical thinking skills even before analytical tools were mastered. It also included the experience-theory-skill complement at the level of the curriculum and in individual courses via field trips, inductive and deductive case studies, cooperative group learning, literature review, debate and job-specific skills learning. This program was designed to fit in a liberal arts context and emphasized political ecology, geography and agroecology. This Sustainable Food Systems program and others like it can support effective learning among undergraduates to address the complex problems of contemporary food systems.

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