From Tropical Plantations to K-cups

A socio-environmental analysis of the global journey of coffee

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Summary

This is a case study of the social, environmental, and economic impacts of coffee production and consumption worldwide. Coffee, as a globally traded commodity, has a large and growing ecological footprint, from land and water resources dedicated to growing it in developing countries, often displacing biodiverse forest ecosystems, through its transport to markets worldwide, the energy and materials used to package it for the market, to the landfills where the waste eventually ends up, especially from new technologies of consumption such as Keurig cups. Coffee consumption also has significant social and cultural dimensions, adding to the economic value of the trade. There is also growing concern about the sustainability of coffee due to the threats of global warming, which is shifting the optimal growing regions, and prevalent monoculture of a narrow genetic pool which leaves coffee crops vulnerable to disease and other stressors. The global coffee system therefore exemplifies a "wicked problem" in sustainability: a complex Socio-Environmental System (SES) with many stakeholders dispersed across socioeconomically disparate and culturally diverse nation-states, with significant ecological impacts and an uncertain future. The case study is motivated by conflicting reports about the sustainability of Keurig coffee cups, and builds on students' own experiences with coffee consumption to engage them in a conceptual analysis of the the global coffee SES. Students will work in small groups (3-4) to synthesize information about different aspects of the coffee SES, discuss impacts from different stakeholder perspectives, collaborate to develop a conceptual model to analyze the coffee SES and find sustainable solutions. Summative activities engage students to construct tools that show the interconnections between all parts of the SES, leading to a final signature assignment where students make recommendations for the most socially responsible and environmentally sustainable ways to consume coffee on campus.

What courses might this case study might be appropriate for?

- Methods Courses (see section 14 Assessment)
- Critical Thinking
- Environmental Sociology
- Foundational and Breadth Courses
- Integrative GE Courses

What level is this case study appropriate for?

- First Year Experience
- Lower Level Undergraduate
- Upper Level Undergraduate
- Graduate Level (digging deeper into the complexity of the system)

Socio-Environmental Synthesis Learning Goals

SES Goal 1a. Be able to identify the environmental and social components of a coffee system and its related interactions, particularly for campus.

Related activities: to identify system components, students used Mental Modeler to brainstorm parts of the coffee S-E system. After having to identify the main components (i.e., perspectives--like economic, socio-cultural, biological, agricultural, environmental, political, etc.), students used activities from three vetted SESYNC case studies--the Geoduck Case Study by Mulvaney et al., the Save the Turtles? Case Study by Che-Castaldo et al, and the Urban Green Case Study by Stander and Aronson--to do an information needs assessment of their group perspective, which was then used to make coffee information memos like the ones they used in the Save the Turtles exercise.

SES Goal 1b. Use tools and modeling approaches to understand the dynamics of the coffee system.

Related activities: students used Mental Modeler to both identify system components (goal 1a.) as well as explore the connections and feedbacks in the coffee system.

SES Goal 2. Consider the importance of scale and context in addressing coffee socio-environmental problems.

Related activities: students start exploring the coffee S-E system with activities aimed at the global scale, which they then scale down to propose sustainable solutions for the campus.

SES Goal 3. Co-develop coffee sustainability solutions in inter- and transdisciplinary teams.

Related activities: following the Six Hats icebreaker and group sorting activity, students are separated into disciplinary groups to produce group memos from their expert perspectives. Students are then jigsawed into new groups, containing one member from each expert perspective, which then work on making a new system model and problem tree that will then be used to propose more sustainable coffee offerings on campus.

SES Goal 4. Ability to find, analyze, and synthesize existing data, knowledge, methods, and ideas.

Related activities: in becoming disciplinary experts and creating group memos, students follow the information needs assessment framework from Stander and Aronson's Urban Green case study to identify and find information they need to create their group memos.

Groups analyze the the references and synthesize what is known by creating memos that are then used to rank the sustainability of a variety of coffee options--fairtrade, Starbuck, Keurig, traditional grocery store coffee, etc. Students map out their rankings to make problem trees, which are then turned into solution trees to propose ideas, reporting out what we can do on campus to make coffee more sustainable.

Case Study Learning Objectives
(what should students know or be able to do as a result of this activity?)

- identify various stakeholders, perspectives, and research tools for addressing complex socio-environmental systems

- use a system framework to analyze complex socio-environmental interactions

- identify a core problem, develop and evaluate possible solutions

GE Critical Thinking Learning Objectives *(Institutional Perspectives)*:

- Recognize, analyze, evaluate and construct arguments in ordinary language.

- Distinguish between inductive and deductive reasoning.

- Identify common fallacies of reasoning.

- Analyze and evaluate the various types of evidence for various types of claims

Course Learning Objectives

- Use inductive reasoning to form sound scientific hypotheses that show conceptual understanding based on experimental data

- Use deductive reasoning to predict expected experimental observations based on a scientific hypothesis

- Evaluate observations and experimental data to determine if a hypothesis is supported by or refuted by an experiment

- Critically evaluate the validity of inductive and deductive reasoning and data interpretation appearing in the scientific literature

- Use cause-effect chains to support a reasoned explanation of experimental observations

Introduction

The impetus for this case study comes from the use of Keurig coffee makers and their ecological footprint, resulting in a case for students to examine whether coffee may be consumed sustainably on the campus grounds of California State University, Fresno. Students need to develop an understanding of how and where coffee is produced, and in turn, how it is consumed, examining what is problematic both in terms of production and consumption, and critically thinking about what solutions may be developed for the problems they identify. To make complex connections, students explore and investigate the natural resources and materials that are directly used for a Keurig cup, energy flow and cycling between the coffee and the environment, water required to grow coffee, carbon emissions related to transporting and packaging the coffee and pods, social impacts of coffee growing for farm workers and local communities employed by the coffee trade, and ecosystem service impacts of coffee growing.

We used this case study in a newly-developed first-year experience for College of Science & Mathematics students, which consists of two courses, taken in cohorts, over the academic year. These courses fulfill "critical thinking" and "lifelong learning" General Education requirements, respectively, on our campus. The case study is also coupled with a sociology research methods class with modules that could also be modified for other introductory General Education and science courses.

Student prior knowledge:

- experience identifying different perspectives and stakeholders and how to come to an agreement while taking into account these different perspectives (e.g. Endangered Species case study from SESYNC).
- experience using concept maps to illustrate a system, its components, and their relationships

Sequence in the course:

- Start early, but not in the first two weeks (for a semester-long case study)
- Use prior SESYNC case study exercises to build into a semester-long case study

Motivating the Case:

Videos to motivate the case:

- *Dukale's Dream* film trailer (production)
- *Laughing Man* coffee and videos from Keurig website
- Interview with John Sylvan (inventor of the Keurig k-cup)
- Kill the k-cup (consumption)

In the trailer for his documentary, Dukale's Dream, Hugh Jackman journeys to Ethiopia to discover the origins of coffee, befriends a local man, Dukale, along the way, and learns of his plight as a coffee grower. Jackman makes several return visits over the course of several years, meeting with his friend, learning of the conditions of rural coffee producers and leading to his advocacy of fair trade coffee for consumption. Jackman observes the impoverishment of coffee growers, and looks for a solution to their plight. His friendship and interaction with Dukale leads to the development of Laughing Man coffee, of which Keurig Green Mountain is a buyer (and for which Jackman is a spokesperson).

"I flew 4,800 miles to find the perfect coffee. You only have to walk to your kitchen," asserts Jackman in the commercial "A Cup Half Full" for Laughing Man coffee. Jackman discusses the creation of a coffee bar in New York City, Laughing Man, as the fulfillment of a promise to Dukale to find a solution to his plight as a coffee grower. Jackman then reveals the taking of that promise to a new level, collaborating with Keurig Green Mountain to bring four varieties of coffee to consumers, all of which are products of fair trade.

From this video trailer viewers transition to a video of an interview with John Sylvan, in which he expresses regret for the invention of the K-Cup. Keurig Green Mountain made $4.7 billion in revenue in 2014, much of which was derived from the single serving coffee system. "I feel bad sometimes that I ever [invented the K-Cup]," Sylvan notes. "It's like a cigarette for coffee, a single serving delivery mechanism for an addictive substance." In 2013, 11.6 million coffee pod machines were sold in the US (by comparison only 1.8 million were sold in 2008), and if all K-Cups sold in 2014 were laid end to end, they would circle the Earth more than 10 times. As for Sylvan, he does not own a coffee pod machine, and sold his interest in the company in 1997. Moving in a more environmentally conscious direction, Sylvan now runs a company that produces low cost solar panels.

This interview is followed by a two minute short called Kill the K-Cup, which conveys the detrimental effects of single serving coffee consumption through an "invasion" of Earth by Keurig monsters and spaceships. Mike Hatchey, producer of the film, notes that K-Cups are not recyclable and pile up quickly, creating "a monster of an environmental mess." Over 60 billion K-cups have gone into landfills since the coffee pod machine's inception. The short, shot in a "found footage" format, shows a group of office workers presenting a birthday cupcake to a colleague, when suddenly, the building shakes from an unknown source. With their singing of "happy birthday" mysteriously interrupted, the curious workers rush outside, only to discover a giant K-Cup flying saucer assaulting the city, firing K-Cups as lethal projectiles on the unsuspecting inhabitants of the city. As the people flee, they are presented with an additional threat in the form of a dinosaur-like mass of K-Cups, vomiting coffee and launching immense K-cups from its body that flatten their victims in the street. As the military ineffectually attempts to protect the people from the K-cup apocalypse, Keurig

drones launch an attack that kills the camera operator, with the last shot from the dropped video camera being the litter of spent K-cup ammunition blanketing every surface of the city.

Class Activities and Weekly Breakdown

Given that we used this case study approach with a first-year-experience for incoming College of Math and Science students, we made the case-study span the full semester. A table summarizing the weekly learning objectives, activities, and assessments are below, followed by a more detailed description of the class activities. For assessments, summative/ major assignments (substantive feedback) are in bold for ease in discerning between major and lower stakes, formative (rapid feedback). Section 14 has more detailed descriptions about how we used these different styles of assessment for individual and group grading.

Summary Table of Semester-long Coffee Case Study

Week	Learning Objective	Activity/Assignment	Assessment
1	Course introduction	Syllabus class activity	Socrative
2	Introduction to sustainability	Reading discussion	Reading reflection
3	Introduction to systems & S-E synthesis thinking	#1: Classroom concept map	Minute paper
4	Using group memos to understand different stakeholders and perspectives	#2: Endangered species	Socrative
5	Identifying the different stakeholders and perspectives for coffee & start coffee concept mapping	#3: Case study motivation, identifying competing perspectives	Socrative
6	Continue S-E models of the coffee; start building expertise + survey of existing literature (research skills)	#4: Information needs assessment	Reflection on concept map, feedback on information needs assessment
7	Coffee group memos	#4: Work on group concept maps and memos	2 page white paper memo + information needs assessment (+ Group/Self Assessment)
8	Coffee group memo ranking	Use class memos to rank different types of coffee (i.e., Starbucks, grocery store, etc.)	Socrative
9	Master system map	Jigsaw: 2 experts from each group into new larger group, create a master system	Reflection on master system + opportunity for public input

Week	Learning Objective	Activity/Assignment	Assessment
10-11	Problem/Solution Tree	Identify core "wicked" problems, cause + effects, solution tree	Written explanation of trees and definition of problem
12-13	Identifying & Evaluating Interventions	Presentation of research conducted by SOC 176 Qualitative Research Methods students on coffee consumption	Comparison table + written explanation of how intervention will address core problem (causal chain) draft of individual recommendation and opportunity for feedback
14-16	Recommendation for Action (integration & synthesis)	Individual Recommendation for Action, consider limitations	draft, peer review, group presentations

Weekly Breakdown and Teaching Notes:

Weeks 1-2: COURSE INTRODUCTION
Class Plan (~4 class periods)
1. Ice breaker activities (like Six Hats) to form groups and get to know students and instructors
2. Practice using the learning management system
3. Read syllabus and discuss expectations for this course
4. Sustainability reading and discussion (recommend Sustainability spotlight reader by Weisser)

Week 3: SYSTEMS THINKING & CONCEPT MAPS
Class Plan (2 class periods)
1. Review Sustainability (can watch the Story of Stuff)
2. Review systems and system models
   a. system: a dynamic grouping of things/parts and their interactions/ relationships
   b. model: a representation of the real thing
   c. systems models are useful because they help us understand the structure of a system and predict its behavior over time and under different scenarios
3. Concept Mapping Exercise (**Student Handout Assignment #1**)
4. Groups: Create first concept map of socio-environmental system
5. All: Class concept map of socio-environmental system

Week 4: IDENTIFYING STAKEHOLDERS AND DIFFERENT PERSPECTIVES

(*adapted from Save the Grizzlies!*)

1. Practice systems-thinking from different points of view
2. Groups use S-E synthesis to determine to prioritize species conservation (**Student Handout Assignment #2**)
3. Encourage students to take note of how the expert memo sheets are structured-- they'll be working on making similar expert memos for coffee in the upcoming weeks.

Week 5: CASE STUDY INTRODUCTION, BACKGROUND & CONTEXT

Class Plan (~2 classes)

1. Day 1 - Motivate Coffee Case Study (**Student Handout Assignment #3, Part 1**)
   - As a class, watch videos (links in worksheet) - give students 1-2 min to take notes about videos in between (~10 minutes to watch, 10 minutes for notes)
     i. Dukale's Dream Trailer (3 min)
     ii. A Cup Half Full (1 min)
     iii. Interview with Keurig founder (< 1 min)
     iv. Kill the K-cup (2:30 min)
   - Students fill out worksheet (main ideas) → turn in for assessment (C/NC)
     v. What are the main ideas?
     vi. Compare and contrast with your group (can come up with the argument stated in each video?)
     vii. Groups report out to class
     viii. Begin Brainstorming components of the coffee system & assign coffee related reading (prep for Day 2) (10 minutes)
       1. [Saving Coffee](#) (Rosner, Scientific American)
       2. [The Culture of Coffee](#) (D'Acosta, Scientific American Blog)
2. Day 2 - Coffee Stakeholders & Perspectives (40 minutes)
   - Start by gathering some quick feedback on readings
     i. e.g. golden nugget, muddiest point, what new questions do you have?
     ii. can have students report out on the board after short group discussion -- ask students to stand up and share ideas from their table
   - See if class can come up with the major categories of distinct perspectives in the coffee system (**Part 2 of Assignment #3**). Our classroom had 8 tables, so we encouraged students to try to come up with 8 different coffee perspectives (i.e., socio-cultural, environmental, agricultural, industrial, economics, political-institutional, medical, and ethical-social justice). This is arbitrary, and can be modified for the needs of different classes.

- o Students finish Assignment 3 and turn in group concept maps for assessment (C/NC with feedback)

Week 6: BUILDING EXPERTISE IN COMPONENTS OF THE S-E SYSTEM
Class Plan (1-2 class periods + out of class time)

1. Introduce the different perspectives/components - student groups were assigned one of the 8 coffee perspectives, and we discussed the goal of them now crafting expert memos for their perspectives, similar to the memos they used in the Save the Grizzlies activity. These memos will eventually be used to rank the different types of coffees available to us to consume (typical Starbucks, grocery store, fairtrade, Keurig, etc.), so the class should come up with a common group-memo-template that everyone will follow (again, they can refer back to the formatting of the Save the Grizzlies memos) so we can eventually rank the most to least sustainable of the different types of coffees.
    - o Example Group Perspectives
        - i.   Socio-cultural
        - ii.   Environmental
        - iii. Agricultural
        - iv.   Industrial
        - v.   Economic
        - vi.   Political-institutional
        - vii. Medical
        - viii. Ethical-social justice

2. Begin identifying information the group needs to become experts in their perspective (**Student Handout, Assignment #4**)
    - o Review different types of information - we had the First Year Librarian visit the class to review the different types of resources (primary, secondary..) and show the class how to search the Articles+ feature of the university library system.
    - o Currency, Reliability, Authority, and Purpose/Point of View (CRAP) Test (as a way of motivating information needs assessment)
    - o Introduce the information needs assessment table; students are asked to find their perspective information for each of the different types of coffees.
    - o Ask what kinds of information do they need to write a group memo from their perspective for each of the coffees?
    - o What information do they already have access to? (We posted some starting articles for each perspective on Blackboard for the students).
    - o Ask them to identify the information that they don't have; for the remainder of the class and for the next class, they can focus on finding that information.
    - o Start drafting group memo - again, this should include information from their perspective for each type of coffee (Starbucks, grocery, Keurig, fair trade, etc.), along with a new group concept map of the coffee system.

Week 7: BUILDING EXPERTISE CONTINUED - GROUP MEMOS

Class Plan (2 class periods)

1. Groups work on further developing their expertise within their respective perspective groups
   - Groups continue working on their perspective memo and concept maps.
   - Report activities can be done in class, as well as peer reviews, to help students make progress.
   - The group memos are to be finalized and submitted at beginning of Week 8, for an in class ranking activity.

Week 8: BUILDING EXPERTISE CONTINUED - GROUP MEMO ACTIVITY

Class Plan (1-2 class periods)

1. Similar to the Save the Grizzlies activity, student rank the different types of coffees from least to most sustainable using the memos made by each perspective. This helps them apply what they've learned while identifying the most problematic type of coffee--which will also help them in constructing solutions to coffee.
   - The first day can be spent on this new adaptation of the ranking activity, while the second day we had "experts" from campus visit and interact with students and answer any of their outstanding specific questions reported by students in Socrative (faculty invited guest experts to come and help students).

Week 9: MASTER SYSTEM MAP & REFLECTION ON SYSTEMS THINKING

Class Plan (1-2 class periods)

1. Jigsaw into new groups with at least one person from each perspective.
2. New groups work to create a revised master system map (can be more instructor guided or not)
3. Reflect on systems thinking and master system map (writing)
   - consider strengths and weaknesses of a systems approach
4. Whole Class Discussion of reflections

Assignments

- Written reflection on master system map (what changed) and systems thinking in general

Week 10-11: PROBLEM/SOLUTION TREES

Class Plan (1-2 class periods, time for feedback and revision)

1. Brainstorm core problems
   - clearly defined (measurable in terms of success of solution?)
   - may consider different perspectives
   - can be done as a whole class or in groups, with guidance and feedback
2. Identify causes and effects of core problem
   - use the master systems map

- o divide temporally into immediate and further consequences
- o cause statement written in negative terms -- how it causes the core problem
- o could do a gallery walk here where students give feedback to each other's trees -- put 'post it' notes on posters around the room (or upload (e.g., in google docs))

3. Develop a solution tree
   - o rephrase negative statements into positive statements
4. Opportunity for feedback [since this is a crucial element]

Assignments

1. Write up of problem/solution tree and how they've incorporated instructor and peer feedback

Week 12-13: EVALUATING INTERVENTIONS

Class Plan

1. Use solution tree to brainstorm solutions
2. Write out the causal chain that will lead to the outcome
3. Compare and contrast the interventions (table of interventions and characteristics/ impacts)
4. * As a tie-in with a senior level research methods class in sociology, students received presentations of field research on coffee consumption habits and behavior, providing students who had assumed the socio-cultural stakeholder perspective additional information regarding coffee consumption. (See section 14 under fieldwork assignment)

Week 14: INDIVIDUAL WRITTEN ARGUMENT: RECOMMENDATION FOR ACTION

Class Plan (1-2 class periods + time outside of class)

1. Introduce possible proposals for action (can be several) - have a reading (maybe examples of sustainable systems or policies in place in different contexts)
2. Students identify the policy action
3. Students use concept map to evaluate the action and the impacts on the system

Assignment

- ● written evaluation of the action plan

Week 16: STUDENT RECOMMENDATION FOR CAMPUS ACTION

Class Plan (1-2 class periods + time outside of class)

- ● Create a system map of the issue, clearly identifying the "decision point" or proposed action
- ● Identify areas/connections in the map that appear to be strong/weak
- ● Identify possible effects if decision is adopted/implemented (using system map)

- Identify additional information needed to complete system map, or understand issue more fully
- Depending on time available, teams give short presentations (3-5 mins) with class discussion, OR have teams turn in a written product. Can do in-class presentation or use discussion board for comments on presentations. In-person presentations and discussions more effective

Background

The impetus for this case study comes from the use of Keurig coffee makers and their ecological footprint, resulting in a case for students to examine whether coffee may be consumed sustainably on the campus grounds of California State University, Fresno. Students need to develop an understanding of how and where coffee is produced, and in turn, how it is consumed, examining what is problematic both in terms of production and consumption, and critically thinking about what solutions may be developed for the problems they identify. This process should produce within students an understanding of converting problems into potential solutions (creating a solution tree), and situating a local problem within the context of global interactions of socio-ecological systems.

Keurig coffee makers are known for providing single servings of coffee - each user places a coffee pod into the machine, which then brews a single cup of coffee. The device is resource intensive, as producing a single cup of coffee produces significant waste. Over 60 billion coffee pods have been dumped in landfills since Keurig was first marketed for home and office use. As a form of waste, the pods are not easily metabolized, and in addition to this issue, each coffee maker intensifies use of water and electricity for home and office coffee consumption. With innovations in the use of any resource for consumption, the marketing and advertising of these innovations leads to increased purchasing of devices for consumption of the resource, and new forms of consumption intensify the use of a given resource, requiring more production of that resource. In the case of coffee, this means greater exploitation of growers of coffee in developing countries, conversion of habitat for other species into coffee plantations, and other socio-environmental impacts.

Using Keurig as a launching point, students in the course will take on the roles of different stakeholders (e.g., growers, consumers, political actors, business interests) involved in the cycle of coffee production and consumption, examining issues involving production and consumption from the particular stakeholder's perspective that they have assumed. In doing so, students will develop expertise on coffee production and consumption from the perspective of a particular stakeholder. Through this process, students will interact with each other, arguing their perspective in looking at both the problems facing coffee production and consumption, and the possible solutions to those problems they've identified. The ultimate goal will be the internalization of thinking about complex issues from a socio-ecological systems approach.

To make complex connections, students explore and investigate the natural resources and materials that are directly used for a Keurig cup, energy flow and cycling between the coffee and the environment, water required to grow coffee, carbon emissions related to transporting and packaging the coffee and pods, social impacts of coffee growing for farm

workers and local communities employed by the coffee trade, and ecosystem service impacts of coffee growing.

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Suggested Modifications

We designed and taught this case study primarily as a semester-long case study, at the core of a critical thinking class, with opportunities for students to dig deep into different aspects of the global coffee SES. The case-study may also be taught over a much shorter period of time within a broader course. It may be modified as follows:

Multi-week approach:

Maintain the sequence of modules we used, but condense or reduce the number of activities within each. After the initial motivation, using the videos, the class may be broken up into expert groups studying the SES from different perspectives. Instead of having students do their own guided literature survey to develop expertise, provide them with a fact sheet summarizing key points for each perspective. Have students develop a concept map based on the fact sheet and discuss it within their group. Some of this may be assigned as homework. The following week, each group presents their expert perspective to other groups. Jigsaw the groups to shuffle them into multi-perspective groups where they use the fact sheets to develop a whole SES conceptual map identifying the key components and interactions in the coffee SES. Ask students to list and prioritize 3-4 key problems, or nodes in the system where intervention may be applied to improve sustainability. Students may then be asked to write individual position papers, or make group presentations on the whole system. In a final session, students apply the SES model to find local sustainability solutions on their campus, using a solution-tree analysis.

Single 3-4 hour session

Quick motivation with one or two video clips (15min), which may also be provided in advance as homework along with some background reading. Students split into expert groups, and use provided fact sheets to develop a model of the coffee SES (approx 30 min). Jigsaw to shuffle students into multi-perspective teams. Students collaborate in new groups to create a whole system SES (30 min). Ask students to list and rank key problems / nodes, and share their models and problem sets with the whole class. End with a whole class discussion of the coffee SES, and assign a short paper or presentation for final assessment.

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As students take on the roles of different stakeholders in their problematizing the sustainability of coffee production and consumption in learning about SES, the following readings and web sites provide students with background information for the stakeholder positions they have assumed.

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Acknowledgements:

Note to instructors:

If you use this case, let us know how you used it and how it went. You can reach Madhusudan Katti via email at mkatti@csufresno.edu.