THE COFFEE CONUNDRUM: EXPLORING THE SOCIO-ENVIRONMENTAL ISSUES OF OUR CULTURAL ADDICTION

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Summary
Around the world, coffee consumption is becoming a cultural norm. Coffee related stores and products are on the rise and increasing in popularity. Because of this, coffee is the second most commonly traded commodity behind crude oil, and its annual production continues to increase to meet the ever-growing societal demand for this crop. This case study will introduce students to the socio-environmental implications of this ever-increasing cultural addiction. Students will explore the ecological and social details related to coffee agriculture to discover how the unique nature of this crop results in a perfect storm of social and environmental problems. Students will explore the effects of coffee demand from predominantly developed regions on 1) the rainforest ecosystem (e.g. local and global effects) and 2) the farmers and indigenous cultures of predominantly developing regions. Using a systems approach, students will hopefully recognize the truly integrative nature of this problem and begin to critically evaluate various coffee agricultural approaches (e.g. traditional, fair trade, rainforest alliance, cooperatives, etc.) in order to identify any ecological or social shortcomings that may make the system unsustainable. Using their gained expertise on this issue, students are immersed in a role-playing game where they are part of a coffee cooperative and are asked to evaluate letters from several different companies requesting coffee from their cooperative. The student agents will evaluate their coffee inventory and find the coffee varieties that best fits each company's mission. Students will then reflect on the sustainability of the coffee industry based on their recommendations and the current market trends.

SESYNC Learning Goals for Socio-Environmental Synthesis
Below each goal is a description (*in italics*) of how this case study is relevant to each goal.
1. Understand the structure and behavior of socio-environmental systems.
   -This case study will help students identify the environmental and social components of the coffee industry. Throughout the case study, students use concept maps to help demonstrate the connections between these components in this complex problem. Using feedback loops in their concept maps, students can recognize the relative contribution of components within the system to the overall problem and identify opportunities where innovation can make progress towards sustainability.

2. Consider the importance of scale and context in addressing socio-environmental problems.
-This case study will help students identify issues of scale within socio-environmental systems. Different activities approach the overall issue from a different scale, starting with issues regional physical environment characteristics and social demographics related to coffee agriculture, spanning to global coffee corporations and their effects on the entire coffee industry.

3. Co-develop research questions and conceptual models in inter- or trans- disciplinary teams.
-(Optional) Depending on how you assign students to their coffee brands, you could intentionally setup interdisciplinary firms based on student major/background/interest. This will work well for general education courses where students come in with different perspectives based on their individual major. It would be interesting to compare the decisions from inter-disciplinary teams to those of teams composed of single disciplines.

4. Find, analyze, and synthesize existing data, ideas (e.g. frameworks or models), or methods.
-Early in this case study, students will analyze different sources of data to look at the interaction between environmental and social factors involved in coffee production. In addition, the decision dilemma that students face when recommending coffee brands for the coffee cooperative to carry will require students to synthesize ideas and data from both ecological and social systems. Only a complete perspective will lead students to coffee recommendations that are truly sustainable.

Case Study Student Learning Outcomes
Students who successfully complete this case study will be able to…
1. Describe the ecological constraints associated with coffee production.
2. Compare the social demographics of societies where coffee is produced versus consumed
3. Summarize the environmental and societal implications of coffee production and infer how feedback between these two may result in new and larger issues
4. Evaluate environmental and societal sustainability of current coffee production along with alternative solutions proposed in the case study
5. Illustrate the complex nature of a complex socio-environmental system.
6. Synthesize and integrate data and ideas to determine sustainable courses of action.

Topic Area – Socio-Environmental Synthesis, Environmental Science, Sustainability, Agriculture
Education Level – Undergraduate lower division, Undergraduate Upper Division
Intended Audience – This case study was designed as a synthesis exercise to be integrated into the end of an introductory Environmental Science class. In this case, much of the content required for an understanding of environmental and social systems will have already been covered and students will be asked to apply some of this understanding into making a decision. This case study could easily be adapted and inserted into intermediate-level courses where students begin the course having been introduced to much of the important content that this case focuses on.
Type/Method – Decision Case, Interrupted Case, Small Group Work
Length of Case – 4 classes as presented entirely

Introduction/Background

Coffee consumption has steadily increased over the past 25 years. According to the International Coffee Organization, coffee is consumed worldwide with 92 countries reporting to their database. Interestingly, while coffee consumption is nearly worldwide (92 countries reporting), coffee production is relatively restricted to a narrow region across our planet, and only 55 countries report coffee production of any kind (International Coffee Organization). The two primary varieties of coffee, Arabica and Robusta, have slightly different environmental requirements for their growth, but both tend to require hot and humid environments. This requirement of the physical environment restricts the regions on our planet to a few thousand miles on either side of the equator. The location of this prime agricultural zone for coffee has important implications on the extensive social and environmental effects of this popular crop.

The prime agricultural regions for coffee production overlap with the most biodiverse terrestrial ecosystems on our planet. Irresponsible agricultural practices that convert pristine natural habitat to disrupted farm ground results in dramatic losses of biodiversity and directly affects ecosystem functioning potentially interrupting important ecosystem services. Ecosystems services such as flooding mediation, nutrient cycling, soil formation, and even ecotourism all feedback directly into the local system on shorter time scales, while larger scale services like carbon sequestration has planetary implications through more indirect impacts on our climate. It is clear that disruption of these services (and others not listed) have both regional and planetary consequences.

Timeline & Classroom Management
Class 1 – Introduction to Coffee and the Geography of the Industry (50 minutes)
- Assigned Readings (Before Class)
    - From Bean to Cup – exploring the journey of coffee
      http://equalexchange.coop/products/coffee/steps
    - Jha, S. et al. 2014. Shade coffee: Update on a disappearing refuge for biodiversity. Bioscience 64:416-428.
    - Optional Information on the pressures on the Rainforest Ecosystem
      http://library.cqpress.com/cqresearcher/document.php?id=cqresrre1999061100
- Instructors should begin the case study with an introduction to the coffee industry, coffee plant, and coffee agriculture (presentation slides provided with supplementary material) – 15 minutes
    - Trends in coffee consumption
    - Ecology of the coffee plant. This should provide students with the information on the physical environmental requirements (precipitation, light, temperature, soil, altitude, etc.) that the different varieties of coffee plants (arabica, robusta) needs to survive and enhance high coffee yields.
    - Introduction could also extend on the introduction to different approaches in coffee agriculture and an identification of the coffee belt, including the environments and social demographics of the people that live there.
- Put students in pairs and provide each pair with the International Coffee Organization (ICO) data set handout showing most recent complete annual data on coffee production and consumption by country. Students should discuss what trends and patterns they see

and map out the data on blank world maps to represent the geographical patterns of coffee producing and coffee consuming countries.

- o Main countries that produce coffee (top 10)
    - ▪ General pattern of location of coffee producing countries
- o Main countries that import/consume coffee (top 10)
    - ▪ General pattern of location of coffee consuming countries
- o Once the main countries in the coffee industry are identified, students will gather social and demographic data (Per Capita Income) from these countries using an easy online resource that shows important social, demographic, economic, and health data for each country called GAPMINDER (https://www.gapminder.org/tools/#_chart-type=map). Students will access and collect this information and eventually overlay it on a separate blank world map.
- o Worksheet Questions in the student handout will extend student engagement and synthesis of material in this activity
- o **POSSIBLE EXTENSION:** Students can explore the data in the ICO worksheets to see how countries have changed in their coffee production/consumption over the past 25 years. This gives a temporal aspect to the issue. GAPMINDER also has a timeline function on the scroll bar under the map to go back in time. Students can also collect changes in social data changes. This extension is likely best for upper level courses where students can explore data/trends with less direction.

Class 2 – Environmental and Societal Implications of Coffee Production (50 minutes)
- • Social Issues of Coffee Production Video – Show a video on the social issues related to coffee production. "The Source: The Hidden Human Cost Within a Cup of Coffee" (https://vimeo.com/196448366). The video link is also in the introduction presentation focuses on the coffee industry in Mexico and how low wages and lack of work in that region force families to put their children to work on the coffee plantations. (25 minutes)
- • Environmental and Social Implications Concept Map Activity (20 minutes – students may not complete this in class, but will get a good start on it)
    - o Start this by going over the idea of what a concept map is and how it works. A great resource on how to explain concept maps and what they mean can be found at the end of this tutorial on teaching socio-environmental synthesis concepts (https://www.sesync.org/system/tdf/resources/tutorial_1_overview_of_socio-environmental_synthesis_0.pdf?file=1&type=node&id=967&force=). Be sure to explain what the "+" and "-" will indicate (positive vs. negative relationship between variables) when added to the arrows that connect the pieces of the complex system. Students are expected to expand on the environmental and social issues that were each lumped into a small box on the original concept map found in the Introduction presentation. Going over examples of these in class to get the students started may help. A list of environmental issues related to habitat destruction is included in the environmental implications section of the

introduction in the student handout. These would be good for students to include. It may be useful to show a feedback loop and explain what this means.

- o Students will diagram their socio-environmental issues concept map using the sheet provided in their student handout. The sheet is separated into two equal halves. Students are to construct separate concept maps for environmental and social implications of coffee production by representing each of the areas affected with a circle. The size of the circle will represent its "importance" to ecosystem and/or social functioning. After completing each side separately, have each student highlight two feedback loops. Using a 5-sentence narrative, students should describe the feedback loop and how it works in this system to affect the environment and social issues in new and/or larger ways. Students should hand this in-class activity in for grading and feedback. (25 minutes)
  - ▪ Student concept maps that incorporate the correct components of the system, the correct interactions between these components, and representations of the strength/importance of these interactions will receive better overall scores (see rubric).
- Introduce Killer Coffee Cooperative Activity (5 minutes)
  - o Hand out the "Killer Coffee Cooperative" information packet to each student. This packet will include the Welcome/Explanation page, Coffee Inventory Information, and 3 letters from companies requesting the services of KCC. KCC is a cooperative that controls the distribution of 10 brands of coffee in their region. Companies looking for coffee to sell often request KCC to recommend the most appropriate brand for them. Their job as an agent in KCC is to make recommendations to companies that hire them with regards to each companies' mission and objective. KCC just received letters from three very different companies requesting our service and distribution. As a committee (5 students), their job through the week is to evaluate our inventory and each company's mission/goals. Each committee is supposed to draft a response letter to each company indicating which brands KCC recommends as an appropriate coffee matching that companies' needs. Be sure to explain that not all brands in our inventory must be used, and that recommendations to one company brand choice or volume should not affect any subsequent recommendations to the other companies. Each committee will be made of 5 agents (students), with each student being an expert on 2 different coffee brands in our inventory. The committee meetings will occur during the next class period, but students should make their committees and be prepped on the brands they are responsible for before then.
- Day 3 Pre-Class Activity – Have your students go to the local grocery store and count how many total different brands and varieties they can purchase. Of those options, have them investigate how many are traditional, organic, fair-trade, or rain forest alliance, farmer cooperatives. Have each student pick one of the alternative initiatives that interest them, research the benefits of this approach, what rules that coffee growers/companies must follow to be certified as such, and any flaws in the approach that could be exploited. Bring this data and report as an "entry-ticket" to get into class.

- o Students may avoid certain alternatives (such as farmer cooperatives) leaving no students to discuss and report out in tomorrow's jigsaw activity. If you feel this is likely to happen, assign students with the alternatives they must research.

Class 3 – Killer Coffee Cooperative Role Playing Activity
- Discuss the data collected on coffee options from local grocery stores. (5 minutes)
- Optional Extension – students can explore the journey from bean to cup in the Starbucks supply chain and experience how this major company is attempting a more sustainable approach to coffee production
  - o ESRI Map Story – "From Bean to Cup: Starbucks, Supply Chain, and Sustainability" http://starbucks.maps.arcgis.com/apps/MapJournal/index.html?appid=f89083cd220d409b81ab10c7fa6c6f67
- The entirety of this class session will be focused on this role-playing jigsaw activity.
- KCC Committee Meetings – This meeting will allow each of the committees to discuss and evaluate the coffee brands in our inventory and match them to the companies requesting our service based on their listed goals/mission in their letters. The goal of this meeting will be to finalize their recommendation to each of our clients. It will be helpful while the firms are meeting to remind the students the values and business goals of Killer Coffee Cooperative by posting them on the board or a projector (40 minutes)
- Have students bring their final recommendation rankings to you. Instructors should enter each firm's rankings into a spreadsheet to compare all the committee's recommendations. Show the spreadsheet with all of the different recommendations and discuss the results as an entire class. During discussion of the recommendations, be sure to address the following: (5 minutes)
  - o Is there any variation in the different firms' recommendations? Do all groups recommend the same order? If not, why? Ask them to explain their reasoning. If there are any outliers, be sure to have them explain how they came up with their recommendation. What about their process of decision making was different? Did they value different aspects of social vs. environmental sustainability more?
- Students should write up their formal recommendation and rationale in a formal document addressed to each company. This assignment represents an actual report as produced by our coffee cooperative firm. The letter should include the overall recommendation and a rationale explaining how these suggested coffees meet the values and goals of their company.

Day 4 – Sustainability and the Power of the Consumer (50 minutes)
- Class Discussion (15 minutes)
  - o Discuss the outcomes of the different recommendations with regards to environmental and social sustainability. Which company dominates the industry in terms of sheer volume of coffee orders? How does this makeup of the coffee industry affect the sustainability of this socio-environmental system in terms of the Triple Bottom Line (Economically, Socially, Environmentally).

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- Video: TEDx Talk: Rebecca Scott - "Sustainable coffee, sustainable dollars, sustainable lives" https://www.youtube.com/watch?v=y9awoy3HZI4 (25 minutes)
  - Highlight the power they have as consumers. Each dollar they spend is a vote of support for the companies they buy products from. There are plenty of companies that offer products that are not only economically reasonable for consumers, but also environmentally and socially responsible. Supporting these companies increases their ability to good in the world and change lives.
  - Discussion of the video (10 minutes)
- Post-Class Synthesis Assignment – Have each student highlight copies of their original socio-environmental concept map showing components that are differentially affected by each company's order. Additional questions on this synthesis worksheet as the student to explore other approaches to the coffee industry including farmer-direct models (thrivefarmers.com).

Outcome/Activity/Assessment Table

Outcome	Activity	Assessment
Describe the ecological constraints associated with coffee production	-In pairs, students will evaluate ICO data on coffee production and consumption, mapping the locations across the planet. -Lecture on the coffee plants, including a focus on the physical factors that coffee plants require of an environment to survive and produce greater yields. -Students will evaluate the climate and physical features of the regions that produce coffee.	-Pair discussion of patterns recognized from ICO coffee production data -Class 1 Assignment: Question on identification of "coffee belt" on the coffee production map and describing why it is located there (students receive feedback and grade)
Compare the social demographics of societies where coffee is produced versus consumed	-In pairs, students will evaluate ICO data on coffee production and consumption, mapping the locations across the planet. -In pairs, using GAPMINDER, students will research the social and demographic characteristics of the regions suitable for producing coffee. Students will overlay the social and demographic data on the blank world map and compare this to maps of coffee production and consumption.	-Pair discussion of patterns recognized from ICO coffee production data (students receive informal feedback) -Post-Class 1 Assignment: Environmental Suitability & Demographics map (students receive feedback and grade)
Summarize the environmental and societal implications of coffee production and infer how feedback between these two may result in new and larger issues	-Assigned readings on social and environmental implications of coffee production -Video on social issues related to coffee farms -Students will construct separate concepts maps diagramming social & environmental effects of coffee production. They will illustrate the relative importance of these components in construction of the map, link them together showing connections between the social and environmental systems, and finally highlight different feedback loops and discuss their distinct effects.	-Informal feedback from group discussions of the video on social issues related to coffee farms -Social & environmental concept map (students will receive feedback and grade – see rubric for concept map)
Evaluate environmental and societal sustainability of current coffee production along with alternative solutions proposed in the case study	-Students will assess the availability of current alternatives to coffee production in their local grocery stores	-Pre-Class 3 Assignment has students collect data on coffee selection from their local grocery stores and then answer questions related to these options and sustainability

	-Students will research these alternatives and then share their findings with one another in a jigsaw activity	(students receive formal feedback and grade) -reporting to student committee of KCC on the details of the coffee alternative they researched (students receive formal feedback on worksheet and informal feedback in their group)
Illustrate the complex nature of a complex socio-environmental system	-All unit activities will be used to address the complexities associated with this learning outcome	-Class 2 Social & Environmental Concept Map representing the effects of coffee production on these issues -Class 4 Synthesis Worksheet – Students highlight the places in their first concept map that will change in response to the types of coffee recommended to each company in the KCC activity -Comparisons of these three concept maps will allow students to understand the complexity of and the implications of the coffee industry on this delicate socio-environmental system. Teachers can compare these concepts maps to gauge student learning as a result of the case-study (Students receive feedback and a grade on their original concept map and their adjustments based on their KCC decisions)
Synthesize and integrate data and ideas to determine sustainable courses of action	-Using their research on the social and environmental implications of the various approaches to coffee, students will assess different coffee varieties and make recommendations to a coffee cooperative in a role-playing game where they act as socio-environmental consultants	-Killer Coffee Cooperative formal recommendation write-ups (students working in group will receive feedback and grade)

Acknowledgements

Sources

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Photo Attributions

1st Page (Left to Right)

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