

Our Coffee Conundrum: The Socio-Environmental Issues of our Cultural Addiction

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Around the world, coffee consumption is becoming a cultural norm. Coffee related stores and products are on the rise and increasing in popularity. The International Coffee Organization reports coffee consumption from 92 countries, and overall this consumption has steadily risen over the past 25 years across (Figure 1). Currently, coffee is the second most commonly traded commodity behind crude oil.



COFFEE ECOLOGY

The coffee plant is a woody perennial evergreen in the Family *Rubiaceae*. Coffee plants a medium/tall understory shrubs (often considered a tree), meaning they typically prefer growing in shaded areas, but this varies with coffee variety. The coffee beans, like the ones we grind and ultimately brew, are actually seeds from fruit (commonly called cherries) of the coffee plant (Figure 2).

There are two primary varieties of coffee bean, Arabica and Robusta, which come from two different species of coffee plant *Coffea arabic* and *Coffea canephora* respectively. While coffee plants in general tend to require hot and humid environments, each of these species prefer slightly different environmental conditions (Table 1). Generally, Robusta plants are heartier and produce greater yields of beans/plant.



Figure 2. Arabica Coffee Plant

Table 1. Ideal Growing Conditions Arabica and Robusta Coffee Plants

Factor	Arabica	Robusta
Temperature (°C)	15-24	18 – 36
Precipitation (mm)	1200 – 2200	2200 – 3000
Altitude (ft)	1800 – 3600	0 – 3000
Light Environment	Shaded	Sun



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Coffea plants produce phytochemicals that help them avoid damage from herbivores like insects and other animals. Two of the chemicals produced in these plants include caffeine and chlorogenic acid, which generally taste bitter, deterring plant consumption. *Coffea canephora* (Robusta) plants produce nearly twice as much caffeine (2.2%) and chlorogenic acid (7-10 %) compared to *Coffea arabica* (caffeine: 1.2 %; chlorogenic acid: 5.5-8 %). These properties render Robusta plants heartier and more resistant to pest damage than Arabica plants. While Robusta does have a higher caffeine content which is important for some coffee drinkers, this also leaves Robusta beans with a more bitter flavor and a harsher coffee experience.

COFFEE AGRICULTURE

These strict requirements of the physical environment of the coffee plants restricts the regions on our planet where coffee can be grown to a few thousand miles on either side of the equator. As of 2010, coffee cultivation used 10.2 million ha globally. This estimate showed a nearly 9% decline in global land area used for coffee production since 1990; however, global coffee yields increased by 36% over that same time. This interesting pattern was likely due to shifts in the type of coffee plant used worldwide (Robusta coffee increased 92% since mid 1980s) and the intensification of agricultural practices on coffee plantations (Jha et al. 2014).

The intensification of coffee production has involved several adjustments in agricultural practices related to the management of coffee plantations. There are two primary methods of coffee cultivation: shade-grown vs. sun-grown (Figure 3. Top Left: Shade-coffee in Guatemala, Top Right: Sun-grown coffee plantation in Kaua'i, HI). While initially dominated by traditional shade-grown coffee plantations, shifts toward more Robusta plants and intentional selection of high producing sun-tolerant Arabica plants, has resulted in a major shift in global coffee cultivation towards more open intensive sun-grown coffee plantations. This trend is particularly evident in eastern countries (Figure 3 Bottom), but is becoming more widespread as the demand for coffee increases. Overall, 41% of the land area used to grow coffee is now considered “no shade”, 35% is “sparse shade”, and only 24% is “traditional diverse shade” (Jha et al. 2014).



This shift towards sun-grown coffee was coupled with consistent and heavy fertilizer additions to enhance plant productivity and supplement the lost nutrients no longer added to the system from leaf decomposition in plots that used to be typified as dense-growth forest.

ENVIRONMENTAL IMPACTS OF COFFEE PRODUCTION

The shift towards intensive agricultural practices that focused on producing higher coffee yields through fertilizer inputs and sun-grown coffee dramatically disrupted the pristine natural habitat of each region. Sadly, the prime agricultural regions for coffee production overlap with the most biodiverse terrestrial ecosystems on our planet (Figure 4)

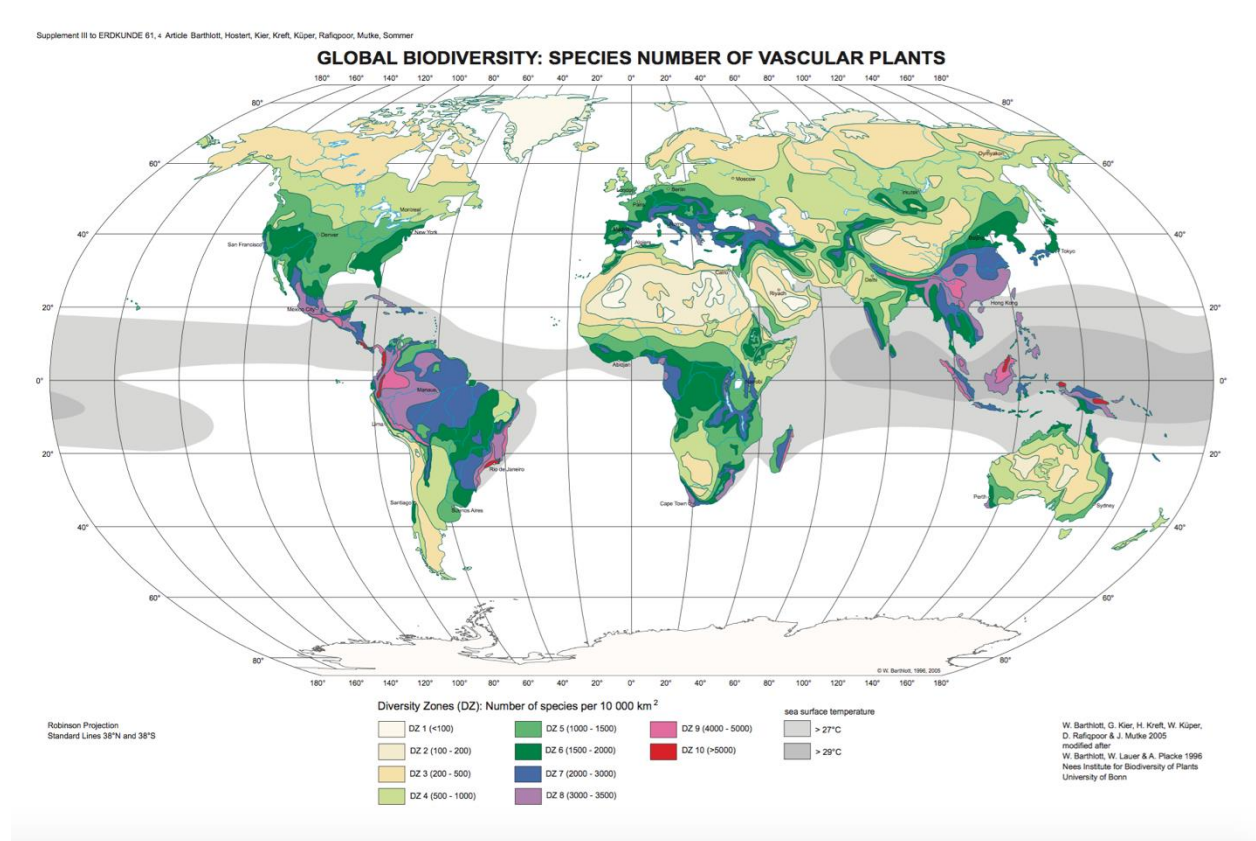


Figure 4. Patterns of biodiversity of vascular plants across the planet (Barthlott et al. 2007)

This conversion of naturally diverse ecosystems to relative monocultures of coffee obviously results in dramatic losses of biodiversity. These species losses can directly affect other species in the community that rely on interactions with the now missing species. Compounding consequences of species losses alters how ecosystem processes operate (e.g. enhanced or reduced) which could ultimately destabilize how it functions overall.

Ecosystem Processes Altered by Habitat/Species Loss

- | | | |
|------------------|----------------------|------------------------|
| Nutrient Cycling | Carbon Sequestration | Pollination |
| Soil Formation | Flood Mediation | Pest Control |
| Erosion Control | Climate Moderation | Water/Air Purification |



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Disruption of these services have both regional and planetary consequences. For example, some of these ecosystem processes feedback directly into the local system affecting ecosystem operation on shorter time scales (e.g. erosion control, pollination, flood mediation, soil formation), while larger scale services (e.g. carbon sequestration, water/air purification) likely have planetary implications through more indirect impacts on our climate and our shared resources.

SOCIAL IMPACTS OF COFFEE PRODUCTION

The restricted regions suitable for coffee production are not only some of the most biodiverse regions on our planet, they are also the most underdeveloped regions. The countries located in the coffee belt are consistently low in the Human Development Index, which is a composite score that includes life expectancy, education, and per capita income (Figure 5).

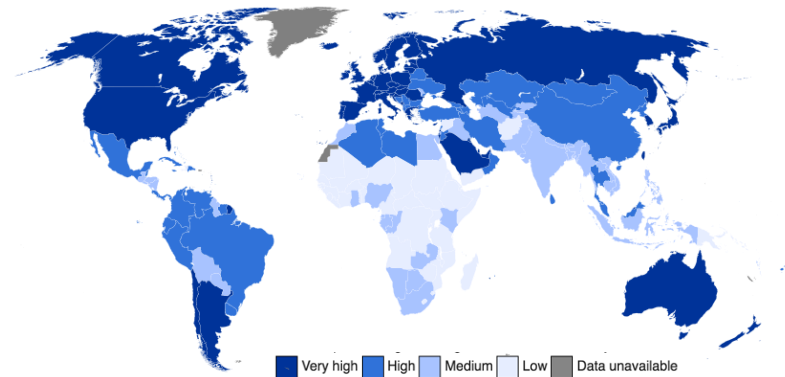


Figure 5. Human Development Index by country (Data from 2015-16)

Coffee farmers in this region are already in economic distress. Current coffee prices pay farmers on average \$1.28 per pound for conventional coffee approaches. This price represents roughly 60% of the price we paid in 1983 after figuring in inflation (after inflation, we should be paying around \$3.00 per pound). Fair trade and farmer cooperatives are both alternative practices that promise more equitable and sustainable treatment of coffee farmers, however, this only guarantees an increase to \$1.40 per pound. Because of this, farmers are struggling to pay the bills that accumulate with the costs of coffee production. Increasing financial issues makes it difficult for farmers to meet basic family needs while corporate coffee brands are making billions from their sales of coffee in developed countries. For more information, watch the video on the source of our big brand coffee here: <https://vimeo.com/196448366>.

The inequity between these two groups grows and often forces the hands of farmers to put children to work and/or change agricultural practices to increase yields through many of the approaches listed above. The implications of these more intensive practices, both environmental and social, will ultimately feedback and interact with each other to compound the original problems and even create new ones. This case study will lead you through some of environmental and social issues related to our global addiction to coffee.



GEOGRAPHIC PATTERNS OF THE COFFEE INDUSTRY - ACTIVITY

1. Using the 2016 data from the International Coffee Organization, map out the main countries involved in coffee production across our planet. Include the top 10 countries, indicating each country's level of production using different colors. Be sure to include the key that you have developed to help show their production data. (Hint: countries can be grouped into 4-5 categories/colors based on production level)
2. Using the 2013 data from the International Coffee Organization, map out the main countries involved in coffee consumption across our planet. Include the top 10 countries, indicating each country's level of consumption using different colors. Be sure to include the key that you have developed to help show their consumption data. (Hint: countries can be grouped into 4-5 categories/colors based on consumption level)
3. Using the data from GAPMinder (https://www.gapminder.org/tools/#_chart-type=map), map out only the countries included the above 2 maps with respect to "income" in 2015. You can view each country's income by selecting "Income" in the "Color" drop-down menu in the upper right hand corner. By hovering over the country, the exact Per Capita income will appear in that box. Indicate each per capita income using different colors on the map below. Be sure to include the key that you have developed to help show their poverty data. (Hint: countries can be grouped into 4-5 categories/colors based on poverty level)

COFFEE PRODUCTION



Key (Thousands of 60kg bags/Year):



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COFFEE CONSUMPTION



Key (Thousands of 60kg bags/Year):

COUNTRY PER CAPITA INCOME LEVEL



Key (Annual Per capita Income in US\$):

GEOGRAPHIC PATTERNS OF THE COFFEE INDUSTRY - QUESTIONS

4. Identify the coffee belt in your maps, why is coffee production restricted to this area?

5. Arabica and Robusta beans are generally not grown in the same regions. From the data reported at this website (<https://www.gislounge.com/geography-of-coffee/>), what countries more Robusta beans? Arabica beans? Are there any countries that produce both?

6. What patterns do you see in the production and consumption maps you created (e.g. geographic location, economic status)?

7. What are some of the key social and economic differences between the countries that consume and produce coffee? Look through the drop-down menu on GAPMinder and find 2 other important social or economic indices that generally differ across these groups?

8. What are the social and environmental implications of this disconnect?



INTERACTION OF SOCIO-ENVIRONMENTAL ISSUES RELATED TO COFFEE INDUSTRY

1. Looking at your concept map, highlight two different feedback loops that show an interaction between social and environmental issues related to coffee production. Describe each of these feedback loops using a 5-sentence narrative for each.



LOCALLY AVAILABLE COFFEE VARIETIES

1. There are a variety of approaches to growing coffee. Some of them are sustainable approaches, others are not. To get a sense of what options are available to you and what are the most common varieties at most marketplaces, go to your local grocery store and find the coffee aisle, collect the following data on ground or whole bean coffee (not Kcups or instant). Many of these varieties will include a logo or seal that advertises this certification, although some brands are not obvious.



Coffee Variety	# Options	% Shelf Space	Average \$ / Lb
Conventional			
Organic			
Rainforest Certified			
Fair Trade			
Farmer Co-op			

2. If you were a customer, based on the selection available, what variety would you be most likely to purchase? Why?
3. Does the grocery store or coffee brand do anything to advertise the other more sustainable coffee varieties?
4. Research one of the approaches (varieties) above focused on sustainable coffee production. How is this approach different? Does it address an environmental issue, social issue, or both? Share your findings with your Killer Coffee Cooperative Group tomorrow. This will help you make your decisions and recommendations to the three different companies. (Hint: It may help to assign different sustainable approaches to make sure all of them are researched)



Killer Coffee Cooperative

Welcome to Killer Coffee Cooperative (KCC). As a member of our agency, your job is to match up potential coffee customers with the most appropriate brands of coffee for our coffee inventory based on their mission and business goals. Over the past 10 years, coffee sales are up nearly 20% in our area, and we are constantly receiving new requests from companies (new and old) to serve as their coffee distributor.

Recently, we received 3 requests from different companies with very different missions and goals. Please review their request letters, and after considering their mission and goals as a company, figure out the best way we can serve their needs.

In order to identify the best coffee brands for each company request, you will form a committee with 4 other agents at Killer Coffee Cooperative. Each of the five agents in your committee will be experts for 2 of the 10 coffee brands that we hold in our inventory. Through discussion of each brand, you will determine as a group which coffee brands matches the company's request. Please read through our inventory below and familiarize yourself with the brands that we carry (inventory category descriptions and definitions below).

For each of the request letters we receive, you must draft a letter including which coffee brands and how much of each brand you recommend to fill their request. Along with your recommendation, at Killer Coffee we like to give some background information on the brands we sell along with an explanation in the recommendation letter as to why these brands are the best fit for their needs. Because we are never sure whether companies will accept our proposal, do not let brand use or volume in one proposal affect any subsequent recommendations.

Region – Where is the coffee grown?

Coffee Variety – What variety of coffee is it (Arabica or Robusta)

Grower – Who is responsible for growing the coffee? (Family Farm or Corporate Business)

Type of Company – What kinds of business owns the coffee brand? This unit will purchase green coffee beans from the farmer, roast them, is who we are interacting with to purchase the final coffee product. (Local Business, Farmer-owned cooperative, or Multi-National Corporation)

Volume – How many pounds are available for purchase by KCC per year?

Organic – Do the agricultural methods for coffee production certify the coffee as USDA Organic? (Yes or No)

Rainforest Cert – Do the agricultural methods for coffee production certify the coffee as sustainable and friendly to the ecosystems they are grown in? (Yes or No)

Fair Trade – Is the coffee brand “Fair Trade” certified? Does the coffee brand treat the coffee growers in way that results in equitable and fair pay for this commodity? (Yes or No)

Farmer Paid – How much is paid to the coffee farmer per pound of coffee grown? (U.S. \$)

Cost – How much will this coffee potentially sell for per pound in the store? Amount is based on our cost from the coffee brand plus the markup for our cooperative based on ease of acquisition and an estimated standard 50% markup from the businesses we sell to.



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Killer Coffee Cooperative Inventory

COFFEE BRAND A

REGION: GUATEMALA
VARIETY: ARABICA

NOTES:

GROWER: FAMILY FARM
COMPANY TYPE: MULTI-NATIONAL
VOLUME (LBS/YR): 25000

ORGANIC: NO
RAINFOREST CERT: NO
FAIR TRADE: NO

PRICE PAID TO FARMER: \$1.25 / LB
COST: \$6.50 / LB

COFFEE BRAND B

REGION: COSTA RICA
VARIETY: ARABICA

NOTES:

GROWER: FAMILY FARM
COMPANY TYPE: MULTI-NATIONAL
VOLUME (LBS/YR): 4000

ORGANIC: YES
RAINFOREST CERT: YES
FAIR TRADE: YES



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PRICE PAID TO FARMER: \$1.90 / LB
COST: \$9.00 / LB

COFFEE BRAND C

REGION: VIETNAM
VARIETY: ROBUSTA

NOTES:

GROWER: FAMILY FARM
COMPANY TYPE: LOCAL
VOLUME (LBS/YR): 10000

ORGANIC: YES
RAINFOREST CERT: NO
FAIR TRADE: NO

PRICE PAID TO FARMER: \$1.35 / LB
COST: \$7.00 / LB

COFFEE BRAND D

REGION: BRAZIL
VARIETY: ROBUSTA

NOTES:

GROWER: CORPORATE
COMPANY TYPE: MULTI-NATIONAL
VOLUME (LBS/YR): 30000



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ORGANIC: NO
RAINFOREST CERT: NO
FAIR TRADE: NO

PRICE PAID TO FARMER: \$1.25 / LB
COST: \$6.00 / LB

COFFEE BRAND E

REGION: UGANDA
VARIETY: ARABICA

NOTES:

GROWER: FAMILY FARM
COMPANY TYPE: FARMERS' CO-OP
VOLUME (LBS/YR): 6000

ORGANIC: N
RAINFOREST CERT: Y
FAIR TRADE: Y

PRICE PAID TO FARMER: \$1.65
COST: \$7.50

COFFEE BRAND F

REGION: COLOMBIA
VARIETY: ARABICA

NOTES:



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GROWER: FAMILY FARM
COMPANY TYPE: FARMERS' CO-OP
VOLUME (LBS/YR): 8000

ORGANIC: NO
RAINFOREST CERT: YES
FAIR TRADE: YES

PRICE PAID TO FARMER: \$2.25 / LB
COST: \$9.00 / LB

COFFEE BRAND G

REGION: ETHIOPIA
VARIETY: ROBUSTA

NOTES:

GROWER: CORPORATE
COMPANY TYPE: MULTI-NATIONAL
VOLUME (LBS/YR): 17000

ORGANIC: YES
RAINFOREST CERT: NO
FAIR TRADE: NO

PRICE PAID TO FARMER: \$1.45 / LB
COST: \$8.00 / LB



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COFFEE BRAND H

REGION: KENYA
VARIETY: ARABICA

NOTES:

GROWER: CORPORATE
COMPANY TYPE: LOCAL
VOLUME (LBS/YR): 3000

ORGANIC: YES
RAINFOREST CERT: YES
FAIR TRADE: YES

PRICE PAID TO FARMER: \$1.85 / LB
COST: \$8.50 / LB

COFFEE BRAND I

REGION: INDONESIA
VARIETY: ROBUSTA

NOTES:

GROWER: CORPORATE
COMPANY TYPE: LOCAL
VOLUME (LBS/YR): 15000

ORGANIC: YES
RAINFOREST CERT: NO
FAIR TRADE: NO

PRICE PAID TO FARMER: \$1.45 / LB
COST: \$7.00 / LB



COFFEE BRAND J

REGION: HAWAII, U.S.A.

VARIETY: ARABICA

NOTES:

GROWER: FAMILY FARM

COMPANY TYPE: LOCAL

VOLUME (LBS/YR): 10000

ORGANIC: YES

RAINFOREST CERT: NO

FAIR TRADE: YES

PRICE PAID TO FARMER: \$2.50 / LB

COST: \$10.00 / LB

Killer Coffee Cooperative
1600 E. Euclid
McPherson, KS 67460

Greetings!

In order to meet the growing demand for fine and unique coffee in our city, we are opening Beloved Beans, a local coffee marketplace. You have control of the wholesale of several brands that we may be interested. Coffee sales in our region will support purchasing a total of 8000 pounds of coffee annually for distribution. We need your help in identifying the right coffee brands to bring to our shop.

We want to offer coffee brands that fit in line with our mission. Here is some information on us that will help your recommendation. At Beloved Beans, our goal is to provide a source of sustainable coffee to our community. The market for the craft coffee we hope to offer is not driven by price. The background story behind the bean is something that is important for us to communicate and share with our consumers. We value sustainability on all fronts, economic,



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environmental, and social. We feel that it is in the best interest of everyone when we simultaneously take care your wallet, the planet, and the people that grow our beans.

We are interested in carrying 3-5 brands in our store. Please assess these options and provide a recommendation on the coffee varieties we should purchase by ranking the coffees, and then indicate how much of our total we should purchase of each. Please provide a rationale for this determination along with your report.

Ultimately, our decision will be centered around our goals, which means we want to carry the best coffee for our cooperative, our community, and our planet. Thank you for your help in setting the direction for our exciting new venture.

Sincerely,

Bethany Barista

Bethany Barista, CEO
Beloved Beans

Killer Coffee Cooperative
1600 E. Euclid
McPherson, KS 67460

To Whom It May Concern,

I am the regional manager for six SaveMart Grocery stores, which are a part of a nationwide chain. We recently terminated the contract with our current coffee distributor due to their ever-increasing coffee costs. You have control of the wholesale of several brands that we may be interested in stocking on our shelves. Coffee sales in our region will support purchasing a total of 75,000 pounds of coffee annually for distribution. We need your help in identifying the right coffee brands to bring to the stores in our region.

We want to stock coffee brands on the shelf that our customers will enjoy and will move in high volumes. At SaveMart we pride ourselves on offering unbeatable prices. Our customers appreciate our affordability. Currently, the average prices of coffee that is purchased from our store is \$6.50, we would like to continue to offer a coffee selection that averages out to that



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price. Our margins are low, but the volumes that we sell help us meet our goals of the company, which includes first rewarding our shareholders because of their investment in us. We also like to invest a portion of remaining proceeds back into the communities where our branches are. We feel that it is in our best interest to offer rock bottom prices to our customers, by taking care of their wallet our local economy will grow.

We have room on our shelves for 4-6 different brands. Please assess your coffee lineup and provide a recommendation on the coffee brands we should purchase by ranking the coffees, and then indicate how much of our total we should purchase of each. Please provide a rationale for this determination along with your report.

We will review the costs and potential profit margins associated with your proposal and let you know our ultimate decision. Thank you for your help.

Sincerely,

Bill Folds

Bill Folds, Regional Manager
SaveMart Grocery

Killer Coffee Cooperative
1600 E. Euclid
McPherson, KS 67460

Hello!

We are opening a four brand-new coffee shops across our town. Cup O' Joe Coffee House offers distinctive quality coffee at reasonable prices. We are looking for an interesting lineup of coffee brands that will provide a variety of distinctive options to our customers. In your cooperative, you distribute several brands that we may be interested in. Estimated coffee sales for both stores combined total 35,000 pounds of coffee annually. We need your help in identifying the right coffee brands to offer our customers at both of our new stores.

Early on, we would like to have 2-4 brands on our menu to give customers a good variety, but will also keep our inventory requirements low. The city we serve is progressive and environmental issues are very important to them. Currently, organic coffee offerings are few and far-between. We would like for the O' in our name to stand for "Organic" to capitalize on this potential market opening. Being a specialty coffee house, we understand that coffee prices will be greater, but we are a little concerned with pricing ourselves out of competition, so we would like to our coffee inventory to average no more than \$7.50 per pound retail.



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Please assess your coffee lineup and provide a recommendation on the coffee brands we should purchase by ranking the coffees. Please provide a rationale for this determination along with your report. Thank you for your help.

Sincerely,

Joe Green

Joe Green, Owner
Cup O' Joe Coffee House

SYNTHESIS ACTIVITY

1. The three companies that you served as a part of Killer Coffee Cooperative had very different missions and goals associated with success. For each company, illustrate the components of socio-environmental concept map (that you designed earlier) that would change in the system based on the type of coffee that company would be offering by highlighting the connection between the components of this socio-environmental system. Explain the outcomes of these impacts to the system in each case using 2-3 sentences.
2. Which of these companies (if any) in your mind offer achieve or make progress towards a truly sustainable (economic, environmental, and social) coffee future? Explain your answer.



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3. Compare these made-up companies in the exercise to realistic companies that make up our market today. Looking at the size and differences in these companies and what they ordered, do you think society as a whole is likely to make progress?

4. If dollars spent are equivalent to “votes of approval”, how can consumers bring about change in a multibillion-dollar industry?

5. One of the interesting alternative approaches in the coffee market today comes from THRIVE coffee (<http://thrivefarmers.com/>). How does this farmer-direct model differ from the scenario we went through in this activity? Do you feel this approach is more or less sustainable than our current model? Why?



INTERACTION OF SOCIO-ENVIRONMENTAL ISSUES RELATED TO COFFEE INDUSTRY

Using the information above and the concept map from the Introduction Presentation as beginning guide, draw a concept map that highlights the interconnectivity between social and environmental issues related to the coffee industry. On each side of the map, use a circle to represent one of the environmental or social implications of coffee production on their respective sides. The size of the circle will represent its relative importance to environmental or social functioning. Connect these circles using an arrow if the circles interact, and represent the relationship between the two using “+” (item increases when other increases) or “-” (item decreases when other increases) to represent the effects of one circle on another.

**Environmental Issues****Social Issues**

** Need 3 copies of this handout – 1 per coffee company



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ACKNOWLEDGEMENTS

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IMAGE ATTRIBUTION

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Figure 3a – Shade-grown Coffee: Public Domain – Photo by John Blake

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Figure 3b – Coffee Plantation, Kaua’I, HI: CC BY 2.0 – Photo by Lukas

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Figure 3 bottom – Jha, S. et al. 2014.

Figure 4 – Barthlott, W. et al. 2007. Supplement Figure 3.

Figure 5 – Human Development Index Map: CC BY-SA 4.0 – Photo by Happenstance

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