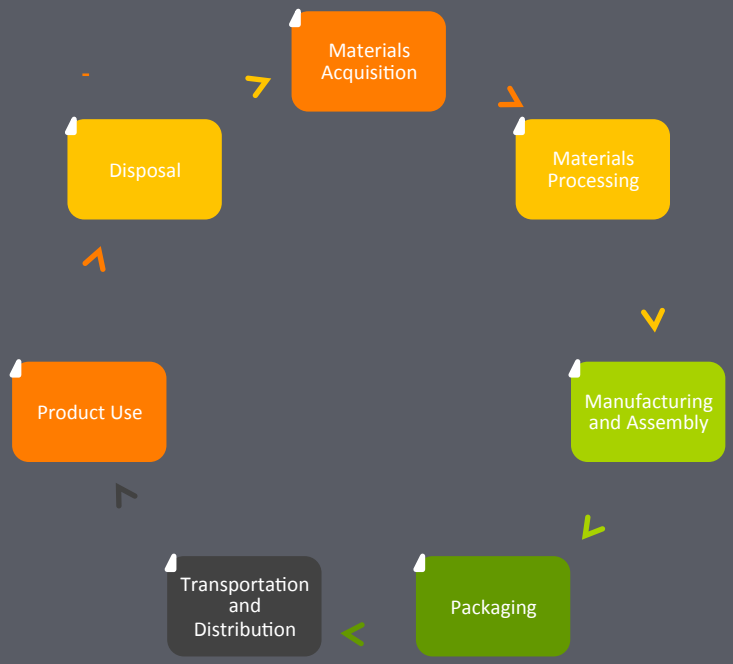
July 17, 2013

Life Cycle Assessment



Key Findings

- Coffee is nearly everywhere and is a $30-32 billion market worldwide (Specialty Coffee Association of America 2012).
- With global consumption of approximately 1.6 billion cups per day, the impacts of coffee are substantial whether it is viewed through an economic, social, or environmental lens (International Coffee Organization).
- The energy for the production of 1000 kilograms of unroasted coffee beans equates to about three months of the average monthly electricity use per household in the U.S. and it takes 33 cups of water to satisfy the average office drinker (Coltro 2006, EPA 2010, and Recruiters 2012).
- A recent life cycle assessment (LCA) comparing instant, drip filter and espresso coffee concluded that instant coffee had the lowest energy consumption and a smaller environmental footprint than both drip filter and espresso coffees.

Coffee Analysis: An In-Depth Look Into Your Morning Brew

By Shannon Thomas

Introduction

With 65% of workers who drink coffee at work, the 'office' has a considerable impact on the coffee industry (Recruiter 2011). Although this paper will take a look into the environmental impacts, it should be noted that the economic and social repercussions are equally concerning and also must be addressed. This papers aims to provide a detailed evaluation into the life-cycle assessment of coffee in hopes that both office employee and business owners will take the initiative to change their drinking and purchasing habits. This paper examines the environmental impacts association primarily with coffee production, but also use and disposal. A case study looking into multiple coffee types is included along with recommendations on what type and where to purchase coffee.

Coffee in the Workplace

A common office norm is to have at least one coffee pot and based off the results conducted by Alterra Coffee, coffee is highly valued in the workplace (Table 1).

Energy and Water Production – Why Care?

Coffee production is both energy and water intensive, leading to large impacts on the environment. For example, based upon the results of an LCA on green coffee (the coffee seed before roasting), the production of 1000 kilograms of green coffee consumed 10,670 mega joules of energy, including the including the extraction of oil and production fuels, and the diesel fuel for machinery and transportation (Coltro et. al 2006). This energy equates to 2964-kilowatt hours,

Table 1: Results of 2011 Study Conducted by Alterra Coffee on the Impacts of Coffee in the Workplace (Recruiter 2011) Introduction:

Percent of workers who drink coffee at work	65%
Average number of cups consumed by workers per day	3
Percent of workers who claimed they couldn't make it through a workday without the aid of coffee	38%
Percent of workers who claimed they drank coffee in the workplace to increase focus and productivity	30%
Number of workers who stated their quality of work would decrease without coffee	More than 1 out of 5

which is about three months of the average monthly household consumption in the U.S. (EIA 2010). The study also concluded that there was a ratio of 11 to one of water consumption to coffee production of 1000 kilograms (fresh water utilized in both the processing and wet method) (Coltro et al 2006). In other words, since the average number of cups of coffee in the workplace is three, then it takes 33 cups of water to sustain this habit. With freshwater sources limited worldwide and especially in the Western U.S., conserving water resources is more important than ever.

Production Process

Approximately one half of the environmental footprint for coffee (with the exception of water usage) is caused by the raw material extraction, manufacturing and assembly, and distribution processes (Humbert et al 2009). Additionally, there are many factors unaccounted for in an LCA such as the social implications including low living standards and wages. The processes that take place before a cup of coffee reaches the consumers hands is abundant, allowing for multiple points of disruption that can lead to change and create a more sustainable industry.

Approximately 60 countries produce coffee, with Brazil and Colombia collectively controlling half of the market. Brazil, however, is the largest producer relative to the size of cultivation land area and the amount of bags produced, comprising 30 percent of the market (Coltro et al 2006). Even within the same region/country there are various production processes based upon the size of the land, climate, types of beans, tillage and harvest methods, cultivation practices (such as chemical usage), topography, and technology availability. The general rule is to purchase organic and/or fair trade coffees[1]. Although these by themselves are no guarantee of environmental sustainability, the current standards and certification for labeling are both steps in the right direction (Giovannucci 2003). It should be noted that Brazil and Mexico are the leaders in producing sustainable coffee along with Colombia, Uganda, Ethiopia, Tanzania, India, Indonesia, Papua New Guinea and East Timor (Giovannucci 2003).

In addition to these factors, there are also two preparation methods, dry and wet, both of which include cleaning, sorting, drying, storing, and categorizing (Coltro et al 2006).

For the dry method, the coffee fruit is dried out in the sun for approximately three to four weeks and then stripped of its skin and pulp. Countries that use dry method: Angola, Benin, Brazil, Central African Republic, Congo, Congo Democratic Republic, Cote d'Ivoire, Gabon, Ghana, Guinea, Haiti, Madagascar, Nigeria, Paraguay, Philippines, Sri Lanka, Thailand, Togo (Chanakya et al 2004).

[1] Organic coffee is grown in accordance with the U.S. standards and certified by an accredited agency by the Department of Agriculture. For example, the standards exclude the use of synthetic pesticides for three years and require that 95% of ingredients are organic (Organic Trade Association 2012). Fair Trade coffee promotes the livelihoods of farmers and protects the environment with standards such as the protection of resources (water and natural vegetation), use of crop diversification, prohibiting the use of pesticides, fertilizers, and genetically modified organisms, and proper management of energy, water, and waste. About half of Fair Trade coffee is certified organic (Fair Trade 2010).

Common Dry Brands are listed in Table 2 (Lush 2009, Starbucks 2013, Peet's Coffee and Tea)[3].

Table 2: Dry Brands of Coffee

Roaster	Coffee
Flat Black Coffee	Ethiopian Harrar Horse
Latitude's	Kenya AA
Peet's Coffee and Tea	Arabian Mocha-Java
Starbucks	Sun-Dried Ethiopia Sidam

The wet processing method requires that freshwater be used during the pulping and washing of the coffee fruit (Chanakya et al 2004). This method consumes more energy due to the fuel needed to machine dry (Salamone 2003). Countries that use wet method: Bolivia, Burundi, Cameroon, Colombia, Costa Rica, Cuba, Dominican Republic, East Timor, Ecuador, El Salvador, Equatorial Guinea, Ethiopia, Guatemala, Honduras, India, Indonesia, Jamaica, Kenya, Malawi, Mexico, Nicaragua, Papua New Guinea, Rwanda, Tanzania, Uganda, Venezuela, Vietnam, Zambia, Zimbabwe (Chanakya et a 2004). Common Wet Brands (Lush 2009, Starbucks 2013, Peet's Coffee and Tea). It is shown in Table 3.

Table 3: Wet Brands of Coffee

Roaster	Coffee
Chazzano Coffee	Costa Rica Tarrau san Laura
Paradise Coffee Roasters	Colombia Diamante Micro-Lot
Flat Black Coffee	Puerto Rico Hacienda San Pedro
Flat Black Coffee	Puerto Rico Hacienda San Pedro
PT's Coffee Roasting Co.	Guatemala Santa Isabel Organic
Peet's Coffee and Tea	Costa Rica
Starbucks	Burundi Ngozi

Typically the dry method is associated with coffee of lesser quality, creating pressure for producers to adopt the more resource intensive wet method. Although organizations like the Sustainable Agriculture Initiative Platform are currently pushing for efforts to reduce the amount of water used in the wet processing method through the use of more efficient technologies and recycling wastewater, the method is still resource intensive. In addition, packages do not mark wet processing versus dry processing, but the information is usually included on the company's website.

Use

Use comprises the second half of environmental impacts and even more so with water usage (Humbert et al 2009). Consumer preferences, coffee type, appliance type, and disposal methods create a large impact on the environment especially with washing. Therefore, consumers should be aware of their large impact and take measures to reduce their water use, energy use, and purchase coffee from more sustainable suppliers.

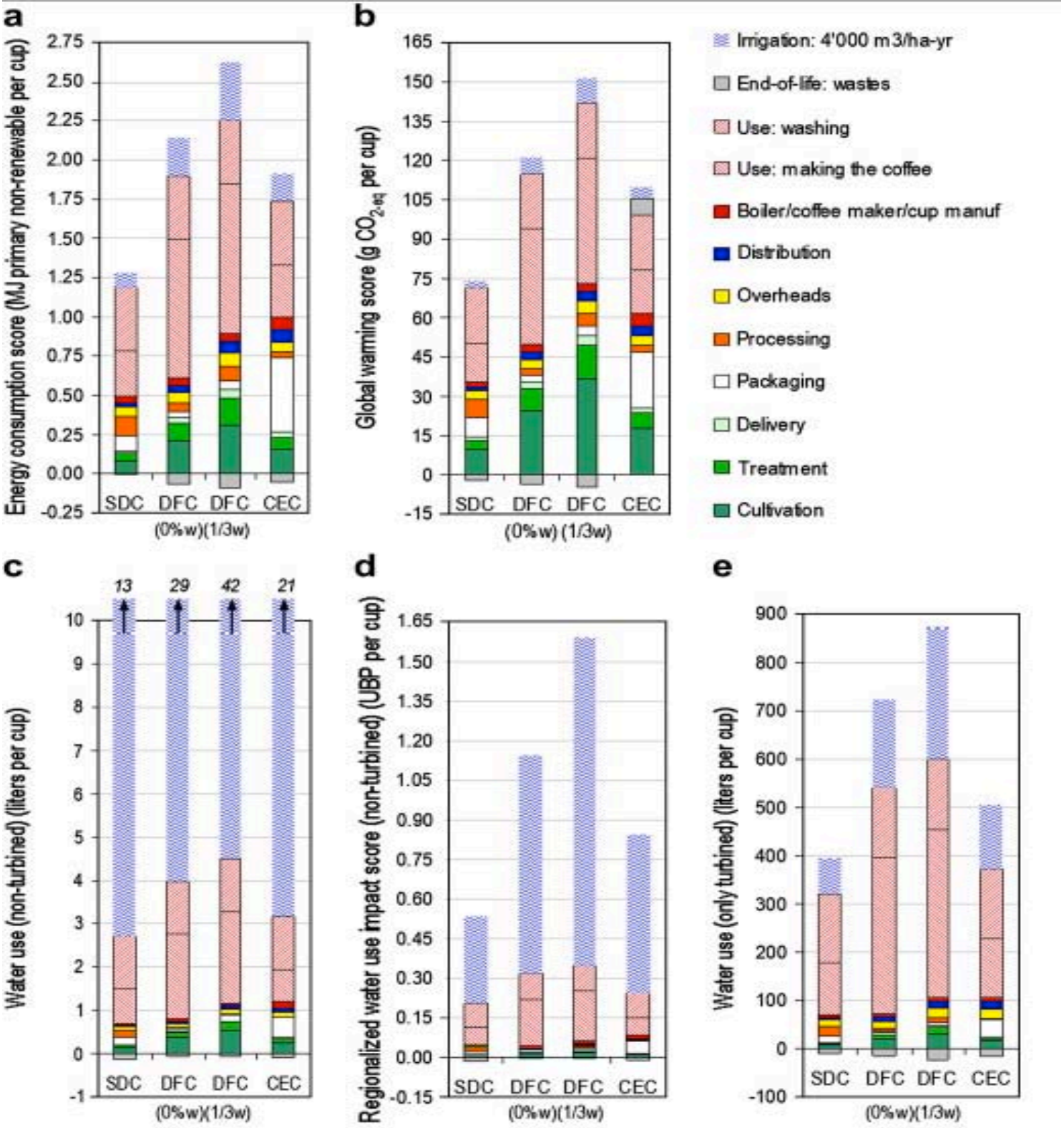
Case Study: Comparison of Coffee by Type

To provide a more detailed look into the impacts caused by the production process, a recent study analyzed the life cycle differences of instant coffee compared to drip filter and capsule espresso.[4] According to the results of the study, instant coffee had the smallest environmental impact while drip filter showed the worst impact (Figure 1).

[3] ROASTe.com is a coffee connector that allows customers to purchase coffee based upon specific guidelines and preferences including Fair Trade and organic and also provides examples of wet processed and dry processed brands.

[4] The LCA conducted by Humbert et al published in the Journal of Cleaner Production used data collected directly from both suppliers and manufacturers, producing results on energy consumption, greenhouse gas emissions, and water consumption (Humbert et al., 2009).

Figure 1: Results of LCAs for Instant, Drip Filter, and Espresso Coffees



Source: Humbert et al 2009

Figure 1 Key

- The graphs display the following information:
  - Graph A: Energy consumption score
  - Graph B: Global warming score
  - Graph C: Non-turbined water use inventory
  - Graph D: Non-turbined water use impact score
  - Graph E: Turbined only water use inventory presented in parallel
- The acronyms are defined below:
  - SDC – Spray dried soluble coffee [instant]
  - DFC (0%w) – Drip filter coffee with 0% wasted coffee
  - DFC (1/3w) – Drip filter coffee with 1/3 of the coffee wasted
  - CEC – Capsule espresso coffee

To summarize, the results of the LCA showed that spray dried soluble or instant coffee had the lowest energy consumption and a lower overall environmental footprint than both drip filter and espresso coffee with the former having the worst environmental footprint of the three (Table 4) (Humbert et al 2009).[5]

Supplemental Environmental Issues

Packaging
Additionally, packaging shows varied results depending on the material used including pouches, metals, glass, and sticks[6]. Pouches, and to a lesser extent metals (tin cans), hold lesser environmental impacts as compared both glass and sticks (Humbert et al 2009).

Disposal
For the disposal of coffee, all coffee grounds, no matter the method, can be composted.

Conclusion/Recommendation

Although it is unlikely that any coffee consumer will reduce their consumption completely from the previous information, there are several methods that are encouraged in order to reduce the environmental impact of coffee in the office.

Reduce – Although to completely stop drinking coffee may not be feasible or desirable in your office – reducing consumption does produce the largest environmental benefit.

Informed Decisions –Another opportunity for consumers is to look into purchasing coffee from producers that publish LCAs on their website and provide sustainable products that are Fair Trade or Organic Certified. Green Mountain Coffee Roasters not only displays an LCA on their website, but

Table 4: Summary of Results (Humbert et al., 2009)

Impacts	Instant Coffee	Drip Filter	Capsule Espresso
Energy Consumption	Lowest	Highest	Middle
Global Warming Impact	Lowest	Highest	Middle
Non-Turbined Water Use Inventory	Lowest	Highest	Middle
Non-Turbined Water Use Impact	Lowest	Highest	Middle

[5] For entire LCA, visit http://www.sciencedirect.com/science/article/pii/S0959652609001474.
[6] Sticks are common packaging for coffee and sugars that are named for their long, skinny shape usually made from plastic or paper that have two sealed ends connected with one down the back.

additionally Fair Trade USA announced Green Mountain Coffee Roasters as the largest buyer worldwide of Fair Trade coffee in 2010. Moreover, the company offsets all of its direct greenhouse gas emissions and allots five percent of its profits (pre-taxed) to projects supporting environmental and social purposes (Green Mountain Coffee Roasters, 2009). Buyers should be warned, however, that even though companies may be Fair Trade partners, this does not mean all of their products abide by this. For instance, Starbucks is listed as a Fair Trade partner, but only 8.1% of their coffee purchased in 2012 was Fair Trade Certified and only 1.6% was certified as organic (Starbucks Corporation, 2013). Table 5 provides a list of fair trade partners with at least some organic options that can be found in the Colorado area or in local supermarkets.

Table 5: Examples of Fair Trade Partners with Organic Certified Products (Fair Trade USA, 2010)

Coffee Company	Manufacturing	Fair Trade Partners	Organic Products
Allegro Coffee Company	Thornton, CO	Yes	Organic options
Barista Espresso	Colorado Springs, CO	Yes	All organic
Boulder Organic Coffee	Denver, CO	Yes	All organic
Coda Coffee Company	Denver, CO	Yes	Organic options
Green Mountain Coffee Roasters	Waterbury, VT	Yes	Organic options
Peet's Coffee & Tea	Berkeley, CA	Yes	Organic options
Starbucks	Seattle, WA	Yes	Organic options

Resources

- Check to see if your coffee provider is a Fair Trade partner - http://www.fairtradeusa.org/products-partners
- Facts about organic coffee including information on certification - http://www.ota.com/organic/organic_and_you/coffee_collaboration/facts.html
- An example of a coffee company (Green Mountain Coffee Roasters) publishing results of their own LCA on their website - http://www.gmcr.com/Sustainability/SustainableProducts/Products/ProductImpact/LCA.aspx
- Fact sheet on the coffee market. Learn about the staggering statistics on coffee use in recent years - http://www.scaa.org/PDF/resources/facts-and-figures.pdf
- Read the entire LCA comparing instant coffee to espresso and drip filter - http://www.sciencedirect.com/science/article/pii/S0959652609001474

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