

Executive Summary: Environmental Footprint Literature Review

Coffee



Coffee is one of the most valuable internationally traded commodities, second only to oil. World coffee consumption in 2015 totaled 9.13 billion kilograms. Sixteen percent of this (1.46 billion kilograms) was consumed in the U.S. alone. For environmentally conscious coffee consumers in the global north, their “daily grind” may feel like an uncomfortable compromise: coffee is only grown in tropical and equatorial areas. It must be shipped long distances. To complicate things further, the coffee value chain is incredibly diverse. Companies of all types and sizes operating across the globe may all contribute to a single cup of coffee.



Life cycle assessment (LCA) is one way in which we can measure some of the environmental impacts associated with coffee consumption and its complex value chain (shown above). Beginning with farm production and processing to distribution, roasting, packaging, brewing, and disposing the coffee and packaging waste, considering the environmental impacts associated with each stage of the coffee bean life cycle can help empower coffee drinkers and coffee purveyors to make environmentally sound choices.

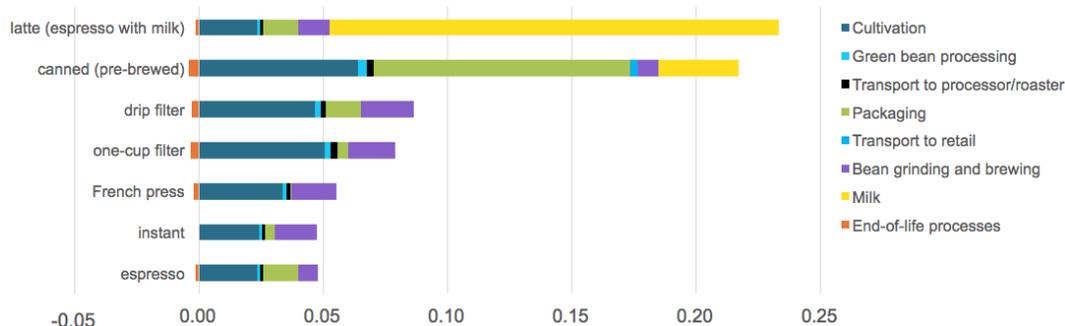
Key Findings

Coffee is consumed in a variety of forms, from concentrated espresso to rich and creamy lattes to pre-brewed, packaged drinks. This variety of consumed forms can lead to real differences in environmental impact, and makes comparisons difficult.

However, two life cycle stages stand out as most important in nearly all of the studies considered: on-farm coffee production, and the final brewing or making of coffee. Packaging format may also be a significant contributor to the environmental profile, particularly for pre-brewed varieties of coffee drinks. Multiple studies demonstrate the importance of consumer-level brewing methods and behavioral choices, offering accessible improvement opportunities.

The graph above shows proportional contribution of life cycle stage or process to the carbon footprint (CF) per serving of coffee. A number of important conclusions can be drawn including that in many cases, coffee cultivation is the dominant contributor to the CF. Interestingly, impacts of international transport of coffee from the country of production to the country of consumption, shown in the black bar, is relatively minor across all examples. Energy use in brewing coffee is another significant contributor, and adding milk to the coffee can drastically increase the overall CF on a per serving basis. In one study that included washing of a coffee cup, the impact from heating water for washing is notable, yet is very dependent on how and how often the cup is washed. Perhaps most surprising, instant coffee has the lowest carbon footprint in three different studies that consider it. This is due primarily to the smaller quantity of coffee beans required and the fact that boiling water to rehydrate instant coffee typically requires less energy than a coffee maker.

Carbon footprint comparison of coffee brewing scenarios



Use Phase Behaviors and Habits

Personal habits about coffee consumption – from the type of brewing method, amount consumed versus wasted, boiling of water, keeping the pot on warm vs. reheating, and cleaning, etc. – can be variables that alter the overall CF of coffee. Though seemingly easy to alter, many of these behaviors can be difficult to change especially in commercial or workplace settings. One study demonstrates that the total life cycle carbon footprint of making coffee with a single-serve capsule system is essentially equal to a drip-brewed coffee maker if there is no waste or other inefficiencies in the use of the drip coffee system. When more coffee is made than is consumed, as is common with drip-brewed systems, the impacts of wasted coffee present a trade-off with the impacts of packaging in single-serve systems that may need more material resources to produce. In general, over-preparing and wasting coffee adds to its impact, and in situations where this occurs often, it may be environmentally preferable to use single-serve systems.

Packaging and Disposable Cups

A study of coffee packaging by Franklin Associates (2008) indicates that brick packs and laminate bags perform better with respect to energy use, GHGE and total solid waste generated, out-performing steel cans, plastic canisters, and fiberboard and steel canisters. The question of whether reusable or disposable cups, and which disposable cups, are better for the environment has to consider the energy efficiency of dishwashing machines and regional electricity grid mix, as impacts of a reusable cup (500+ uses) are almost completely driven by washing the cup. The reusable cup is the better option in regions corresponding to approximately 68 percent of the nation's residential population for all dishwashers evaluated in one report, including the oldest (least efficient) options. This includes the Pacific Northwest, where the electricity grid mix has a lower carbon footprint than the national average and the reusable cup is the preferred option with respect to the carbon footprint regardless of dishwasher energy efficiency. For the remaining 32 percent of the nation's population, with the most carbon intensive electricity mixes, the results depend on appliance efficiency.

Conclusions

Many individuals make daily coffee consumption choices. A better understanding of the environmental impacts of those choices can lead to reductions in system impacts. This review of the LCA literature has identified the following conclusions:

- On-farm coffee production and the “use” phase of brewing coffee (and cleaning up after consumption) stand out as the most important stages across the life cycle.
- Contrary to popular imagination, international transport from the country of coffee production to the country of consumption is a relatively minor contributor to the overall environmental footprint.
- Contrary to consumption trends, instant coffee appears to be an environmentally preferable way to consume coffee.
- Informed choices and behavioral shifts such as avoiding making too much coffee or boiling extra water, turning off “keep warm” features, and washing cups in cold rather than hot water can lead to significant reductions in the environmental impact of consuming a cup of coffee.
- Packaging can be an important contributor to environmental impact for pre-brewed coffee.
- Multi-material laminate packaging appears to be preferred over plastic, steel or fiberboard/steel canisters for packaging coffee beans.
- With multiple cup brewing systems, over-preparation and subsequent waste of brewed coffee can have a significant influence on overall environmental performance. Despite the increase in packaging, single-serve machines may represent a preferable option if they aid in avoiding over-preparation.
- Likewise, coffee machines with “ready-to-serve” or “keep warm” features can result in noticeable increases in energy consumption and thus environmental impact.
- While the literature doesn't consistently identify a clear winner in choosing which type of single-use cup to drink your coffee from, reusable cups have demonstrated environmental benefits, particularly in areas where electricity (used for heating water and washing cups) is not entirely derived from coal or petroleum. Rinsing and reusing ceramic cups even once between full washes can dramatically improve environmental performance per use.

The full report created by Center for Sustainable Systems - University of Michigan can be downloaded from <http://www.oregon.gov/deq/mm/food/Pages/Product-Category-Level-Footprints.aspx>.