

#WhyESGMatters

How sustainable
is your morning coffee?



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Climate change poses a significant threat to coffee production as suitable land for cultivation diminishes, and bean quality and yields decline. Meanwhile, the coffee industry faces mounting pressure for transparency within its supply chain, with technology emerging as a key-enabler. Investors are waking up to social risks, consumer preferences and future developments to improve the industry's sustainability.

In this issue of #WhyESGMatters, we discuss the importance and methods of achieving more sustainable coffee production, highlighting the role of technology in enhancing supply chain transparency.

Did you know?



1. Starting from the ground

What is brewing

From home to popular coffeehouses, coffee lovers across the globe consume over 400bn cups of coffee every year. Nearly 10bn tonnes of coffee is produced annually, primarily concentrated in regions known as the “Coffee Belt”, with the top five producers - Brazil, Vietnam, Colombia, Indonesia and Ethiopia - accounting for over 70% of global production.

Remarkably, small-scale farmers contribute to about 80% of the world’s coffee production, supporting the livelihoods of approximately 125m people. But this popular drink could be at risk. The Intergovernmental Panel on Climate Change (IPCC) predicts a decline in suitable areas for coffee cultivation by 2050. This is supported by several studies indicating that rising temperatures encourage the proliferation of coffee plant pests and diseases, putting the industry in jeopardy.



Headed for trouble

Rising temperature and changing rainfall patterns pose several threats to coffee plantation:

- **Reduced crop yields:** Coffee plants are sensitive to temperature fluctuations, and prolonged heatwaves can hinder their growth and productivity. Arabica and Robusta are the two primary species of coffee cultivated globally. Robusta is relatively less sensitive to heat (but more vulnerable to drought), while temperature plays a crucial role in the development and maturation of Arabica coffee. Arabica plants thrive in the temperature range of 18-21°C, but continuous exposure to temperatures above 30°C can damage them, resulting in decreased yields and compromised bean quality.

The temperature in key coffee-producing regions has already been increasing. For instance, Brazil, the top producer of Arabica, has experienced an increase of 1.16°C in annual mean temperature between 1971 and 2021. A recent study published in the journal PLOS Climate revealed that the sub-optimal conditions for coffee yield have increased since 1980. The last decade was found to be more acute with five of the six most hazardous years occurring since 2010.

- **Shifts in suitable growing regions:** The IPCC projects a decline of 38-89% in the Central American coffee-growing area by 2050 due to changing temperature and rainfall patterns, as well as the minimum altitude for cultivation to raise from 2,000 feet above sea level to 3,300 feet.¹ A recent study published in the journal PLOS One modelled how growing conditions for three popular foods—coffee, cashews and avocados—will change by 2050, and found coffee is particularly vulnerable, with a projected decline of 50% in the number of regions most highly suited for coffee cultivation.²
- **Increased pest and disease outbreaks:** Warmer temperatures create a more favourable environment for pests and diseases that can ravage coffee plants. Coffee leaf rust, a devastating fungal disease, has already caused significant damage in Central and South America. The coffee rust epidemic in Colombia, which occurred from 2008 to 2011, reduced production by 31% on average when compared to 2007.³



1. 'Climate and Coffee', National Oceanic and Atmospheric Administration (NOAA), 19 June 2015

2. PLOS One, expected global suitability of coffee, cashew and avocado due to climate change, 26 June 2022

3. 'The coffee rust crises in Colombia and Central America (2008–2013): impacts, plausible causes and proposed solutions', J. Avelino et al., Food Sec, 2015

The bitter notes

While rising temperature is known to brew trouble for coffee production, the cultivation of coffee is linked to deforestation, further exacerbating climate change. Vast areas of tropical forests are often cleared to meet the growing demand for coffee and create optimal growing conditions. Per the World Resources Institute (WRI), nearly 2m hectares of forest were replaced by coffee plantation between 2001 and 2015. There're two methods of coffee cultivation: shade-grown (agroforestry system) which is environmentally sustainable, and sun-grown which involves forest clearing and depletes soil nutrients.

In many countries, the coffee industry has already transitioned to full-sun production to meet the growing demand. This shift is partly driven by the commonly held assumption that fungal infections are limited by sun exposure, as well as by the financial appeal it offers. Additionally, shade-providing leguminous tree species have been found to compete with coffee plants for soil and water during severe drought, resulting in mortality of coffee plantation. Stuck in a vicious cycle, deforestation due to coffee plantations not only reduces carbon sinks but also eliminates critical habitats, exacerbating biodiversity loss and climate change.

Water and energy consumption

Coffee production also requires substantial amounts of water across its lifecycle, affecting local communities and ecosystems in water-stressed regions. According to the Food and Agriculture Organisation (FAO), a cup of coffee requires 140 litres of water to grow.⁴ From roasting to brewing, the coffee supply chain guzzles energy, adding to its carbon footprint.

To address these pressing issues, various adaptation measures and sustainable solutions are being implemented. For instance, **regenerative agriculture** through intercropping helps improve the quality and biodiversity of soil which is beneficial for coffee yield and quality. It also aids in long-term security for farmers who are among the most vulnerable to climate risk, by diversifying outputs and income.

A seven-year study analysing intercropping between macadamia and coffee found a 10% increase in coffee yield under rain-fed conditions, and the highest profitability after the first five harvests in the irrigated coffee plantation regime.⁵ Regenerative agriculture also aids in the reduction of the water footprint of coffee by enhancing soil filtration and retention capacity.



4. 'Your morning cup of coffee contains 140 litres of water', World Economic Forum, 22 March 2019

5. Agronomy Journal, Irrigation and intercropping with macadamia increase initial Arabica coffee yield and profitability, 1 March 2015

2. Supply chain developments brewing

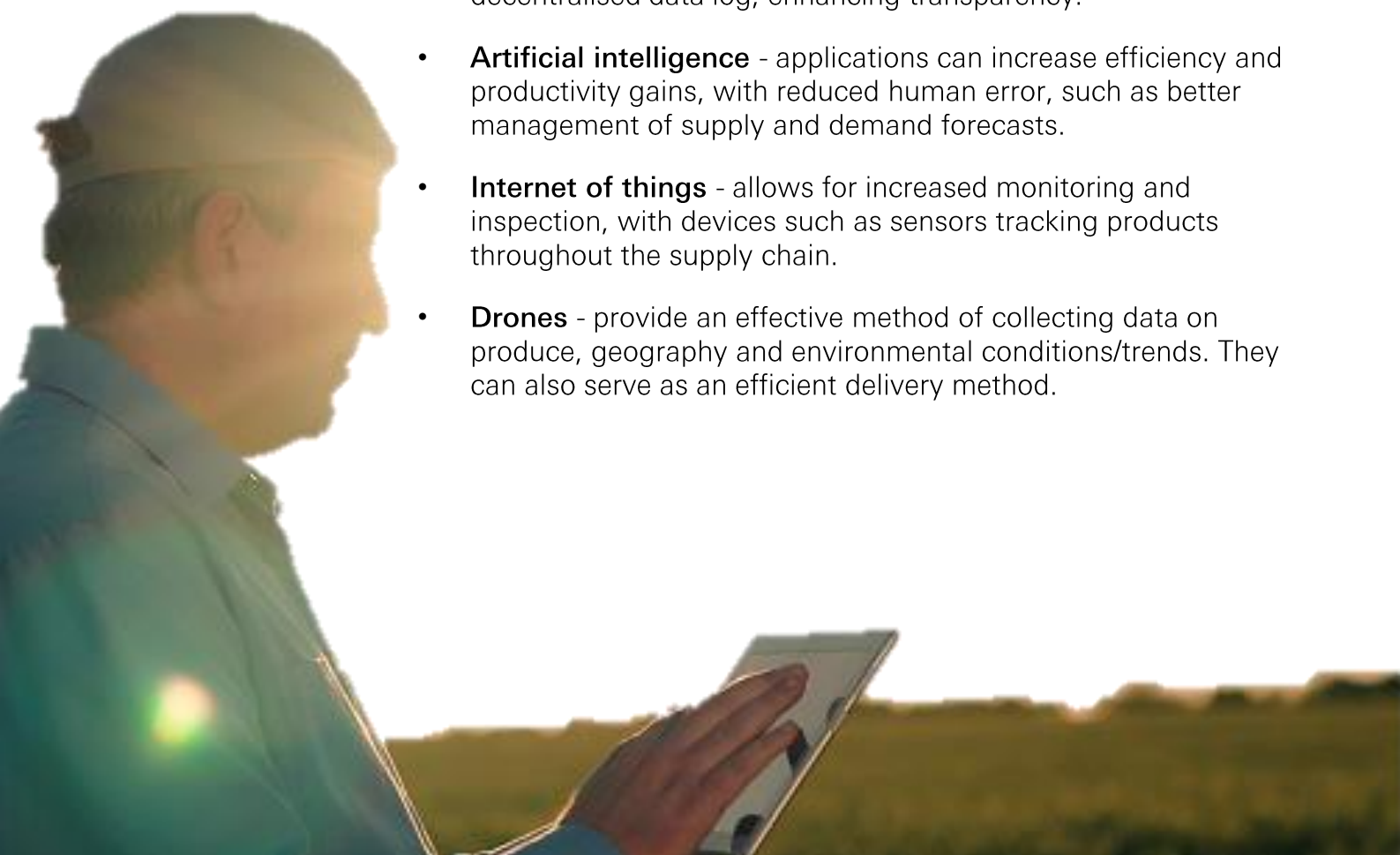
The desire for transparency across consumer goods is growing, and this includes the daily coffee we drink. Pressure from regulators, investors, retailers and consumers is driving the demand for greater traceability in the coffee industry, fuelled by both social and environmental concerns.

Considering the environmental impacts of coffee plantations previously discussed, it's essential to map the entire supply chain, enabling greater transparency and the collection of important ESG metrics such as emissions, water usage and deforestation. Regulatory developments, such as the EU Deforestation Law, highlight the importance of gathering this information across the entire value chain.

Worker well-being is also a significant consideration in the coffee industry, with **heat stress** emerging as a growing concern, particularly in agriculture. Southern American countries, which are key coffee producers, have seen a 2x increase in working hours lost since 1995 due to heat stress. This presents a key health and safety risk to coffee farm workers and a threat to global coffee production if precautions are not properly taken.

Technology plays a crucial role in improving transparency and simplifying increasingly complex and dynamic supply chains. Key disruptive technologies are important in the transition to traceable supply chains:

- **Element analysis** – provides verification of product samples and locations through scientific traceability techniques, ensuring accuracy and reliability.
 - **Blockchain** – gives the ability to map the entire journey of a product through from raw materials to finished goods on a decentralised data log, enhancing transparency.
 - **Artificial intelligence** - applications can increase efficiency and productivity gains, with reduced human error, such as better management of supply and demand forecasts.
 - **Internet of things** - allows for increased monitoring and inspection, with devices such as sensors tracking products throughout the supply chain.
 - **Drones** - provide an effective method of collecting data on produce, geography and environmental conditions/trends. They can also serve as an efficient delivery method.



Standards and regulations

Alongside regional food safety requirements, sustainability standards are becoming increasingly important in the coffee market. In the European Union, mandatory requirements encompass aspects include food safety/containments, pesticides and pathogens, among others, as well as additional third-party curated sustainability certifications that aim to demonstrate compliance with social criteria. Well-known certifications include Fairtrade, Rainforest Alliance and Fair for Life.⁶

Fairtrade aims to make a positive impact on producers and workers across the globe in a range of products, including coffee. Fairtrade Minimum Price sets a floor price for products to safeguard against volatile markets while Fairtrade Premium provides additional funds for farmers and workers to invest in infrastructure, healthcare and social projects. Currently, Fairtrade coffee accounts for around 25% of total coffee sales in the UK, including a significant market presence and consumer support for sustainable and ethically-sourced coffee.⁷



6. 'What requirements must coffee comply with to be allowed on the European market?', CBI, 14 December 2022

7. Fairtrade Foundation

3. Your coffee decisions matter

Individual consumption choices have a significant impact on emissions, waste generations and pollution. Alongside the environmental effect, differences between bean type – Arabica or Robusta – as well as the decision to purchase ground or instant coffee, can have varying environmental costs. Studies show that with respect to the lifecycle of both instant and ground coffee, instant has higher environmental costs than ground as it requires 7-11x more energy.⁸ Globally, instant coffee accounts for more than 34% of retail brewed coffee consumption.⁹

Ground pods represent 16% of UK coffee sales, and although they provide the consumer the opportunity to create barista-style coffee at home, their sustainability has come under scrutiny. Beyond the emissions generated during the preparation of coffee from the pods, the post-consumer waste associated with pods and capsules contributes to additional emissions and landfill contribution.¹⁰ We've observed retailers switching to aluminum pods and implementing recycling schemes, as well as compostable pods (such as Grind Coffee) to help alleviate risks.

Coffee volume sales in the United Kingdom

48% Standard instant

8% Decaffeinated instant

4% Instant mixes

16% Ground pods



24% Standard ground

Source: 'An environmental and economic sustainability assessment of coffee production in the UK', P. Gosalvitr et al., Chemical Engineering Journal, 2023.

8. 'An environmental and economic sustainability assessment of coffee production in the UK', P. Gosalvitr et al., Chemical Engineering Journal, 2023
9. Euromonitor
10. 'Carbon footprint of different methods of coffee preparation', M. Cibelli et al., Sustainable Production and Consumption, 2021

Disposable coffee cups pose an additional environmental risk as the majority are unable to be recycled due to plastic linings and, thus, end up in landfill. In the UK alone, approximately 2.5bn coffee cups are disposed of each year.¹¹ Offering consumers with environmentally friendly alternatives and providing monetary incentives for reusable cups have proven to be effective solutions. Studies find that nearly 93% of consumers are willing to bring their own reusable cup if they receive discounts exceeding a certain value, approximately USD0.265.¹²


A time for coffee innovation

Seeking sustainable coffee has spurred various innovations, such as lab-grown coffee and energy production from waste. Cellular agriculture, for example, offers the possibility to create coffee cells in a lab. This can be of great use to coffee-flavoured products; however, adoption into mainstream coffee drinking remains a social question for consumers.

Additionally, taking demand away from small-holder farms in developing regions risks their livelihoods.¹³ Utilising coffee ground waste is a promising area to alleviate landfill contributions. Combining coffee grounds with polymers creates a material that can be used in the garment industry. Additionally, converting grounds into logs provides an alternative to wood for burning purposes.¹⁴ Exploring bioenergy production and building material from coffee cups also present opportunities for environmental sustainability.

4. Conclusion

Reusable coffee cups are commonplace for many regular coffee drinkers. However, more concerted efforts are required to reduce the industry's overall impact and ensure the reliability of the coffee supply chain. Embracing regenerative agriculture, new coffee species adaptations and technology are opportunities to increase supply chain resilience. Progress in standards and regulations lead to certifications that address growing social risks. Innovative developments in lab-grown coffee and waste recycling create opportunity to reduce environmental impacts. Considering the projected tripling of coffee production requirements by 2050 (World Economic Forum, 2021), it's imperative to continue driving sustainable practices and innovations within the coffee industry.

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11. 'Coffee waste: Companies offer up new solutions', BBC, 22 April 2021
 12. 'Explaining the willingness of consumers to bring their own reusable coffee cups under the condition of monetary incentives', J. L. Nicolau et al., Journal of Retailing and Consumer Services, 2022
 13. 'Where can you find the world's most sustainable coffee? In a lab in Finland, of course...', World Economic Forum, 20 October 2021
 14. 'Coffee waste: Companies offer up new solutions', BBC, 22 April 2021

Disclosure appendix

1. This report is dated as at 26 July 2023.
2. All market data included in this report are dated as at close 24 July 2023, unless a different date and/or a specific time of day is indicated in the report.
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