Making a case for a circular economy in the coffee sector

Insights from the multi-stakeholders working group on circular economy in coffee
“A circular economy can create better incomes and a healthy environment for coffee farmers by making high quality products and minimizing the environmental impact their processes can generate.”
- Jonathan Duran, International Sales Manager, COOPEAGRI and NAOX, Costa Rica -

About

This document provides some insights on the work by the multi-stakeholders working group on Circular Economy in Coffee, part of the ITC’s Coffee Guide Network. An extended version will be included in the upcoming ICO Coffee Development Report on Circular Economy.

This work is a collaboration of 46 Working Group members from across the global coffee sector, including representation from producers, roasters, MSMEs, exporters, corporates, consumer facing companies and institutions. They leveraged emerging practices, scientific research, practical case studies, and critical insights from a global questionnaire designed specifically for this exercise to define potential gaps and future trajectories for circular economy in practice within the coffee sector.

The goal of this report is to accelerate the circular economy agenda, supported in practice by the launch of the Center for Circular Economy in Coffee (C4CEC), a pre-competitive platform established to put recommendations and solutions into action.
The main partners of this document include the International Trade Centre (ITC), the International Coffee Organization (ICO), the Fondazione Giuseppe e Pericle Lavazza Onlus, the Politecnico di Torino, United Nations Industrial Development Organization (UNIDO) and the Center for Circular Economy in Coffee (C4CEC).

**The International Trade Centre (ITC)** is the joint agency of the World Trade Organization and the United Nations. ITC is the only development agency that is fully dedicated to supporting the internationalization of micro, small and medium-sized enterprises (MSMEs). Its Alliances for Action programme initiative leverages partnerships for sustainable food systems.

**The International Coffee Organization (ICO)** is the only intergovernmental organization for coffee, bringing together exporting and importing governments. It currently represents 93% of world coffee production and 63% of world consumption.

The Circular Economy Working Group is coordinated by ITC as part of the Coffee Guide Network, a pre-competitive initiative within the Alliances for Action Programme. The working group aims to share and deepen knowledge of current practice, gaps, and potential for circular economy in the coffee sector.

**The Fondazione Giuseppe e Pericle Lavazza Onlus** was established in 2024 to promote and implement economic, social, and environmental sustainability projects for coffee-producing communities worldwide.

**The Politecnico di Torino** is one of the top European technical universities for education and research. Its goal is to become a driving force for societal sustainable development.

**United Nations Industrial Development Organization (UNIDO)** is a specialized agency of the United Nations with a mandate to promote, dynamize and accelerate industrial development. It focuses on three areas: ending hunger by helping businesses from farm to fork; stopping climate breakdown by using renewable energy and energy efficiency to reduce industrial greenhouse gas emissions; and supporting sustainable supply chains so that developing country producers get a fair deal and scarce resources are preserved.

**The Center for Circular Economy in Coffee (C4CEC)** is a pre-competitive initiative to accelerate the transition from linear to circular in the coffee sector. It provides a platform for putting circular economy into practice. Established in Turin, Italy, as a nonprofit organisation and officially launched in September 2023 during the ICO World Coffee Conference in Bangalore, India, the Center is supported by a global network.
Circular Economy in Coffee: Why does it matter?

Coffee is both one of the most widely consumed beverages in the world and one of the most important internationally traded commodities. The sector generates jobs and income in over 50 coffee growing countries and for millions of people worldwide.

Like other agricultural commodities, it also generates a great amount of waste at every step of the value chain, which can contribute to global pollution and climate change. Instead, this waste could be reduced and reused in other productive processes.

According to ICO, in crop year 2022/23, 10.09 million tons of coffee were produced, and 10.38 million tons consumed.¹

This generated a global total of 34-39 million tons of biological material each year (not including green coffee beans) through coffee processing across the value chain.²

Coffee farmers, who already face mounting risk because of environmental damage and economic uncertainty, are the most vulnerable to the negative consequences of excessive supply chain waste.

This same supply chain waste can be instead used for new productive purposes. A circular economy can generate opportunities for value addition and new economic opportunities for farmers and MSMEs, by using by-products and waste. This can enable job creation for youth and income diversification for better resilience and growth.

As we reach the era of ‘global boiling’, the world understands that nature needs to be protected to regenerate, that we must drastically reduce the input materials we use, and that product supply chain waste must be recycled or eliminated across the value chain, from seed to cup.

Global disparities also remain in the access to knowledge, finance, innovation and markets required for transformation and value-added products in the coffee sector. Coffee growing countries often have few options for the diversification of their activities and more profitable endeavors.

Circular economy is both a system and a mindset shift. Products and processes are designed to add value to resources, reduce waste and keep materials in use for as long as possible, at their highest value. Waste streams are reimagined to create new uses, generating additional value for the environment through regenerative agricultural practices as well as new income streams for people.

“A Circular Economy model for the coffee sector designs, balances, and implements regenerative practices, resource efficiency, and waste reduction while giving value to process outputs, achieving environmental, social and economic sustainability. Driven by a systemic and holistic approach, it draws inspiration from the dynamics of natural systems to regenerate, maintain, and create shared value for all stakeholders, across different contexts and within the entire coffee value circle.”

- ITC Coffee Guide Network, Circular Economy Working Group -

3. Adapted from the Ellen MacArthur Foundation www.ellenmacarthurfoundation.org/topics/circular-economy-introduction/overview.
A global survey to gauge the coffee industry’s stance on circular economy

The Circular Economy Working Group, part of the ITC Coffee Guide Network, launched a global survey to coffee sector actors to gauge the sector’s overall understanding, perception, and implementation of circular economy. It was distributed in English, Portuguese, French, and Spanish from August to November 2023.

Early results revealed some key considerations for the identification of gaps and opportunities for the implementation of a circular economy in the coffee sector:

Gaps and Opportunities
- With an average response of 4.3 on a scale of one to five, survey respondents indicated broad consensus that a circular economy is a model capable of improving environmental, social, and economic sustainability in the coffee sector.
- In stark contrast, only 37% of respondents declared they implement some form of circular practice within their activities.
- 72% of respondents indicated they have limited to moderate knowledge about circular economy in practice.

Main identified challenges
- Lack of knowledge
- Financial constraints and limited access to funding
- Low levels of coordination between research centres and private sector organizations
- Balancing economic viability with broader circular economy goals
- Lack of standardized guidelines and best practices to implement a circular economy
- Inadequate regulatory frameworks
- Low consumer awareness and associated reluctance to pay means that potential

The global survey included responses from:
- 64 countries
- 8 value chain segments
- 24% coffee farmers
- 23% coffee support organizations
- 24% coffee traders and mills
- 20% consumer facing and roasters
- 7% government authorities
- 2% Other coffee industry

This survey remains open in order to collect a larger number of responses from across the global coffee sector. The results including more details and analysis will be included in the joint ICO Coffee Development Report and updated on ITC’s Coffee Guide Resource Hub. You can support and inform this ongoing coffee sector research by adding your input.
From linear to circular: Reinventing the coffee value chain

Circularity rethinks the connection between people and planet, resources and products, and value and capital.

The circular approach seeks to disrupt the “take-make-waste” linear model by nurturing collaboration and actively considering production and consumption systems, and their impacts, across the entirety of value chains.

Integrating the circular business model and solutions in the coffee sector can contribute to a sustainable future for coffee from seed to cup.

A circular coffee economy and solutions will help farmers, governments, businesses and consumers work together to create better jobs and income, reduce pollution, fight climate change and make the sector better for all.⁵

The Circularity Gap Report 2024 states that the global economy is only 7.2% circular to date, meaning that the amount of reused or recycled materials used by the global economy is declining year on year, driven by rising material extraction and use, while consumption continues to accelerate.⁶

The Ellen MacArthur Foundation estimates that by 2025, about USD$ 1 trillion per year of materials cost savings could be generated from circular business models.⁷

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Circular economy: a model towards environmental, economic, and social sustainability

Three foundational elements are essential to reach the holistic goals of a circular economy.

Local approaches to generate local value
By considering each process by-product as a new resource rather than a waste product, value addition allows for diversification of product offerings in new markets and customer bases, particularly at coffee origin.

Shifting from a value chain to a value circle
The concept of a value circle balances a need for profit with its relative costs to the environment. By its very nature, a circle must seek balance or it becomes broken. In this way, a circular economy model mimics nature itself. It is holistic and systemic.

Regenerative agriculture
To bring environmental systems into balance by restoring degraded lands, growing healthy foods and commercially valuable crops through sustainable methods and preserving biodiversity through agroforestry systems that act as significant carbon sinks.

Regenerative agriculture is an application of a circular economy in agricultural production.

It improves soil health, creating farming systems that “work in harmony with nature to improve quality of life for every creature involved.” It puts into practice circular economy principles for food production and systems.

These impacts include strategies to regenerate ecosystems where coffee is grown, alleviating the burden of agricultural and transformation processes, new local economies capable of supporting the incomes of coffee farmers, and the development of innovative products that demonstrate the potential hidden behind what, until now, has been called waste.

Regenerative agriculture can also diversify incomes and crops. It can help improve food security, soil quality, biodiversity, and climate-smart adaptation.

Regenerative organic agriculture will play a key role in the implementation of a circular economy. They work hand in hand, amplifying each other’s opportunities and impact.

Opportunities for a coffee value circle

- For every ton of cherries, approximately 200 kilos of green coffee beans are obtained. 

- 1 ton cherries = 200 kilos green coffee beans

- Packaging, coffee capsules, and logistics to reach the consumer demands for convenience and quality generates greenhouse gas emissions and waste that is not efficiently recyclable.

- 10.3 million tons of green coffee consumed in 2022/2023

- 7-8 million tons of spent coffee grounds are replaced annually.

- Coffee processing from coffee cherry to cup generates a global total of 34-39 million tons of biological material each year. These estimates are calculated using known conversion ratios. They include the total biomass created from green coffee processing, roasting, and brewing (husks, pulp, mucilage, parchment, silverskin, spent coffee grounds, and water that will be evaporated). This does not include the weight of the green coffee bean itself.

- 34-39 million tons of biomass generated

- 1-5% of the original cherry remains in our cup.

- The coffee cherry is made up of elements with unique bio-active compounds that can be used across industries, from cosmetics, food products, agriculture production, energy, to bio-plastics and others.

10. International Coffee Organization.
Opportunities to add value, reuse or reduce waste in a coffee value circle

Each step from bean to cup requires inputs and generates outputs. A circular economy seeks to either reduce the number or amount of inputs, or source more sustainable ones, and upcycle outputs into high-value, sustainable products or applications.

The entire coffee plant has unique attributes that can be used across industries and products. The coffee cherry itself – from skin, pulp, mucilage, parchment, husk, silverskin, to the spent coffee grounds of its processed form – has unique bioactive compounds.

Here are just a few of the innovative ways that entrepreneurs are converting the previously discarded pieces of the coffee cherry into new, valuable products throughout the coffee processing cycle.

**Coffee cherry skin and pulp (cascara), husks, and parchment**

- The coffee cherry skin can be used in various food products including teas, flours, drinks, and snack foods
- Coffee mucilage and pulp are high in antioxidants and are being transformed into high value products, such as ready-made beverages, for human consumption
- Coffee cherries, pulp, and husks are ideal components for biofoliars, compost and mulch, animal feed, and even building materials

**Examples**

**Coffee Cherry & Co.** developed coffee flour as a pilot project in Nicaragua. It’s a nutritious flour from dried cherries, that provides environmental benefits, economic opportunities for farmers, and addresses dietary deficiencies.

**UNIDO** and supply chain actors piloted a small-scale pyrolysis system in Vietnam to transform coffee waste into three main products: heat for drying coffee husks, biochar, and wood vinegar, which can be sold as a natural pesticide.

The **Woodpeckers** panels, developed in Colombia, aim for construction in rural areas and accessibility for low-income populations with ready-to-use building kits made with coffee husks.

**NAOX** is a ready-to-drink beverage high in antioxidants that is made from coffee mucilage concentrate. The product is sold in major retailers including WalMart throughout Costa Rica. Mucilage concentrate has been product-tested for multiple uses including organic foliar fertilizer sprays and preservatives. CoopeAgri, a member of CLAC-Fairtrade, produces the coffee mucilage concentrate at an agro-industrial scale through a joint venture Agri-SANAM, aiming to increase economic opportunities for its farmers with the goal of using 100% of the coffee cherry in circular economy practices.

In Uganda, ITC’s Market Access Upgrade Programme (MARKUP) supported coffee wet mill Mountain Harvest on recovering waste and increasing profitability, under its Resource Efficient and Circular Production coaching programme. The goal was to reduce their operational costs and improve their risk resilience, while minimizing their environmental footprint. By composting the waste coffee pulp and transforming it into organic fertilizer, they created the additional business opportunity to sell it to local farmers.
Spent coffee grounds

- Only 20% of coffee grounds end up in a cup of coffee. They are usually disposed of as waste and are responsible for landfill emissions. However, they are rich in cellulose, hemicellulose, lignin, proteins, and bioactive compounds such as polyphenols.
- Entrepreneurs in coffee producing countries and consuming countries alike are using coffee grounds or pulp as substrate for cultivating high-value mushrooms.
- Industrial biochar is made from biomaterials including coffee pulp, husks, and grounds.

Examples

Kaffibre, developed by Kaffee Bueno, is a flour derived from spent coffee grounds. Since it is gluten-free, protein-rich, and high in fiber and potassium, it is a versatile ingredient ideal for dietary and high-protein recipes.

In the United Kingdom, Bio-Bean Ltd. developed second-generation biofuels from waste coffee grounds, including pellet fuels for biomass boilers, biodiesel, and briquettes for barbecues.*

In Egypt, Cupmena is repurposing spent coffee grounds into high value products, including specialty mushroom cultivation and organic fertilizers. High sought after mushrooms are cultivated using spent coffee grounds as the growing substrate. The work requires effective collaborative efforts with coffee chains for efficient spent coffee ground collection and market development aspects to sell and market the mushrooms as a sustainable product.

Silverskin (chaff)

- Silverskin is the thin and light layer around green coffee beans that is removed during roasting.
- It has unique chemical and physical properties, with potential for use in cosmetics, paper, vegan leather, and food products.

Examples

The Italian project CirCo optimized coffee silverskin through a cascade process. Lipid extraction enabled Intercos (Italy) to produce pigmented lip products, while Favini (Italy) used the remaining cellulose to replace 15% of virgin cellulose in their paper production.

In March 2023, a factory fire and inflationary pressures led the company to file. The UK bioenergy company Envar Composting acquired its assets.
Coffee grounds can be leveraged for multiple uses and products across sectors

This diagram maps known potential uses and products for spent coffee grounds, as well as the sector in which it can be applied, and the process required for its application.

Spent grounds can be used following an initial stabilization to stop the decomposition of the grounds, followed by extraction, drying/milling, pyrolysis, or in some cases, no treating is required.

Challenges remain for the implementation of a circular economy at scale in the coffee sector

- **Policies and regulations that need adaptation.**Associated technologies and products are new, and the food safety requirements, labelling, and regulations for using a traditional food byproduct as a new food ingredient are major hurdles and vary in each country and context.

- **Mobilization of finance sources and mechanisms.**Innovations, R&D, and industrialization at scale require significant funding.

- **Market development, consumer awareness, and new supply chains.**These are challenges that must be tackled. Mainstream consumers are not yet on board.

- **Regulatory barriers.**Regulations and standards for import/export of new products can be absent or too stringent. Food safety regulations and labeling requirements differ by country and region.

- **Matchmaking process outputs with product makers.**The collection, management and stabilization of agricultural and food byproducts (such as spent coffee grounds) can be bottlenecks for implementation. The logistics of collecting and moving a process byproduct to an entrepreneur who makes use of that product, in a sanitary and time-efficient process, will require effective coordination.

- **Meeting potential consumer demand and availability of the product.**Demand and product availability may be mismatched. Market strategy, new global supply chains, logistics, and international transport may be required.

- **Low consumer awareness.**This means that potential investment undertaken by coffee cultivation and transformation actors isn’t always viable.

- **The value isn’t always circular, but should be.**The added premiums and value should feed back into the first stages of the value chain.
Preliminary findings on the integration of a circular economy in the coffee sector confirm trends seen in other sectors. New approaches are necessary to accelerate the transition from linear to circular.

**Key Takeaways & Recommendations**

*Regenerative agriculture*, combined with local approaches for coffee processing, can make agricultural production circular and add value for coffee producer communities.

*Collaboration, coordination, and global networks* can help design and implement circular economy actions and effective cooperation between public and private sector actors to activate processes.
Addressing these complex challenges requires a holistic approach that acknowledges the complex relationships and interdependencies between environmental, social, and economic factors.

- **Build enabling policies, R&D of innovative solutions, efficient waste collection systems, and investment** - particularly in the Global South - to support a sector-wide transformation.

- **Encourage regenerative agriculture so circularity can be engaged from production level**, allowing better adaptation to climate change and biodiversity loss and improved economic resilience.

- **Foster R&D for value-added products**, support services and innovations to generate job creation, and especially for youth.

- **Establish standardized guidelines and best practices** to implement a circular economy within each stage of the value chain.

- **Develop new (or build on existing) innovative financial mechanisms** to support regenerative agriculture and circular business models.

- **Engage coffee supply chain collaboration** to tackle the root causes of unsustainable symptoms and practices, while fostering positive outcomes across multiple dimensions.

- **Establish equitable and fair value distribution** throughout the coffee value circle to make value addition from circular approaches profitable and accessible to all, and especially coffee producers and small business owners.

- **Raise consumer awareness to build the value of circular economy** products and processes, including recycled or reused materials.

- **Promote and support global knowledge networks** to design and implement circular economy practices.

Find out more in the upcoming Coffee Development Report on Circular Economy, a joint flagship report from the ICO, co-created with the ITC, ITC Coffee Guide Network, and C4CEC.

**Join us at the C4CEC**

- Transform and reinvent the global coffee value chain into a value circle to generate a fair and win-win economic transaction, particularly for coffee farmers and young entrepreneurs and MSMEs in producing countries.

- Integrate the circular business model and solutions in all areas of the global coffee sector.

- Understand and reimagine our own waste streams as valuable resources for new products and regenerative processes.
The Center for Circular Economy in Coffee (C4CEC) is a pre-competitive initiative to accelerate the transition from linear to circular in the coffee sector. It provides a platform for putting circular economy into practice:

- Piloting innovations
- Furthering research
- Collecting and sharing all good practices, solutions, case studies, and practical information about the circular economy applied to the coffee value chain.

To access resources and tools, and learn how to become a member, please visit: www.circulareconomyincoffee.org

Contact: info@circulareconomyincoffee.org
The International Coffee Organization (ICO), established by the first International Coffee Agreement in 1962 under the aegis of the United Nations, is the only intergovernmental organization for coffee bringing together exporting and importing governments to strengthen the global coffee sector and promote its sustainable expansion in a market-based environment for the benefit of all actors in the Global Coffee Value Chain (G-CVC).

The ICO flagship publication, the Coffee Development Report (CDR), focuses periodically on specific themes of key relevance to the coffee sector. The 2023 edition, to be published in September 2024, will be centred on how to make the coffee economy circular and regenerative.
Find out more about ITC’s Coffee Guide Network

About the International Trade Centre

The International Trade Centre (ITC) is the joint agency of the World Trade Organization and the United Nations. ITC is the only development agency that is fully dedicated to supporting the internationalization of micro, small and medium-sized enterprises (MSMEs).

About the Alliances for Action Programme

ITC’s Alliances for Action programme initiative leverages partnerships for sustainable food systems. It does this through partnerships that cultivate ethical, climate-smart, sustainable agricultural value chains.

It aims at achieving resilience and growth for farmers and MSMEs through more mindful and responsible trade, production and consumption systems and improved opportunities to compete on a global market.
About the Coffee Guide Network

The Coffee Guide Network is a global community of coffee experts that creates, curates, and disseminates neutral, practical resources and knowledge for the coffee sector.

It aims to produce practical resources that bridge information gaps for coffee sector professionals, policymakers, academia and consumers and to promote widespread co-creation and collective action.

The member network formed through a unique collaborative effort to pool knowledge and experience for the fourth edition of ITC’s Coffee Guide, widely considered the industry reference for coffee knowledge. The Coffee Guide is freely available in English, French, Spanish, Portuguese, and most recently, Amharic.

About the Circular Economy Working Group

The Circular Economy Working Group is coordinated by ITC as part of the Coffee Guide Network, a pre-competitive initiative within the Alliances for Action Programme, facilitated in collaboration with Lavazza Group and Politecnico di Torino.

The group’s 47 members represent value chain and coffee sector actors globally who convene to co-create and share knowledge about the circular economy in the coffee sector. Through discussion, the goal is to understand the state of the circular economy in the coffee sector in practice, uncover challenges, gaps, and opportunities, and collaboratively generate knowledge related to the application of the circular economy concept throughout the coffee value chain.
Circular Economy Working Group Members

We are grateful for the dedication, time and insights contributed by the Working Group’s valued members. The working group is jointly facilitated by International Trade Centre, Lavazza, and Politecnico di Torino.

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