

CIRCULAR ECONOMY BUSINESS CASE STUDIES IN SOUTHEAST ASIA

Thanh Long International JSC

- Hanoi, Vietnam
- Agro-industry
- www.thanhlongplastic.com
- Analysis period: 2019-2024

Bioplastics Made from Coffee Husk and Agricultural By-products

Business Spotlight

Thanh Long International Joint Stock Company (hereafter Thanh Long) was established in 2019 to specialise in using coffee by-products for production of bioplastics.¹ Thanh Long is a member of Minh Tien Group's business ecosystem, a leading coffee exporter in Vietnam. Its mission embraces circular economy model for coffee production, where every value is derived from every part of the coffee crop. Coffee by-products, or waste from processing coffee beans, are traditionally disposed of in landfills in Vietnam. Thanh Long succeeded in making high quality bioplastics (i.e. biodegradable plastic resin BIO-MT and bioplastic products) from Vietnam's Arabica coffee husk and agricultural by-products. Thanh Long's bioplastics target high-end customers in the EU, USA, Canada and export-oriented companies operating in Vietnam, helping to:

- optimise the business model by utilising available discarded coffee husk as input material for production and thereby increase company revenue;
- increase income for the farmers by buying their

coffee by-products and agricultural by-products; and

- reduce the production of plastic and waste.

This environmentally and socially responsible business practice also positively impacts the company's reputation and image. Processing coffee husk into bioplastics by Thanh Long is an innovation that addresses environmental problems and contributes to circular green agriculture, aligning with global and national sustainable development goals.

Keywords

Agriculture waste and by-product, Biodegradable resin, Coffee production

Innovation

Product/Service design, Manufacturing, End-of-life management, Resource circularity, Resource substitution

¹ Bioplastics are defined by two properties either on their own, or together: bioplastics are bio-based, biodegradable, or both. The first property means bioplastics comprise – at least a proportion – of renewable raw materials. Almost all bioplastics are bio-based. Bioplastics are generally biodegradable, i.e. they can be degraded by naturally occurring microorganisms into water and CO₂ with a small proportion of biomass.

Context and baseline

Coffee is enjoying global popularity and its consumption continues to increase with the growing population and development. Vietnam accounts for around 16% of global coffee production, second only to Brazil. According to the International Coffee Organization (ICO), global coffee production reached 168.2 million 60 kg bags 2022/23.² The high demand for coffee generates enormous amounts of by-products during all coffee processing steps.

The coffee bean accounts for around 50% of the coffee cherry³, with the rest ending up as by-products in green coffee processing (pulp, mucilage, parchment and husk) and roasting (silver skin and spent coffee grounds). All of these fractions are generally discarded, despite their high potential value. Given their polysaccharide-rich composition, along with a significant number of other active biomolecules, coffee by-products are being considered for use in the production of plastics, supporting the circular economy. The residue of the coffee industry has historically not been seen as a concern, given its biodegradability. However, these residues can potentially be converted into biodegradable and compostable packaging, and products that could substitute for plastics to address environmental pollution and climate change concerns. Hence coffee companies have started searching for opportunities to use their coffee byproducts and food residues to create biopolymer materials. In 2024 Thanh Long successfully used the husks of Arabica coffee and agricultural by-products to produce biodegradable plastic composite resin BIO-MT and bioplastic film and products on an industrial scale.

Innovation

Thanh Long innovates toward the utilisation of coffee husk and agriculture by-products through the production of bioplastics.

Coffee by-product and other agriculture by-products utilisation. The circular innovation of Thanh Long is based on the customised application of compounding bioplastic technology. Coffee husk is mixed with other agricultural by-products and materials as the main components of the bioplastics. Coffee husk is the outer skin of the coffee bean that is removed after drying and before roasting. This by-product is routinely discarded from the production process. However, it is valuable waste from the dry-processing of coffee beans. Coffee husk has a moisture content of 13%–15%, depending on the drying process time.

This by-product contains high levels of lignin and cellulose, and a fraction of hemicelluloses rich in xylose residues, etc. Thanh Long utilises coffee husk and agricultural by-products for making biodegradable plastic resin BIO-MT and bioplastic products. Besides coffee husks, Thanh Long is also utilising agricultural by-products such as corn, sweet potato and cassava starch, and rice husks, which are abundant in Vietnam in the production of plastic resin BIO-MT and bioplastic products. Thanh Long bioplastics can be decomposed into water and CO₂ within six to twelve months under aerobic composting conditions.

Wide application of products made from bioplastics. Bioplastics made from coffee husk and agricultural by-products can be applied in the extrusion, injection moulding and film blowing industries to create useful products to replace plastics without the need for new machinery, helping businesses save transition costs. Due to the superior natural properties of coffee husk and agricultural by-products, the bioplastic material has high hardness and durability so it can be used in most of the production technologies of traditional plastic. Most importantly, there are attractive opportunities for investment in innovation and technology. As bioplastic production is further optimised, the product life cycle can be extended with the prolonged use of the materials. Moreover, production costs can come down as production capacity increases.

Circular Economy impact

Bioplastics production at Thanh Long contributes to the circular economy principally through the circular use of natural resources (known as resource circularity), and by enabling the substitution of non-renewable materials (plastics and possibly others) with a renewable material (known as resource substitution).

Resource circularity is achieved by using the Arabica coffee husk waste from the coffee cherry processing and other agricultural by-products for production of the bioplastic composite material, thereby preventing it from being composted, burned or simply dumped. For example, green coffee processing leads to the production of significant amounts of by-products representing around 50% of fresh coffee cherry weight. The wastes generated from coffee processing not only have environmental risks, but also represent a significant loss of nutrients with high bioactive properties. Recent research has shown that coffee by-products contain between 16.0–

² https://icocoffee.org/documents/cy2023-24/Coffee_Report_and_Outlook_December_2023_ICO.pdf

³ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10347136/>

25.0% cellulose fibre, 9.0–11.0% hemicellulose, and 6.0–10.0% lignin.⁴ Hence, using husk for bioplastics production not only minimises waste and associated pollution, it also mitigates greenhouse gas (GHG) emissions that would otherwise be produced by the fermentation or uncontrolled decomposition of the husk. Thanh Long has been piloting bioplastics production at a small workshop in Hanoi since 2019. In 2024 the operations attained 15 metric tonnes/day on average.

Converting coffee husk and agriculture by-products to bioplastics is an eco-friendly alternative to the traditional production of plastic starting from non-renewable oil. This illustrates resource substitution. Biodegradable plastic resin Bio-MT and products made from Bio-MT have durability and ductility comparable to regular plastics. The distinguishing feature is their biodegradability, allowing bioplastics to decompose into water, CO₂ and biomass humus, and the latter can be used as fertiliser. Environmental pollution can be reduced by replacing various plastic products such as plastic cups and containers, food packaging films, bags, etc. This is particularly relevant in the fight against plastic pollution which poses a threat to wildlife, nature and environment, in Vietnam and globally.

Business and market impact

The circular economy innovation delivers financial, environmental and social benefits for Thanh Long. Aside from preventing an important source of coffee waste, bioplastics improve the economics of coffee processing.

About 90% of the coffee husk used by Thanh Long comes from Minh Tien Group, which helps to optimise business activities and reduce the input cost. Thanh Long aims to export its biodegradable plastic resin Bio-MT to high-end markets such as Europe, the US and Canada. For domestic markets, Thanh Long supplies its packaging and bioplastic products to foreign direct invested companies operating in Vietnam.

Thanh Long is the only company in Vietnam capable of making bioplastics from coffee husk and agricultural by-products using the necessary state-of-the-art technology. Thanh Long recently invested in equipment and facilities to increase its production to an industrial scale in Bac Ninh province. The first factory has a capacity of 20,000 metric tonnes of finished product annually which is expected to be achieved by the end of 2024. Its investment amounted to about USD 10 million and is expected to be fully recovered within 2 years. A second phase is already foreseen to expand annual capacity to

around 43,000 metric tonnes.

Rapid economic growth, urbanisation, and changing lifestyles in Vietnam and globally have led to a plastic pollution crisis. Against this background bioplastics have gained considerable attention owing to their low carbon footprint, sustainable raw materials, and biodegradability. Higher demand for bioplastic is expected in the years to come, providing a market opportunity for bioplastics companies including Thanh Long.

For society, GHG emissions and industrial waste are significantly reduced, and as a consequence the costs for remedial and adaptation measures decrease as well. Local communities can access secure jobs, which in turn leads to the assurance of sustained economic growth.

Thanh Long has always maintained that the application of scientific and technical know-how is fundamental for business success. This principle guides the company's activities, and its journey continues to see successive breakthroughs. The company continues to seek innovative ways to improve sustainability, practice its philosophy of providing environmentally friendly products to the community, and contribute to social development. Thanh Long has built a strong foundation for further advancing the circular economy in Vietnam.



Coffee husk



Thanh Long bioplastics factory

⁴ A. Hejna, Potential applications of by-products from the coffee industry in polymer technology – Current state and perspectives, Waste Manag., vol. 121, pp. 296–330, 2021, doi: 10.1016/j.wasman.2020.12.018.



Bioproducts made from Thanh Long's BIO-MY resin

Stakeholders

The main source of coffee husk for producing biodegradable the plastic resin Bio-MT of Thanh Long comes from the Minh Tien Group of growers and their production network. In addition, Thanh Long has also partnered with other coffee farmers to supply coffee husk and agriculture by-products for bioplastics production. The price for coffee husk is VND 2 million per tonne (about EUR 73). The bioplastics production thus also provides a boost for small coffee farmers, making coffee a more profitable crop for farming communities, especially for small or independent farms in the northern mountainous provinces of Vietnam.

Implementation

With its bioplastic development, Thanh Long and Minh Tien Group have taken their sustainable development efforts to a next level. They are building upon several other initiatives taken by the company since 2010, such as development of the sustainable coffee growing areas in the provinces of Quang Tri, Dak Lak, Dien Bien and Son La and in Lao PDR, and they have achieved certifications for FRA/UTZ and 4C sustainable agriculture certification, the production of Ha Chuc cascara tea, and making fertiliser from coffee waste.

Thanh Long started its R&D on bioplastics production from coffee husk and agricultural by-products since its establishment in early 2019. In June 2024, Thanh Long opened the first phase of commercial scale bioplastics production in Bac Ninh province with full final design annual capacity in second phase of 38,000 metric tonnes of biodegradable plastics resin, 3,900 metric tonnes of food packaging films and bags, and 1,400 metric tonnes of plastic products such as plastic cups and containers. The economic potential for bioplastic is large. As the industry and economy develop, the use of various plastic products, such as disposable plastic containers and plastic films, continues to increase. Thanh Long foresees setting up a second factory with full capacity of 200,000 tonnes in 2026.

Takeaways

- Processing coffee husk and agricultural by-products into bioplastics is an innovative process that brings multiple benefits to the business sector and the environment.
- The outlook provided by Thanh Long is that plastics formulated and/or reinforced with residues from coffee husk need to develop on a large scale to become competitive as well as be able to supply adequate quantities to potential users.

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