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"Reconcile land system changes
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Closing the loop: Composting coffee co-products for sustainable soil fertility in northern Nicaragua

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Abstract

Maintaining soil fertility is critical for coffee production, especially as climate change shifts and reduces suitable growing areas. In Nicaragua, where coffee contributes 20 % to agricultural GDP and supports 15 % of the national labour force, this challenge is particularly urgent. Producers also face rising fertiliser costs and limited access to sustainable alternatives. Meanwhile, nutrient-rich coffee processing co-products remain underused, despite their potential to improve soil health and close nutrient cycles. Composting these materials offers a promising strategy to enhance system resilience and support more circular production.

The BioFabrica project is a public-private partnership between HAFL, FiBL, Kaffeemacher GmbH (Switzerland), and Bridazul (Nicaragua), supported by Innosuisse. It explores how coffee co-products can be transformed into compost using locally available resources. In collaboration with producers, the goal is to co-develop practical, cost-effective fertilisation strategies that reduce reliance on external inputs. The approach emphasises climate adaptation, farm-level relevance, and collaboration across the value chain.

The project combines composting trials, plant trials, and interviews with 16 producers to assess current practices, barriers, and adoption potential. A practical composting guide is being developed to support broader application.

Initial composting trials identified a promising mix of coffee pulp, parchment, and cattle manure, though nitrogen content remained below optimal due to manure quality constraints. Applying agua miel (honey water) may help boost nitrogen levels. Compost piles met thermal and aerobic standards, though moisture management remains a challenge, particularly due to parchment's hydrophobic nature. Vermicomposting showed high nutrient potential but is labour-intensive, while biochar from parchment presents a future opportunity to improve compost quality and water retention.

All 16 interviewed producers expressed interest in composting, though many viewed it primarily as a soil amendment rather than a direct fertiliser. Composting is feasible both on-farm and at processing sites, depending on material availability. Fertilisation scenarios showed that compost, combined with reduced mineral fertiliser, could cut synthetic input

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use by up to 56 %. However, labour shortages and costs, both for production and application, remain barriers.

Coffee co-products offer strong potential for producing quality organic fertilisers. Future efforts should improve nutrient content, compost stability, and involve producers to ensure local relevance.

Keywords: Circular agriculture , coffee, composting, organic fertiliser, soil fertility