



Tropentag, September 16-18, 2026, hybrid conference

“Towards multi-functional agro-ecosystems
promoting climate resilient futures”

Agrivoltaics an incentive mechanism for the wefe nexus: A perspective from Colombia's just energy transition

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Abstract

This study presents a perspective on agrivoltaic (APV) systems as incentive mechanisms to align energy access, agricultural production, ecosystem conservation, and local value addition within the Water–Energy–Food–Ecosystem (WEFE) nexus. It draws on the design of the JET-AgriSOL project, implemented in Colombia in alignment with the country's Just Energy Transition (JET) agenda, and argues that APV can move beyond a technological innovation to function as a governance instrument that structures incentives across sectors and actors.

In the Amazonian deforestation frontier of Caquetá, APV systems are conceptualised as embedded within dairy value chains to link on-farm energy access with zero-deforestation commitments of downstream buyers. The perspective highlights how value-chain finance mechanisms can connect the energy needs of milk producers (such as reliable electricity for milk cooling) with responsible sourcing strategies of dairy companies. By structuring co-investments in APV infrastructure, energy access can be made conditional on compliance with zero-deforestation requirements, creating a direct economic link between climate-smart production and market incentives.

In parallel, in the highland agrobiodiversity systems of Cumbal (Nariño), APV installations are framed as complementary to Payments for Agrobiodiversity Conservation Services (PACS), in collaboration with the CGIAR Multifunctional Landscapes Science Program. Here, energy access and processing capacity are linked to the conservation of underutilised native crops, while enabling local value addition and entrepreneurship through small-scale processing and product diversification.

Building on these cases, the study proposes a framework of adoption and outcome indicators to assess how APV systems may influence decision-making across WEFE domains, including energy use, inclusion, land management, water interactions, biodiversity conservation, and value creation. The framework integrates insights from existing literature with the design of monitoring systems for upcoming pilots.

The perspective advances the argument that APV systems can serve as a lever for integrated resource governance by embedding energy infrastructure within value-chain conditionality and conservation incentives. It outlines how such mechanisms can be empirically

tested and refined, contributing to a more systemic understanding of how energy innovations can catalyze synergies across WEFE domains in contexts characterised by weak conservation incentives.

Keywords: Agrivoltaic, incentive , just energy transition, nexus, perspective