

Economic, environmental, and social impacts of silvopastoral systems: Evidence and scaling pathways from Colombia

Stefan Burkart and Danny Sandoval
International Center for Tropical Agriculture (CIAT), Colombia
Contact: s.burkart@cgiar.org

Introduction

- Colombia's cattle sector supports >500,000 farming households but is a major driver of deforestation, land degradation, and greenhouse gas emissions.
- Conventional grazing occupies large areas while delivering relatively low productivity.
- Silvopastoral systems (SPS) integrate trees, shrubs, improved forages, and livestock to increase productivity, ecosystem services, and climate resilience.
- Despite their proven benefits, SPS adoption remains around 1% of cattle producers, due to land tenure insecurity, limited access to finance and extension, and weak institutional coordination; highlighting the need for effective scaling strategies.

Objectives

Assess the economic, environmental, and social impacts of SPS in Colombia.
Identify enabling policy, financing, and market conditions for large-scale implementation.
Explore how Colombia's experience can inform scaling across tropical livestock systems.

Methodology

- **Systematic literature review.** Review period: 2000–2025.
- **185 publications synthesized:** peer-reviewed articles, institutional reports, government policies, international organization reports
- **Evidence synthesized across:** economic performance, environmental outcomes, social impacts, investment mechanisms, policy frameworks, scaling pathways

Results (Figure 1)

Economic impacts (in blue)

- Milk productivity increased by **21–36%**, with some systems doubling production
- Liveweight gain increased by **49–51%**, in some cases 100% or more; stocking rates **3.75x**
- IRR increased from 11% to >20%, reaching **41–61%** in some cases
- Payback period shortened from 6 to 4 years, some systems recovering in **2.4–3.3 years**
- Additional income opportunities from: timber, fruit, carbon credits, **payments for ecosystem services (PES)**.

Environmental impacts (in green)

- SPS sequester **>2 t C ha⁻¹ yr⁻¹ in biomass plus ~0.5 t C ha⁻¹ yr⁻¹ in soils**; improved soil fertility and water regulation
- Lower enteric methane emissions
- Net GHG emissions per unit of production decreased by nearly **50%**
- Animal body temperatures were up to **4°C lower**, reducing heat stress
- Increased biodiversity and wildlife habitat
- Reduced pressure for agricultural expansion and deforestation

Social impacts (in yellow)

- Higher and more stable farm incomes
- Greater resilience to drought and climate variability
- Improved food security
- Enhanced opportunities for women, smallholders, and conflict-affected communities
- Contributions to multiple Sustainable Development Goals

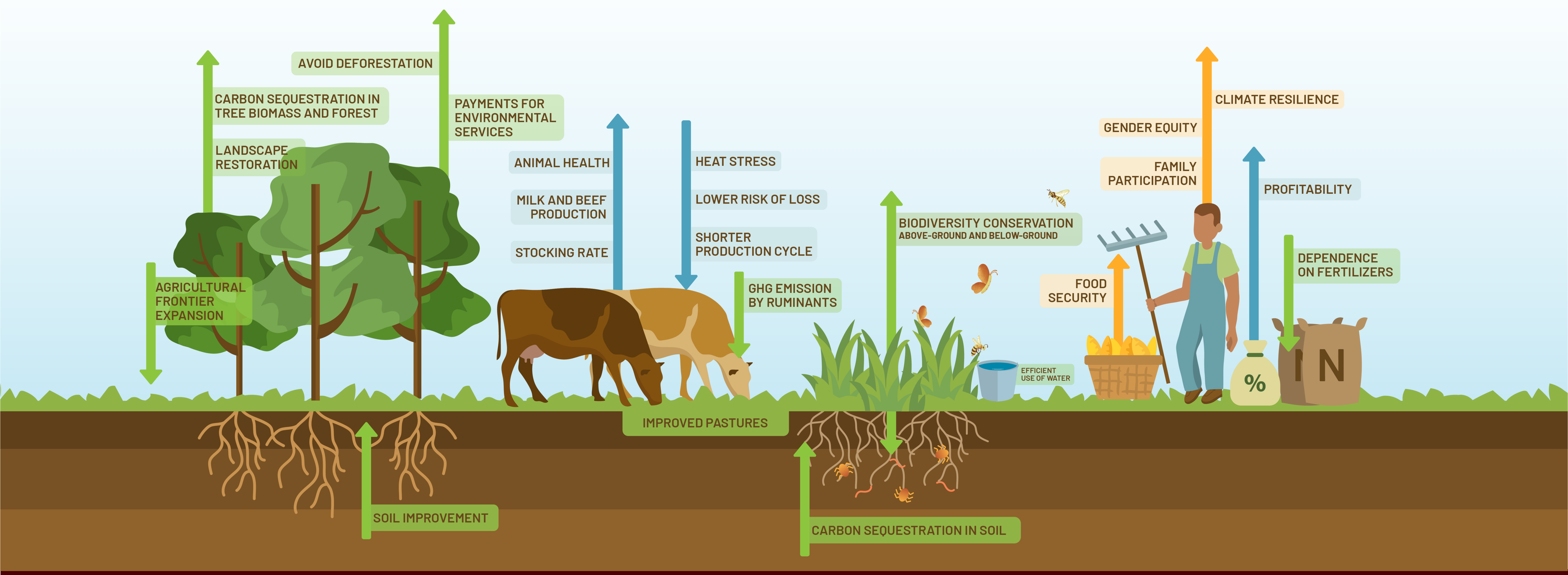
Scaling and investment

- Multiple financing mechanisms are available or under development: blended finance, green finance, carbon markets, PES, ESG investment, sustainable certification/sustainability-linked supply chains.
- Colombia's supportive policy framework creates favorable conditions for scaling, with strong scientific and practical evidence available.

Discussion and Conclusions

- Higher productivity, environmental restoration, and social sustainability can be achieved simultaneously. SPS are a high-impact climate-smart investment for tropical livestock systems.
- Scaling requires more than technical evidence. It depends on coordinated policy support, financial innovation, technical assistance, market incentives, and public-private partnerships.
- Colombia offers a practical roadmap for scaling sustainable cattle production across the tropics.
- The remaining challenge is moving from successful pilot projects to landscape-scale adoption.

Figure 1. Overview of the benefits of investing in silvopastoral systems (SPS).



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Related work

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