Sustainable intensification of cattle husbandry systems in the Colombian Amazon (Caquetá) - A cost-benefit analysis

Adrian Lüdtke; Christian Lippert; Stefan Burkart; Anja Lienert

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Introduction

Fig. 1: Landscape in Caquetá

- Extensive cattle farming is the primary land user in Colombia
- Its mode accounts for adverse environmental impacts
  - Primary cause for deforestation, due to which between 2001 and 2022, 2.88 Gt of CO2 were emitted
  - Going along with biodiversity loss and displacement of rural communities, amongst others
- Sustainable intensification of the cattle sector on national policy agendas
  - Technologies, such as Silvopastoral systems or legumes, have been known for a long time
  - Still, adoption rates of these technologies remain low (less than 1% for Silvopastoral systems)

Objectives

- **Objective**: To improve the understanding of different feed production methods and their prevailing benefit-cost structures, as well as differences in profitability levels between 3 farmer types

GAPS

- Agronomic advantages of sustainable intensification technologies are known…
- But little information on economic advantages in the Amazonian context
  - How profitable are the distinct production methods under local conditions?
  - Which systems are most suitable for which farm type?
  - What political incentives are needed?
    - Subventions, credit programs, etc.

Importance of the study

- **Socioeconomic Opportunities:**
  - Improve income for smallholders and rural farmers by identifying more profitable practices
  - Sustainability appeals to consumers and international markets, potentially opening new market opportunities!

- **Environmental Conservation:**
  - By identifying sustainable production methods, the study offers ways to reduce the livestock sector's carbon footprint
  - Improve soil health through nitrogen fixation, increase soil organic matter content
  - Work in harmony with local ecosystems, which helps to maintain or increase local biodiversity

Methodology

First explorational stay in Caquetá

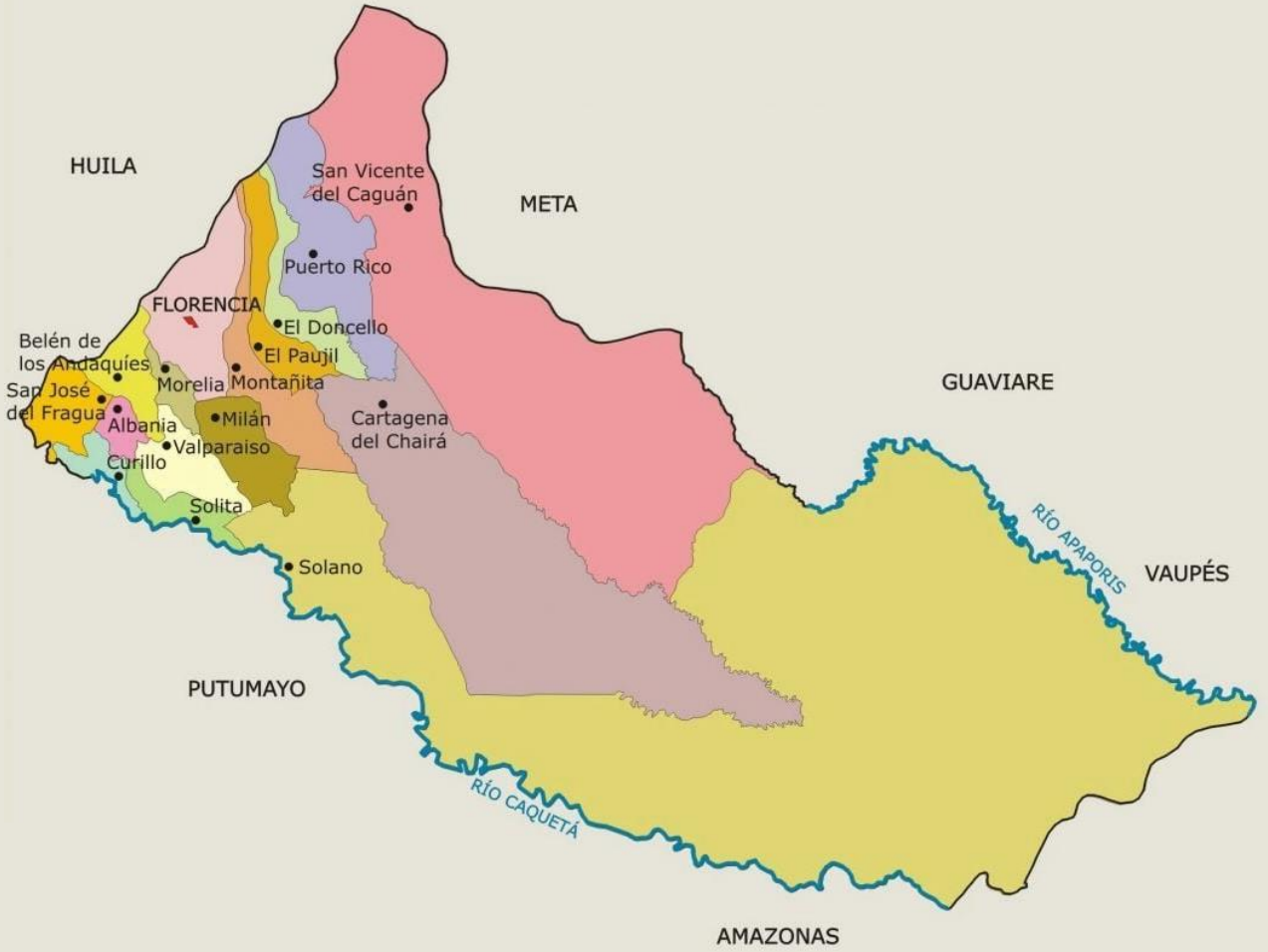
Design of Interview Guidelines

Data Collection (July)

Data Assessment (CBA)

Study Area

- **Area:** 88,965 km^2 (third largest department)
- **Population:** 401,849 (1% of total population)



Key Findings

Farm Characterization

Characteristic	Unit	Type 1	Type 2	Type 3
Minutes to nearest town	Minutes	36	97	108
Type of cattle husbandry	Text	Specialized dairy	Dual purpose	Dual purpose
Hectare finca	Hectare	110	82	35
Herd size	Hectare	90	42	25
Average milk yield	l/cow/d	8	4	4
Transforming milk?	Text	No	No	Cheese
Use of reproduction technologies?	Text	Yes	No	No

Street Conditions

Production Methods (1-2)

1. Natural Pasture: cattle husbandry on areas with native/ low-productive pasture grasses

- Encompasses lowest productivity levels
- Unprofitable for all farm types
- **Specificity Type 1:**
  - Highest regular cost (concentrated feeds, reproduction technologies …)
  - Results in strongest Cost-/Benefit-Disbalance!

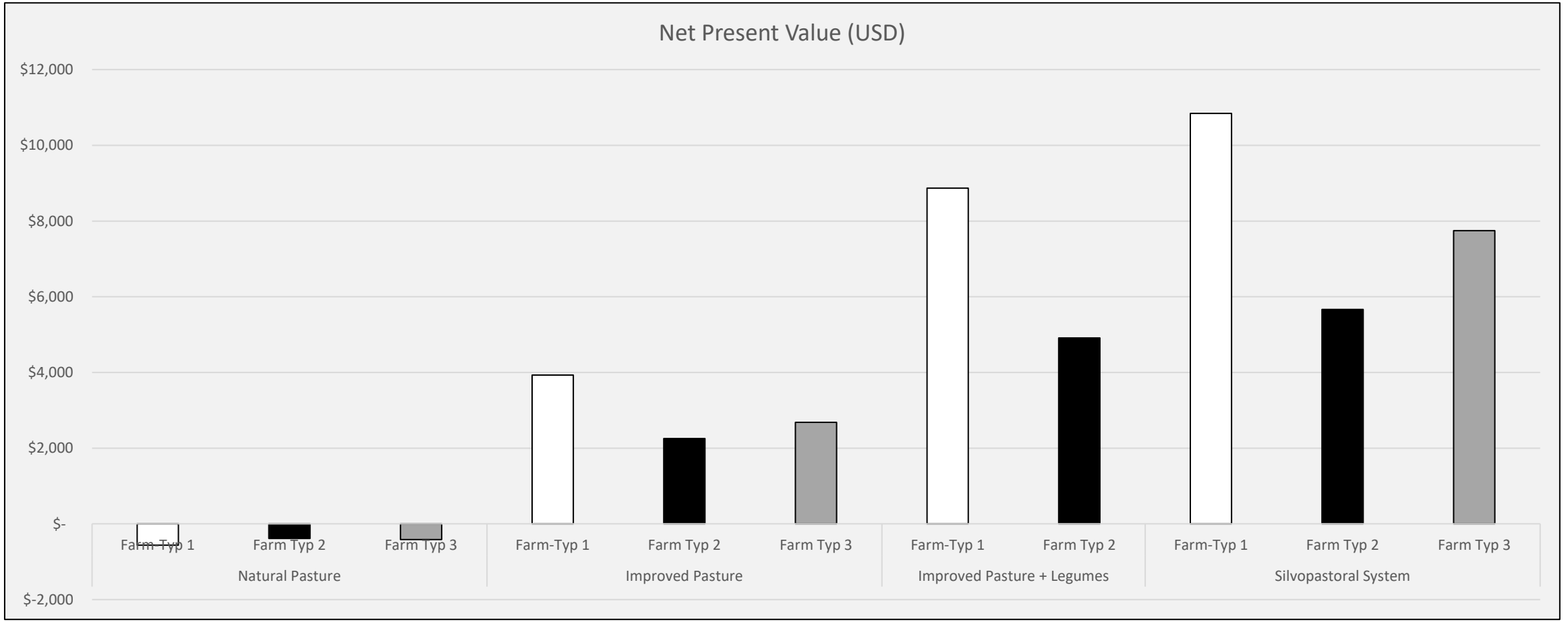
2. Improved Pasture: Introduction of potentially high-yielding grass varieties, e.g., *Brachiaria brizantha*

- Higher carrying capacities (1 AU/ha) = Higher productivity levels
- Profitable for all farm types, with an increase of up to 4,000 USD compared to the Natural Pasture!
  - Highest profitability for Farm-Type 1
- Inherent challenges of pasture degradation due to open nutrient (N) cycles, amongst others!

Brachiaria Pasture

Production Methods (2-2)

System Comparison



Sensitivity Analysis

- Natural and Improved Pastures are most adversely affected (up to –70% profitability loss)
  - External inputs (e.g., fertilizers) are required to maintain pasture productivity
  - Higher vulnerability due to reliance on only 1-2 species
- Introduction of legumes and trees increases system resilience!
  - Only productivity losses of 10%
  - Benefits of shade provision, nutrient mining, and pasture diversification, amongst others

Policy Implications

- Silvopastoral systems feature diverse ecosystem services, e.g., carbon sequestration, biodiversity enhancement
  - These needs to be rewarded, e.g., through Payment for Ecosystem Services
- Low adoption rates can be met through:
  - Provision of technical assistance to meet the higher complexity of technologies
  - Financial incentives such as Credit Line Programs or direct subvention of seeds and young trees (highest 1-time cost!)
  - Fostering sustainable beef labels to achieve (i) consumer awareness and (ii) *Price Premium*!

Limitations & Future Research

Limitations:

1. Study representativeness is limited due to the nature of a case-study approach
2. Problem of partly missing/insufficient cost-information
3. Compliance of productivity development with regional context, but only partly with farm context (plant species, sowing and planting densities, etc.)

Future Research:

1. How does the monetary valorization of ecosystem services influence these results?
2. How can adoption barriers, such as a lack of legume seeds and tree plantings, be overcome?

Conclusions

- *Land sparing* due to (i) productivity and (ii) profitability increases of intensified feed production technologies incentivized
    - Reduced deforestation --> reduced greenhouse gas emissions
    - Release of land for natural conservation (biodiversity conservation (e.g., Amazon Rainforest)
- Silvopastoral systems have the highest potential to contribute simultaneously to (a) increases farm profitability and (b) climate change mitigation
    - Especially in carbon-depleted soils of Caquetá!
    - Nevertheless, the local farm context needs to be integrated! (labor shortage)

Thanks!

Contact: Adrian Lüdtke – adrian.luedtke@uni-hohenheim.de

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