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Profitability analysis of a silvo-pastoral system in Colombia: Economic and environmental benefits

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Competing pathways for equitable food systems transformation: trade-offs and synergies

Introduction



Beef, dairy, and dual-purpose systems have considerable environmental impacts, such as deforestation and methane (CH_4) emissions by ruminants. To counteract this, technological innovations must focus on economic and environmental sustainability.



Silvo-pastoral systems (SPS) are a valuable option since they offer economic benefits while providing ecosystem services, e.g., CH_4 emission reductions, microclimatic regulation, carbon sequestration, nitrogen fixation, biodiversity, among others.



To estimate benefits, we developed an experiment with two different systems: SPS and grass monoculture (M).

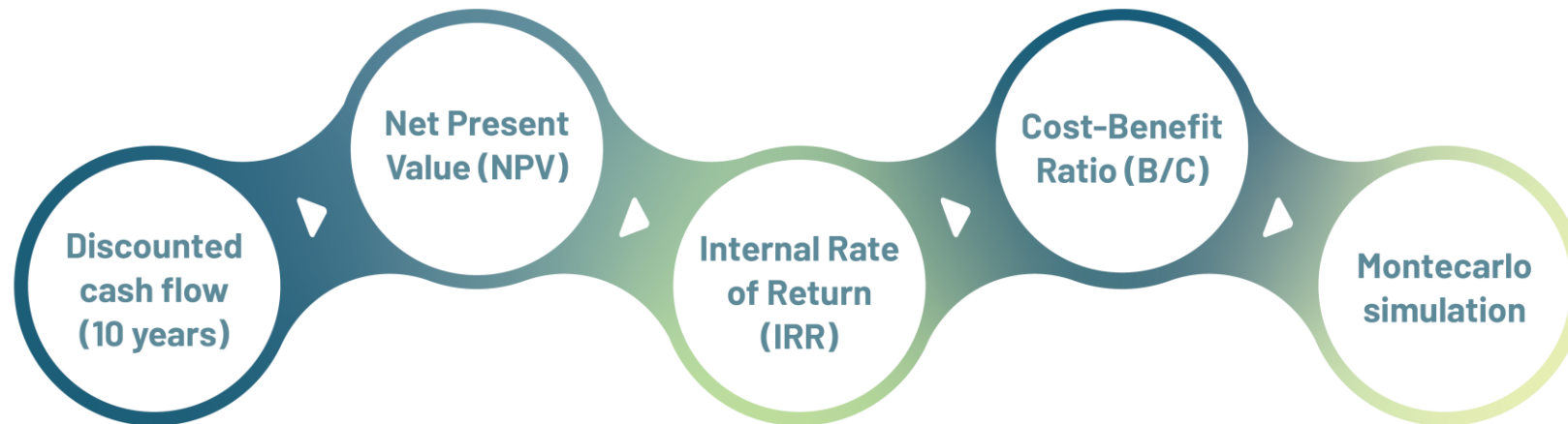
Objective

Estimate the economic and environmental value of implementing SPS instead of a grass monoculture (M).



Methodology

▶ Economic evaluation.



▶ Environmental evaluation.



Data and sources

Variable	Grass monoculture		Silvo-pastoral system	
	M Toledo	M Cayman	SPS Toledo	SPS Cayman
Grasses	<i>Urochloa brizantha</i> cv. Toledo and <i>Urochloa</i> hybrid cv. Cayman	<i>Urochloa brizantha</i> cv. Toledo and <i>Urochloa</i> hybrid cv. Cayman	<i>Urochloa brizantha</i> cv. Toledo and <i>Urochloa</i> hybrid cv. Cayman	<i>Urochloa brizantha</i> cv. Toledo and <i>Urochloa</i> hybrid cv. Cayman
Legumes			<i>Leucaena leucocephala</i>	<i>Leucaena leucocephala</i>

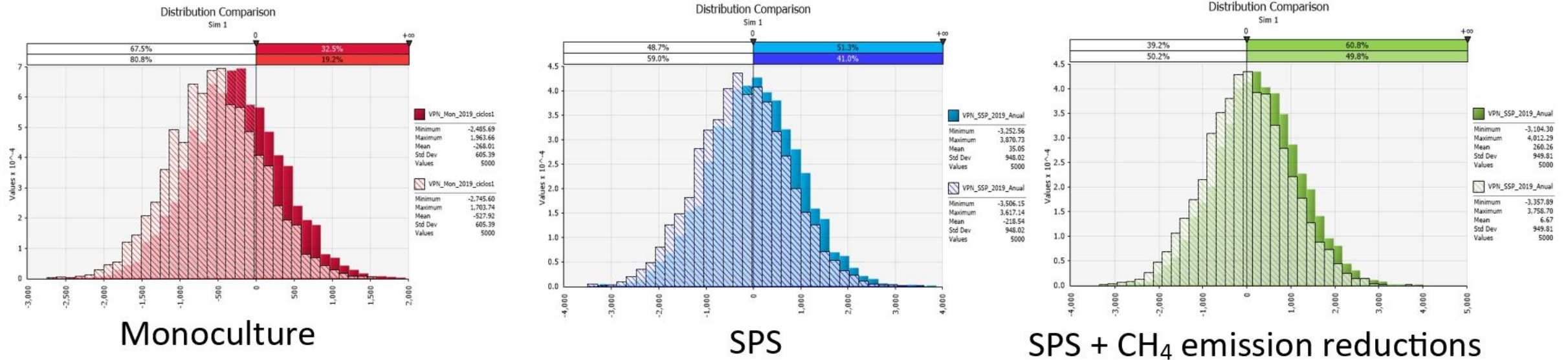
Results: Economic evaluation

Economic indicator	Evaluation criteria	M Toledo	M Cayman	SPS Toledo	SPS Cayman
Economic benefit	NPV mean (US\$)	(268.05)	(527.96)	35.10	(218.49)
	IRR mean (%)	4.39	0.06	0.58	2.39
	Risk (prob)	67.16	80.95	48.84	59.56
	NPV<0 (%)				
	B/C ratio	1	0.99	1.03	1.02
Economic benefit + avoided methane emissions	NPV mean (US\$)	-	-	259.97	6.38
	IRR mean (%)	-	-	3.00	0.23
	Risk (prob)	-	-	39.27	50.07
	NPV<0 (%)				
	B/C ratio	-	-	1.04	1.03

The SPS treatments present better results for the NPV and IRR indicators, it is highlighted that the probability of obtaining negative values for the NPV is considerably reduced compared to the M treatments.

When the economic benefit of avoided methane is considered, all the indicators of the SPS treatments improve in comparison with the SPS base scenario.

Results: Risk analysis



The figures present the NPV distributions for the M, SPS, and SPS + CH₄ treatments. It is observed how SPS and SPS + CH₄ treatments considerably reduce the risk of obtaining NPV less than 0. This translates into lower risks of losses for the producer who implements SPS technologies.

Results: Environmental evaluation

By valuing the ecosystem services generated by SPS treatments, a benefit of 24.49 US/ha is obtained for the reduction of methane emissions and 2,026 US/ha for the ecosystem service of microclimate regulation.

CH₄ Emissions Reductions

Emissions avoided in SSP (ton CO ₂ eq)	0.1449
Price (US\$/ton CO ₂ eq)	42.25
Benefit/cattle head (US\$)	6.12
Total benefit (US\$)	24.49

Microclimatic Regulation

Shadow coverage (m ²)	12,082
Total Value (US\$)	4,053
Annual Value (US\$/ha)	2,026

Conclusions



The knowledge component of SPS is important, and much of the adoption depends on the available extension, and technical assistance, as well as farmer networks. A strengthening of these elements and better coordination among the actors involved is thus recommended.



Is essential to integrate the monetary values of the environmental benefits and ecosystem services into the financial analysis of SPS, so that the stakeholders involved in the adoption process can make more informed decisions.



Conclusions



SPS lead to higher NPV and IRR, as well as lower risks of obtaining economic loss. Including the economic value of avoided CH₄ emissions in the calculation of benefits, the economic indicators further improve.



Our study shows that CH₄ emissions can be reduced by 8% when compared with a grass monoculture. This reduction is valued at US\$ 6.12 per cattle head. Microclimatic regulation provided in a SPS generated an economic value of 2,026 US\$ ha/year.



References

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Thanks!



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