CGIAR Livestock, Climate and System Resilience

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Effects of adopting improved forages on poverty alleviation in cattle systems: evidence from Colombia

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Context, objective and methodology

Problem description

- In Colombia, livestock is a source of nutrient-rich diets, workforce, and contributes to generating income for more than 600 thousand livestock producers.
- Although the cattle sector is one of the major contributors to greenhouse gas emissions, it is also heavily affected by the impacts of climate change, ultimately affecting producers' livelihoods
- The livestock sector in Colombia is crucial to stimulate economic growth, overcome poverty, and enhance food security.
- The adoption of improved forages as cattle feed has demonstrated improved productivity, hence higher incomes and a significant reduction of climate change-related risk on cattle farms, which ultimately improves producer welfare.
- However, research on livestock technologies that explicitly points to a causal effect between technology adoption and poverty reduction is scarce.

Improved forages and poverty

Improved forages:

Set of forage species (grasses and legumes) with wide adaptability to diverse climate and soil conditions, of high production and quality, and tolerant or resistant to pests and diseases in pastures.

B. brizantha CIAT 26110
Pasto Toledo

P. *maximum* cv. Mombasa
Pasto Guinea

Poverty alleviation through adoption of improved forages:

- Increased benefit/cost ratio
- Reduced weeding cost and need for synthetic fertilizers
- Workforce saved
- Recovering of degraded land
- Improvements in productivity and yields
- Sale of products with added value and higher quality
- Increased ability to adapt to and mitigate CC

Main challenges

- X To ensure proper handling and use of the technology (i.e., sowing date, fertilizer rate, weeding management, and other agronomic managements).
- X The obtainment of benefits depends on the number of years a farm has established the technology.
- X The magnitude of changes may be affected by location and farm-specific factors (e.g., climate, type of technology adopted, willingness of farmer to reinvest, etc.).

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Objective and Dataset

This study aims at measuring the **causal effect** of adopting improved forages in cattle systems on poverty indicators at the household level.

- The study uses a primary dataset collected in 2017 by CIAT and different Partners.
- Data were obtained through a multistage sampling procedure with **1,039 cattle households**
- A propensity score matching (PSM) model was used to assess **the causal impact** of technology adoption on producer welfare (PPI, HDDS)
- We considerer adopters at different levels: non-low adoption (>25%); partial-adoption (>50%); high-adoption (>75%); and full adoption (>99%).

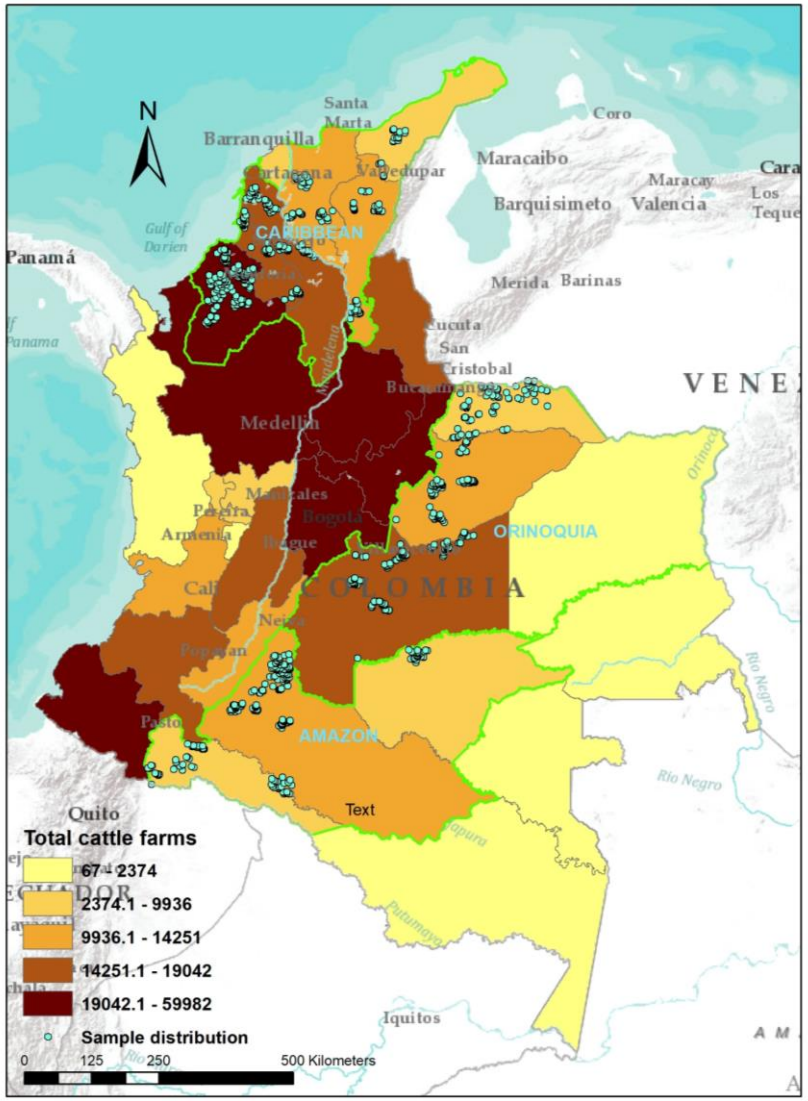

Figure 1. Spatial distribution of collected data

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Materials and methods

- Estimation of p-scores using a probit-logit model.
- Matching algorithm: teffects and psmatch2.

Table 1. Commonly included determinant of adoption and the direction of change expected

Category	Variables	Expected direction
Socio-demographics	Age, education, gender, household size, dependency ratio	Mixed
Farm characteristics	Geographic location, assess index, farm size, herd size, pasture area, area native forest	Mixed
Labor availability	Family size, number of adults	Mixed
Institutional factors	Access to credit, extension-training, membership in farmers' associations	Positive
Tenure security	Land tenure	Positive
Risk and shocks	Presence of climate event, presence of armed conflict	Mixed
Distance to market	Distance to market	Negative

Results and conclusions

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Results-Adoption of improved forages

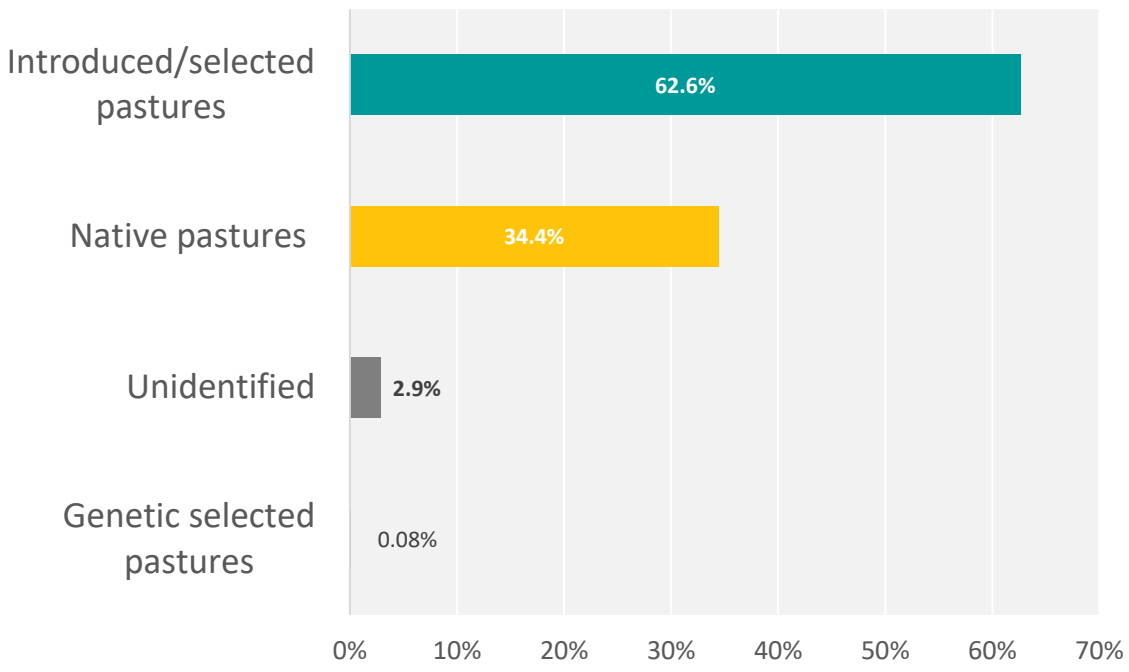

Figure 2. Adoption rate of improved/selected pastures

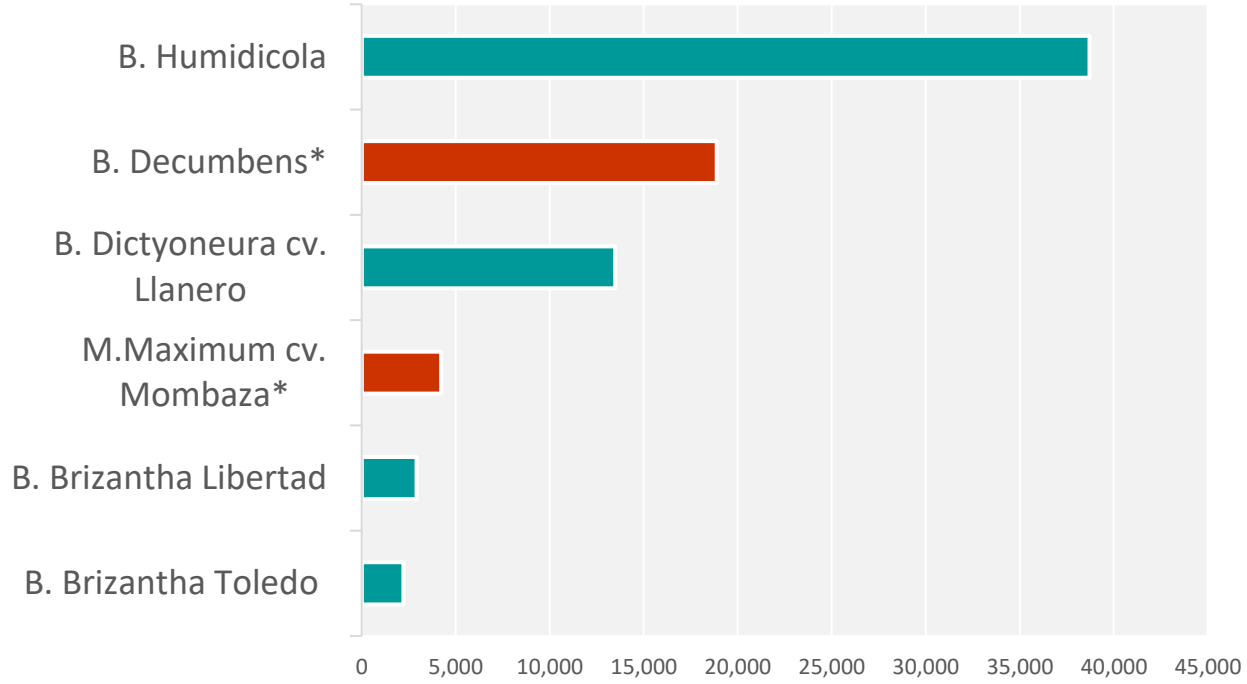

Figure 3. Adoption of improved pastures (Most representative varieties, hectares)

- Pastures released at the ends of the ’80s and beginning of the ’90s: 54.77% (First generation)
- Pastures released after of the '90s: 5.25% (Second generation)

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Results-Adoption of improved forages

- Improved pastures have been established (on average) for over 17 years.
- In total, 18% of improved pastures receive some form of fertilization.
- Better pasture managment conditions (fertilization) are concentrated among the adopters with higest adoption levels (>75%).
- Among the producers surveyed, only 22% said they have access to credit (multiple destinations) and 20% to technical assistance.

Table 2. Carrying capacity according to different definitions of improved forages and level of adoption.

Level of adoption	Native pastures	First generation improved pastures[1]	Second generation improved pastures[2]
full	0,48	1,24	3,25
high	0,61	1,28	1,70
partial	1,39	1,25	1,62
low	1,14	0,57	1,57
null	1,33	0,67	0,88

[1] varieties released >80´s-95: Decumbens, Humidicola, Llanero, La Libertad and Marandú; [2] varieties released after 1995: Toledo, Mulato I and II, Cayman, Mombasa and Tanzania.

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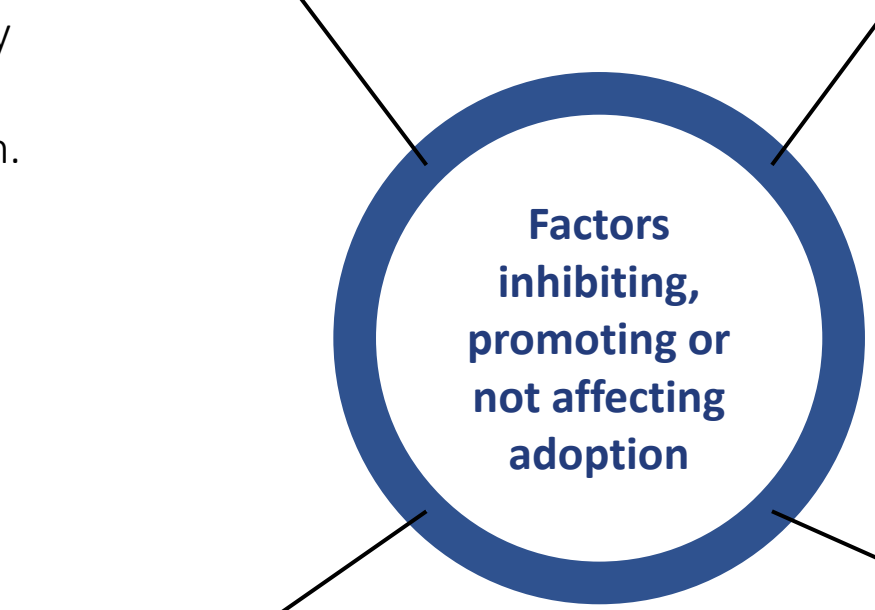
Results- Probit model



Location

Producers from the Caribbean and Orinoquia regions are more likely to adopt improved forages than the ones from the Amazon region.

Institutional factors

Credit access and technical assistance have a negative and significant effect on forage adoption.

Households and farm characteristics

- Household and sociodemographic characteristics seem not to affect adoption.
- Improved forage adoption is negatively affected by farm size.

Climate change vulnerability

Producers who have faced climatic events like droughts and floods are more likely to adopt improved pastures.

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Results-Sample poverty characteristics

Adoption level		USD 1.90 PPP		USD 3.10 PPP	
		Mean	Std. Dev.	Mean	Std. Dev.
Low-non adoption (>25%)	Adopters Obs.: 779	24.62	20.52	22.14	22.82
	Non adopters Obs.: 262	23.95	20.71	21.67	23.18
Partial adoption (>50%)	Adopters Obs.: 595	24.91	20.47	22.39	22.83
	Non-adopters Obs.: 446	23.84	20.68	21.54	23.01
High adoption (>75%)	Adopters Obs.: 421	24.61	19.94	21.89	22.07
	Non-adopters Obs.: 620	24.34	20.98	22.12	23.46
Full adoption (>99%)	Adopters Obs.: 274	23.51	19.11	20.51	21.05
	Non-adopters Obs.: 767	24.79	21.05	22.56	23.52

Table 3. Probability of being under poverty of adopters and non-adopters of improved forages, according to different adoption levels.

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Results-Causal effect on poverty.

Table 4. Causal effect on poverty between adopters and non-adopters, under different levels of adoption.

ATET adopt_nodecumbens (1 vs 0)	Non-low adoption (>25%) Adopters= 779 Non-adopters= 262		Partial adoption (>50%) Adopters= 595 Non-adopters= 446		High-adoption (>75%) Adopters= 421 Non-adopters= 620		Full adoption (>99%) Adopters= 274 Non-adopters= 767	
	Coef.	P > | z |	Coef.	P > | z |	Coef.	P > | z |	Coef.	P > | z |
USD 1.90 PPP	-0.949	0.558	-1.508	0.337	-0.690	0.618	-3.008	0.042
USD 3.10 PPP	-1.360	0.463	-2.068	0.249	-1.360	0.388	-4.158	0.013

- Adopting improved forages reduces the probability to fall under the poverty line. The effect is only significant at higher levels of technology adoption (full adoption).
- Cattle farmers who adopt improved forages for the whole pasture area in their farms, reduce their probability of living in poverty (4% and 3%, according to the poverty line).

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Conclusions

- The adoption of improved pastures, although considerable with respect to the total farm area, is dominated by **improved pastures released before the 90's** which are used with management deficiencies (fertilization).

- The variables **technical assistance** and **access to credit** seem to be **discouraging the adoption of improved pastures.**

- Improved adoption of forages is significantly influenced by **location**. Several factors can contribute, including agro-ecological conditions, institutional factors, and regulations.

- Producers were less likely to live below the poverty line with **full adoption** of improved forages.

- **Better production indicators** (e.g., stocking rate) and more frequent fertilization of pastures (although still at low levels) are highlighted at **higher levels of adoption**.

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Conclusions

- Although a positive effect was found with full adoption, the **relationship between adoption and poverty reduction is complex**: location, management practices, institutional conditions, the presence of climatic events, and other factors determine potential performance and thus improvement in adopters' incomes and welfare.

- We are working on robustness checks of our model, trying alternative specifications.

- Policies to promote the adoption of improved forage technologies in Colombia **should aim for a complete adoption of the technological package.** They should go beyond the establishment and seeking a broad area coverage and adequate management practices.

- Promoting improved forage adoption should be part of **rural development programs/policies at the national level,** aiming at reducing poverty and improving cattle producer households' welfare.

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Thanks!

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