Climate change mitigation in Livestock systems: Putting the pieces of the puzzle together

CIAT 1967-2017

CGIAR

RESEARCH PROGRAM ON
Climate Change, Agriculture and Food Security

CCAFS

What is the true cost of food?

- Economic (paid)
- Social (mostly unpaid)
- Environmental (mostly unpaid)

The true cost of food is not paid in full and the bill is due

What are our excuses?

- Price too high
- Someone else should pay
- Its too difficult
- We believe in miracles
- The system is bankrupt
- It’s all a fairytale

Seven stories from CIAT and partners on what can be done

The Fisher et al 1994 carbon story

TABLE 2 Carbon in pastures compared to savanna

Site	Matazul farm			Carimagua research station				
Pasture	Savanna	*A. gayanus/S. capitata*		Savanna	*B. humidicola* alone		*B. humidicola/A. pintoi*	
Depth (cm)	Carbon in layer (t ha^{-1})	Carbon in layer (t ha^{-1})	Difference from savanna (t ha^{-1})	Carbon in layer (t ha^{-1})	Carbon in layer (t ha^{-1})	Difference from savanna (t ha^{-1})*	Carbon in layer (t ha^{-1})	Difference from savanna (t ha^{-1})*
0–20	64.0	71.1	7.1 ± 2.0†	70.3	76.0	5.7 ± 4.3‡	88.1	17.8 ± 4.2†
20–40	42.7	51.9	9.3 ± 2.8†	52.4	57.6	5.3 ± 3.2‡	71.2	18.6 ± 6.0†
40–100¶	79.8	114.2	34.3 ± 9.3§	74.3	89.2	14.9 ± 6.2‖	108.4	34.0 ± 10.0†
Total	186.5	237.2	50.7 ± 11.4§	197.0	222.8	25.9 ± 7.7†	267.7	70.4 ± 15.5§

Carbon increase compared to Native Savanna:

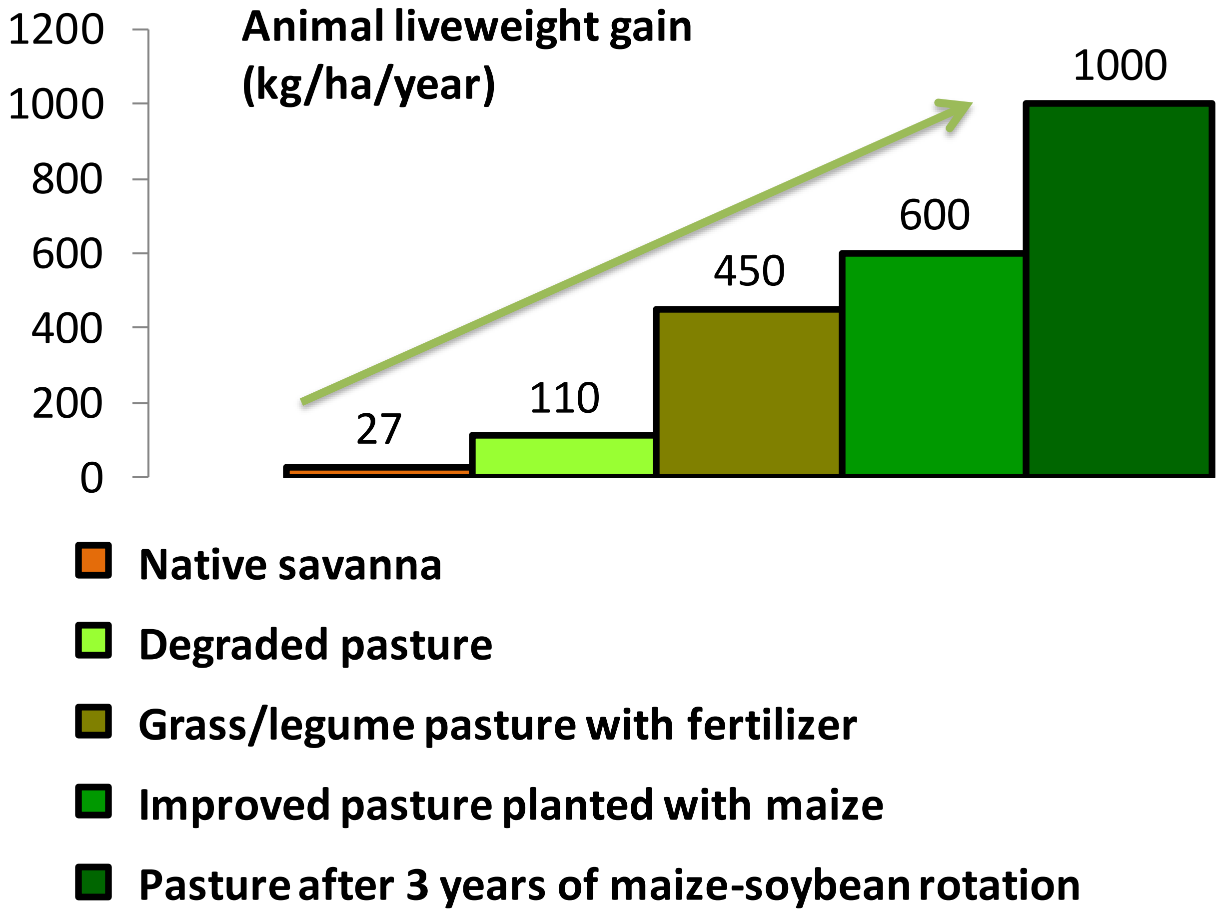
- 25 Mg ha^{-1} in grass-alone Brachiaria pasture
- 70 Mg ha^{-1} in grass-legume association of *Brachiaria humidicola* and *Arachis pintoi*

The Rao and Trujillo et al's story on the origins of this carbon

- Rao (1998) mean live standing root biomass (0-80 cm depth) for seasons
  - Improved grass alone pasture (5.7 Mg ha^{-1}) *vs.* Native savanna (1.4 Mg ha^{-1})
- Trujillo et al's (1997) mean root biomass
  - Improved grass alone pastures (8.6 Mg ha^{-1} y^{-1}) *vs.* Native savanna (2.9 Mg ha^{-1} y^{-1})
  - Why in some cases fertilizer applied at establishment and for maintenance
  - After 1 year remaining organic matter was 2.8 times higher under improved stand alone pastures compared to native savanna pastures

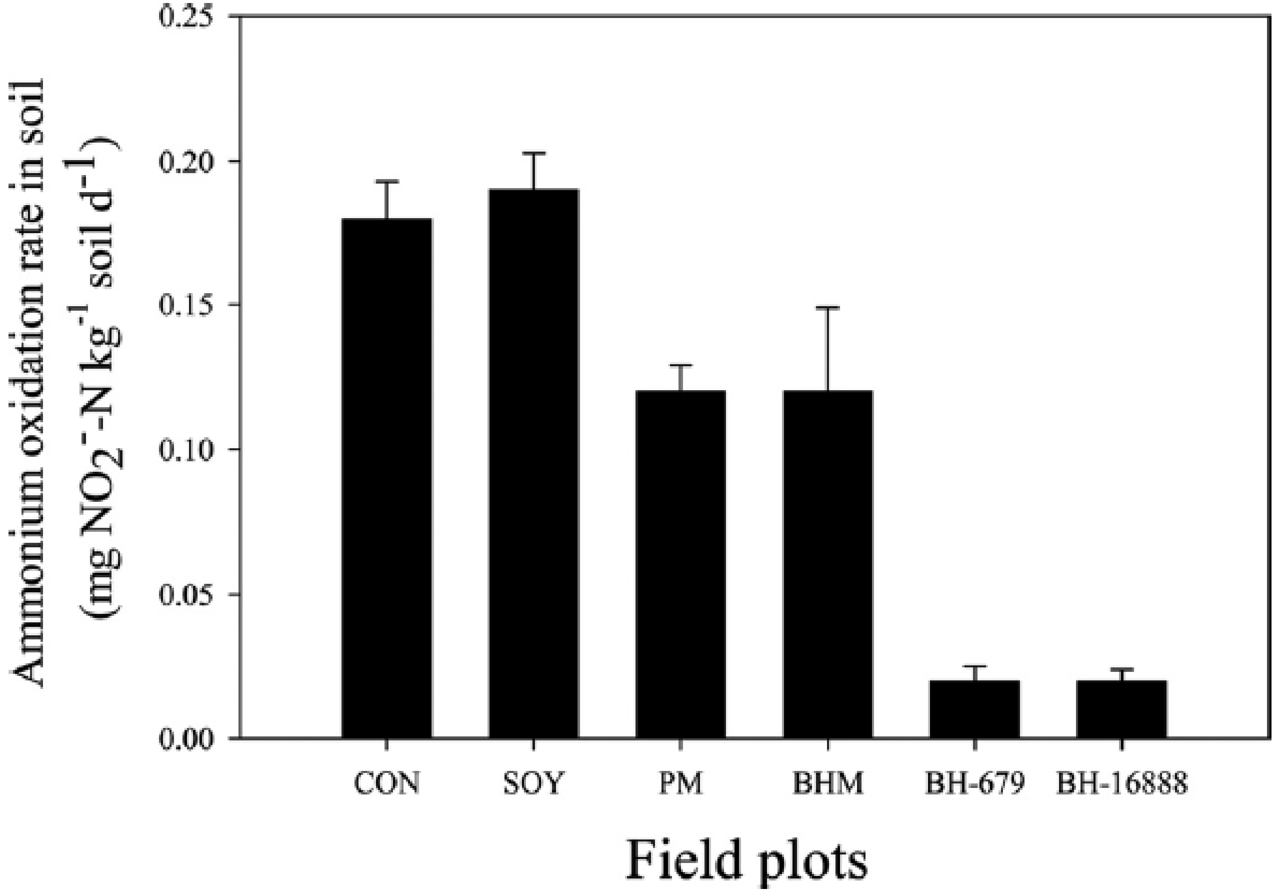
Pasture	C (g kg^{-1})	N (g kg^{-1})	P (g kg^{-1})	Lignin (g kg^{-1})	C:N (g g^{-1})[a]	C:P (g g^{-1})	Lignin:N (g g^{-1})
Native savanna	413 b	6.1 b[b]	0.4 a	152 a	67.7 b	1031.5 b	24.9 ab
B. dictyoneura	353 c	3.5 c	0.3 b	119 b	100.8 a	1764.5 a	33.9 a
Arachis pintoi	501 a	2.4 a	0.4 a	112 b	20.8 c	1251.8 b	4.7 c
B. dictyoneura + *A. pintoi*	395 b	4.4 c	0.3 ab	116 b	93.6 a	1315.3 b	25.6 b

The Rincón and Flórez 2013 story: animal liveweight gains in the acid soil savannas of Colombia



Rincón and Flórez (2013)

The Subarrao et al's BNI story



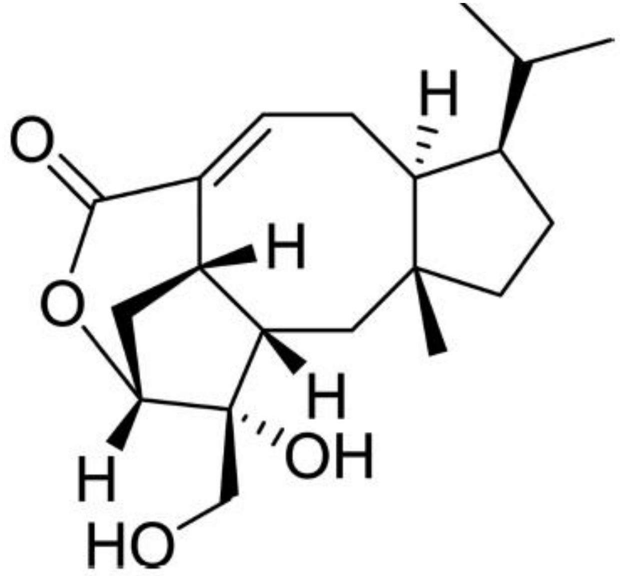


Fig. 1. Chemical structure of brachialactone, the major nitrification inhibitor isolated from root exudates of *B. humidicola*.

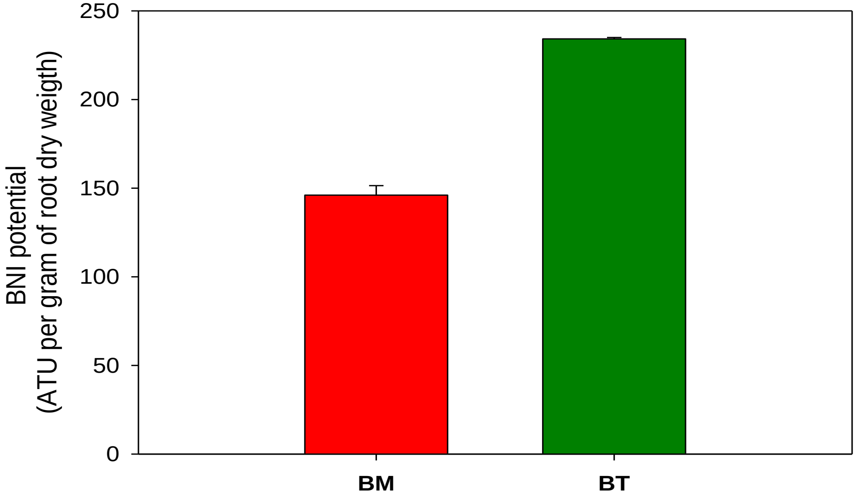
Some Brachiaria pastures produce root exudates that contain nitrification inhibitors

Subbarao et al., 2009

The Byrnes et al. story on reducing N_2O emissions from urine patches

Brachiaria hybrid Mulato: low BNI *vs.* Bh CIAT 679 cv. Tully: high BNI

BNI potential



Contents lists available at ScienceDirect

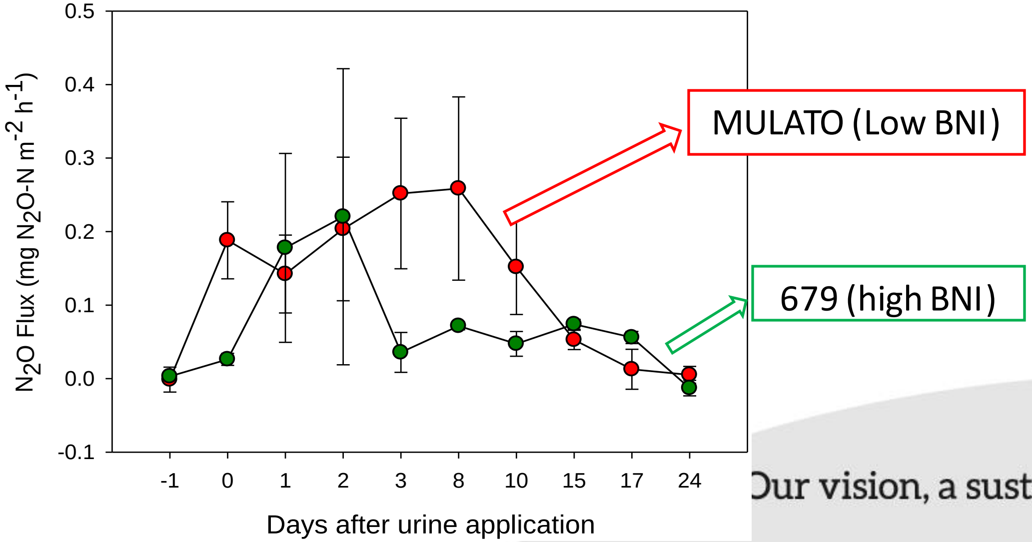
Soil Biology & Biochemistry

journal homepage: www.elsevier.com/locate/soilbio

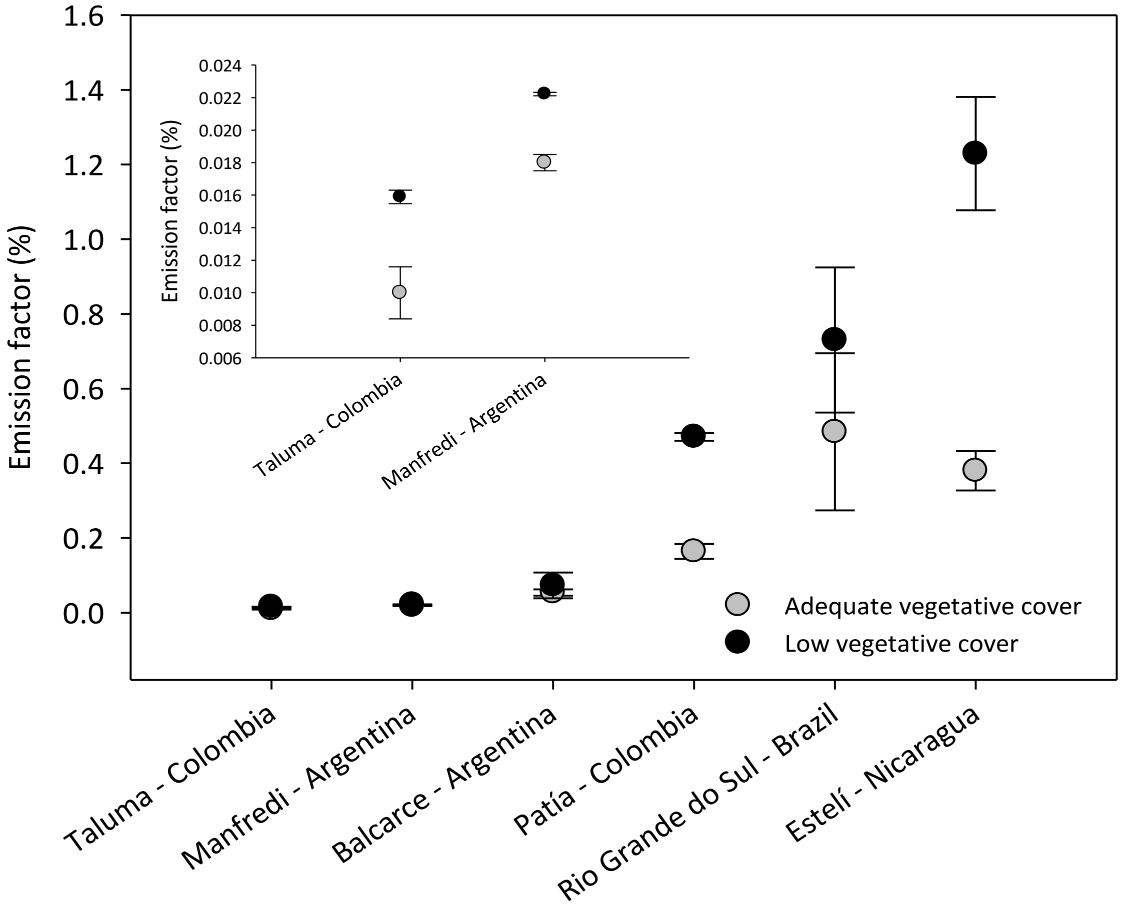
Biological nitrification inhibition by *Brachiaria* grasses mitigates soil nitrous oxide emissions from bovine urine patches

Ryan C. Byrnes [a, b], Jonathan Nùñez [a], Laura Arenas [a], Idupulapati Rao [a], Catalina Trujillo [a], Carolina Alvarez [c], Jacobo Arango [a], Frank Rasche [d], Ngonidzashe Chirinda [a, *]

N_2O fluxes

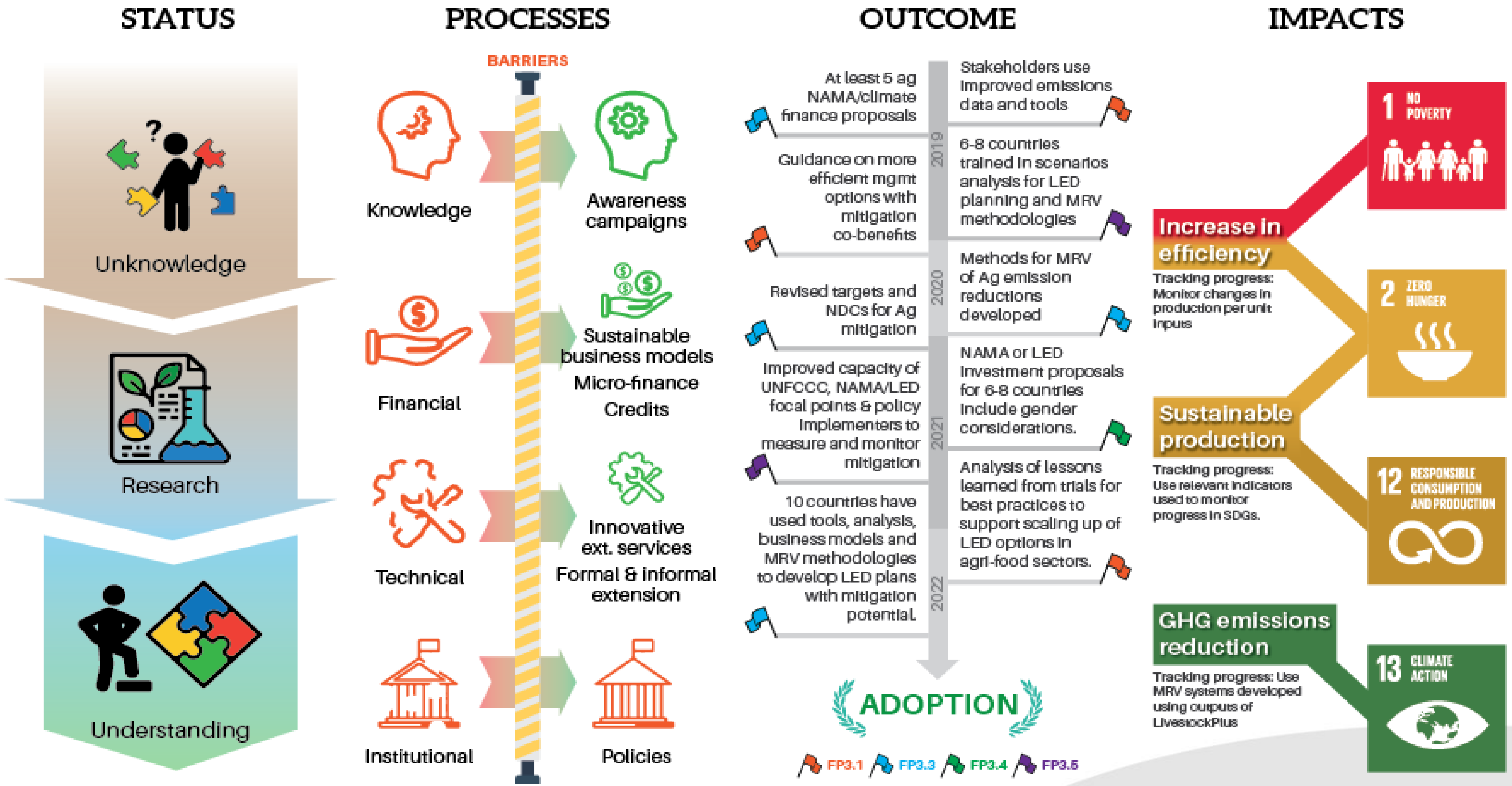


A recent story on pasture degradation impacts on N_2O emissions



Chirinda et al., 2019

Catalyzing farmer innovations and the adoption of promising management and technological options to facilitate the development of low-carbon cattle value chains in Latin America



Our vision, a sustainable food future

A snapshot on where we are now with this evolving story…

- Studied Brachiaria pastures result in high C sequestration
- Brachiaria pastures with high BNI potential decrease urine-based N_2O emissions
- Pasture degradation is bad for both animal productivity and urine-based N_2O emission
- More listening and well thought-out joint actions are needed to accelerate the necessary changes

Thank you for this opportunity & your attention

References

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- Byrnes, R.C., Nùñez, J., Arenas, L., Rao, I., Trujillo, C., Alvarez, C., **Arango, J**., Rasche, F., **Chirinda, N**., 2017. Biological nitrification inhibition by Brachiaria grasses mitigates soil nitrous oxide emissions from bovine urine patches Soil Biology & Biochemistry 107, 156–163.

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