Do we need more trees to achieve carbon neutrality on livestock farms? Accounting for negative emissions on small tropical livestock farms in Ecuador

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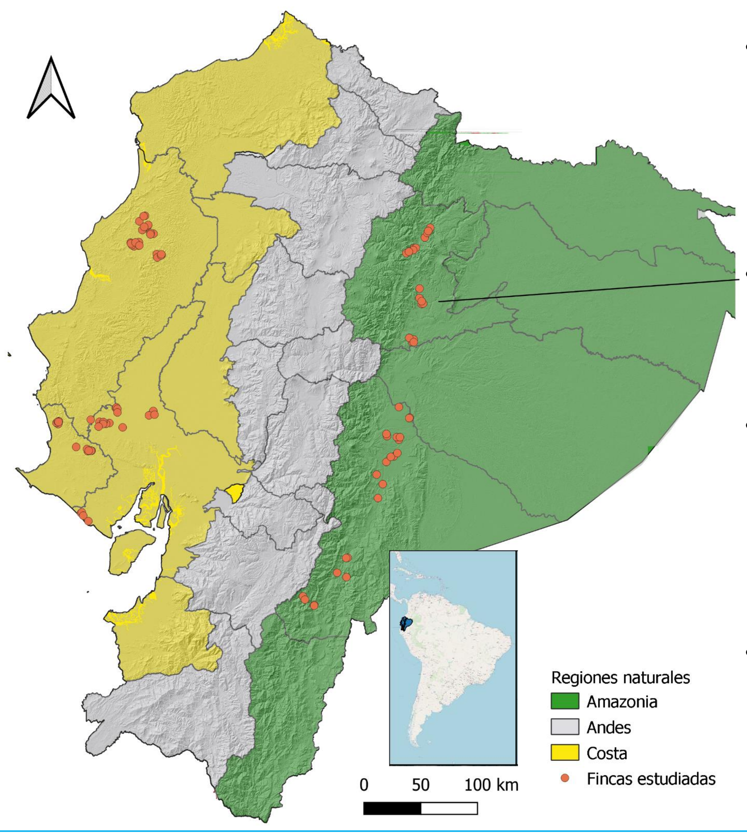
Introduction

- Grasslands - mainly for cattle - occupy 57% of agricultural land in Ecuador
- Livestock is responsible of 46% of agricultural emissions
- Approximately 80% of cattle population is distributed in subsistence systems (<20 AU/farm)
- Ecuador has committed to reduce GHG emissions to the UNFCCC.
- Trees on pasture (SPS) contribute to carbon sequestration and storage
- Potential to achieve mitigation goals accounting for C on SPS.
- Potential to increase C sequestration by increasing SPS area



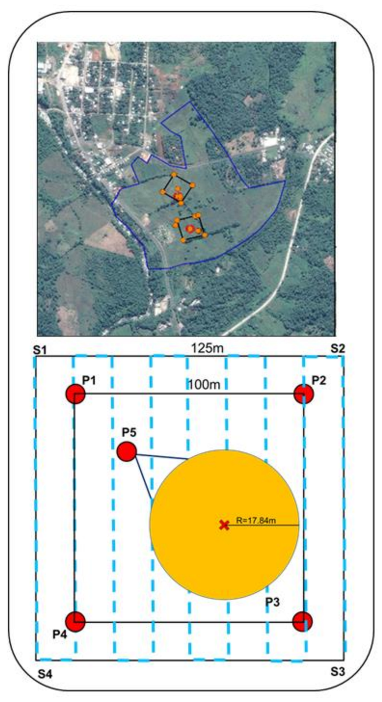
Objectives

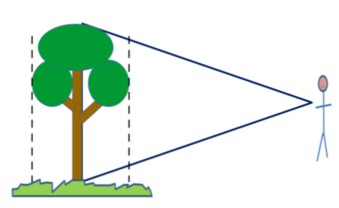
- To estimate direct GHG emissions from cattle livestock in two regions in Ecuador
- To estimate carbon stocks for SPS
- To estimate carbon sequestration through NPP information for land use mosaics
- To understand the carbon balance of livestock farms in the amazon and coastal regions of Ecuador

Methods

Survey:
- Land uses
- Herd characteristics
- Production goals

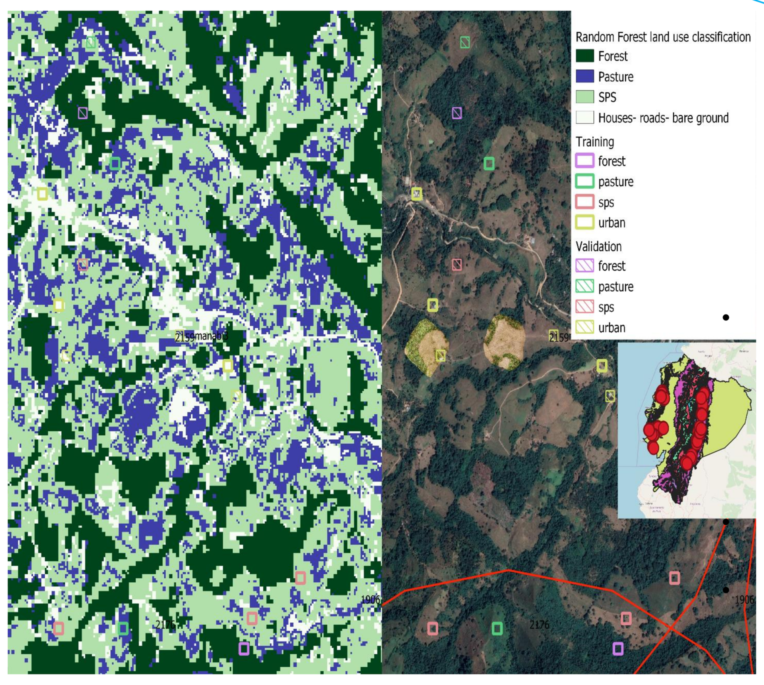
Direct emissions Tier 1a IPCC
- CH_4 enteric fermentation
- CH_4 manure on pasture
- N_2O manure on pasture



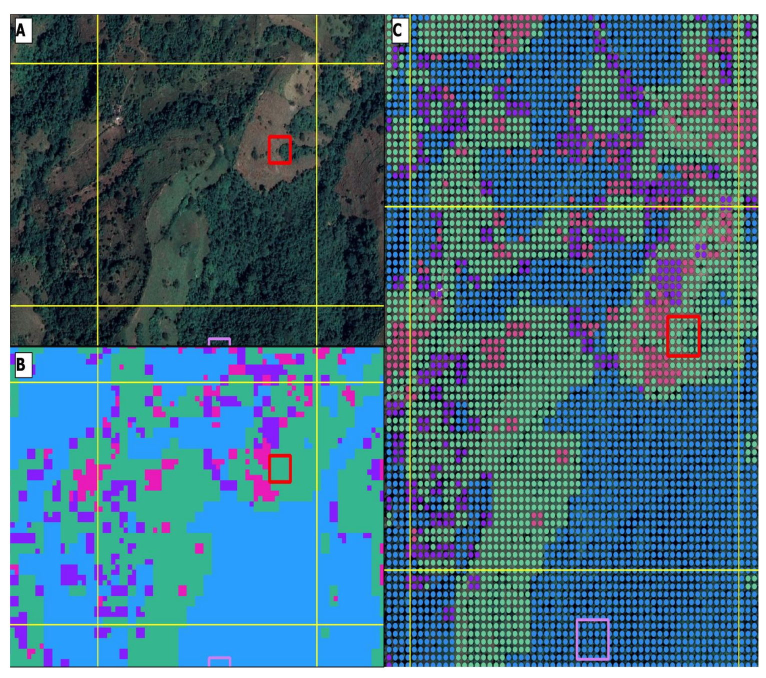


UAV survey
- Tree height
- Crown diameter
- Tree density

Measurements:
- Tree height
- Diameter breast height
- Above ground biomass (Chave et al., 2014)



SENTINEL
- Land use classification (Random Forest) 10m resolution SPS, forest, pasture



MODIS
- NPP 2000- 2019
- 500m resolution
- Assign Land use to NPP values

Cluster Analysis
- Land use mosaics
- Assign predominant land use to farms

Carbon sequestration
- NPP differences between years
  - + values = C gain
  - - values = C losses

Carbon Stocks
- C in SPS systems:
  - AGB from UAV extrapolated to SPS areas
- C in forest:
  - GlobBiomass to forest areas
- SOC: GSOCmap to farm

Carbon balance
- Emissions – C Sequestration

Findings and insights

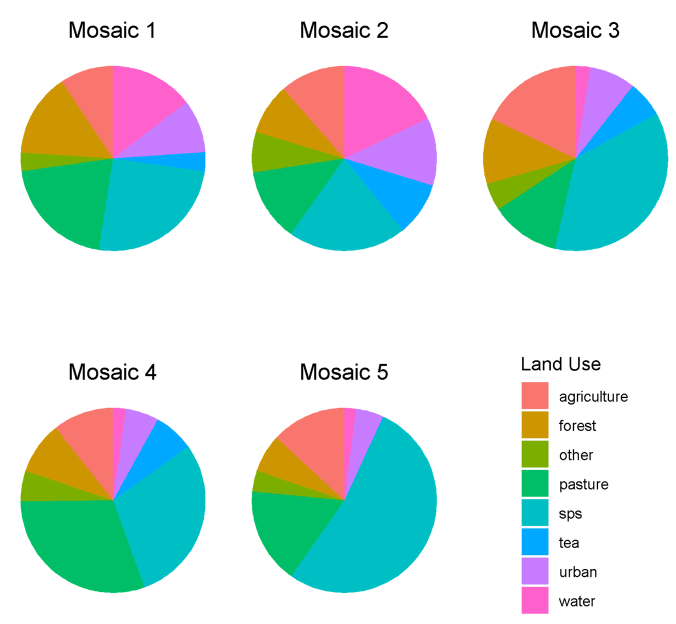


Figure 1: Land use mosaics on livestock landscapes in the coastal and amazon region in Ecuador

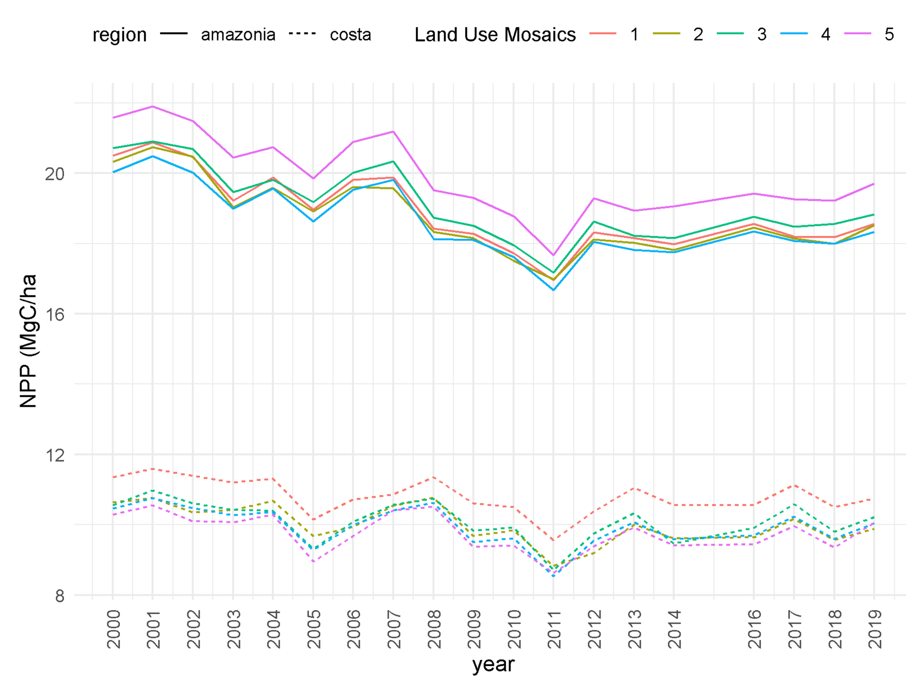


Figure 2: NPP dynamics on livestock landscapes in the coastal and amazon region in Ecuador

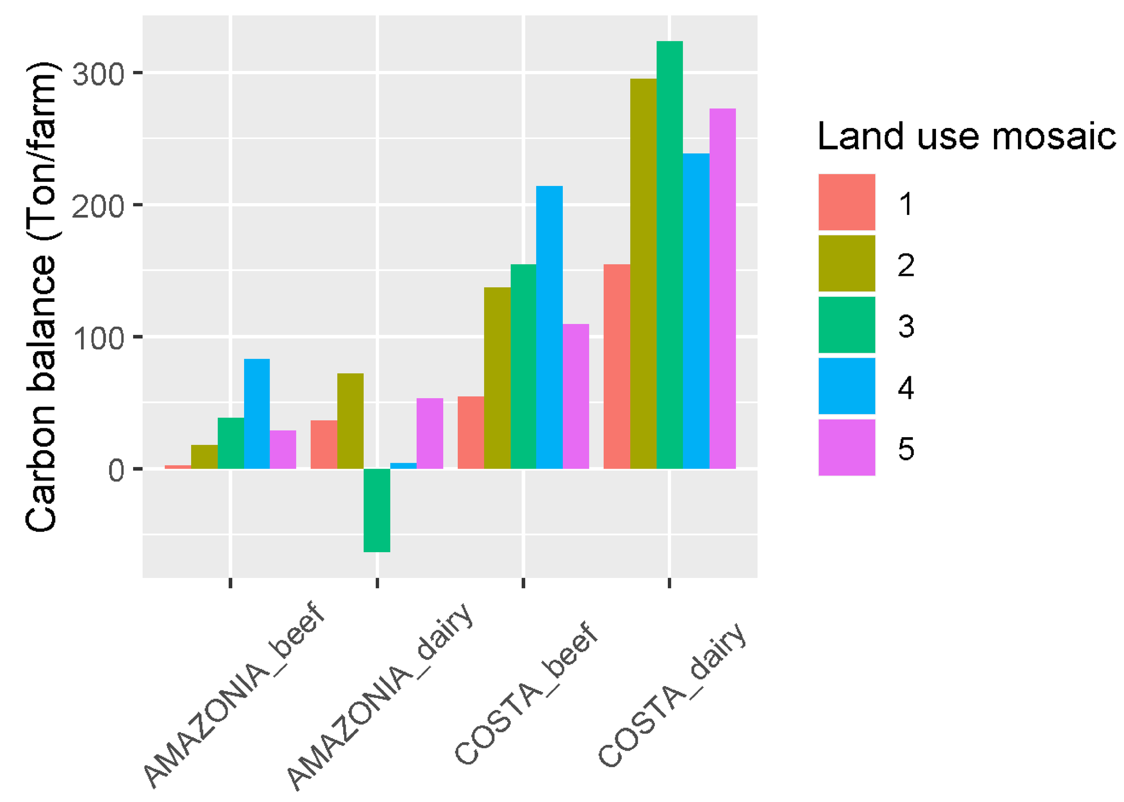


Figure 3: Carbon balance averaged to region, production system and predominant land use mosaic on livestock landscapes in the coastal and amazon region in Ecuador

Table 1: Livestock farm characteristics, Carbon stocks and direct greenhouse gas emissions in Ecuador

Region	Production	N	Farm Size	Herd size	Altitude (masl)	Precipitation (mm/year)	Forest area (ha)	Pasture under SPS (%)	C Stock (MgC)	SPS share C stock (%)	GHG emissions (CO2eq Ton/farm
Amazon	Beef	20	32.7(21)	25.4(17.2)	895	3620.	5.4	60 (16)	3997.86	1.45	46.57 (30.05)
Amazon	Dairy	22	31(27)	26.9 (15.3)	1357	2779.	6.9	50 (11)	4732.26	0.67	48 (28.04)
Coastal	Beef	28	39.4(39)	34.4(41.2)	97	705.	12.1	68 (18)	2983.33	1.33	65.69 (79.92)
Coastal	dairy	30	49(53)	69.5(60.6)	207	1165	9.9	55 (16)	2922.04	2.39	124.15 (114.78)

Conclusions

- NPP decrease over the last 19 years.
- GHG emissions are larger for the coastal region and AGB on SPS is larger for the Amazon region
- Dairy systems seem to have fewer areas of pasture with trees.
- SPS contribute with approximately 1.5% of C stocks, but potentially its contributed can be doubled, by increasing trees on pasture (tree density needs to be considered on future work)

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