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Drivers and scenarios of agricultural expansion in the Argentine Chaco

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Background

Introduction

- Agricultural expansion into natural ecosystems is one of the main drivers of biodiversity loss worldwide.
- Understanding the current and future drivers of land-use (LU) change patterns is thus important to inform land-use and conservation planning.
- Argentina is a prime region where land-use decisions strongly depend on global market prices and demands.
- But how these factros influence land-use change patterns across gradients of climate, soil quality, population density and accessability remains unclear.
- Moreover, drivers of land-use change have not been assessed across eco-regions in Argentina, despite links among regions.

Research goals

- To better understand the underlying drivers of agricultural land-use change in the Pampas and Chaco regions from 2000-2010.
- To explore effects of future market conditions and revenue changes on land-use conversions.

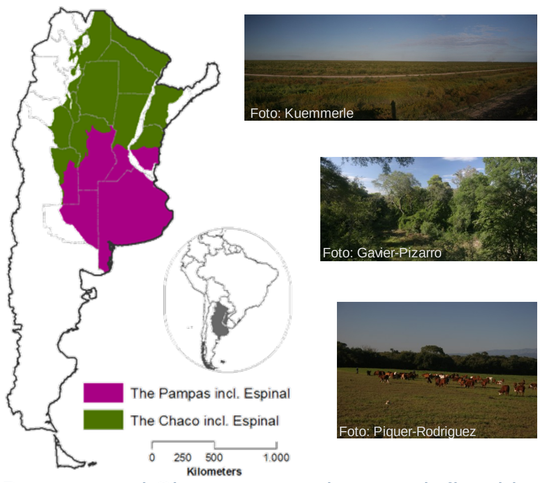
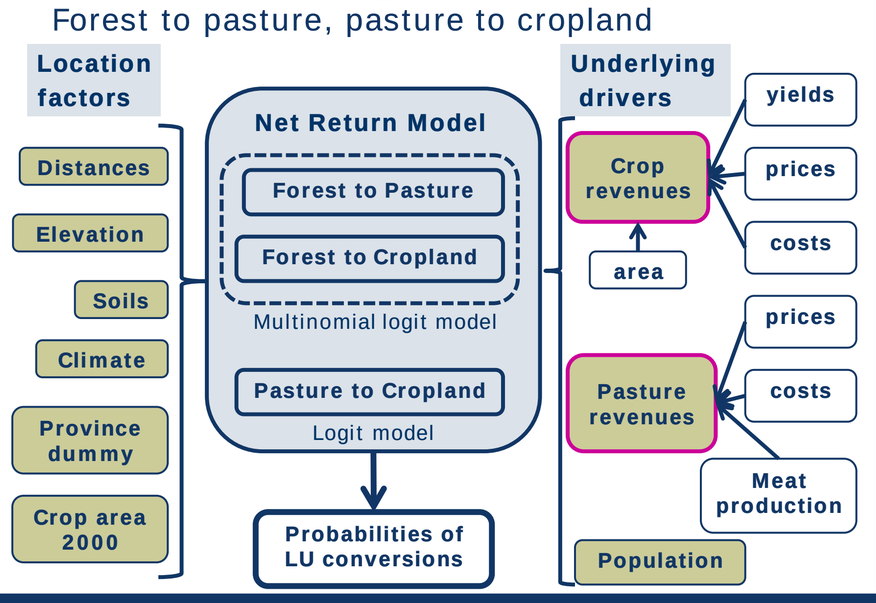


Fig. 1: The Pampas and Chaco eco-regions as defined in this study

Approach

- Net returns model to incorporate costs and revenues from agriculture 2000-2010.
- Three land-use changes: Forest to cropland, Forest to pasture, pasture to cropland



Revenue conversion scenarios

Results

- Crop revenues, soil quality, and crop area in 2000 primarily determined LU conversion patterns.
- Other location factors such as slope and precipitation were less important.
- Crop revenues not only drive conversions to cropland (from forest or pasture) but also the conversions from forest to pasture (Fig.3).

- **Pampas**: conversions to cropland were sensitive to increases in crop revenue (see Fig. 2, pink line).
- **Chaco**: revenues were a weaker driver compared to the Pampas. Soil fertility and distance to agriculture were important location factors. Climate was important but in a non-linear way.

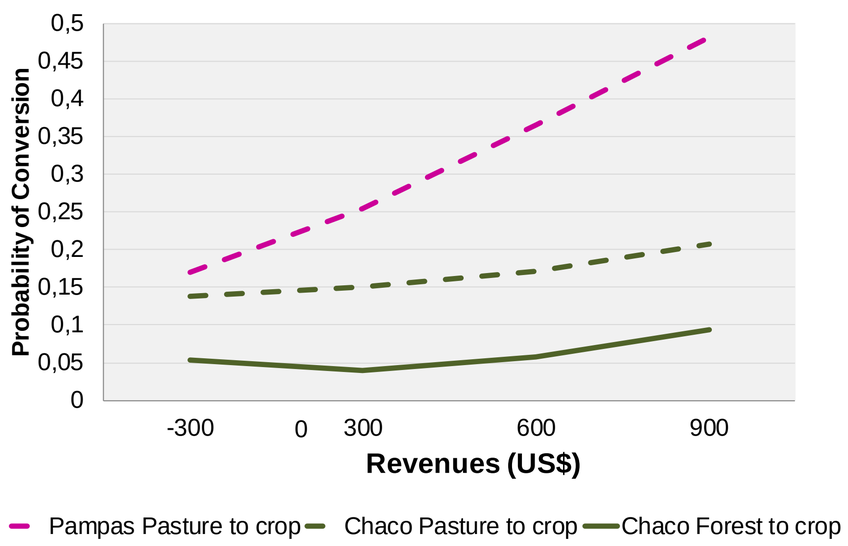


Fig. 2: Probabilities of conversions in 2010 to cropland increase with increasing revenues. This is steeper for the Pampas and in general, conversions from pasture to crop are more sensitive to revenues.

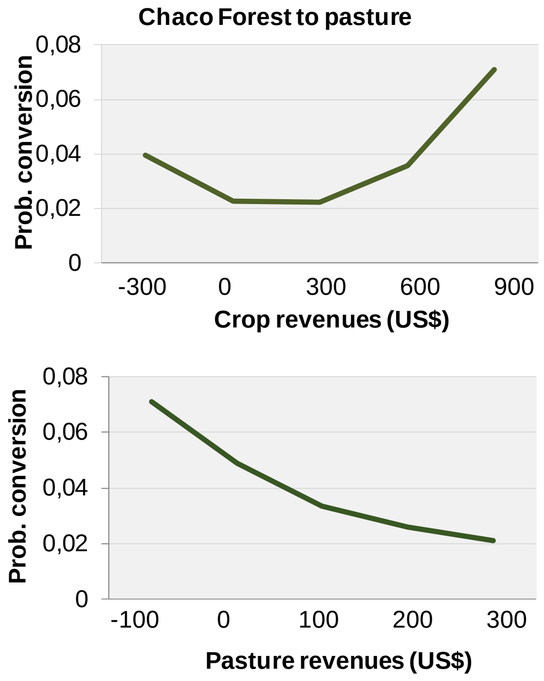


Fig. 3: Probabilities of conversions in 2010 to pastures increase with increasing cropland revenues and not with higher pasture revenues.

Future simulated conversions

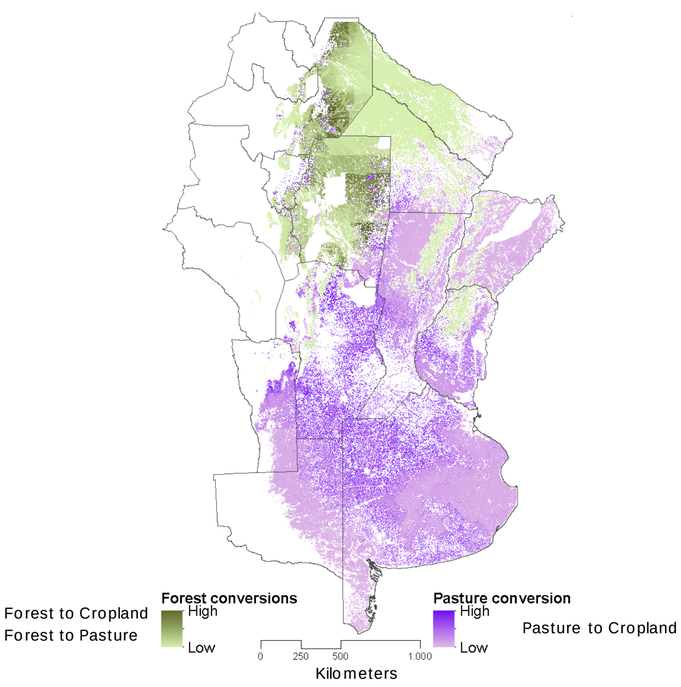


Fig. 4: Simulated spatial agricultural conversions in 2010 highlight the need of forest protection in Salta and S. Estero where potential conversions are high and also the opportunity for intensification in Chaco, Formosa and southwest of the region.

Conclusions

- High cropland revenues increased the likelihood of forest to pasture conversion - This suggests that conversion to pasture is an intermediate step to the ultimate conversion to cropland.
- The importance of crop area in 2000 in determining conversions indicates potential agglomeration effects due to knowledge and technology transfers.
- Sustainable LU planning can benefit from understanding the role of LU change drivers for defining future development pathways:
  - In the Pampas: underlying drivers
  - In the Chaco: underlying drivers and location factors
- Models that include only location factors result in more extense areas being highlighted for conversions.
  - By additionally considering underlying drivers in our model we narrowed down the potential areas in which strategic land-use planning can make an impact in mitigating ecosystem loss.

Data sources:

- Land-use: Forest: Hansen et al. 2013. Pasture and cropland : Volante et al. 2015
- Climate: INTA weather stations
- Elevation: SRTM 1km
- Soils: INTA index of agri. Suitability (FAO)
- Population: INDEC
- Distances: cost distance to provinces
- Revenues: Production(soy, wheat, corn, sorghum, cotton) : SIIA and Agric. Census (INDEC). Costs: MAGyP and Margenes Agropecuarios

References:

- Volante, J., et al. (2015). Expansión agrícola en Argentina, Bolivia, Paraguay, Uruguay y Chile entre 2000-2010. Caracterización espacial mediante series temporales de índices de vegetación. *RIA, 41(2).*
- Hansen, M. et al. (2013). High-Resolution Global Maps of 21st-Century Forest Cover Change. *Science, 342(6160), 850-853.*

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