REPORT

Moving Toward Sustainable Landscapes

Carbon Dynamics in Land Use and Management Transitions

May, 2025

The Nature Conservancy

LAPIG Remote Sensing and GIS Lab

UFG Universidade Federal de Goiás

Lapig

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SUMMARY

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1. Overview

The partnership between TNC and LAPIG, with support from the Universidade Federal de Sergipe (UFS), has brought together a group of Brazilian experts to model carbon dynamics in the Cerrado. This modeling focuses on improving planted pastures and determining land allocation for soybeans and natural restoration. This work builds on the findings of the paper titled "Livestock Intensification and Environmental Sustainability: An Analysis Based on Pasture Management Scenarios in the Brazilian Savanna." The aim is to explore the potential of using degraded pastures to facilitate future meat and soybean production, while also identifying areas suitable for ecological restoration.

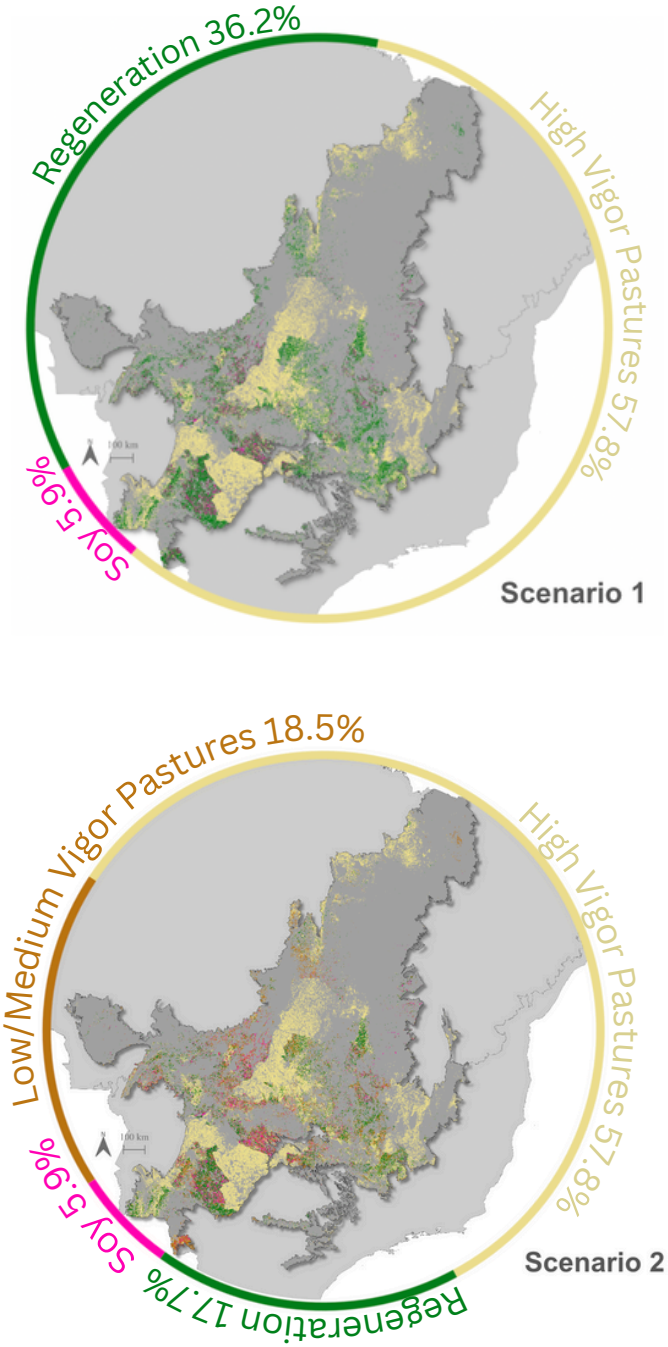
This study addresses important questions regarding carbon stocks in the Brazilian Cerrado. Specifically, it examines:

- What area of pasture is needed to sustainably support the cattle herd in the Cerrado biome with improved pasture management?
- How do future use scenarios, which balance soybean production, regeneration, and pasture, impact carbon stocks?

Additionally, the research allows us to determine the proportion of carbon in native vegetation at risk of legal clearing in the savanna.

2. Principal Results

Using the Century ecosystem model, we estimate current carbon stocks in biomass and soil for both pastures and native vegetation, based on their existing spatial distribution and quality. This model enables us to predict carbon stocks for 2030 and 2050 under various future scenarios of land use change and management in a spatially explicit manner. We applied this model to create scenarios in which degraded pastures are rehabilitated, and areas are designated for soybean cultivation according to their suitability. Any excess degraded land that is not needed for production can be allocated for the recovery of native vegetation through natural processes.

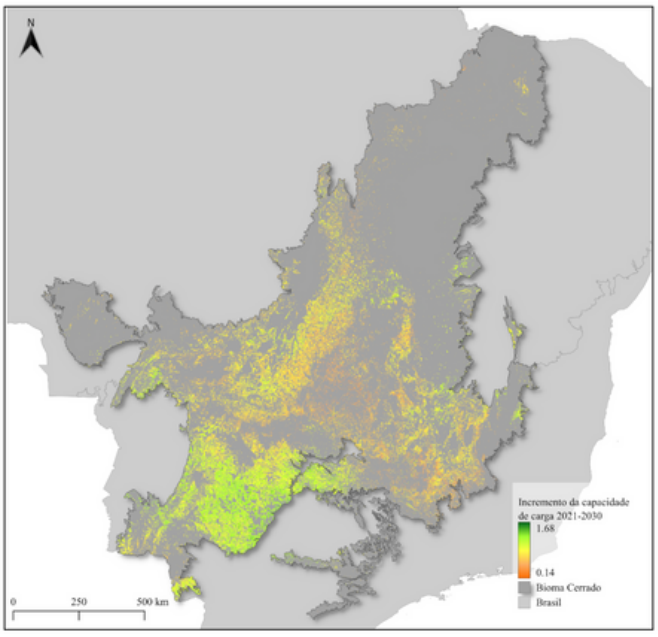


Scenarios of future land use.

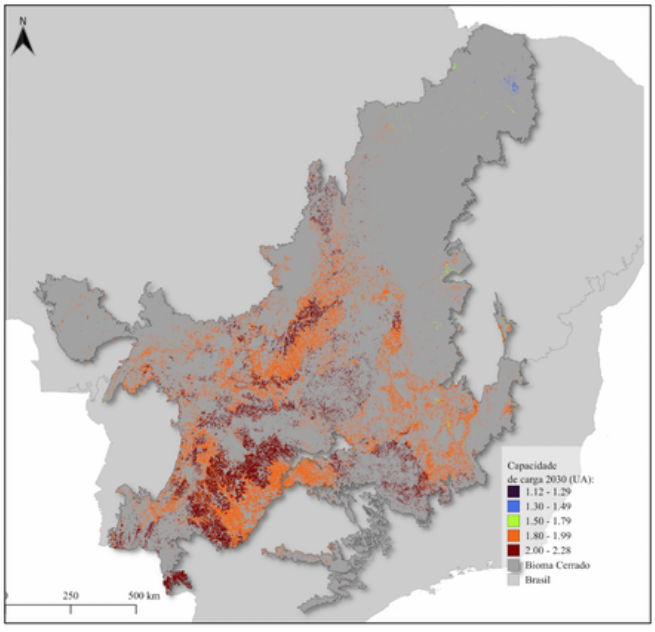
2.1 Carrying Capacity

Maintaining high quality pastures and improving low and medium quality pastures in areas where the impact on carrying capacity is the highest, we find that the portion of the Brazilian cattle herd allocated to the Cerrado for the year 2030 (61 million animal units) requires 29 million hectares (58% of the area currently estimated as pasture).

Potential increase in bovine carrying capacity (UA) by improving pasture quality from low or medium vigor to high vigor.

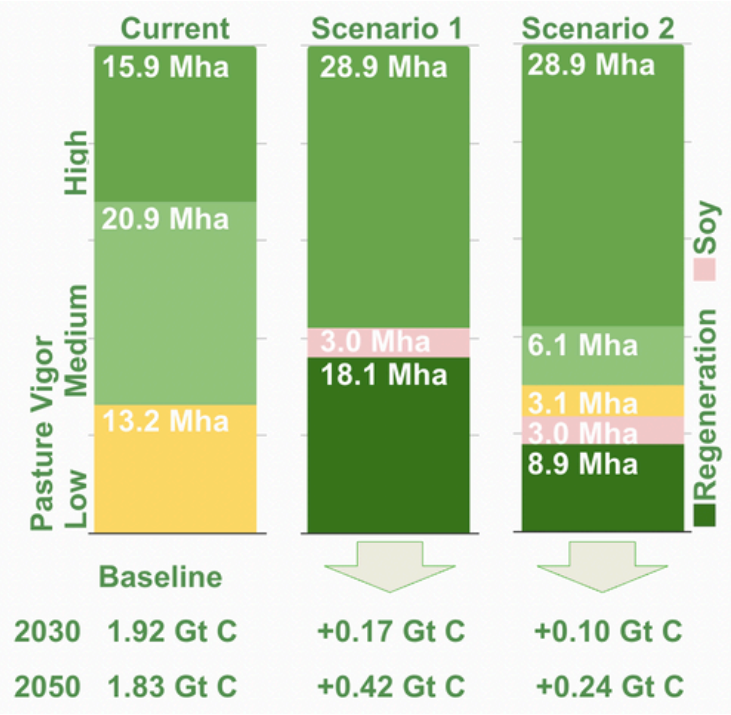


Bovine carrying capacity (UA) in low or medium vigor pastures that are transformed to high vigor.



2.2 Carbon Accumulation

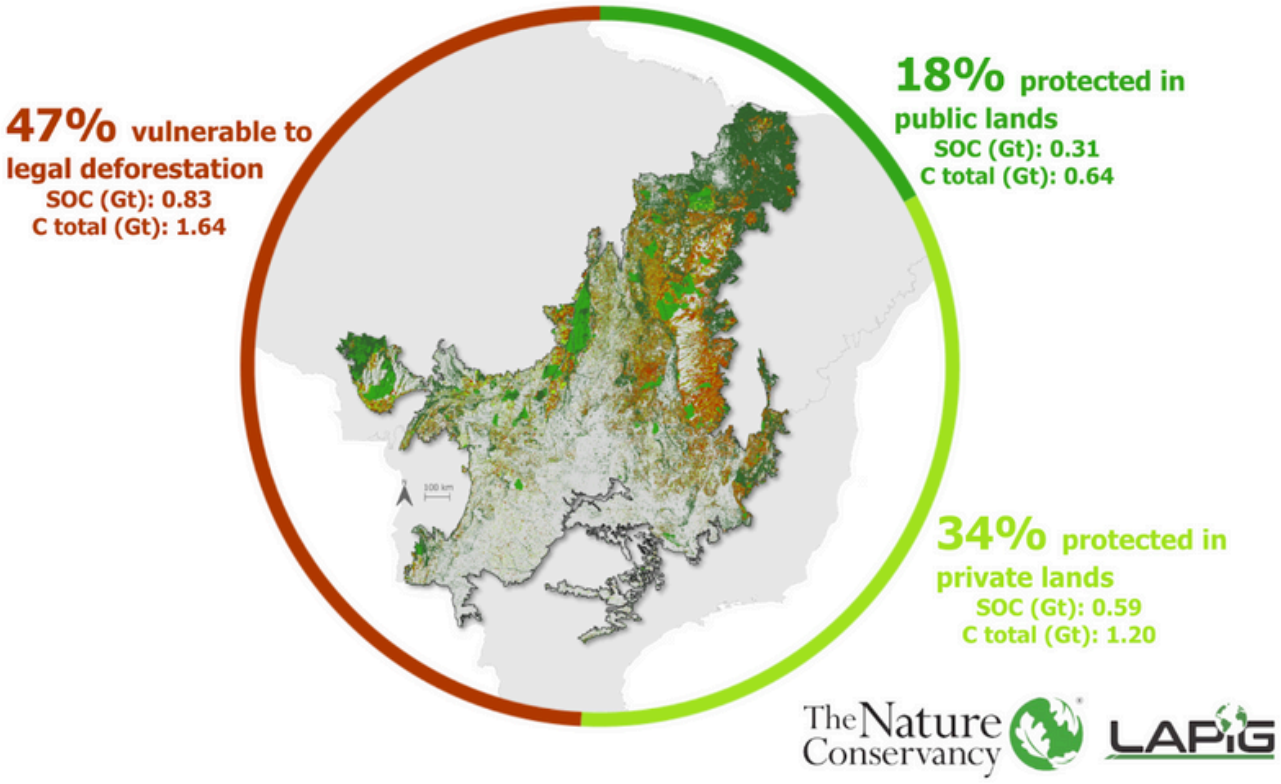
Two scenarios for future use are presented that allocate the aforementioned area to high quality pasture and an additional 3 Million hectares to soybean cultivation. This area is based on estimates that meet soybean demand for 2030. After allocating land to soybean expansion and pasture, 18.1 Million hectares remain that could potentially be more efficiently used. The first scenario we present allocates the entirety of the remaining area to regeneration, whereas the second scenario allocates areas with moderate or high potential for regeneration (8.9 Million hectares) and maintains other areas as non-improved pastures. The first scenario accumulates an additional 0.23 Pg C after 5 years (2030) and an additional 0.48 Pg C after 25 years (2050). The second scenario after 5 years accumulates an additional 0.15 Pg C , and shows an increase of 0.30 Pg C in 2050.



2.3 Vulnerability of Native Vegetation

An interesting estimate derived from this model is the assessment of carbon stocks in the current vegetation of the Cerrado. We used a combination of data from IBGE and MapBiomas to estimate the coverage of savanna vegetation, which is the predominant type in the Cerrado region.

This information was then converted into carbon stock estimates and cross-referenced with data from the declaration of Legal Reserves and Permanent Preservation Areas (SICAR, 2025), as well as additional protected areas and indigenous lands (INCRA).



3. References

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MAPS

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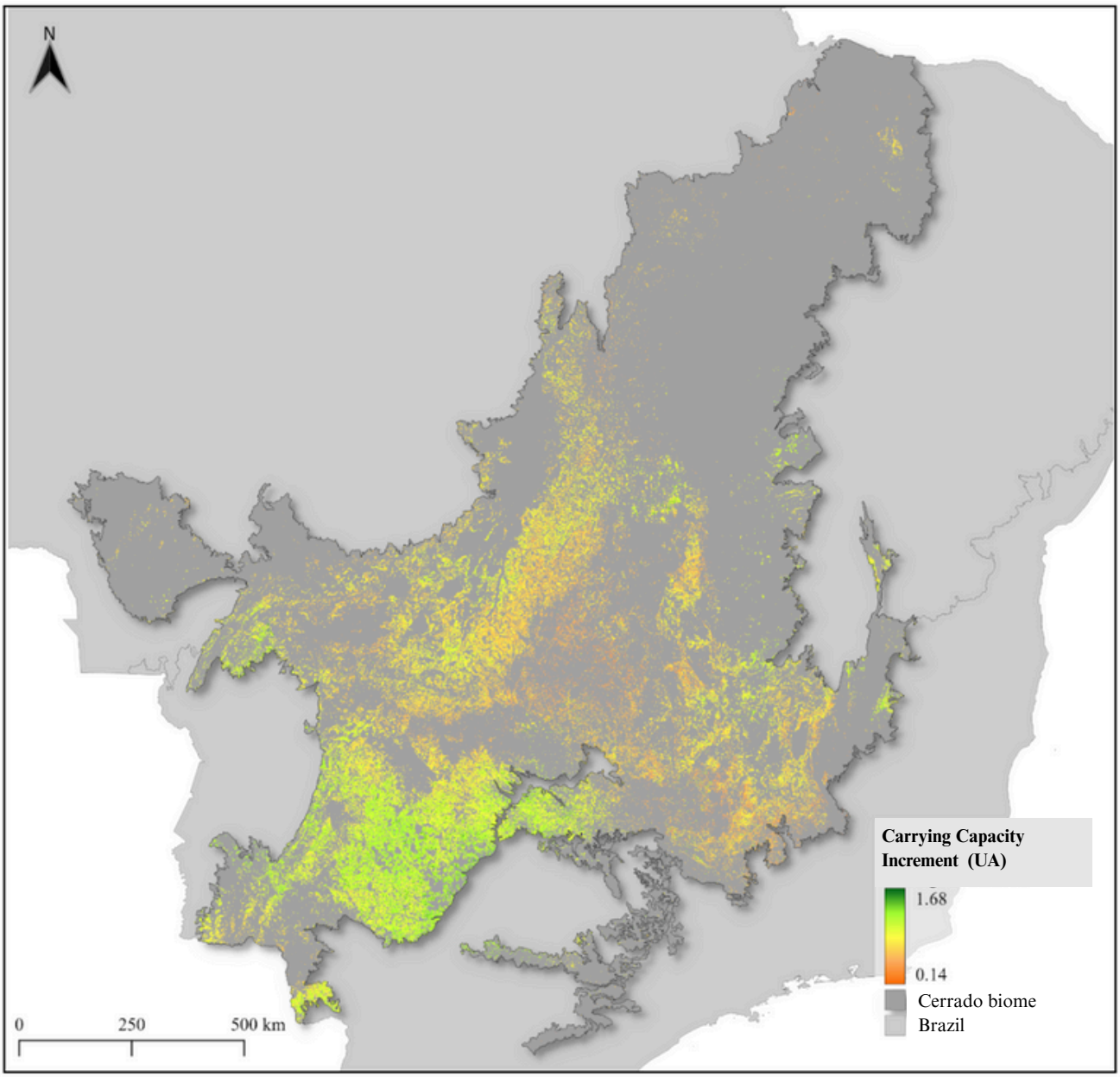
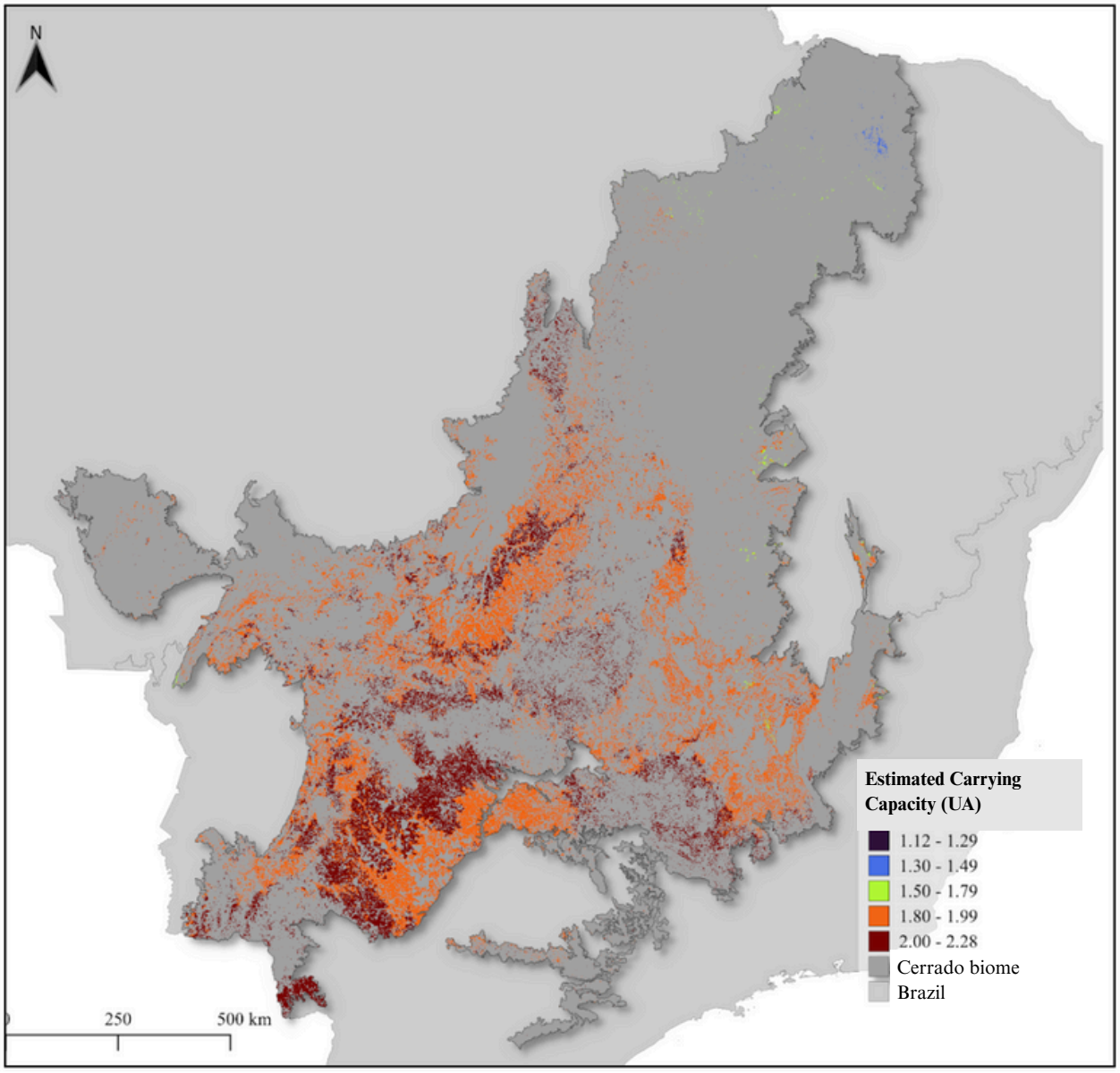
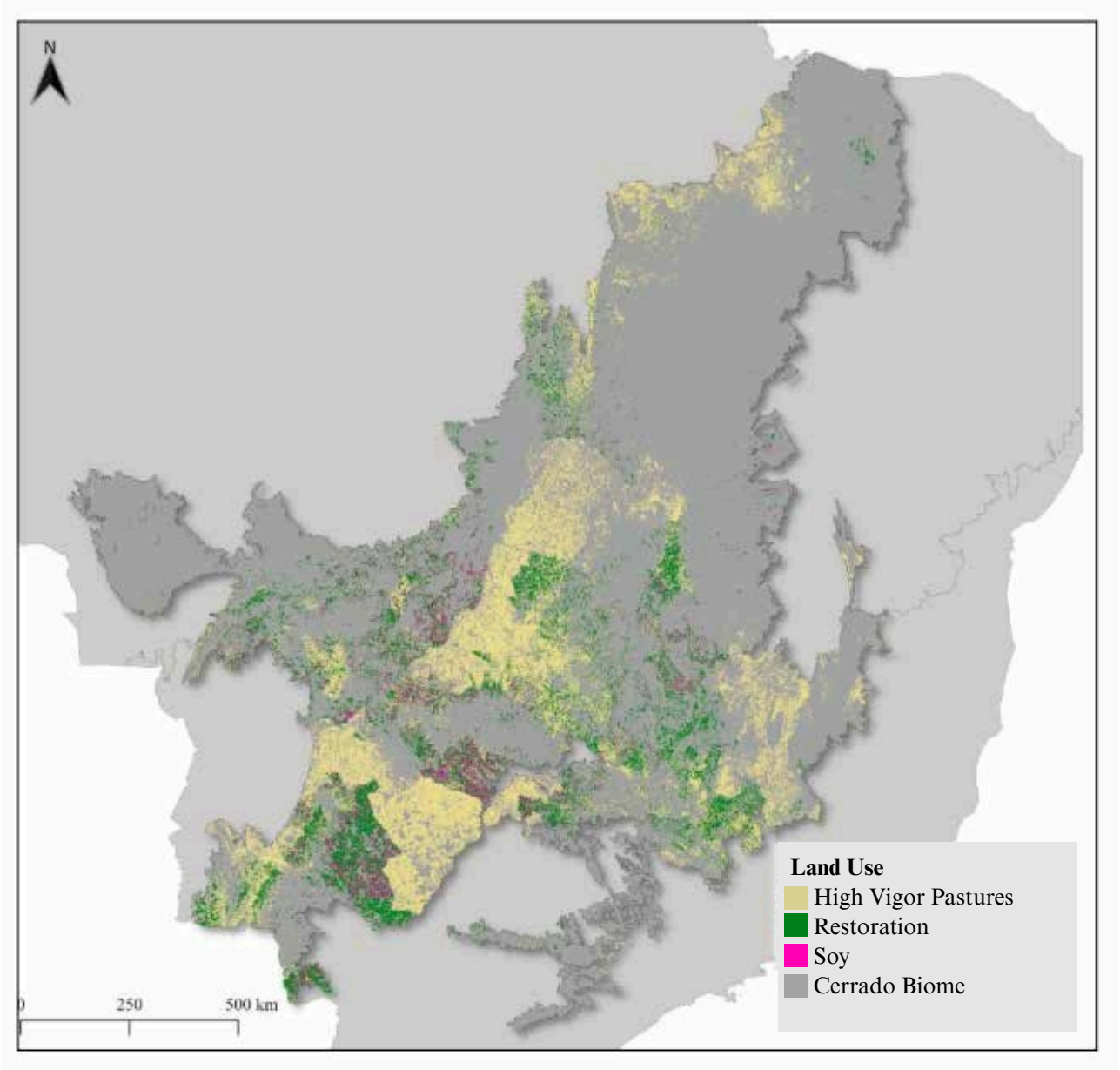


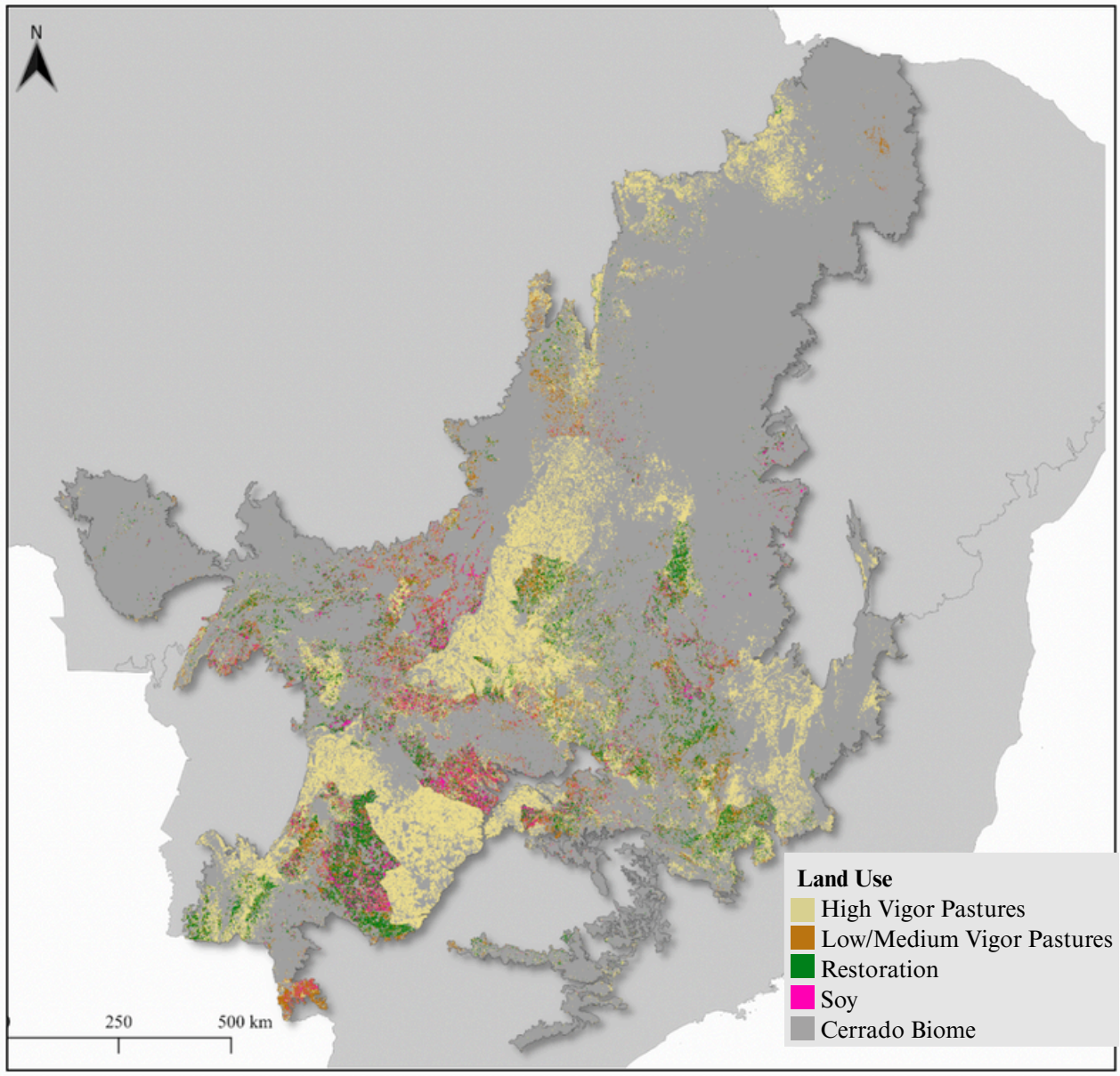
Estimate of increase in bovine carrying capacity with improvement of low and medium vigor pastures to high vigor.



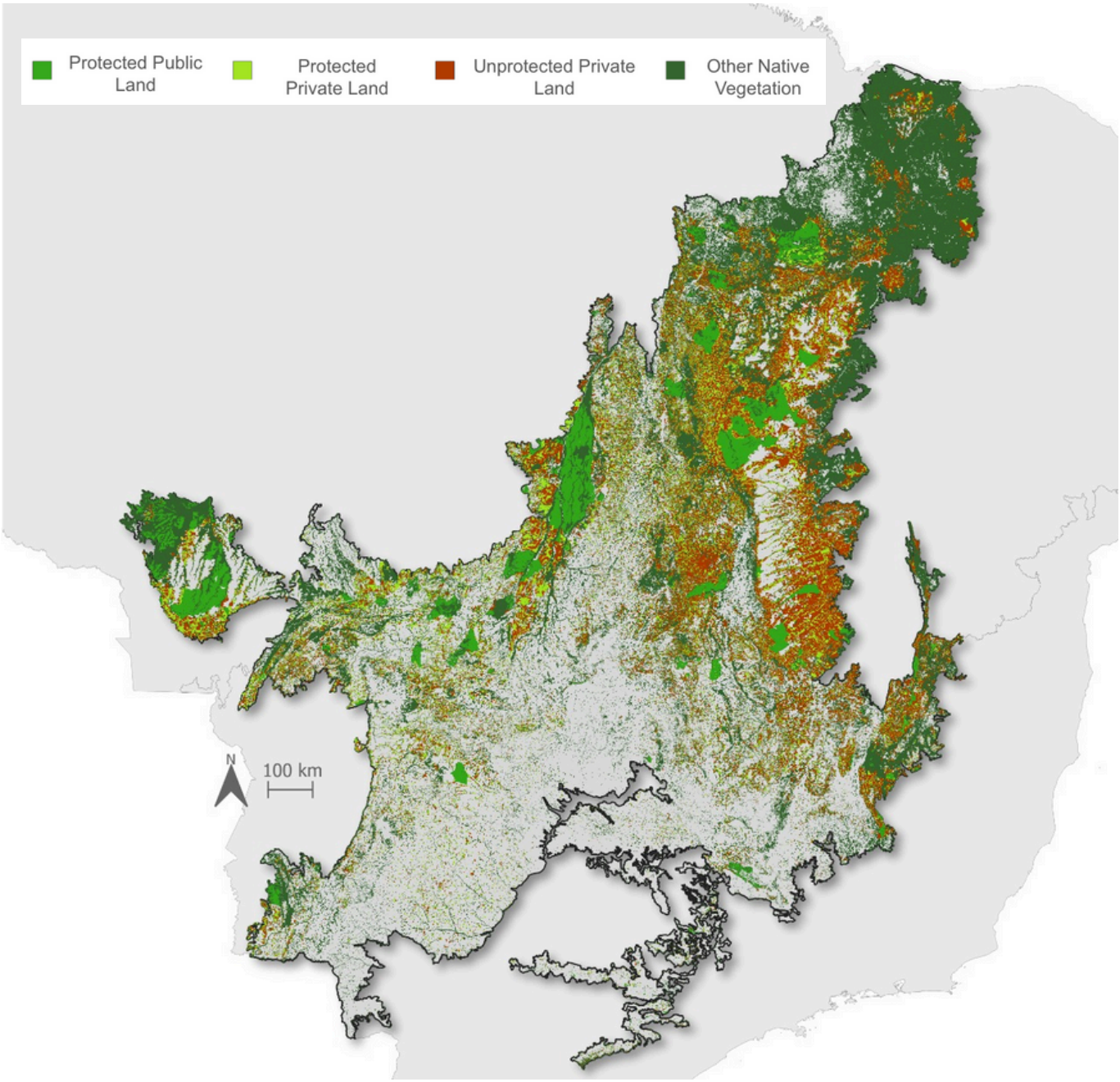
Estimated carrying capacity (UA) in low and medium vigor pastures after improvement to high vigor.



Land Use Scenario 1.



Land Use Scenario 2.



Native vegetation in savanna separated into Private Protected Areas, Public Protected Areas, and Unprotected Areas.

Remote Sensing and GIS Laboratory (Lapig)

Lapig, part of the Institute of Socio-Environmental Studies (IESA) at the Federal University of Goiás (UFG) was formed in 1994 and is active in teaching, research and extension.

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