Linking Historical and Future Land-Use Change to the Economic Drivers and Biophysical Limitations of Agricultural Expansion in the Brazilian Cerrado

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Cerrado Biome:

Tropical savanna environment

2\textsuperscript{nd} largest biome in Brazil (2 million km\textsuperscript{2})

Highest biodiversity of all tropical savannas

Undergoing rapid conversion
South American and the two largest Brazilian biomes: Amazônia and Cerrado. Caatinga, Mata Atlantica, and Pampas are also depicted. The map indicates a transition that has taken approximately 40 years, labeled as "~40 years..."
South American and the two largest Brazilian biomes: Cerrado

Cerrado biome: The largest producer of soy, beef, and cotton in Brazil

- ~ 60 million ha of cultivated pasture
- ~ 80 million head of cattle (1.1 head/ha)

National contribution:
- Beef: 55%
- Soybean: 63%
- Cotton: 89%
- Coffee: 50%
- Corn: 44%
- Rice: 37%
Soybean led the agricultural boom

Largest increases in soy production came from areas of Cerrado

Source: FAO
Galford et al.
Sugar/ethanol: expanding rapidly

- Brazil: sugar cane production increased 35% in 5 yrs
- Largely due to increased production in Cerrado

**Centro-Oeste: Sugarcane area (ha)**

Source: SIDRA/IBGE  Galford et al.
Goals of this project:

Quantify land use and land cover changes in the last decade and relate to biophysical and human drivers

Simulate scenarios of future land cover and land use change as function of regional drivers

Assess impacts of historical and future changes on H₂O, C, N₂O, CH₄, and climate
Quantifying Land Cover and Use Change

Brazilian National Cerrado Deforestation Map

PROBIO 2002

LAPIG 2009

Ferreira team at UFG
Municipal-level deforestation in last decade

Current deforestation is concentrated in two arcs in west and NE

Total area deforested 47,800 km²

Rocha, G.F. et al. Revista Brasileira de Cartografia

MODI3QI
Annual deforestation within Cerrado region

Genival et al. (2011)
Differing deforestation dynamics?

Increased agricultural production in both regions

Decreased clearing in the Amazon but increased clearing in the Cerrado

In Amazon new laws, protected areas, and enforcement appear to reduce deforestation in both biomes

Source: IBGE, LAPIG/UFG  Galford et al.
Sugarcane expansion in Cerrado: (2003 - 2010)

INPE-Canasat, Rudorff et al.
Sugarcane is expanding predominantly over existing commodities.
Fire Scars / Burned Area (2002 – 2010)

Araújo, F.M. et al. Remote Sensing (submitted)
Fire Scars / Burned Area

Araújo, F.M. et al. Remote Sensing (submitted)
Fire Scars / Burned Area (2002 – 2010)

Araújo, F.M. et al. Remote Sensing (submitted)
Produtos MODIS

Acervo de imagens MODIS filtradas e organizadas em mosaicos para todo o bioma Cerrado e Mata Atlântica disponíveis para download.

SIG-OnLine

Base de dados vetorial e raster, do Brasil e regiões específicas, do acervo do LAPIG e outras instituições para acesso online via mapa interativo - 13Geo.

Dados Vetoriais

Destaques

http://www.lapig.iesa.ufg.br/lapig/

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Notícias

Guia para estruturação de artigos científicos

A Publishing Connect disponibiliza uma série de webcats com dicas e truques para estruturação de artigos científicos. Acesse o link Leia mais...

Acessos 57

Disponíveis as primeiras imagens do satélite Pléiades
Applying products to understand effects on historical $\text{H}_2\text{O}$, C, $\text{N}_2\text{O}$, and $\text{CH}_4$
Cerrado deforestation and carbon flux

- 25,000 km² cleared 2007-2012
- Doubling of direct emissions

Galford et al.

Source: WHRC, LAPIG/UMG
Cerrado fires: carbon and N fluxes

- 2010: 7,500 km² burned
- N₂O and CH₄ important

Galford et al.

Source: MODIS, LAPIG/UMG
Significant and complex hydrologic response

Large decrease in mean ET over deforested regions (e.g. -30%) 
Large increase in mean ET rate in years following fires

Macedo et al.; Galford et al.
Land available for agriculture

Soares-Filho et al., in prep
Weights of evidence, econometric model to predict land use and land cover transitions

Start by relating existing distribution of crops and pasture to biophysical and infrastructure characteristics

Soares-Filho et al.; M.E Ferreira et al.
Relationship with existing cleared land

M.E. Ferreira et al., 2012
Sugar cane and relationships to infrastructure

M.E. Ferreira et al., 2012
Agroclimatic zoning derived for soy, cocoa, wheat and cotton
Physical and logistic suitability for Soy

L. Lima et al.
Potential rents for soybean crops in Brazil at 2009 prices
Highest rent for sugarcane, soy, and corn

L. Lima et al.
Suitable pastureland for crops. Of 230 M ha of pasturelands, about 140 M ha is judged suitable for various types of crops.

Soares-Filho et al.
Simulated deforestation probability 2002-2009

T. Lima, 2013
Simulated vegetation change 2010-2050
Simulated climate and crop yield as function of deforestation and GHG scenarios

Oliveira et al., in review
Climate changes from remote (GHG) and local (deforestation)

Deforestation reduces rainfall to point where soy is no longer viable in portions of region

Oliveira et al., in review
Deforestation, intensification, and fires continue at high rates in the Cerrado

Fluxes of C, N, and H\(_2\)O have been significantly altered

Large opportunity for agricultural growth without new deforestation

Simulations suggest significant potential for continued deforestation

Future land cover changes are large enough to alter climate and crop yield