Bioenergy Workshop
Kruger National Park
April 1-3, 2014

"What we know about environmental and social consequences of biofuels production and we should avoid in the future"

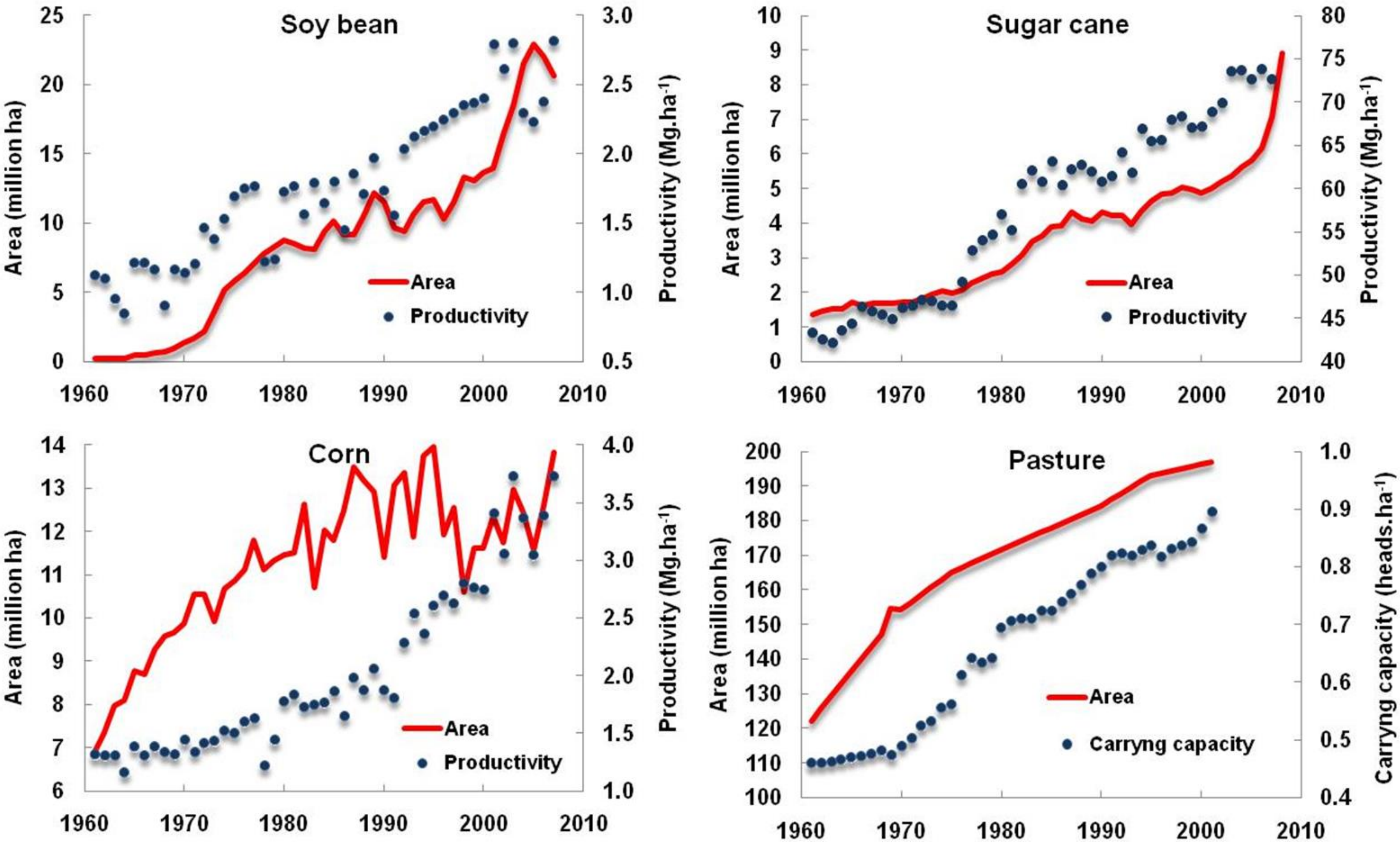
Luiz Antonio Martinelli
CENA-University of São Paulo

BRAZIL

- ✓ Land was available
- ✓ Labor was available
- ✓ Abundant water & mild temp.
- ✓ Macroecomics adjustments (1995)

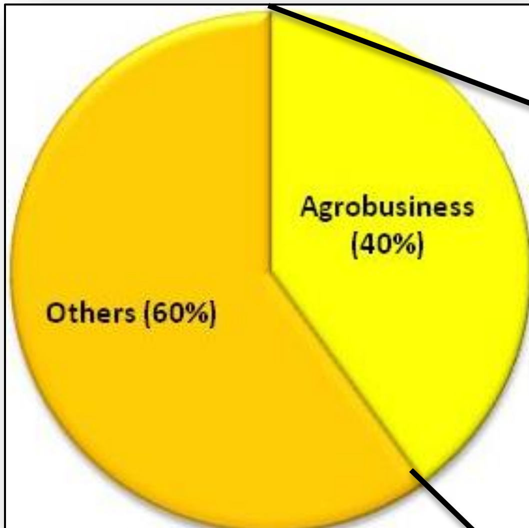
⇩

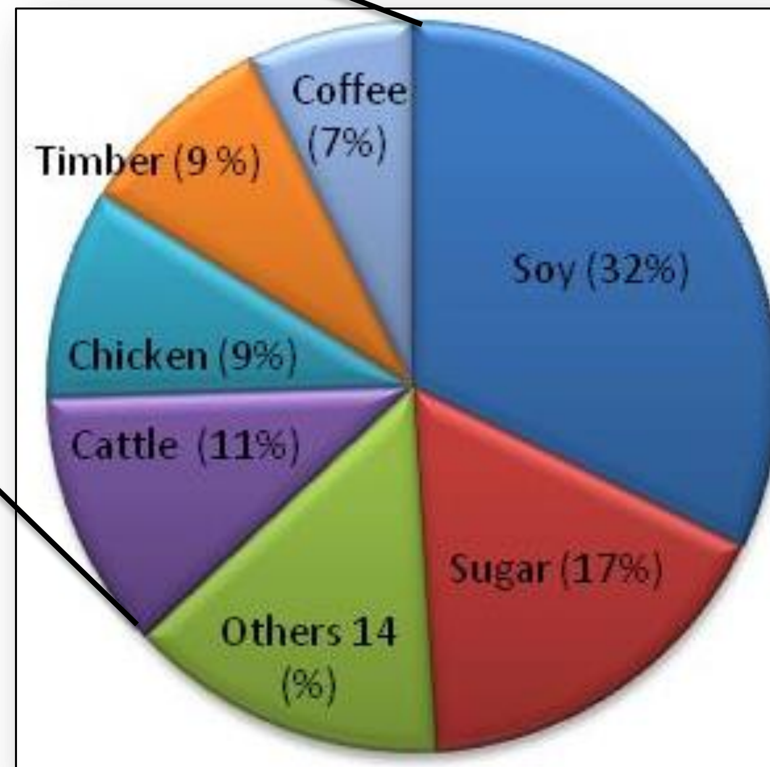
- ➢ Agriculture development



Soy bean
Area (million ha)
Productivity (Mg.ha-1)
Area
Productivity
Sugar cane
Area (million ha)
Productivity (Mg.ha-1)
Area
Productivity
Corn
Area (million ha)
Productivity (Mg.ha-1)
Area
Productivity
Pasture
Area (million ha)
Carryng capacity (heads.ha-1)
Area
Carryng capacity

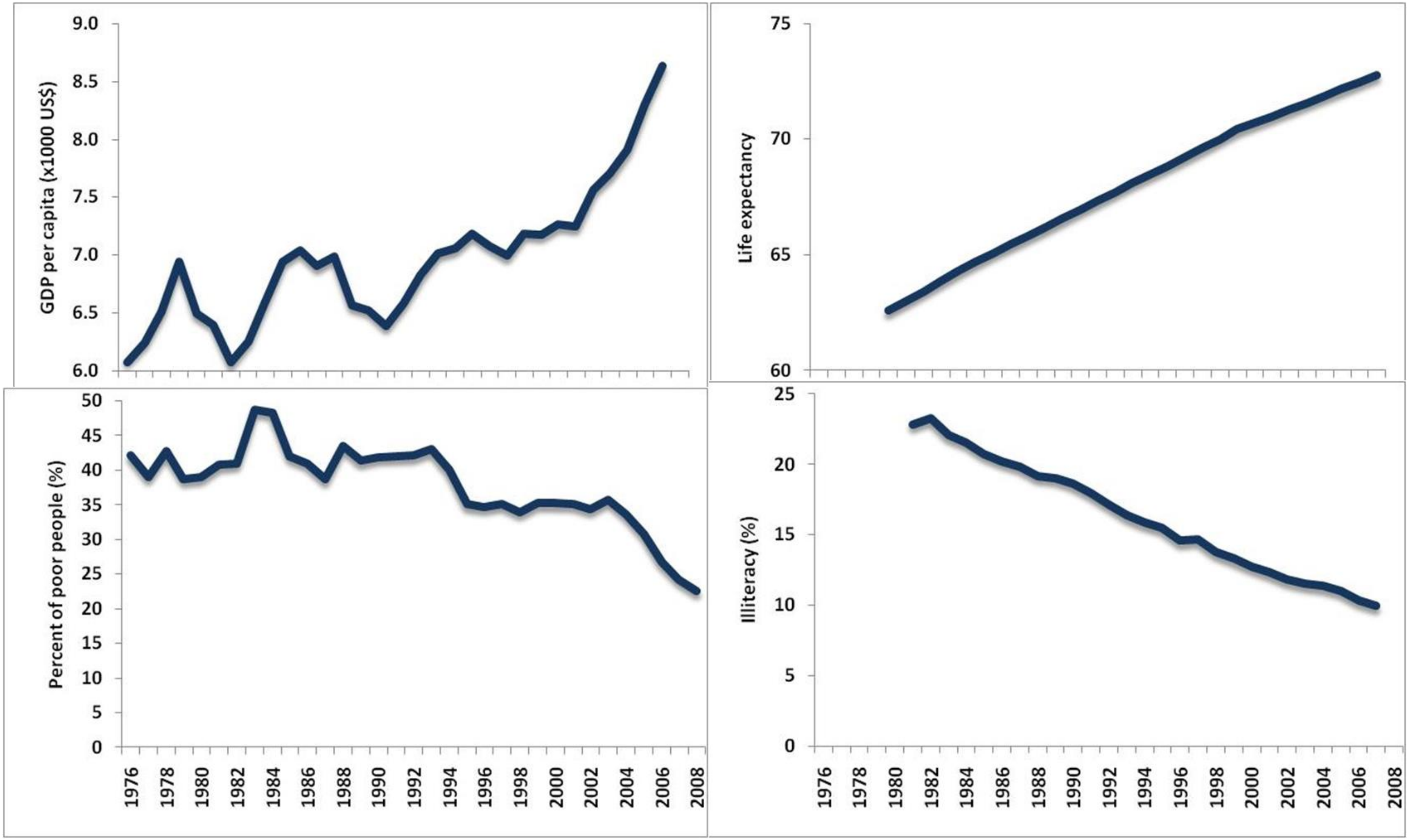
Brazilian Exports 2009





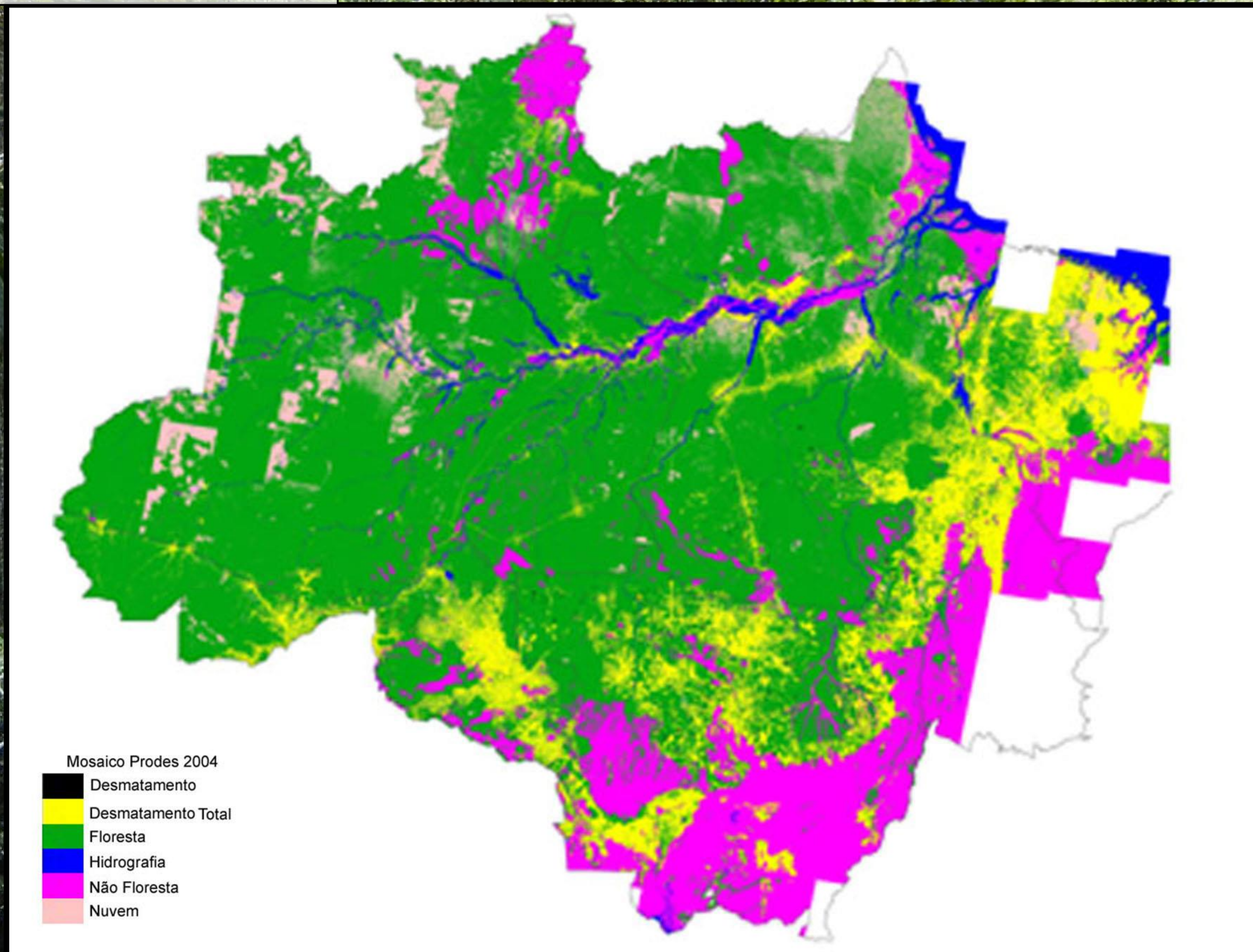
Brazilian Agriculture
9% of the country GDP
Brazilian Agribusiness
25% of the country GDP

Source: Receita Federal do Brasil, 2010



GDP per capita (x1000 US$)
9.0
8.5
8.0
7.5
7.0
6.5
6.0
Life expectancy
75
70
65
60
Percent of poor people (%)
50
45
40
35
30
25
20
15
10
5
0
Illiteracy (%)
25
20
15
10
5
0
1976
1978
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008

Brazilian Legal Amazon
Original area: 5 million km^2
Deforested: 0.8 million km^2 (16%)
Rate: 17,000 km^2 per year



Source: **INPE-DETER**
(www.inpe.gov.br/deter)

Cerrado – Tropical Savanna

Original area: 2 million km^2
Deforested: 1.0 million km^2 (50%)
Rate: 4,000 km^2 per year

Cerrado biodiversity

Plants: 10,000
Mammals: 195
Birds: 607
Reptiles: 225
Amphibians: 186
Freshwater fish: 800
Source: Conservation International

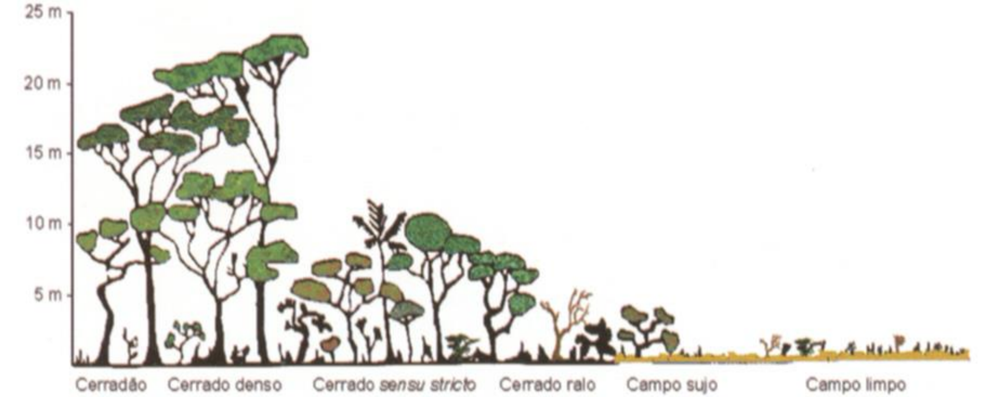
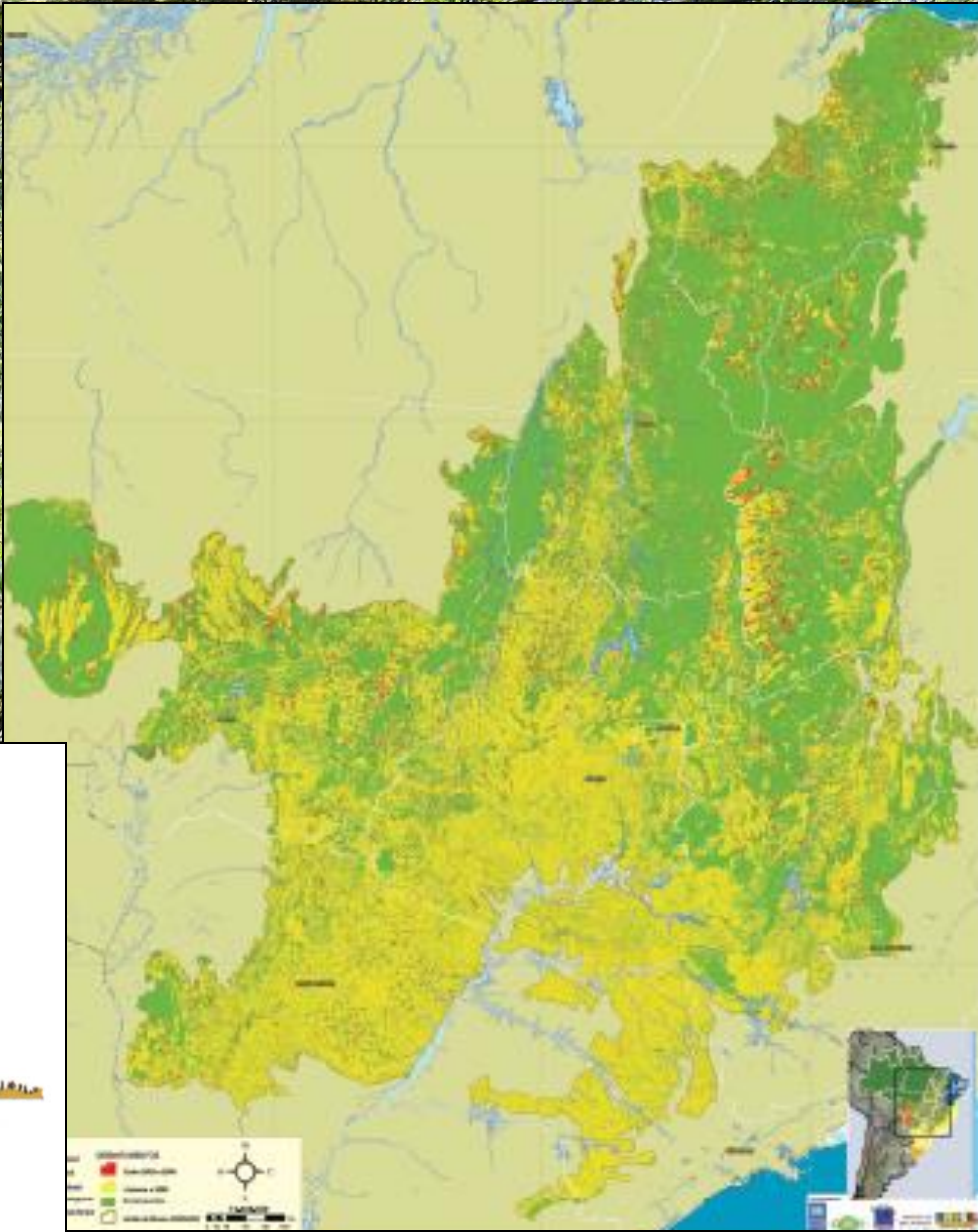


Figure 2—Physiognomic forms of the Cerrado.
Figura 2—As formas fisionômicas do Cerrado.

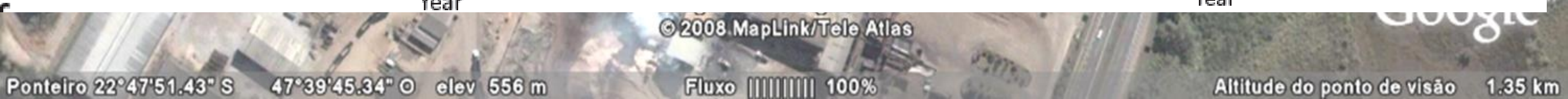


Source: **MMA**
(www.mma.gov.br)

Mata Atlântica – Atlantic Forest

Atlantic Forest
Original: 2 million km^2
Deforested: 1.86 million km^2
Only 15% is lef

Source: **SOS Mata Atlântica**
(www.sosmatatlantica.org.br)



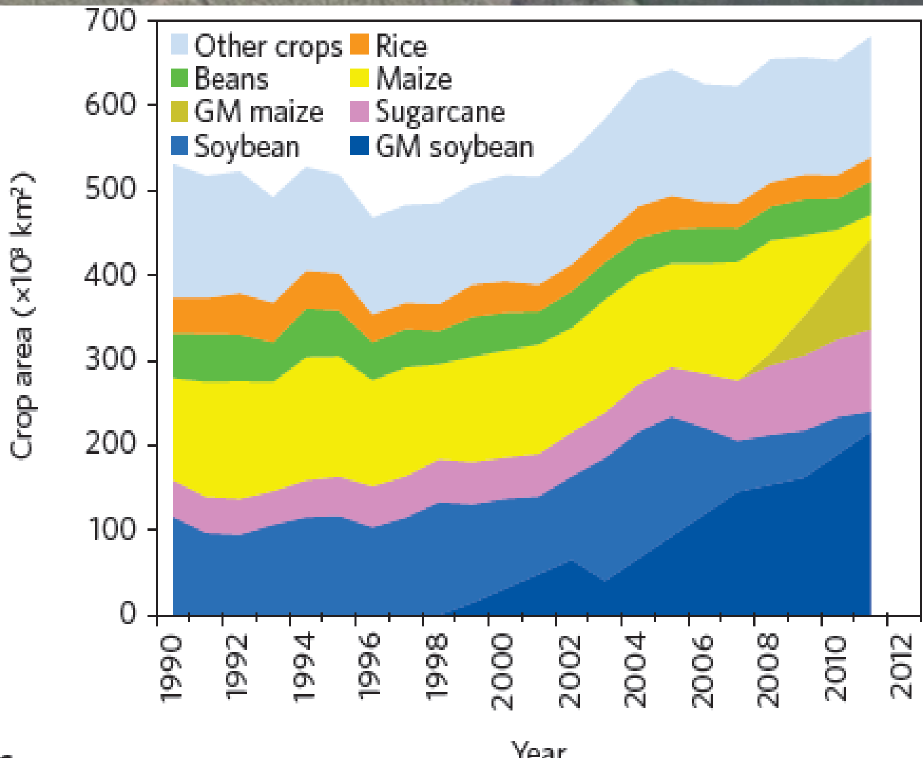
nature climate change

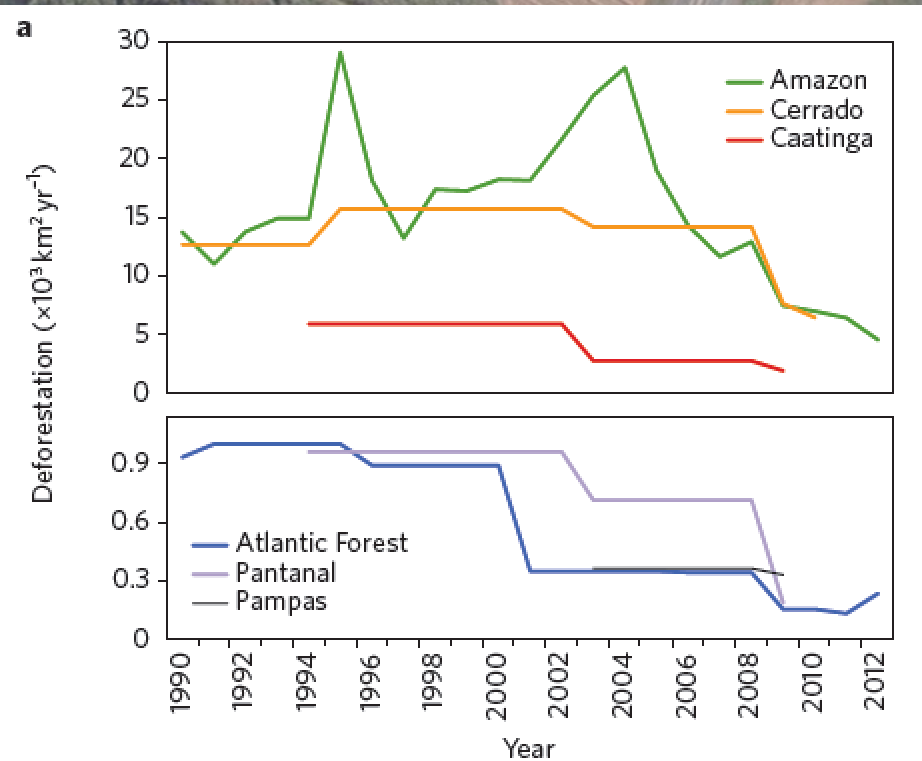
REVIEW ARTICLE

PUBLISHED ONLINE: 20 DECEMBER 2013 | DOI: 10.1038/NCLIMATE2056

Pervasive transition of the Brazilian land-use system

David M. Lapola[1*], Luiz A. Martinelli[2], Carlos A. Peres[3], Jean P. H. B. Ometto[4], Manuel E. Ferreira[5], Carlos A. Nobre[4], Ana Paula D. Aguiar[4], Mercedes M. C. Bustamante[6], Manoel F. Cardoso[4], Marcos H. Costa[7], Carlos A. Joly[8], Christiane C. Leite[7], Paulo Moutinho[9], Gilvan Sampaio[4], Bernardo B. N. Strassburg[10,11] and Ima C. G. Vieira[12]



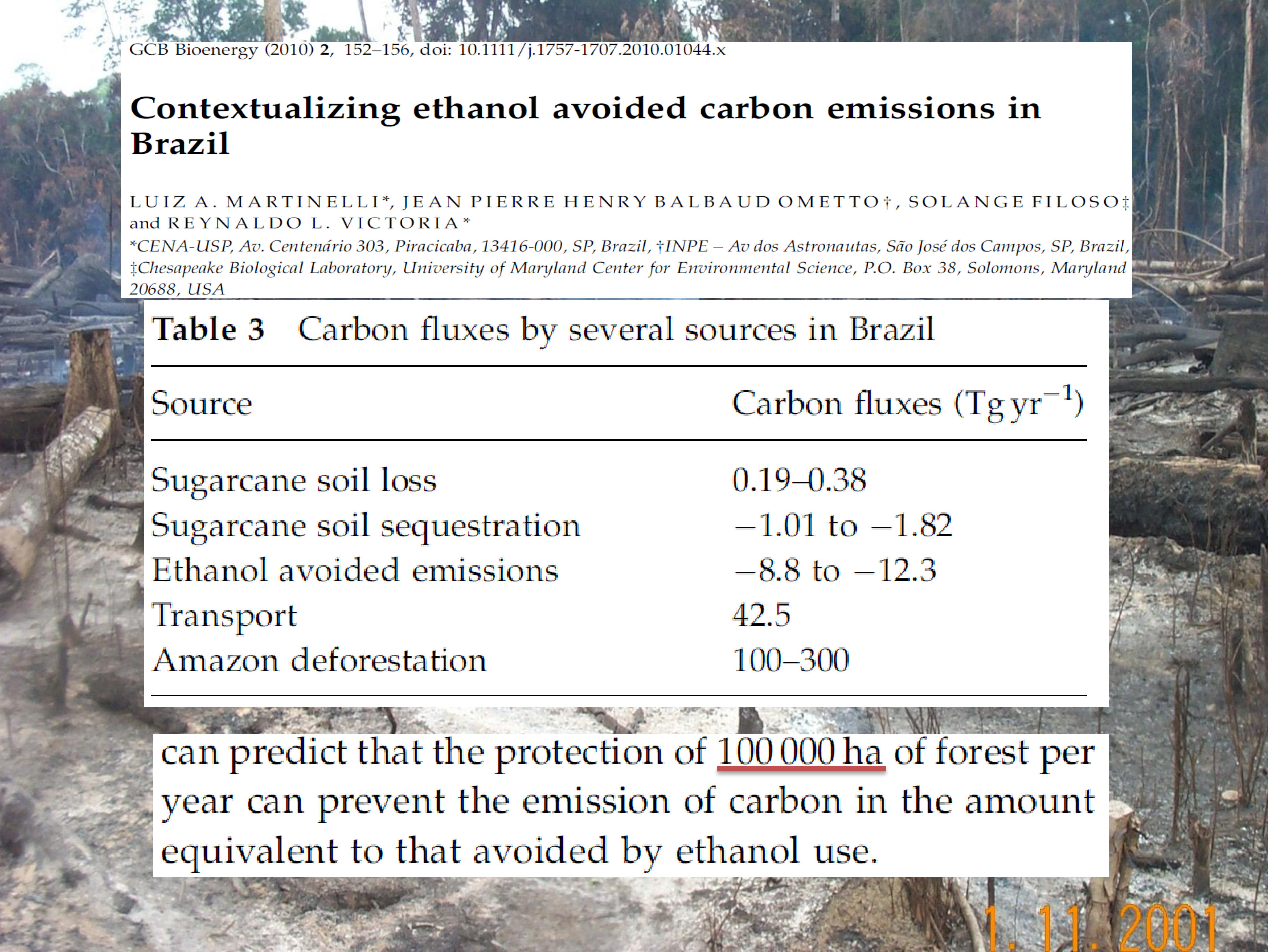


Why is so important to keep deforestation as lower as possible ?

Because “food, fiber and bioenergy” production is the most prescious ecosystem service (ES).

But this service needs an ecosystem that is capable to provide another series of ES that in turn will support agriculture.

Martinelli (2010. Inter-American Development Bank. Technical Notes IDB-TN 382



GCB Bioenergy (2010) **2**, 152–156, doi: 10.1111/j.1757-1707.2010.01044.x

Contextualizing ethanol avoided carbon emissions in Brazil

LUIZ A. MARTINELLI*, JEAN PIERRE HENRY BALBAUD OMETTO†, SOLANGE FILOSO‡ and REYNALDO L. VICTORIA*

**CENA-USP, Av. Centenário 303, Piracicaba, 13416-000, SP, Brazil, †INPE – Av dos Astronautas, São José dos Campos, SP, Brazil, ‡Chesapeake Biological Laboratory, University of Maryland Center for Environmental Science, P.O. Box 38, Solomons, Maryland 20688, USA*

Table 3 Carbon fluxes by several sources in Brazil

Source	Carbon fluxes ($Tg\,yr^{-1}$)
Sugarcane soil loss	0.19–0.38
Sugarcane soil sequestration	−1.01 to −1.82
Ethanol avoided emissions	−8.8 to −12.3
Transport	42.5
Amazon deforestation	100–300

can predict that the protection of 100 000 ha of forest per year can prevent the emission of carbon in the amount equivalent to that avoided by ethanol use.

The most recognizable of these natural services that depend on the landscape in which agricultural fields are embedded are**:**

pollination and biological pest control.





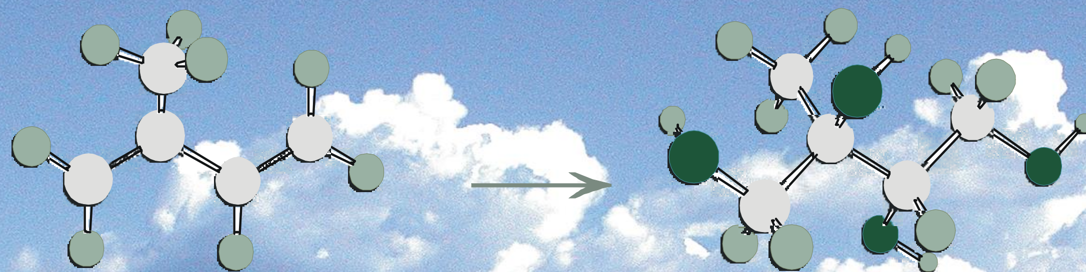

Several **fruits, vegetables, nuts** and stimulant crops like **coffee** are highly dependent (Klein et al., 2007)[I]

It is important to remember that LAC is an **important fruit and vegetable producer and the largest coffee exporter of the world.**

Gallai et al. (2009) estimated that the **insect pollination economic value** for LAC would be worth approximately **12 trillion €.**

- Intense water recycling by evapotranspiration of the trees
- Therefore, the forest depends on the rainfall, but the rainfall also depends on the fores

Emission of isoprene e produção de CCN na Amazônia



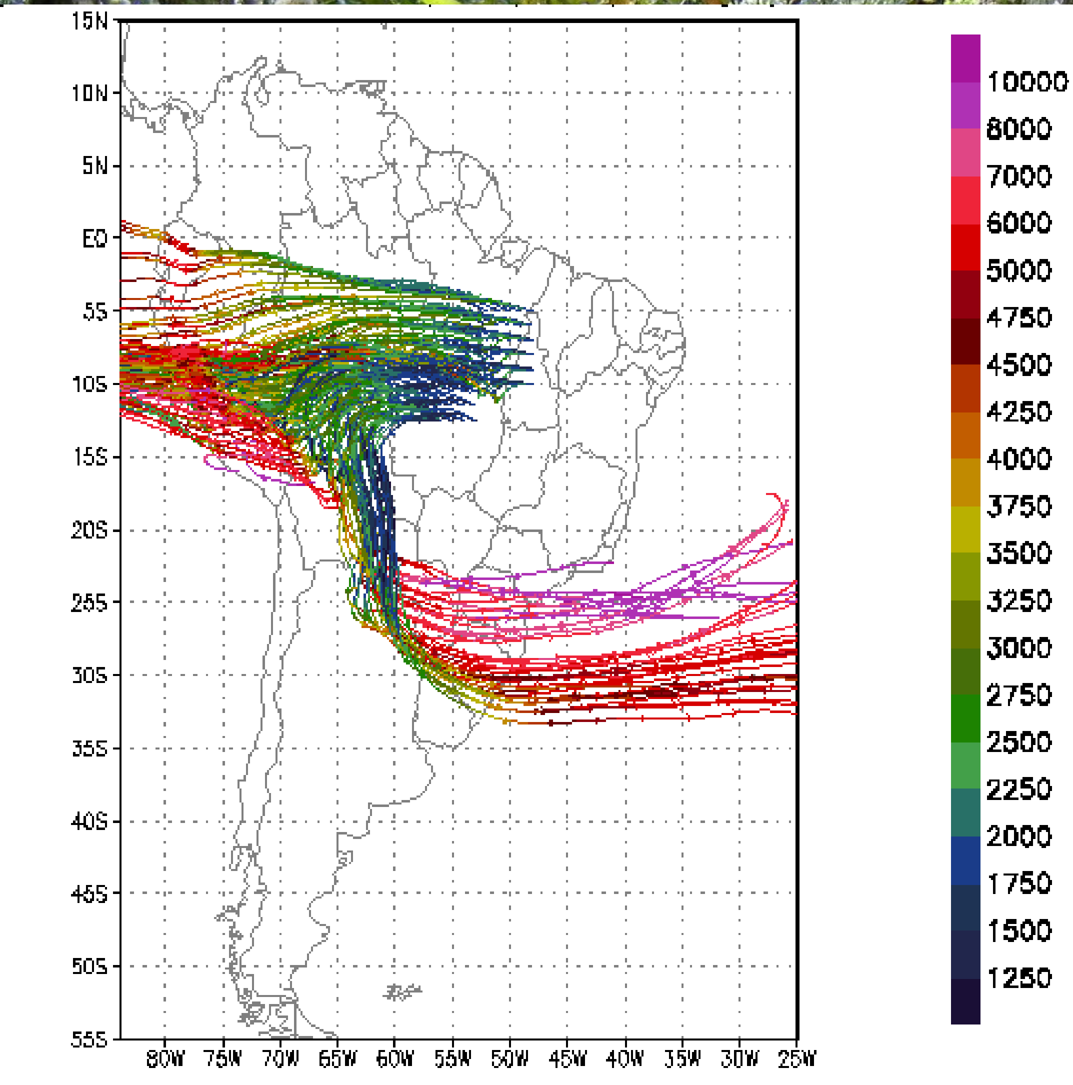
Isopreno (gas)

2-methilthertiol (partículas)

Formation of Secondary Organic Aerosols Through Photooxidation of Isoprene

Magda Claeys,[1*] Bim Graham,[2,3] Gyorgy Vas,[1] Wu Wang,[1] Reinhilde Vermeylen,[1] Vlada Pashynska,[1] Jan Cafmeyer,[4] Pascal Guyon,[2] Meinrat O. Andreae,[2] Paulo Artaxo,[5] Willy Maenhaut[4]

strength of about 2 Tg per year. These compounds have low vapor pressure and are hygroscopic; they can therefore contribute to particle growth (*28*), enhance the ability of aerosols to act as cloud condensation nuclei, and result in the formation of haze (*29*) above forests. The 2-methyltetrols can be regarded as specific molecular markers for the photooxidation of isoprene in the ambient atmosphere and are, as such, of potential interest for source apportionment and air quality modeling studies. Contrary to widespread assumption, we suggest that photooxidation of isoprene emitted by forest vegetation results in substantial SOA formation.



Ecosystem Services

The Amazon forest works like a rain machine that exports water and water vapor to other parts of the South America, including the soybean production area of MT.

(Pedro Dias Leite)

Sustainable Agriculture

Agroecosystems are a simplification of more complex natural ecosystems

The main goal of sustainable agriculture is to *mimic natural ecosystems* adding to agroecosystems *layers of complexity and increase functional diversity*.

Additionaly, sustainable agriculture recognizes the *role of neighboring landscape* to provide *key services to agriculture*

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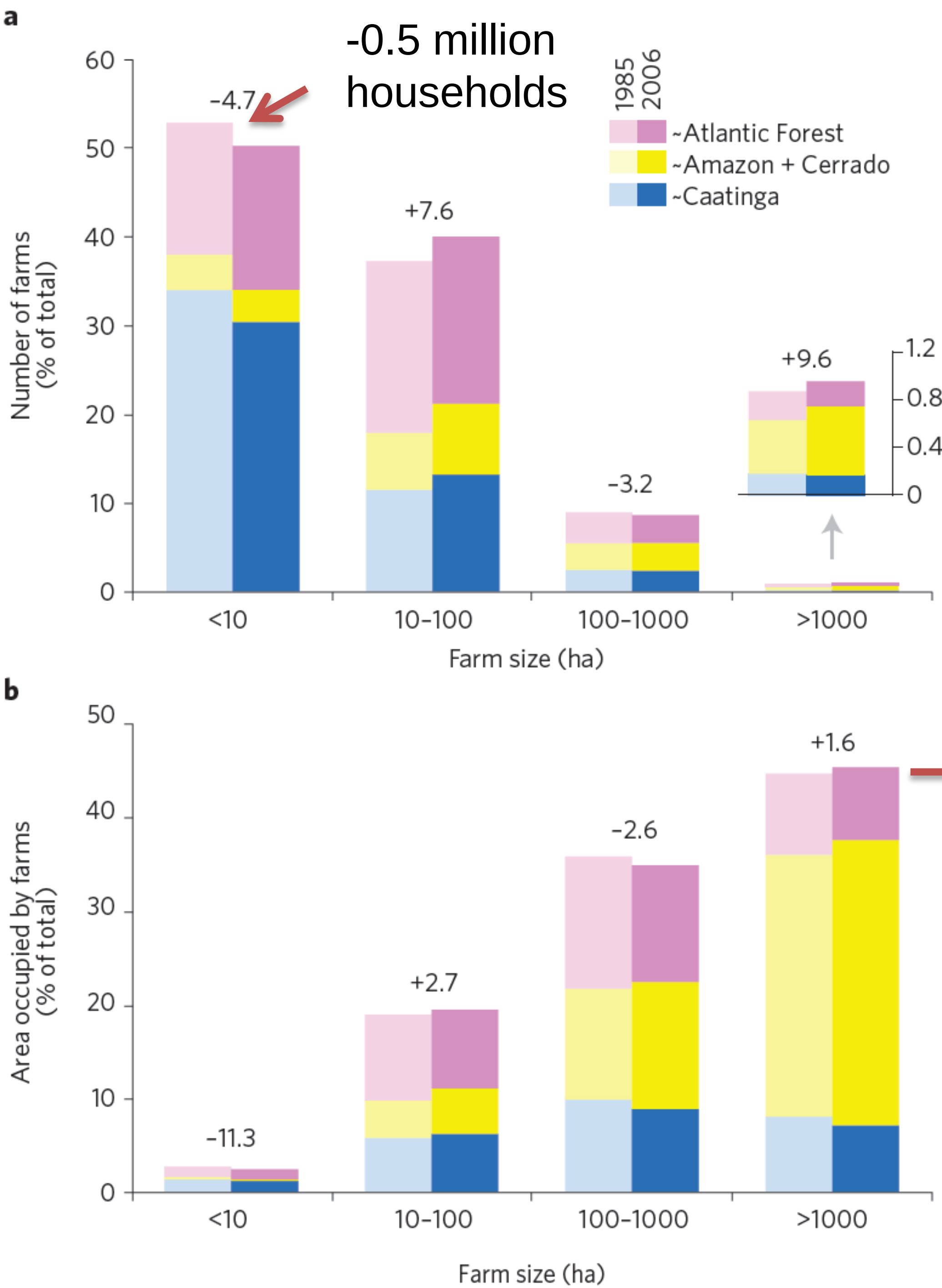
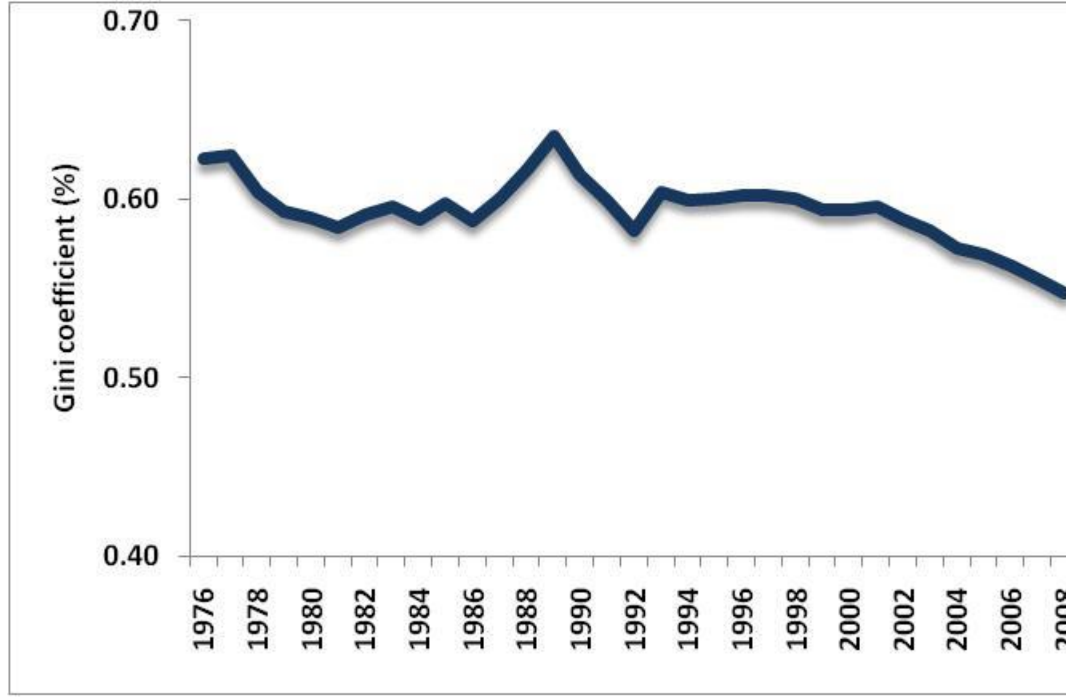


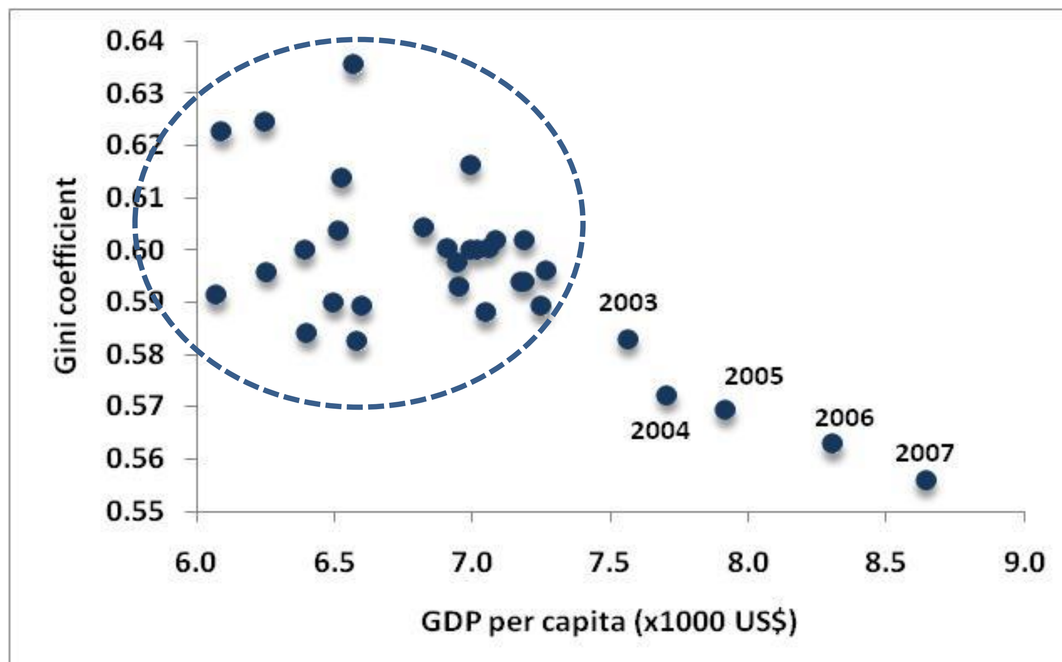
+170 thousand km²

Overseas Development Institute

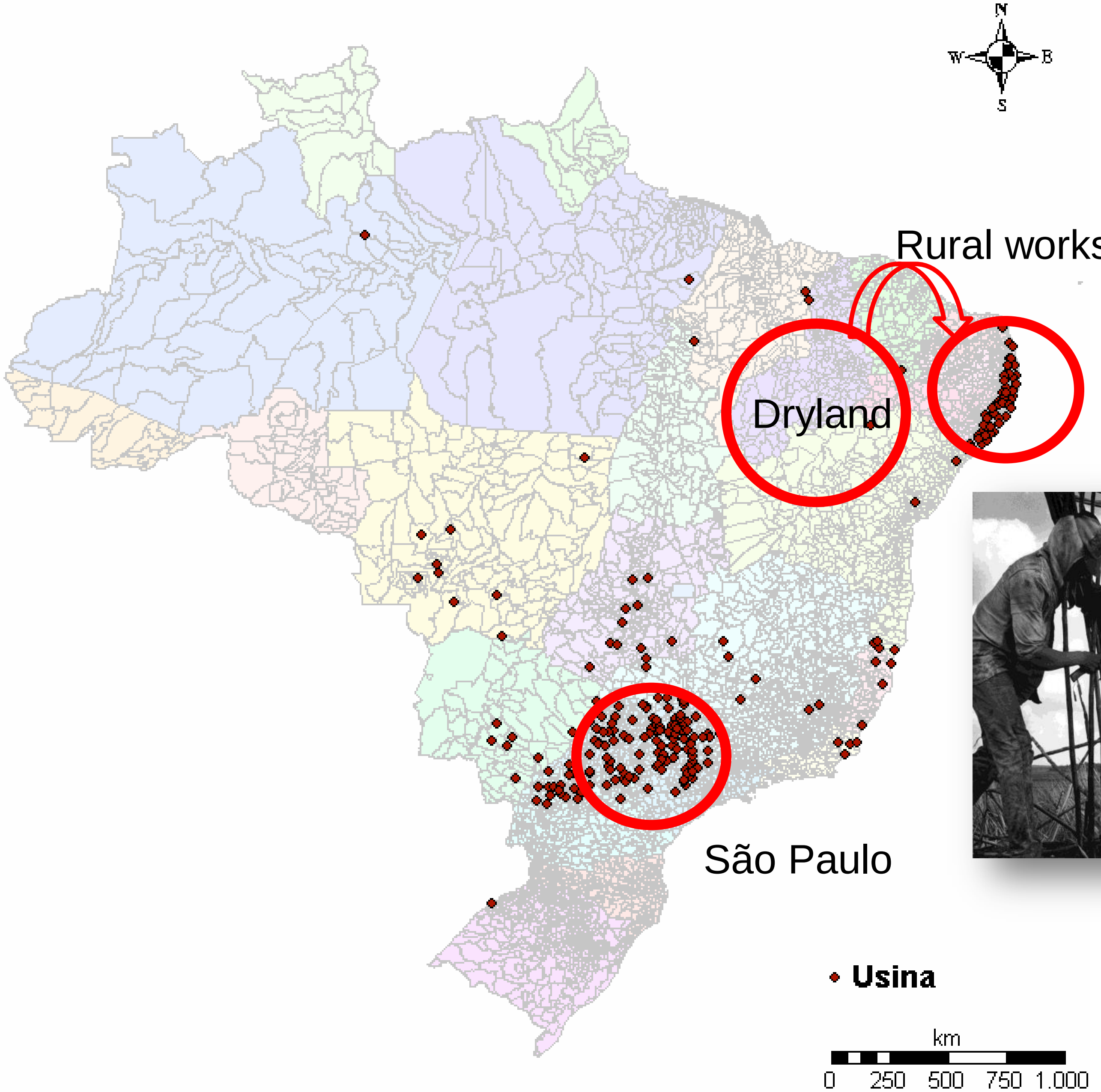
Harry Jones

Equity should be at the very heart of development. Instead, it is often seen as less relevant than other issues such as efficiency, economic growth, conflict and cohesion. Equity is low on the agenda for many governments in the developing world,





IPEADATA (www.ipeadata.gov.br)


N
W
B
S
Rural works
Northeast
Dryland
São Paulo
Usina
km
0 250 500 750 1.000

Ten countries with largest annual net loss of forest area, 1990–2010

Country	Annual change 1990–2000		Country	Annual change 2000–2010	
	1 000 ha/yr	%		1 000 ha/yr	%
Brazil	-2 890	-0.51	Brazil	-2 642	-0.49
Indonesia	-1 914	-1.75	Australia	-562	-0.37
Sudan	-589	-0.80	Indonesia	-498	-0.51
Myanmar	-435	-1.17	Nigeria	-410	-3.67
Nigeria	-410	-2.68	United Republic of Tanzania	-403	-1.13
United Republic of Tanzania	-403	-1.02	Zimbabwe	-327	-1.88
Mexico	-354	-0.52	Democratic Republic of the Congo	-311	-0.20
Zimbabwe	-327	-1.58	Myanmar	-310	-0.93
Democratic Republic of the Congo	-311	-0.20	Bolivia (Plurinational State of)	-290	-0.49
Argentina	-293	-0.88	Venezuela (Bolivarian Republic of)	-288	-0.60
Total	**-7 926**	**-0.71**	**Total**	**-6 040**	**-0.53**

Ten countries with largest annual net gain in forest area, 1990–2010

Country	Annual change 1990–2000		Country	Annual change 2000–2010	
	1 000 ha/yr	%		1 000 ha/yr	%
China	1 986	1.20	China	2 986	1.57
United States of America	386	0.13	United States of America	383	0.13
Spain	317	2.09	India	304	0.46
Viet Nam	236	2.28	Viet Nam	207	1.64
India	145	0.22	Turkey	119	1.11
France	82	0.55	Spain	119	0.68
Italy	78	0.98	Sweden	81	0.29
Chile	57	0.37	Italy	78	0.90
Finland	57	0.26	Norway	76	0.79
Philippines	55	0.80	France	60	0.38
Total	**3 399**	**0.55**	**Total**	**4 414**	**0.67**

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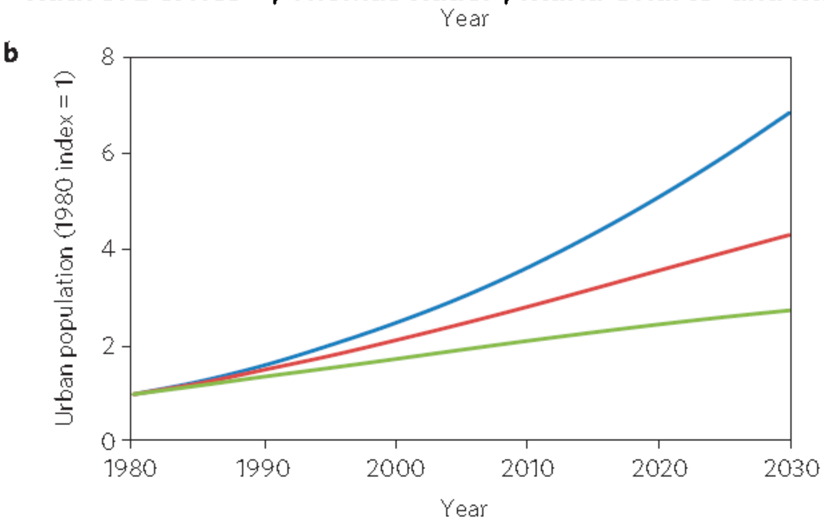
LETTERS
PUBLISHED ONLINE: 7 FEBRUARY 2010 | DOI: 10.1038/NGEO756
nature geoscience

Deforestation driven by urban population growth and agricultural trade in the twenty-first century

Ruth S. DeFries[1]*, Thomas Rudel[2], Maria Uriarte[1] and Matthew Hansen[3]



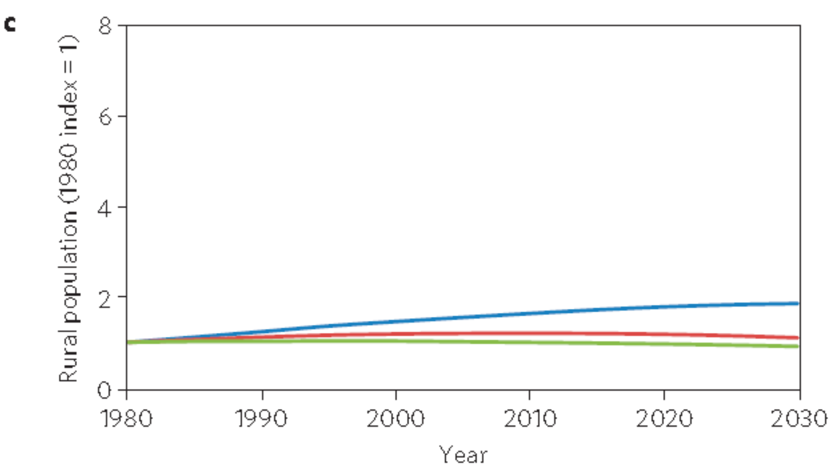
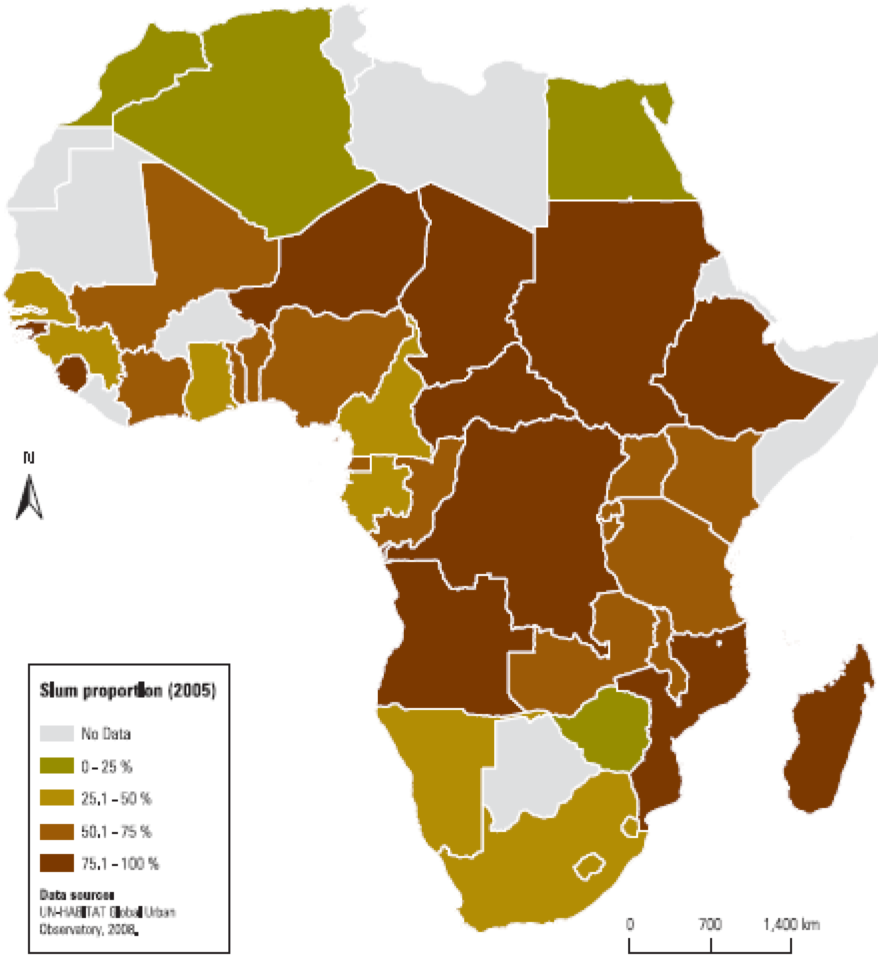


Table 1 | Results of ordinary least-squares regression for annual forest loss for 2000–2005 (ref. 2).

Variable	Coefficient
Intercept	0.031 (0.003)*
Annual urban growth rate (2000–2005)	0.016 (0.004)*
Total annual growth rate (2000–2005)	−0.010 (0.004)[†]
Net agricultural trade per capita (2003–2004)	0.008 (0.003)*
% of agricultural production exported	0.007 (0.004)[‡]
R^2	0.52
Adjusted R^2	0.47*

THE STATE OF AFRICAN CITIES 2008



GLOBAL HEALTH

Urbanization — An Emerging Humanitarian Disaster

Ronak B. Patel, M.D., M.P.H., and Thomas F. Burke, M.D.

Childhood Death Rates in Japan versus Rural and Urban Regions of Kenya.*

Location	Infant Mortality	Mortality among Children <5 Yr of Age
	no. of deaths/1000	
Japan	4	5
Kenya		
Nationwide	74	112
Rural	76	113
Urban (excluding Nairobi)	57	84
Nairobi (Kenyan capital)	39	62
High-income area	<10	<15
Informal settlements	91	151

The Giant Anteater in the Room: Brazil's Neglected Tropical Diseases Problem

Peter J. Hotez*

Sabin Vaccine Institute and Department of Microbiology, Immunology, and Tropical Medicine, George Washington University Medical Center, Washington, D. C., United States of America

Table 1. Burden of Neglected Tropical Diseases in Brazil

Disease	Percentage of Latin America's Disease Burden that Occurs in Brazil	Estimated No. Cases in Brazil	Reference
Blinding trachoma	97%	1.06 million	[6]
Leprosy	93%	44,436 new cases (2006)	[7]
Schistosomiasis	83%	1.5 million	[8]
Visceral leishmaniasis	67%	3,386 (2004)	[9]
Hookworm infection	65%	32.3 million	[10]
Dengue	63%	346,471 reported cases (2006)	[11]
Ascariasis	50%	41.7 million	[10]
Cutaneous leishmaniasis	46%	28,375 (2004)	[9]
Trichuriasis	19%	18.9 million	[10]
Lymphatic filariasis	8%	60,000	[12]
Onchocerciasis	2%	9,000 at risk	[2]
Leptospirosis	Not determined	Not determined	[13]

doi:10.1371/journal.pntd.0000177.t001

MARIELY H. B. DANIEL, ALEXANDRA A. MONTEBELO, MARCELO C. BERNARDES, JEAN P. H. B. OMETTO, PLINIO B. DE CAMARGO, ALEX V. KRUSCHE, MARIA V. BALLESTER, REYNALDO L. VICTORIA and LUIZ A. MARTINELLI*

Water, Air, and Soil Pollution **136:** 189–206, 2002.

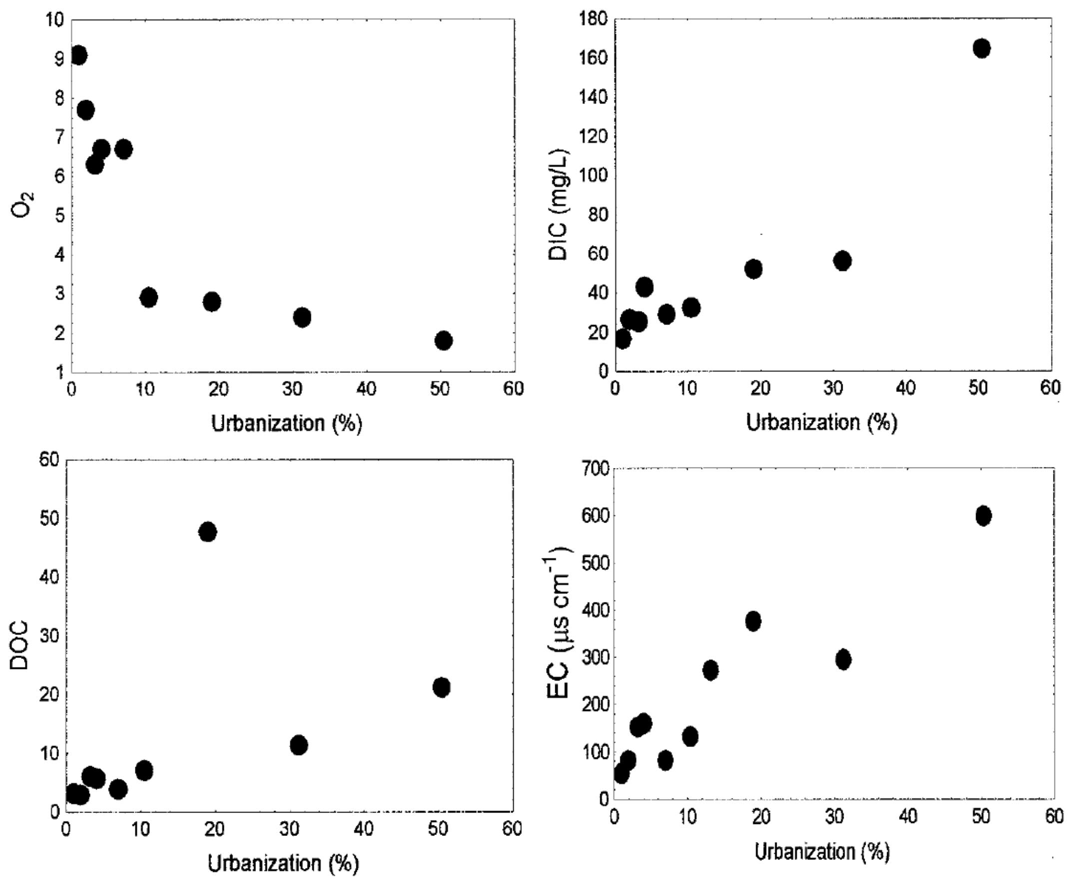
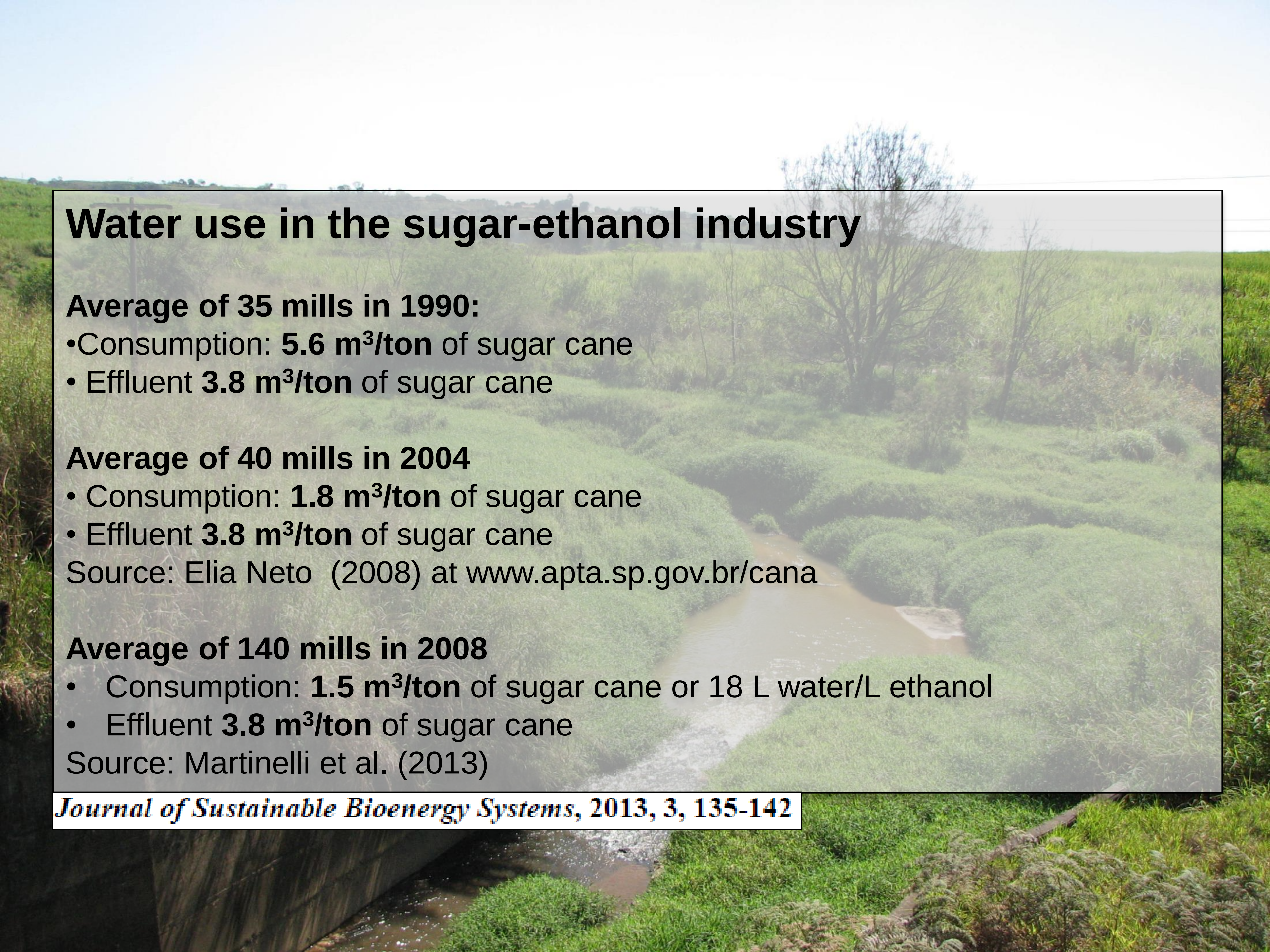


Figure 6. Relation between percentile of urbanized area versus O_2, DIC, DOC, and EC for each sampled stream.

Food vs Fuel

(Amigum et al., 2011; Hazell et al., 2013)

- Most of the Southern African countries are net importers of food.
- Many Africans spend more than 50% of their income on food.
- Positive benefits in household security with income increases.
- Balance between food security and bussiness agenda.



Water use in the sugar-ethanol industry

Average of 35 mills in 1990:

•Consumption: **5.6 m^3/ton** of sugar cane

• Effluent **3.8 m^3/ton** of sugar cane

Average of 40 mills in 2004

• Consumption: **1.8 m^3/ton** of sugar cane

• Effluent **3.8 m^3/ton** of sugar cane

Source: Elia Neto (2008) at www.apta.sp.gov.br/cana

Average of 140 mills in 2008

- Consumption: **1.5 m^3/ton** of sugar cane or 18 L water/L ethanol
- Effluent **3.8 m^3/ton** of sugar cane

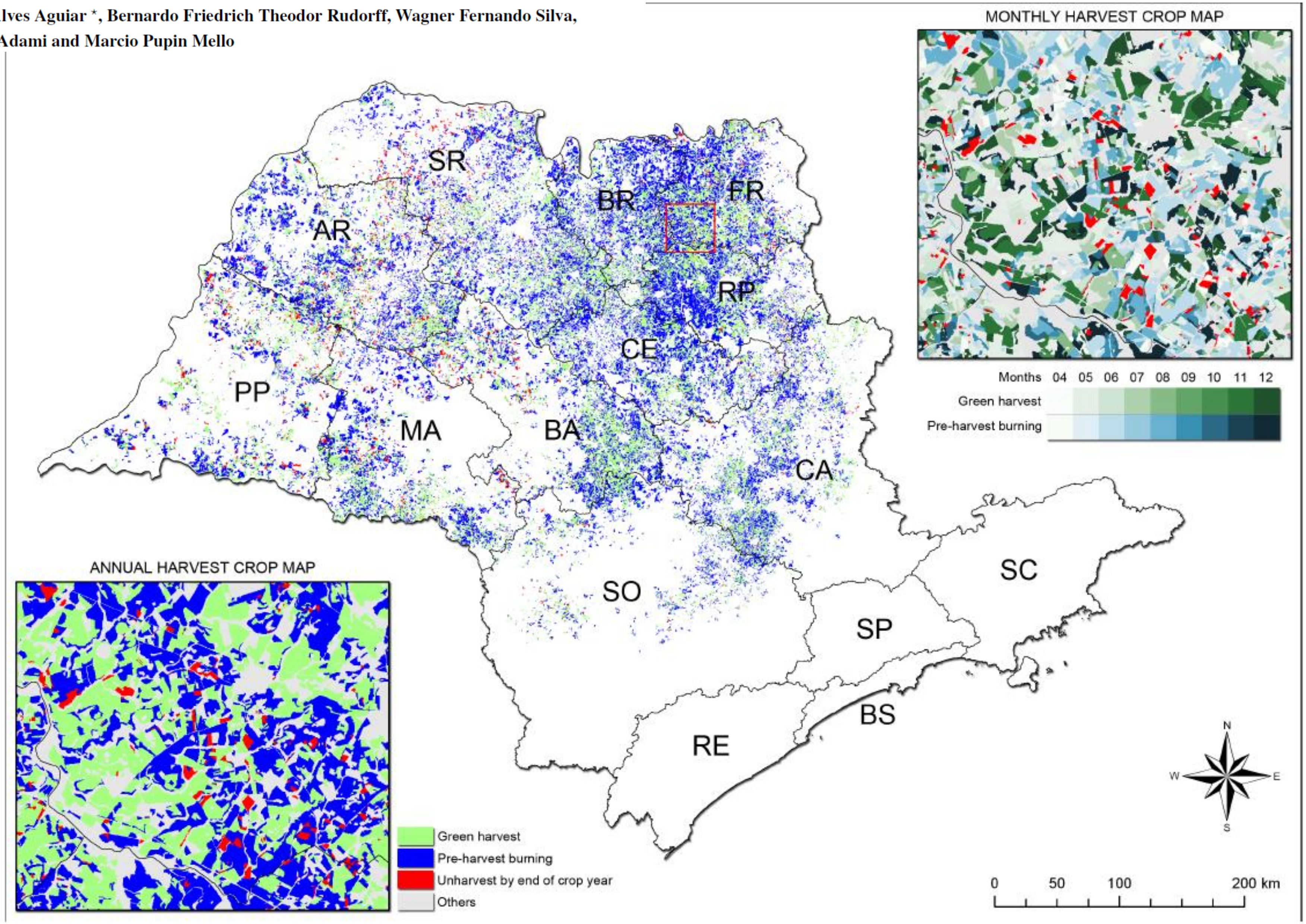
Source: Martinelli et al. (2013)

Journal of Sustainable Bioenergy Systems, 2013, 3, 135-142

Sugar cane burning

Remote Sens. **2011**, *3*, 2682-2703; doi:10.3390/rs3122682

Daniel Alves Aguiar *, Bernardo Friedrich Theodor Rudorff, Wagner Fernando Silva, Marcos Adami and Marcio Pupin Mello

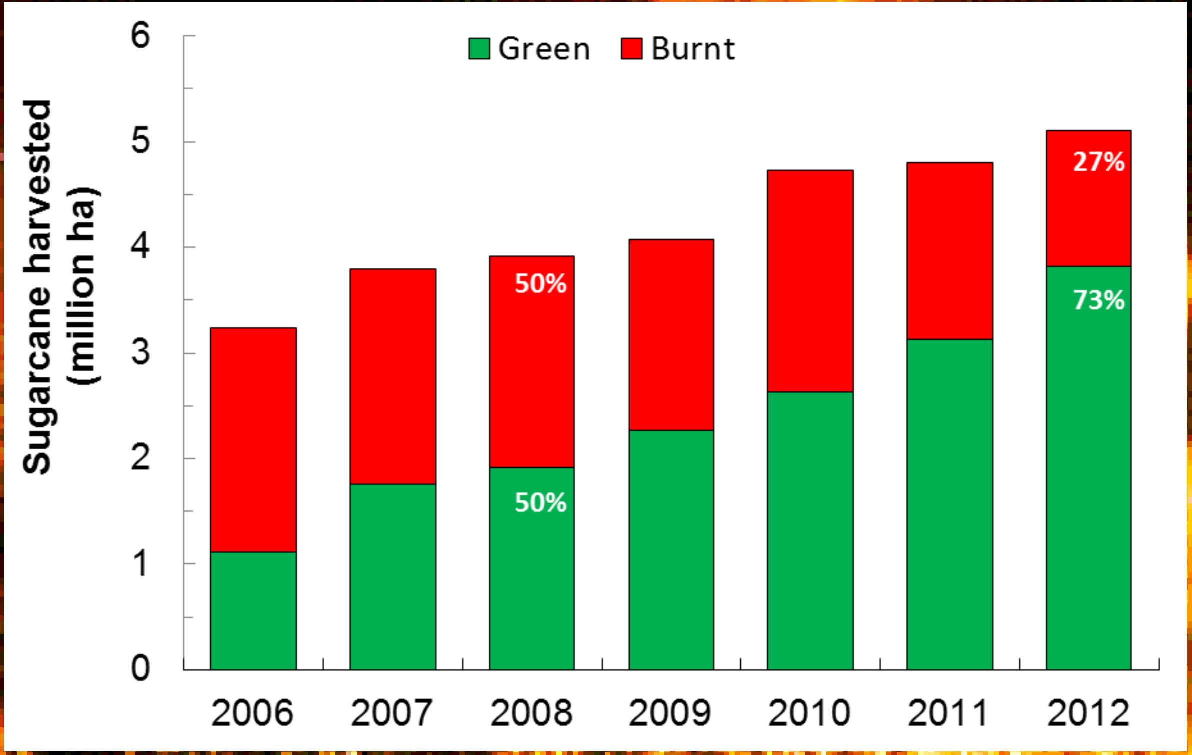


Remote Sensing Images in Support of Environmental Protocol: Monitoring the Sugarcane Harvest in São Paulo State, Brazil

Daniel Alves Aguiar *, Bernardo Friedrich Theodor Rudorff, Wagner Fernando Silva, Marcos Adami and Marcio Pupin Mello

www.drs.inpe.br/canasat/colheita.html

Remote Sens. **2011**, *3*, 2682-2703; doi:10.3390/rs3122682



Sugar cane burning: Atmospheric pollution and health effects

Atmospheric pollution: Lara et al. (2001); Martinelli et al. (2002); Oliveira et al. (2012)

Respiratory diseases: Cançado et al. (2006); Riguera et al. (2011); Goto et al. (2011);
Prado et al. (2012)

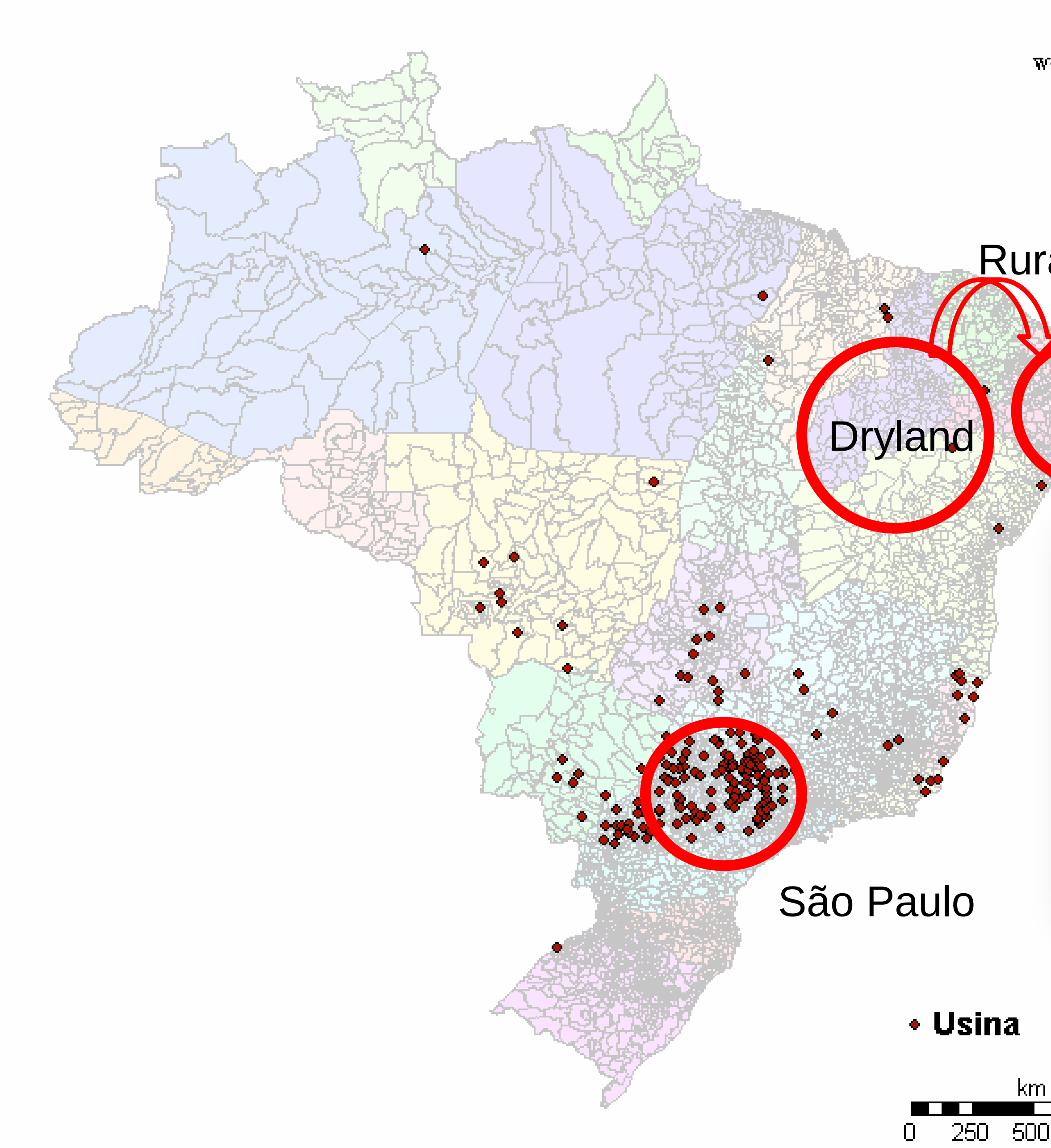
Hipertension: Arbex et al. (2010)

Cardiovascular effects: Barbosa et al. (2011)

Cancer risk increase: Polycyclic Aromatic Hydrocarbons (PAH) - Magalhães et al. (2007), Andrade et al. (2010); Particulate matter – Silva et al. (2010)

Mutagenicity – Umbuzeiro et al. (2008)





N
W
B
S
Rural works
Northeast
Dryland
São Paulo
Usina
km
0
250
500
750
1.000

Falta algo sobre uso da água