

# Ethanol Summit 2011



## Uso da terra, Segurança Alimentar e o Futuro dos Biocombustíveis

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→ [www.iconebrasil.org.br](http://www.iconebrasil.org.br)

# Cropland and Pasture Areas by Different Regions and Biomes of the World

Area in million km2	Forest		Savanna/Grassland		Shrubland		Other Land		Total	
	Cropland	Pasture	Cropland	Pasture	Cropland	Pasture	Cropland	Pasture	Cropland	Pasture
North America	1.03	0.71	1.55	1.42	0.16	1.2	0	0	2.74	3.33
South America	0.37	1.51	<b>0.45</b>	<b>2.26</b>	0.25	0.43	0.01	0.12	<b>1.08</b>	<b>4.32</b>
Africa	0.54	1.11	1.64	4.99	0.44	2.12	0.05	0.98	<b>2.67</b>	<b>9.2</b>
Europe	0.99	0.55	0.12	0.04	0.17	0.06	0	0	1.28	0.65
Former Soviet Union	0.75	0.39	1.24	2.02	0.09	0.83	0.02	0.19	2.1	3.43
Asia	3.33	0.87	0.63	1.84	0.66	0.79	0.09	0.84	4.71	4.34
Pacific developed	0.11	0.07	0.13	1.16	0.17	1.62	0	0	0.41	2.85
<b>Total above</b>	<b>7.12</b>	<b>5.21</b>	<b>5.76</b>	<b>13.73</b>	<b>1.94</b>	<b>7.05</b>	<b>0.17</b>	<b>2.13</b>	<b>14.99</b>	<b>28.12</b>

	Share on Forest (%)		Share on Savanna/Grassland (%)		Share on Shrubland (%)		Share on Other land (%)	
	Cropland	Pasture	Cropland	Pasture	Cropland	Pasture	Cropland	Pasture
North America	38%	21%	57%	43%	6%	36%	0%	0%
South America	34%	35%	<b>42%</b>	<b>52%</b>	23%	10%	1%	3%
Africa	20%	12%	<b>61%</b>	<b>54%</b>	16%	23%	2%	11%
Europe	<b>77%</b>	<b>85%</b>	9%	6%	13%	9%	0%	0%
Former Soviet Union	36%	11%	59%	59%	4%	24%	1%	6%
Asia	<b>71%</b>	20%	13%	42%	14%	18%	2%	19%
Pacific developed	27%	2%	32%	41%	41%	57%	0%	0%
<b>Total</b>	<b>47%</b>	<b>19%</b>	<b>38%</b>	<b>49%</b>	<b>13%</b>	<b>25%</b>	<b>1%</b>	<b>8%</b>

Source: Ramankutty, N.; Evan, A. T.; Monfreda, C.; Foley, J. 2008. Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000. Global Biogeochemical Cycles, vol. 22, gb1003.

# 2030 and 2050 Agricultural Production (FAO/UN)

	2000	2009	2019	2030	2050	09/00	19/09	30/19	50/30
<b>Production (million tons)</b>						<b>Annual Growth Rate</b>			
	<b>World</b>								
<b>Beef</b>	59,603	65,080	74,639	87,480	104,648	1.0%	1.4%	1.4%	0.9%
<b>Pork</b>	89,176	105,088	126,651	154,838	167,707	1.8%	1.9%	1.8%	0.4%
<b>Chicken</b>	69,455	92,630	117,849	143,329	193,043	3.2%	2.4%	1.8%	1.5%
<b>Sugar</b>	132,872	161,475	200,076	256,749	295,187	2.2%	2.1%	2.3%	0.7%
<b>Rice</b>	406,091	456,807	521,701	543,183	565,328	1.3%	1.3%	0.4%	0.2%
<b>Coarse grains</b>	876,249	1,112,022	1,311,084	1,439,291	1,687,949	2.6%	1.6%	0.8%	0.8%
<b>Oilseeds</b>	302,544	407,909	495,298	582,055	799,536	3.3%	1.9%	1.5%	1.6%
<b>Exports (million tons)</b>						<b>Annual Growth Rate</b>			
	<b>World</b>								
<b>Beef</b>	7,260	8,831	10,268	12,155	14,540	2.2%	1.5%	1.5%	0.9%
<b>Pork</b>	3,484	5,979	6,993	8,531	9,240	6.0%	1.6%	1.8%	0.4%
<b>Chicken</b>	6,807	10,342	13,175	15,897	21,410	4.6%	2.4%	1.7%	1.5%
<b>Sugar</b>	40,481	53,601	64,744	73,010	92,722	3.1%	1.9%	1.1%	1.2%
<b>Rice</b>	24,126	30,454	38,304	39,605	41,220	2.6%	2.3%	0.3%	0.2%
<b>Coarse grains</b>	110,645	116,659	138,791	150,558	176,569	0.6%	1.7%	0.7%	0.8%
<b>Oilseeds</b>	65,133	93,776	112,306	173,295	243,935	4.0%	1.8%	3.9%	1.7%

**Future of production growth is not larger than growth in the past  
Larger share of supply will come more from exports**

# 2030 and 2050 Area (1,000 ha, FAO/UN)

	2000	2009	2019	2030	2050	09/00	19/09	30/19	50/30	
	Area (1,000 hectares)					Growth (% per year or hectare per year)				
	Mundo									
Rice	153,951	155,981	163,105	159,305	147,608	0.1%	0.4%	-0.2%	-0.4%	
Coarse grains	301,655	318,238	338,450	342,965	347,740	0.6%	0.6%	0.1%	0.1%	
Oilseeds	178,632	210,384	228,193	240,479	270,961	1.8%	0.8%	0.5%	0.6%	
Total	634,238	684,603	729,748	742,749	766,309	5,596	4,515	1,182	1,178	
Growth over 2009			45,145	58,146	81,706					

	2009 => 2050
Actual	81,706
Equal to 2009-2000	229,440
Equal to 2019-2000	185,095

Current use	
Pastures	2,812,000
Crops	1,490,000

Potencial availability	Total Area	Area <6 hours	Area >6 hours
Sub-Saharan Africa	201,761	94,919	106,844
Latin America and Caribbean	123,342	93,957	29,387
Eastern Europe and Central Asia	51,136	43,734	7,400
East and South Asia	14,769	3,320	11,450
Middle East and North Africa	2,716	2,647	71
Rest of World	52,134	24,554	27,575
<b>World</b>	<b>445,858</b>	<b>263,131</b>	<b>182,727</b>

#### Source:

- <http://www.iconebrasil.org.br/pt/?actA=7&arealD=7&sec aolD=23&artigoID=2199>
- Ramankutty, N.; Evan, A. T.; Monfreda, C.; Foley, J. 2008. Farming the planet: 1. Geographic distribution of global agricultural lands in the year 2000. Global Biogeochemical Cycles, vol. 22, gb1003.
- The World Bank (2010). Rising Global Interest in Farmland: Can It Yield Sustainable and Equitable Benefits?.

# Harvested Area (million ha)

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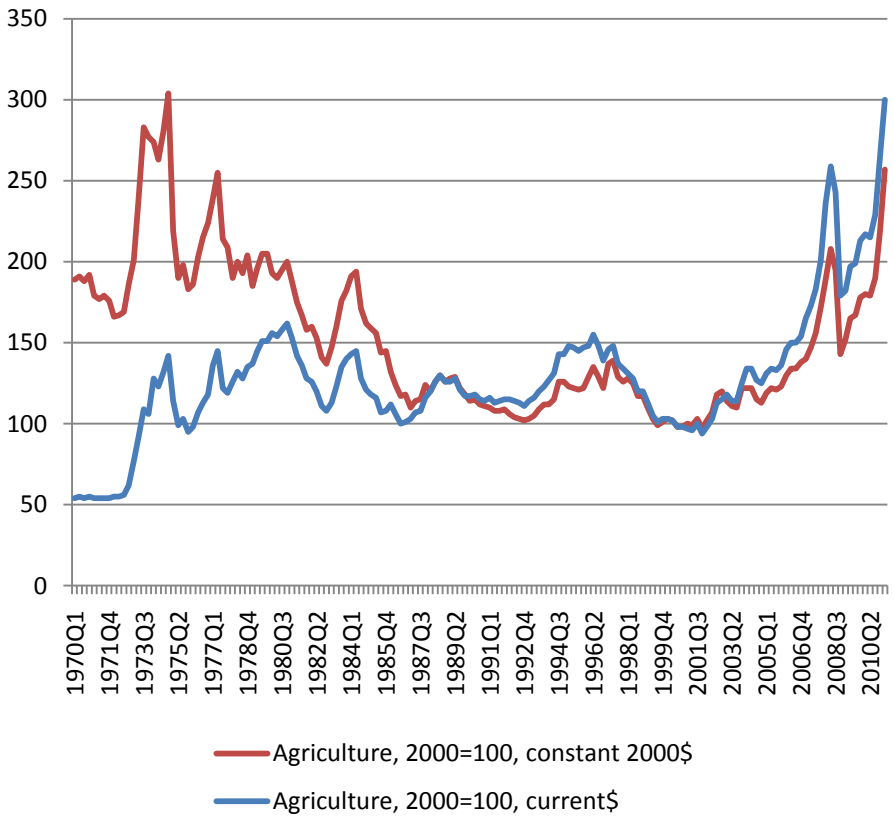
**Table 3. Crop-Harvested Area and Yield of Major Crop Groups by Region**

Area, million ha	Africa	Asia	Europe and Former USSR	Latin America	Middle East	North America	Oceania	GLOBAL
Cereals	79.4	272.2	133.7	36.9	28.3	88.3	17.6	656.5
Oil crops	19.6	69.5	22.1	29.8	2.2	39.5	1.7	184.5
Forage	3.7	12.2	70.5	8.6	2.0	37.2	1.4	135.7
Pulses	16.3	31.5	4.0	5.4	3.0	4.8	2.1	67.0
Roots and tubers	17.8	17.2	9.2	3.9	0.7	0.8	0.1	49.8
Fruit	8.4	18.2	9.6	5.9	2.9	2.5	0.3	47.8
Vegetables	4.4	27.9	5.5	1.7	2.0	2.1	0.1	43.8
Fiber	4.2	18.0	3.5	1.9	1.2	5.4	0.4	34.6
Sugar crops	1.4	9.7	4.3	8.0	0.6	1.6	0.5	26.2
Tree nuts	1.3	1.8	1.2	0.7	1.0	0.4	0.0	6.5
Other crops	9.2	19.1	0.5	7.3	0.6	1.2	0.0	37.9
<b>TOTAL</b>	<b>165.8</b>	<b>497.4</b>	<b>264.1</b>	<b>110.3</b>	<b>44.5</b>	<b>183.7</b>	<b>24.4</b>	<b>1,290.3</b>
Yield, tons/ha/harvest								
Cereals	1.3	3.4	3.0	3.0	2.0	4.7	2.0	3.1
Oil crops	1.4	3.1	1.7	2.6	1.5	2.3	1.7	2.4
Forage	22.0	15.7	14.5	20.9	22.7	19.9	17.2	17.6
Pulses	0.5	0.7	2.1	0.8	0.8	1.3	1.1	1.1
Roots and tubers	8.2	16.2	15.1	12.1	21.0	35.1	26.5	17.7
Fruit	6.9	9.2	7.8	14.2	10.2	18.3	15.2	10.5
Vegetables	9.8	16.5	18.1	14.2	23.0	23.4	21.7	17.1
Fiber	0.9	1.6	2.0	1.6	3.2	1.9	3.8	1.7
Sugar crops	60.7	60.6	38.1	65.4	40.0	65.9	81.8	56.8
Tree nuts	0.6	1.2	0.9	0.3	1.4	2.7	2.1	1.2
Other crops	0.6	1.1	2.5	0.8	1.1	1.0	1.1	1.3
<b>TOTAL</b>	<b>3.4</b>	<b>5.8</b>	<b>7.4</b>	<b>9.6</b>	<b>5.1</b>	<b>8.2</b>	<b>4.7</b>	<b>6.7</b>

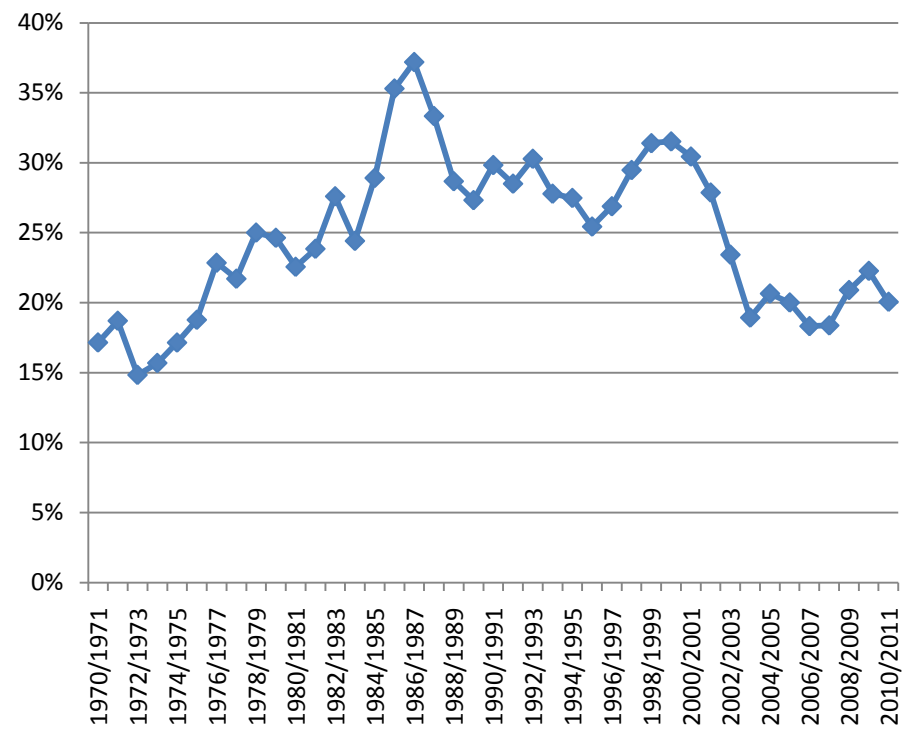
Source: Monfreda, C.; Ramankutty, N.; Foley, J. 2008. Farming the planet: 2. Geographic distribution of crop areas, yields, physiological types, and net primary production in the year 2000. *Global Biogeochemical Cycles*, vol. 22, gb1022.

# Prices and Stocks (1970 onward)

### Agricultural Commodities Price Index (real and nominal)



### Relação Estoque/Use (grãos e oleaginosas)



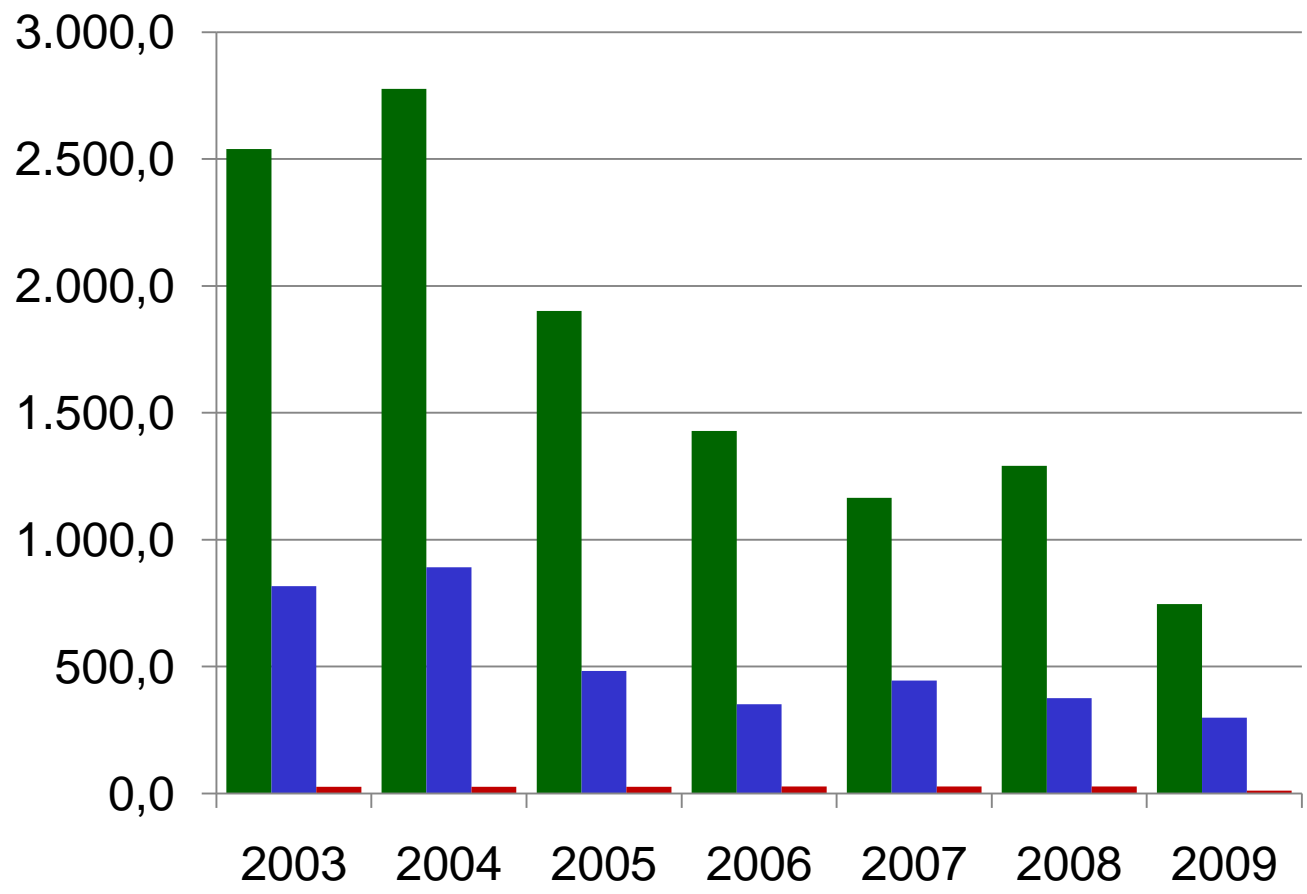
# Brazil: Land Use

Land Use	Area ( 1,000 ha)	Total/Brazil
National parks and indigenous reserves	175,020	21%
Remaining vegetation	369,396	43%
Pastures	182,336	21%
Annual crops	49,204	6%
Perennial crops	6,496	1%
Commercial forests	6,126	1%
Cities and water	35,352	4%
Other uses	27,558	3%
Total	851,488	100%

**Potencial de mitigação ligado a uso da terra**

# Accumulated Deforestation (1,000 hectares)

■ Amazon ■ Savanna ■ Atlantic Forest



Accumulated Deforestation (2002-2009, 1.000 hectares)	
Amazon (INPE/PRODES)	11,849
Savanna (LAPIG/UFG)	3,660
Savanna (IBAMA/MMA, 2008)	8,507
Atlantic Forest(INPE/SOS MA)	168

Source: LAPIG/UFG, PRODES/INPE, SOS Mata Atlântica, MMA

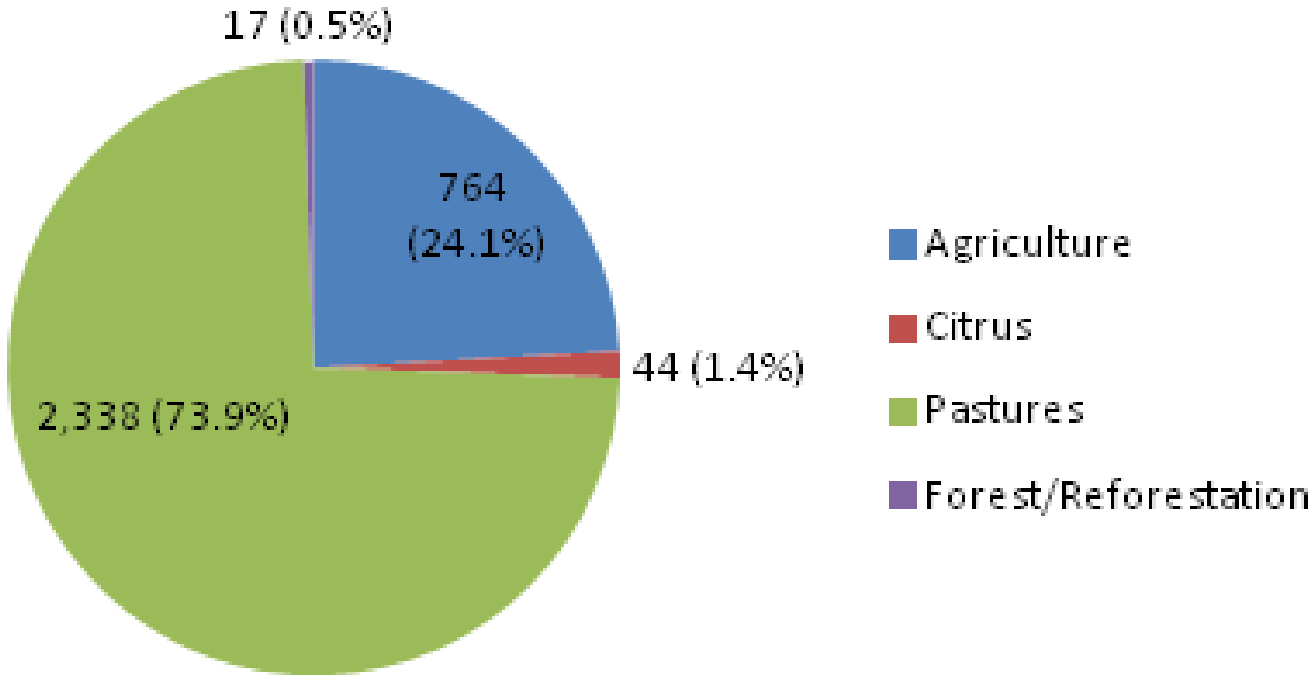


# Beef production in Brazil, “potential production” and reallocation effect

	Pasture Area 1000 ha		Beef Production 1000 tons (observed) (i)		Growth Rate (ii)	Production induced by world demand 1000 tons (iii)	Difference (based on 2008) 1000 tons (iv)	Implied area loss (v)	Additional area (vi)
	1996	2008	1996	2008	1996- 2008	1.05%	(i)-(iii)	(1000 ha)	(1000 ha)
South	20,697	15,784	1,034	1,147	1.52%	1,172	-25	-549	
Southeast	31,287	28,008	1,763	2,368	4.97%	1,998	370		-3,279
Center-West Cerrado	55,058	47,588	2,061	3,520	4.84%	2,336	1,184		-7,470
North Amazon	33,945	45,518	637	1,520	9.87%	722	798		11,573
Northeast Coast	9,878	10,711	357	375	1.53%	405	-30	-656	
Northeast Cerrado	33,277	32,533	335	835	9.86%	380	455		-744
Brazil (total)	184,141	180,143	6,187	9,765	5.34%	7,013	2,752	-1,205	80
							<b>Reallocation</b>		<b>-6.68%</b>

Source: ICONE.

## Types of Land Use Converted to Sugarcane from 2000 to 2009 (thousand ha and %)



**Source: personal communication with Bernardo Rudorff from CANASAT Project/INPE. This is an on going analysis and it cannot be quoted or cited without the authorization from the author.**

# Why the Debate on Land Use Change is Relevant for Agricultural Based Biofuels?

		Today	Future		
			Business as Usual	Additional Demand	Difference
Production	bi. Liters	30.0	60.0	80.0	20.0
	GJ	655,350,000	1,310,700,000	1,747,600,000	436,900,000
Area	mi. Ha	3.8	6.5	8.7	2.2

	LUC 1 (mi. Ha)	Emissions 1 (mi. T CO2e)		LUC 2 (mi. Ha)	Emissions 2 (mi. T CO2e)	
		Annual	Perennial		Annual	Perennial
Pastures	1.7 (80%)	201.0	-7.0	1.3 (60%)	150.8	-5.3
Cerrado	0.4 (20%)	443.3	130.5	0.5 (25%)	443.3	163.1
Amazon	0.0 (0%)	0.0	0.0	0.3 (15%)	255.8	200.8
<b>Total</b>	<b>2.2</b>	<b>644.3</b>	<b>123.5</b>	<b>2.2</b>	<b>849.9</b>	<b>358.7</b>
iLUC Factor (g CO2e/MJ)		49.2	9.4		64.8	27.4
Direct emissions (g CO2e/MJ)		12 a 24			12 a 24	
Kha/Mtoe (iLUC)	39.5			78.9		

Assumptions:

Emission period: 30 years

Yield gain: 15% between today and future (8000 to 9200 thousand liters per hectare)

Uptake: 18 T CO2e /ha on annual crops and 44 T CO2e/ha perennial crops.

# Land use change GHG emissions and ILUC factor associated to sugarcane expansion, 2005 to 2008

Emissions associated to LUC (Ton CO <sub>2</sub> eq)	-46,884
Emissions associated to ILUC (Ton CO <sub>2</sub> eq)	2,462,069
Total emissions (LUC + ILUC) (Ton CO <sub>2</sub> eq)	2,415,186
Additional ethanol production (Ton of total recoverable sugar)	Marginal=> 19,672,059
	Average => 47,221,695
Energy content of additional ethanol production (Giga Joule)	Marginal => 248,330,532
	Average => 596,556,316
ILUC factor (g CO <sub>2</sub> eq / MJ)	Marginal => 11.45
	Average => 4.8
Kha/Mtoe	25