INTERNATIONAL POTASH INSTITUTE

Fertbio 2006 Bonito MS

A BUSCA DAS RAÍZES

Embrapa

Symposium "Potash in Agricultural Systems of Tropical Savannas of South America: Adequate Fertilizing Practices in Areas with Poor Soils"

Tropical Savannas Regions in South America: Geography and Agricultural Development

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Bonito, MS – Brazil 2006

Optimizing Crop Nutrition

In Memoria of Leo Waibel

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- Fertilizers Use in Brazil and in South America

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PHYSICAL GEOGRAPHY

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Landscape Names for Savannas in South America

Savanna

- Non-forested plain in different parts of tropical America*
- Tropical and subtropical steppe with separate trees and bushes, mostly xerophytes**
- Taken from the language of the Caraibes: antipode of “forest”***

Campo

- Campo cerrado (cerrado), cerradão – savanna in Brazil*
- Area with grassland surrounded by forests in Brazil; savanna on plateaus****
- *“Brazilian Campos, as llanos and savannas in Guiana are not uniform… They represent park-like landscapes with undulating relieve, and different types of forest and grassland vegetation, last ones predominant”*****,
- **Campo cerrado** – grassland with bushes and sparsely forests******
- **Campo sujo** – grassland with separate trees (Portug. – “dirty field”) ******
- **Campo limpo** – grassland ******

Llano

- Open area, flat non-forested plain in northern parts of South America*

Pampa(s)

- Grasslands on the plains of temperate belt of South America, syn. of *prairies* of North America

<u>*Sources:*</u>

** Dudley Stamp, L. (ed.). 1961. A Glossary of Geographical Terms*

*** Webster Dictionary*

**** Waibel, L. Place Names as and Aid in the Reconstruction of the Original Vegetation of Cuba*

***** Oxford Dictionary*

****** Schrimper, A.F.W., 1903. Plant Geography*

****** James, P.1959. Latin America

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Savanna and Similar Landscapes Regions in South America

Country	Local Name of Region/Landscape	States/Provinces/Departments	% of Land Area
Colombia	*Llanos Orientales*	Meta, Arauca, Casanare, Vichada	29%
Venezuela	*Llanos del Orinoco*	Apure, Barinas, Portuguesa, Cojedes, Guárico, Anzoátegui, Monagas, Delta-Amacuro*	1/3
Brazil	*Campos, Campos cerrados (cerrados), Campos limpos*	Mato Grosso, Mato Grosso do Sul, Goiás, Tocantins, D.F., Bahia*, Maranhão*, Piauí*, Minas Gerais*, São Paulo*, Roraima*	24%
Bolivia	*Llanos*	Beni, Santa Cruz, Chuquisaca, Tarija	1/2
Paraguay	?	Amambay, Concepción, San Pedro, Canindeyú, Alto Paraná, Caaguazú, Cordillera, Guairá, Caazapá	1/4
Argentina	Región Norte (ex. Corrientes)	Santa Fé, Santiago del Estero, Chaco, Formoza, Córdoba* (*Chaco forests*); Corrientes (*Campos*)	XX

Note: * *(e.g. Bahia*) – savannas occupy smaller part of state/province/department*

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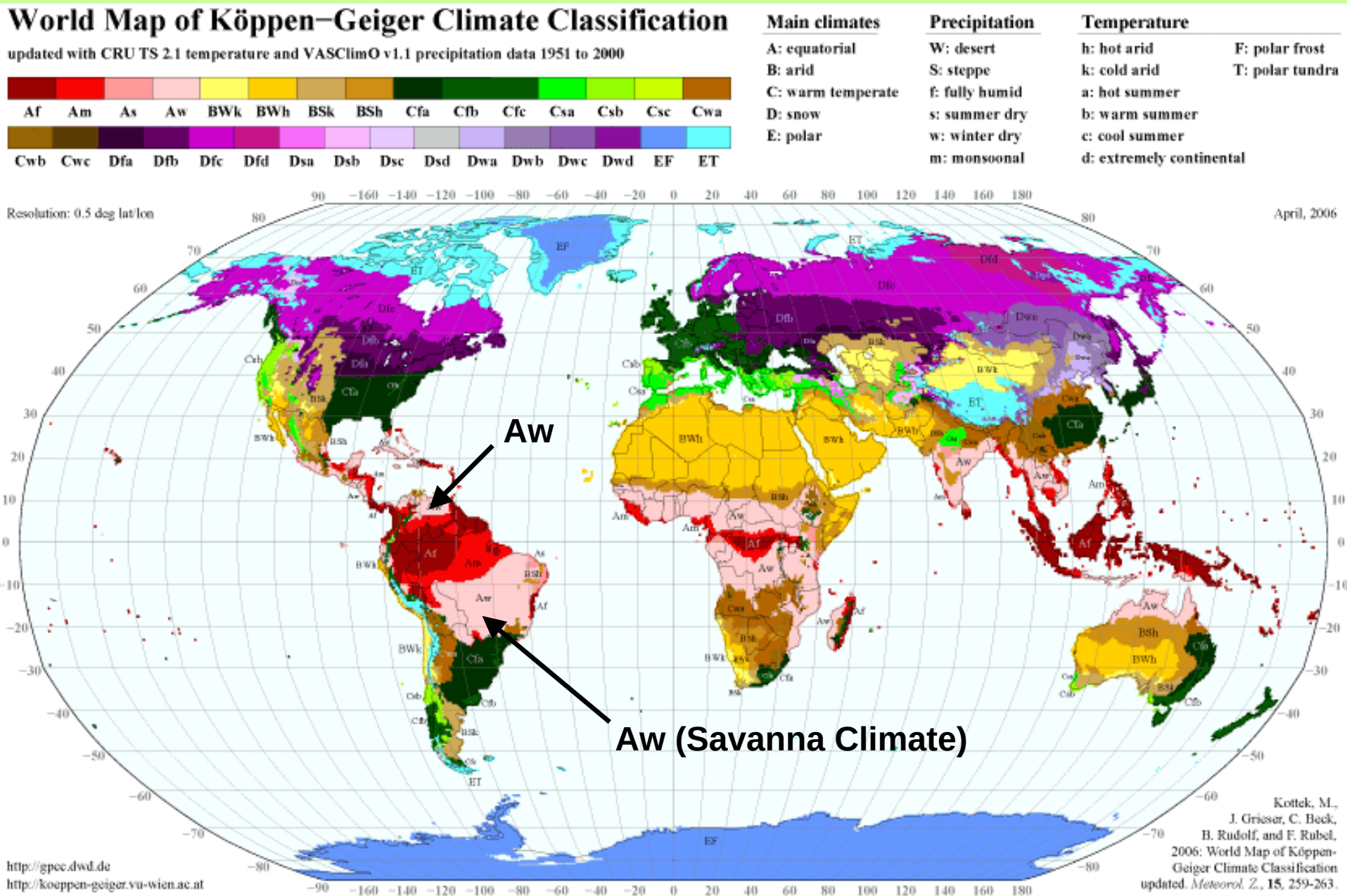
Climate


World Map of Köppen−Geiger Climate Classification
updated with CRU TS 2.1 temperature and VASClimO v1.1 precipitation data 1951 to 2000
Af Am As Aw BWk BWh BSk BSh Cfa Cfb Cfc Csa Csb Csc Cwa
Cwb Cwc Dfa Dfb Dfc Dfd Dsa Dsb Dsc Dsd Dwa Dwb Dwc Dwd EF ET
Main climates
A: equatorial
B: arid
C: warm temperate
D: snow
E: polar
Precipitation
W: desert
S: steppe
f: fully humid
s: summer dry
w: winter dry
m: monsoonal
Temperature
h: hot arid
k: cold arid
a: hot summer
b: warm summer
c: cool summer
d: extremely continental
F: polar frost
T: polar tundra
Resolution: 0.5 deg lat/lon
April, 2006
Aw
Aw (Savanna Climate)
http://gpcc.dwd.de
http://koeppen-geiger.vu-wien.ac.at
Kottek, M., J. Grieser, C. Beck, B. Rudolf, and F. Rubel, 2006: World Map of Köppen-Geiger Climate Classification updated. Meteorol. Z., 15, 259-263.

Meteorological Stations Geo-Reference

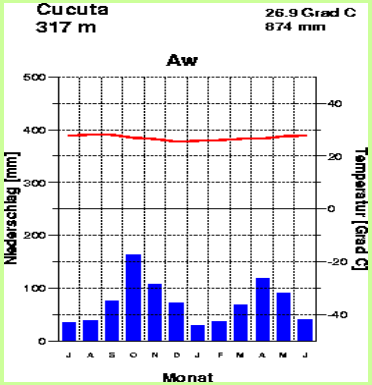
Aw (Savanna) climate

No	Station	Height	Coordinates	
Colombia				
1.	Cucuta	317 m	7°48'N	72°31'W
2.	Puerto Carreno	55 m	6°10'N	67°30'W
Venezuela				
3.	Ciudad Bolivar	48 m	8°09'N	63°33'W
Brazil				
4.	Brasilia	1158 m	15°47'S	47°56'W
5.	Cuiaba	179 m	15°33'S	56°07'W
6.	Campo Grande	560 m	20°28'S	54°40'W
7.	Corumba	170 m	19°00'S	57°39'W
Paraguay				
8.	Puerto Casado	87 m	22°17'S	57°52'W

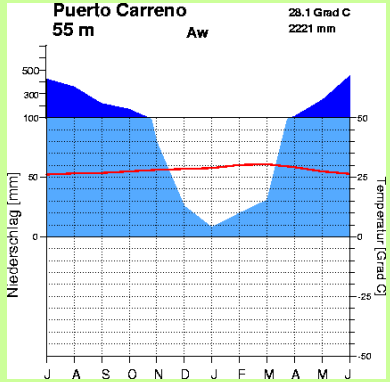
Bolivia				
9.	Santa Cruz	413 m	17°48'S	63°10'W

Cfa climate (Temperate with moderate moisture and hot summer)

Argentina				
10.	Resistencia	52 m	27°27'S	59°03'W
11.	Ceres	88 m	29°53'S	61°57'W



Colombia 1.



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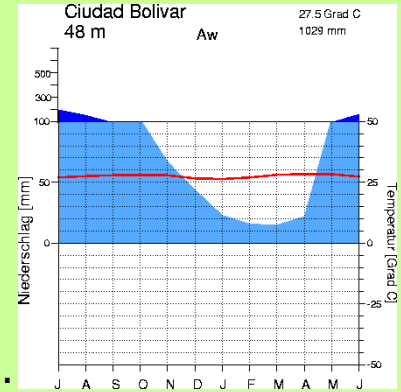
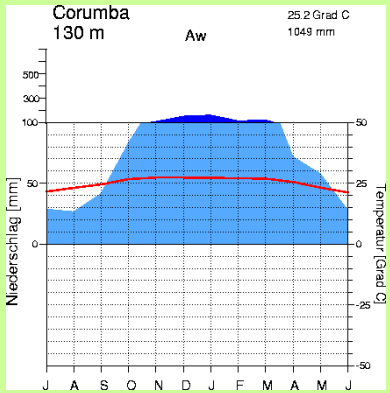


Venezuela 3.

Brazil



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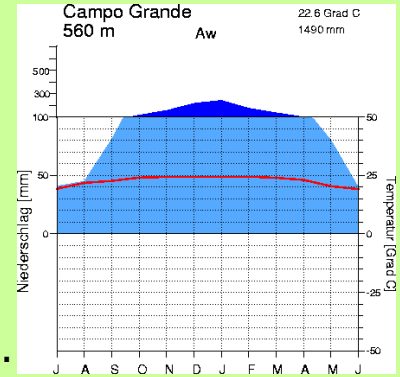

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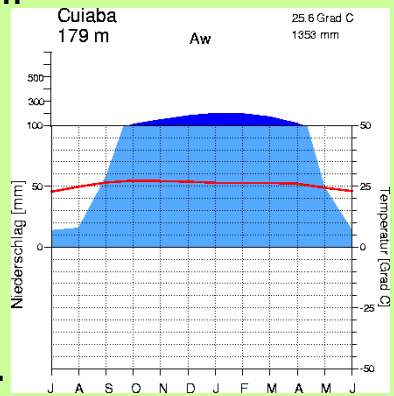

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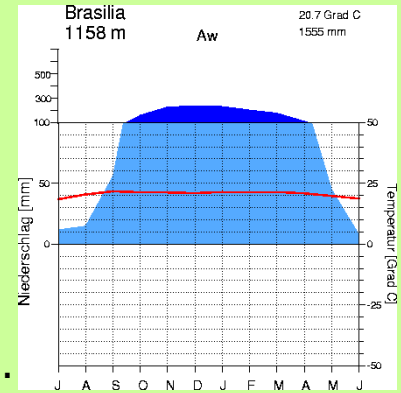

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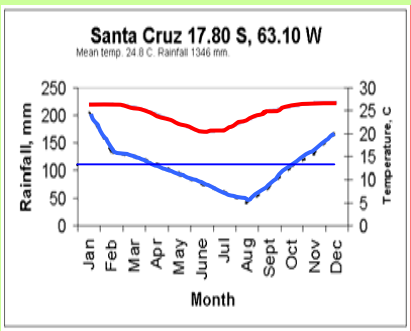

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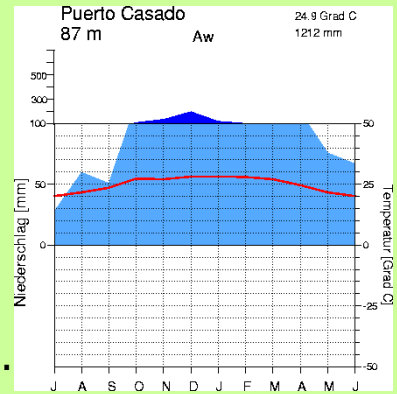

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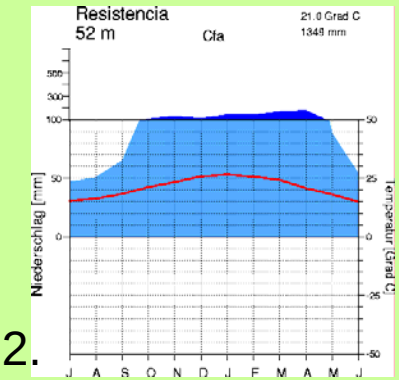

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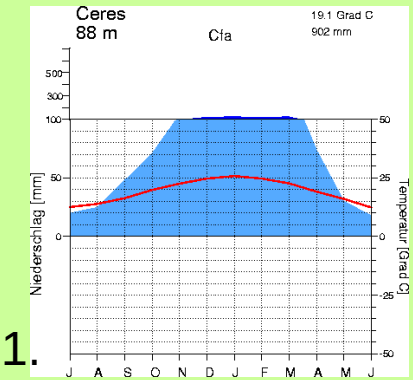

11.

Bolivia

Paraguay

Argentina

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Climate characteristics

- Hot, yearly average T > 20° C, monthly average T 18 – 28° C
- Annual precipitation > 1000 mm
- Wet season with rainfall 100 mm and more

  N. Hemisphere: Apr – Oct

  S. Hemisphere: Oct – March
- Dry season 3 – 4 months with precipitation 20 to 50 mm (depending on location)

Favorable conditions and limiting factors for agriculture

- Warm enough for rice, soybean, maize, cotton, sunflower, sorghum
- Wet enough – no irrigation needed for most grains and fibers

- Periodical draught (affects cover crops, planted during dry season in no-till systems)
- Excess of rainfall during growing season (facilitates diseases expansion as Asian rust and other fungi; causes problems for harvesting; enables lixiviation of nutrients)

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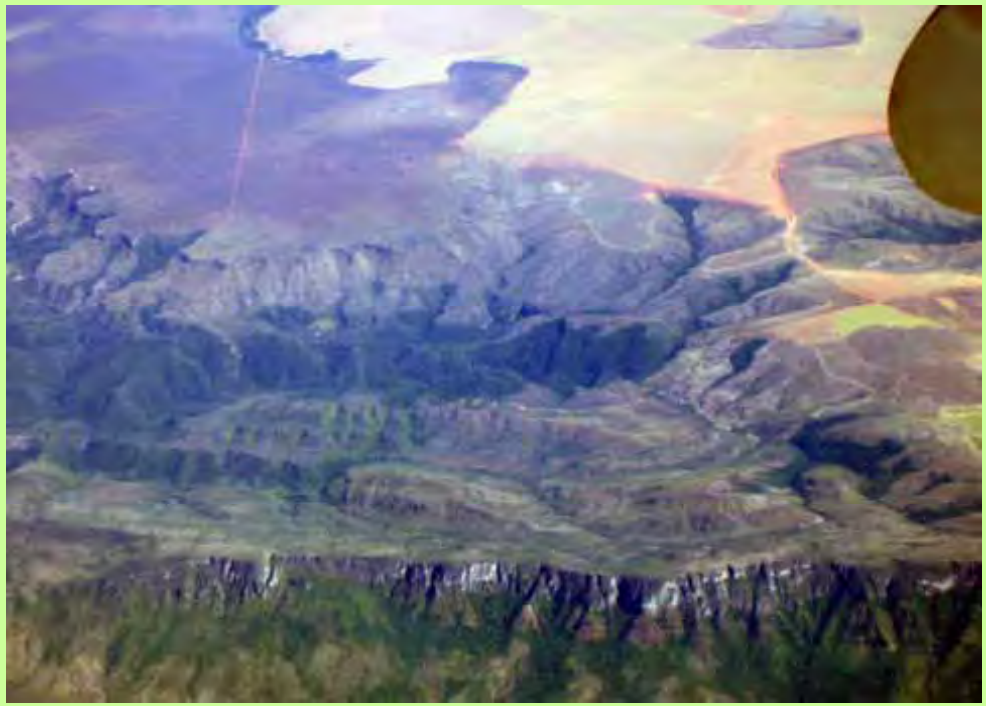
RELIEF

- Elevations between < 200 m and > 1500 m
- Alluvial plains with terraces (Venezuela, Colombia, Bolivia, Paraguay, parts of Brazil)
- Andean Piedmont with dejection cones and eolian plains (Venezuela, Colombia, Bolivia)
- Plateaus of the Brazilian and Guyana shields (Brazil, Venezuela, E. parts of Bolivia and Paraguay)

Favorable conditions and limiting factors for Agriculture:

- Mostly plain
- Erosion on slopes



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SOILS

- Mostly *Ferralsols* (FAO), or *Latossolos* (Brazil)
- Also *Acri/Luvisols* and *Arenosols* (FAO), or *Podzolicos* and *Areias Quartzosas* (Brazil)
- *Latossolos* (*L. vermelhos*) - upper part of the B layer Fe_2O_3 18-36%; B layer at 200 cm). Well developed,), well drained, CTC <17cmol$_c$/kg

Favorable conditions and limiting factors for Agriculture (only *Latossolos*):

- Good physical conditions (deep, well-developed, well-drained)
- Bad chemical characteristics (high acidity, contamination with Al and Fe)

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Source: Uso agricola dos solos brasileiros. EMBRAPA, 2002

Embrapa Solos

MAPA DE SOLOS DO BRASIL

LEGENDA

- AC - ALISSOLO CRÔMICO
- PA - ARGISSOLO AMARELO
- PAC - ARGISSOLO ACIZENTADO
- PV - ARGISSOLO VERMELHO
- PVA - ARGISSOLO VERMELHO-AMARELO
- CH - CAMBISSOLO HÚMICO
- CX - CAMBISSOLO HÁPLICO
- MT - CHERNOSSOLO ARGILÚVICO
- ME - CHERNOSSOLO EBÂNICO
- MX - CHERNOSSOLO HÁPLICO
- MD - CHERNOSSOLO RÊNDZICO
- EK - ESPODOSSOLO CÁRBICO
- ES - ESPODOSSOLO FERROCÁRBICO
- GX - GLEISSOLO HÁPLICO
- GZ - GLEISSOLO SÁLICO
- GJ - GLEISSOLO TIOMÓRFICO
- LA - LATOSSOLO AMARELO
- LB - LATOSSOLO BRUNO
- LV - LATOSSOLO VERMELHO
- LVA - LATOSSOLO VERMELHO-AMARELO
- TC - LUVISSOLO CRÔMICO
- TP - LUVISSOLO HIPOCRÔMICO
- RU - NEOSSOLO FLÚVICO
- RL - NEOSSOLO LITÓLICO
- RQ - NEOSSOLO QUARTZARÊNICO
- RR - NEOSSOLO REGOLÍTICO
- NX - NITOSSOLO HÁPLICO
- NV - NITOSSOLO VERMELHO
- FX - PLITOSSOLO HÁPLICO
- FF - PLINTOSSOLO PÉTRICO
- SG - PLANOSSOLO HIDROMÓRFICO
- SX - PLANOSSOLO HÁPLICO
- SN - PLANOSSOLO NÁTRICO
- VC - VERTISSOLO CROMADO
- VE - VERTISSOLO EBÂNICO
- VG - VERTISSOLO HIDROMÓRFICO

Soils of the Brazilian Cerrados

Sist. Braz	FAO	U.S.	S, km 2	%
Latossolos	Ferralsols	Oxisols	935870	46,0
Areias Quartzosas	Arenosols	Inceptisols	309715	15,2
Podzolicos	Acri/Luvisols	Ulti/Alfisols	307677	15,1
Litolicos	Lithosols	Entisols	148134	7,3
Plintossolos (Laterita Hidromorfica)	Luvi-Gleysols	Ox/Inceptisols	122664	6,0
Cambissolos	Cambisols	Inceptisols	61943	3,0
Concrecionarios	Acrisols	Ultisols-Oxisols	57460	2,8
Gleis	Gleysols	Inceptisols	40752	2,0
Terras Roxas	Nitosols	Alfisols	34231	1,7
Other			19154	0,9
TOTAL			**2037600**	**100**

Source: POTAFOS, 1989. Cultura da soja nos cerrados

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Land Use in Selected Countries of South America, 2003

Country	Land Area 1.000 Ha	Agricultural Area*		Arable Land		Permanent Crops		Permanent Pasture	
		1.000 Ha	% of LA	1.000 Ha	% of AA	1.000 Ha	% of AA	1.000 Ha	% of AA
Argentina	273.669	128.747	47,0	27.900	21,7	1.000	0,8	99.847	77,6
Bolivia	108.438	37.087	34,2	3.050	8,2	206	0,6	33.831	91,2
Brazil	845.942	263.600	31,2	59.000	22,4	7.600	2,9	197.000	74,7
Colombia	103.870	45.911	44,2	2.293	5,0	1.557	3,4	42.061	91,6
Guyana	19.685	1.740	8,8	480	27,6	30	1,7	1.230	70,7
Paraguay	39.730	24.836	62,5	3.040	12,2	96	0,4	21.700	87,4
Suriname	15.600	89	0,6	58	65,2	10	11,2	21	23,6
Venezuela	91.205	21.640	23,7	2.600	12,0	800	3,7	18.240	84,3
S.America	1.753.237	584.285	33,3	107.105	18,3	13.645	2,3	463.535	79,3

Note: * Agricultural area (AA) = Area planted with seasonal crops

Source: www.faostat.fao.org

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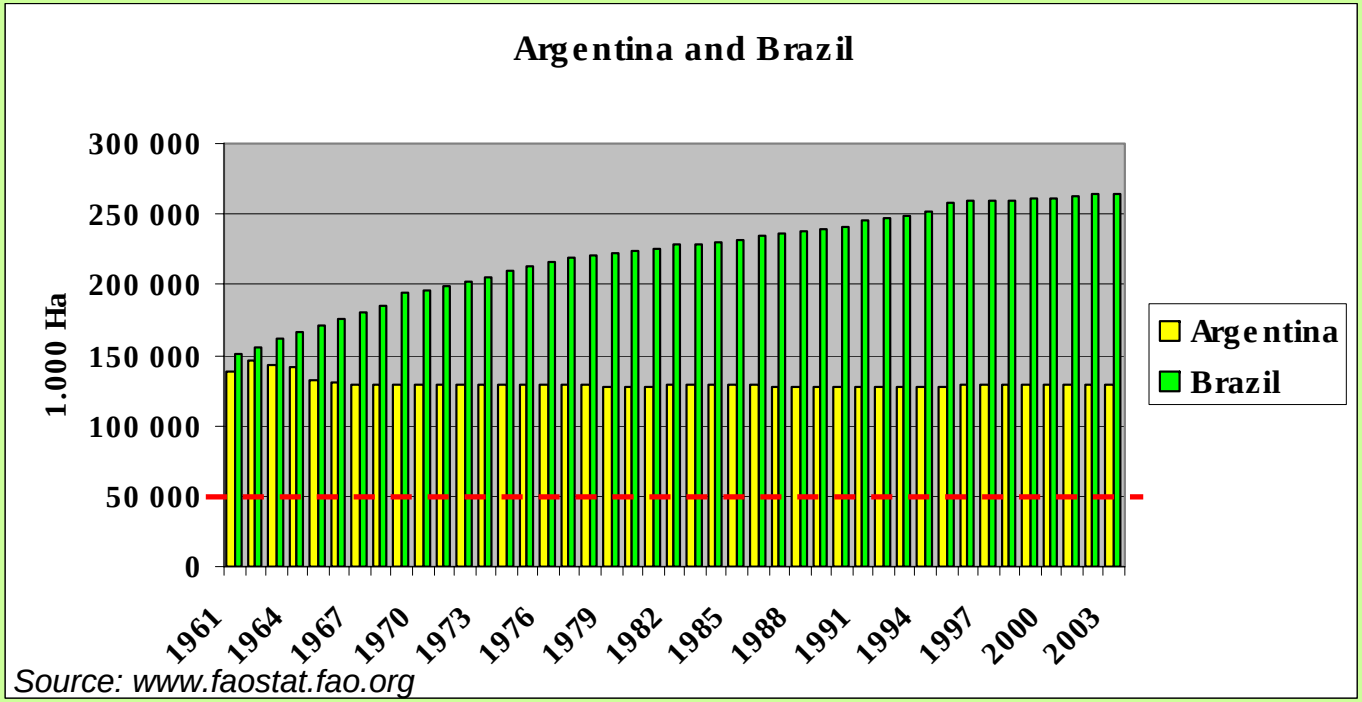
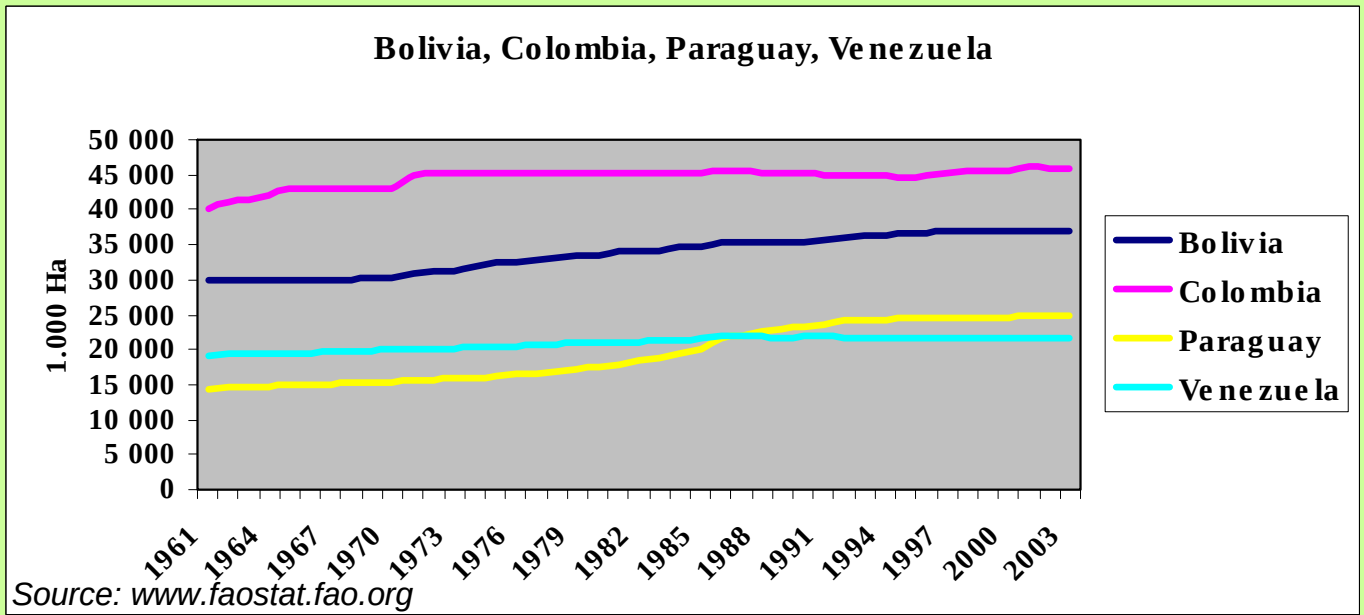
Agricultural Area Growth in Selected Countries of South America

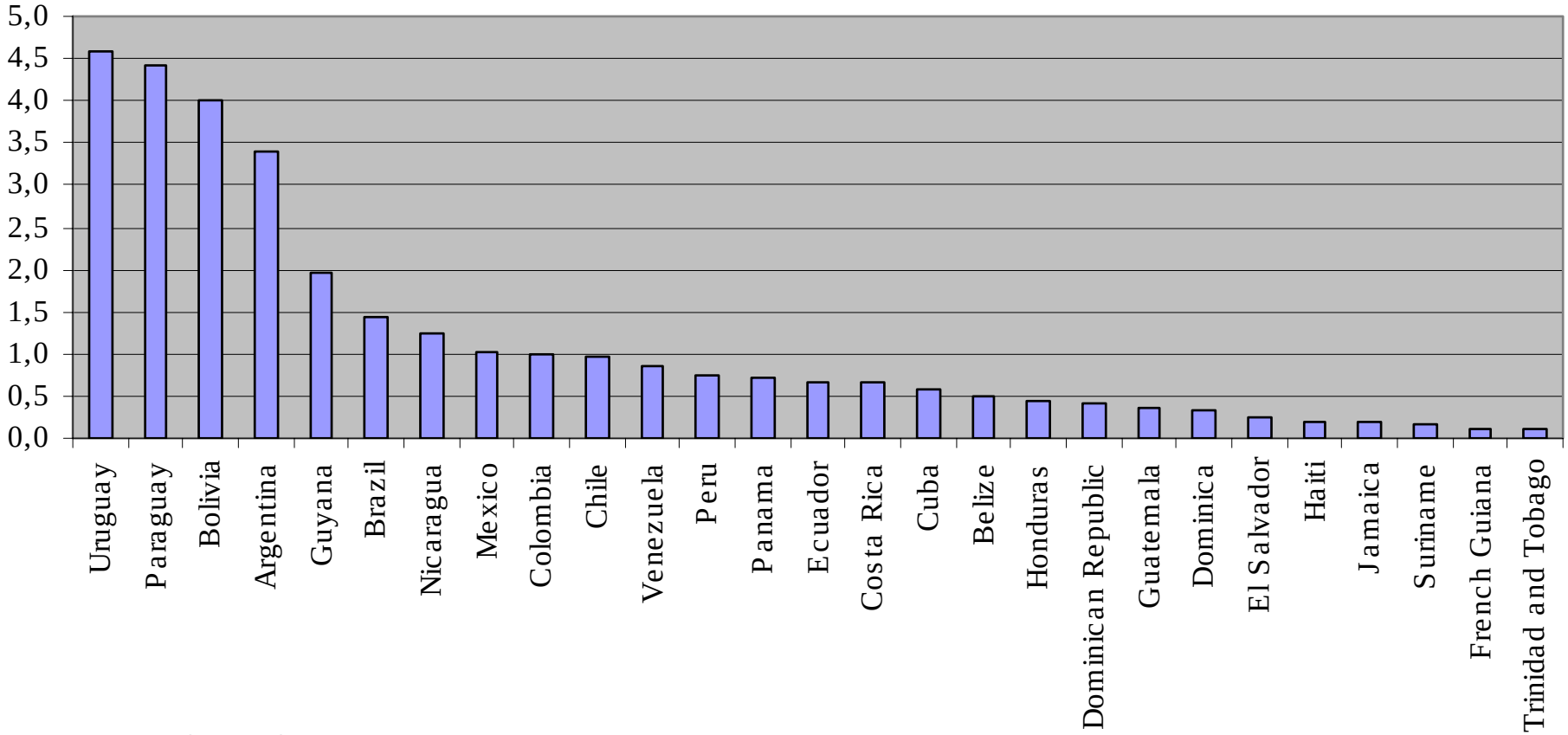


Source: www.faostat.fao.org



Source: www.faostat.fao.org

Agricultural Area (seasonal + permanent crops) per capita, Ha (2005)



Source: www.faostat.fao.org

Savannas: Main Reserve for Agricultural Colonization

Photo taken in Brazilian Cerrado in 2005

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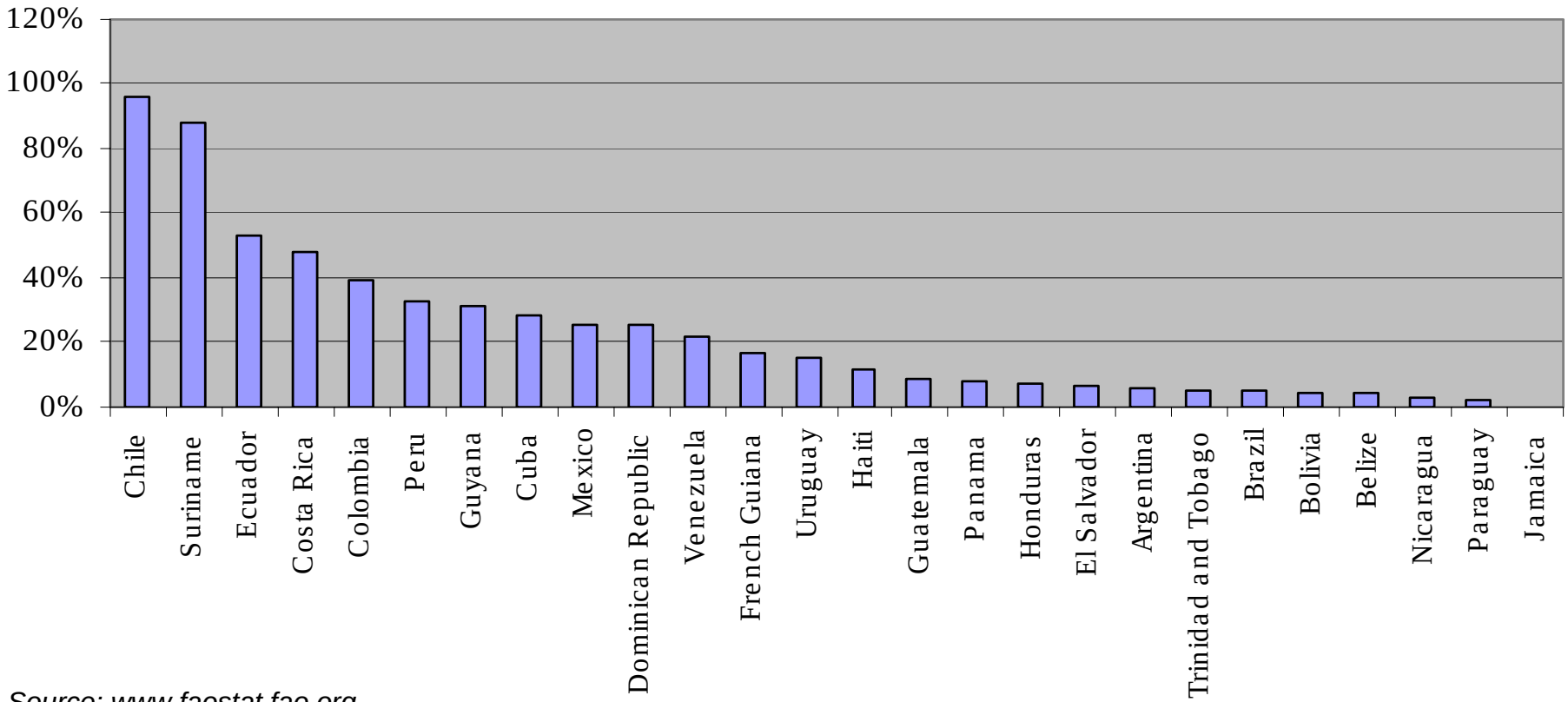
Share of Irrigated Land in The Total Agricultural Area (seasonal + permanent crops), % (2005)



Source: www.faostat.fao.org

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Irrigation: Tool for Widen Productive Areas in Dry Parts of Savannas

Photo taken in Brazilian Cerrado in 2004

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COLOMBIA

Major crops (2005)

- Rice 2.602.300 t
- Maize 1.441.501 t
- Cassava 2.125.163 t
- Plantain 3.400.000 t
- Sorghum 223.950 t
- Coffee 682.580 t
- Sugar cane 39.849.240 t
- Bananas 1.600.000 t
- Oil palm fruits 3.300.000 t

Soybeans 60.058 t

Fertilizers Consumption, t (2002)

N – 335.400
P – 135.900
K – 220.200

Source: www.faostat.fao.org

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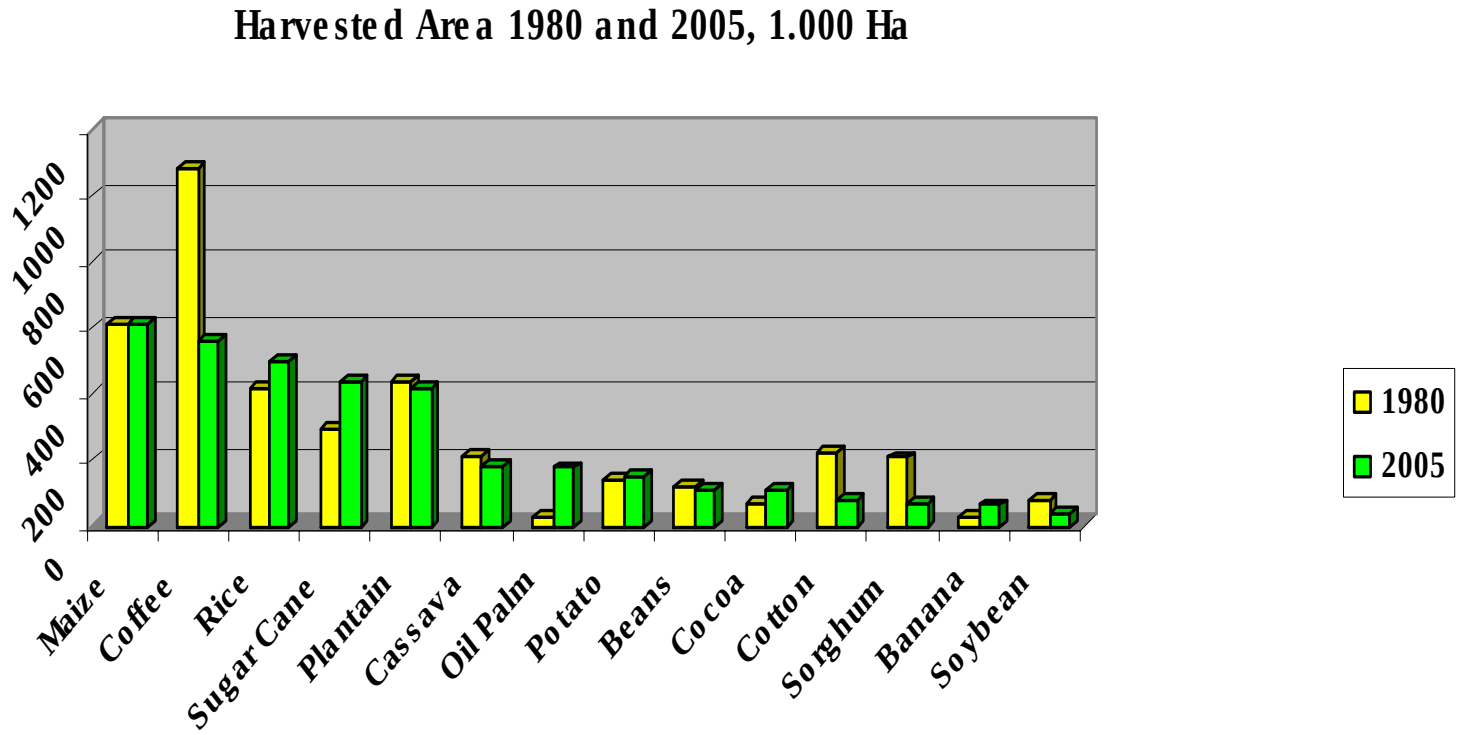
Dynamic of Major Crops Area in Colombia



Source: www.faostat.fao.org

- Monoculture of coffee, traditionally predominant in the Andes, is loosing ground.
- Only rice, sugar cane and oil palm area increased significantly.
- In the 1980s, seasonal commercial crops, planted in the valleys of Magdalena and Cauca rivers, expanded to the *Llanos Orientales* region.
- Road network enables development of agriculture in the piedmont area (2,5 hrs. from Villavicencio, capital of Meta, to Bogota), and on the frontier with Venezuela (bridge over Arauca river).

The Orinoquia Region of Colombia (*Llanos Orientales*)

329.146 km² (38% of the total area of Orinoco basin, 29% of Colombia); *Llanos* landscapes ~ **240.000 km²**; ~600.000 inhabitants (2/3 – Meta dpt.)

- **Meta** dpt.(85.635 km²), intendencias **Arauca** (km²) and **Casanare** (23.812 and 44.640 km²), comissarias **Vichada** and **Guaviare** (100.242 and 42.327 km²)

Soils

- N,P,K deficient, saturated by Al and Fe *("arecife"* layer).
- Piedmont: well-drained, sandy and clayey.
- Alluvial plains: suitable on low and medium terraces.

Erosion, other obstacles

- Wind erosion on elevations and eolian plains.
- Water erosion on high terraces and the *Serrania.*
- Seasonal inundations on lowlands.

Expansion of agriculture started in the 1960-70ˢ with conversion of pastures.

Major crops: rice, maize, cassava, sesame, plantain, coffee, oil palm.

Cattle husbandry > 5 million, ~ ½ in Meta dept.

Sources:
Guhl,E. 1976. Colombia: bosquejo de su geografia tropical. Vol. 1,2. Bogota
Kalmanovitz,S. 1982. El desarrollo de la agricultura en Colombia. Bogota

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Agro-Ecological Zones of the Orinoquia Region of Colombia

Source: Zonificacion agroecologica de Colombia. Bogota. Instituto geografico "Agustin Codazzi". 1985

Agro-Ecological Zones	Area, Ha	Relief	Soil Classes (IGAC)	Soil Fertility and Limits	% of total Colombia
Cg+Ch+Cj	2.050.375	Eolian plain	Psamments, Aquents	Low, erosion	1,8
Ck	86.350	Fringe of Guyana shield	Psamments, Orthents	Low	0,1
Co	2.225.975	Elevated plain	Ustox, Orthox, Tropepts, Orthents	Low, Al saturated	2,7
Cq	453.875	Elevated plain, flat	Aquox, Orthox	Low	0,4
Cr	681.600	Elevated plain, undulated, slopes to 12%	Ustox, Tropepets	Low, Al saturated, erosion	0,6
Cs	5.038.400	Elevated plain, fractioned, slopes to 50% ("Serrania")	Ustox, Orthox	Low, Al saturated, erosion	4,4
Kc	2.473.375	Alluvial valleys	Aquents, Aquepts	Low, inundations	6,4
Cm, Ke, Kd, Kf, Kg	4.179.175	Alluvial plains, inundated	Aquepts, Aquents, Aquults, Aqualfs, Fluvents, Tropepts	Low to medium, inundations	3,8
Kk	662.150	Alluvial plain of piedmont, slopes to 12%	Tropepts, Aquepts, Orthox, Udults	Low, rocky	0,8
Kh	531.775	Fringe of Amazon plain, slopes to 7%	Orthox, Udults, Tropepts	Low, Al saturated	8,6
Ki, Kj	1.059.800	Fringe of Guyana shield, slopes to 7%	Psamments, Orthox, Aquids, Aquods	Low, rocky	4,7
Kn	2.758.000	Elevated plain, undulated, slopes to 25%	Orthox, Tropepts	Low, Al saturated	10,8
Ku	208.875	Mountain ranges, piedmont, slopes to 50%	Tropepts, Orthents	Low, erosion	2,1
Other	687.000				
Total	**23.096.725**				

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COLOMBIA
Meta department
Meta river
Villavicencio
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Image © 2006 TerraMetrics
Google
Pointer 4°05'05.37" N 73°33'37.48" W elev 1209 ft
Streaming 100%
Eye alt 17.42 mi

VENEZUELA

Major crops (2005)

- Oil palm fruits – 315.000 t
- Citrus – 581.100 t
- Coconuts – 170.000 t
- Coffee – 70.000 t
- Maize – 2.050.000 t
- Rice – 950.000 t
- Cassava – 520.000 t

Soybeans – 3.100 t

Fertilizers Consumption, t (2002)

N – 190.000
P – 50.000
K – 60.000

Source: www.faostat.fao.org

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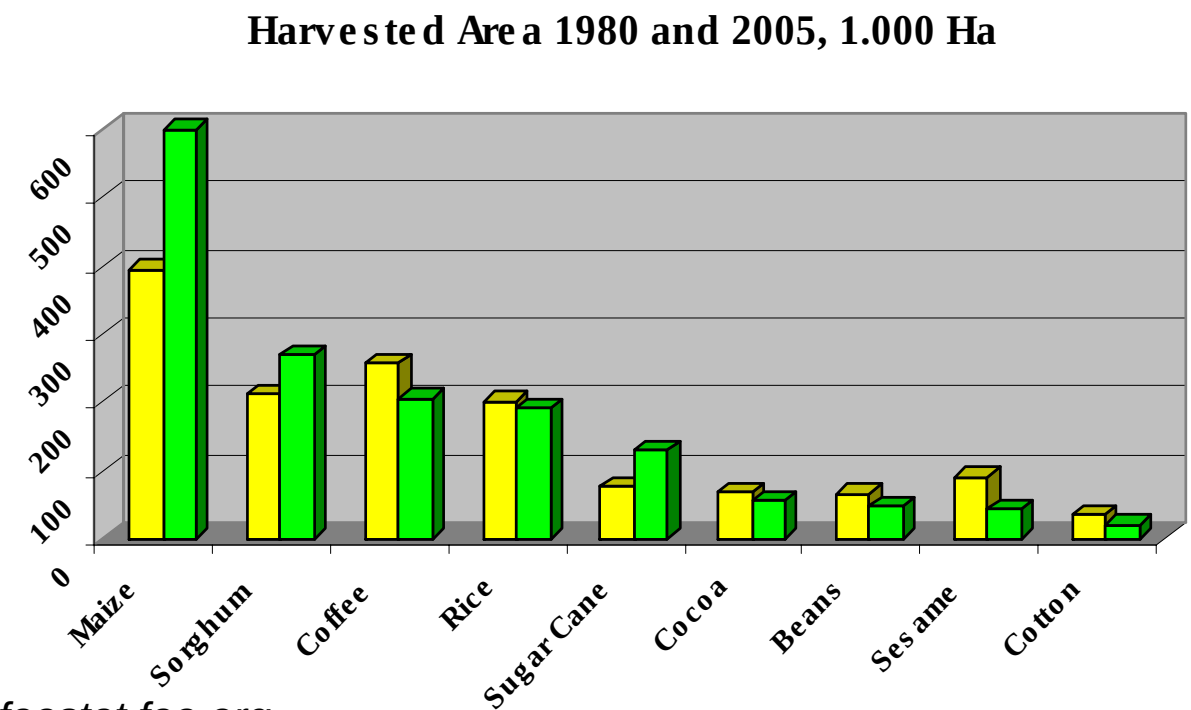
Dynamic of Major Crops Area in Venezuela



Source: www.faostat.fao.org

- Since oil boom, agriculture played secondary role in the national economy.
- Except coffee, most crops are grown for domestic consumption.
- Planted area oscillates depending of oil revenues; from 1.884.435 Ha in 1969-71 in 2 years it dropped 15%.
- In the 1970-80s Venezuela imported food from Colombia and Brazil.
- Since 1990s, expansion to the Llanos of Orinoco is forced; in 2005 planted area reached 21.640.000 Ha (because of maize, sorghum and sugarcane area growth).
- Agriculture seeks modernization, especially staple crops as maize and rice production.

The *Llanos del Orinoco* Region of Venezuela

319.086 km² (35% of Venezuela); 5.251.243 inhabitants

- **Apure** (76.500 km^2), **Barinas** (35.200 km^2), **Portuguesa** (15.200 km^2), **Cojedes** (14.800 km^2), **Guárico** (64.986 km^2), **Anzoátegui** (43.300 km^2), **Monagas** (28.900 km^2), **Delta-Amacuro** (40.200 km^2)

Relief

- Alluvial plains of the Llanos (max elevation 200 m).
- Elevated plains with the *mesas* plateaus.
- Fringe areas of Guyana shield.

Soils

- Red tropical (= Latosols), low fertile, but with suitable physical characteristics
- More fertile in the Western and Central parts.
- Low fertile in the Eastern part (sandy, with high acidity).
- Submitted to erosion and inundations.
- Expansion of agriculture in the Llanos started in the 1960^s after Agrarian Reform; agriculture developed in Western and Central parts, to the North of Apure and Orinoco.

Major crops: maize (40% of the nat. planted area; Guarico and Portuguesa – 1/3 of nat. harvest), sesame (100% area – Portuguesa), rice (90% Guarico and Portuguesa), cotton (80% area, mostly in Barinas), tobacco, sugarcane.

Source:
Martinez Natera, P.1973. Geografia economica de Venezuela. Caracas

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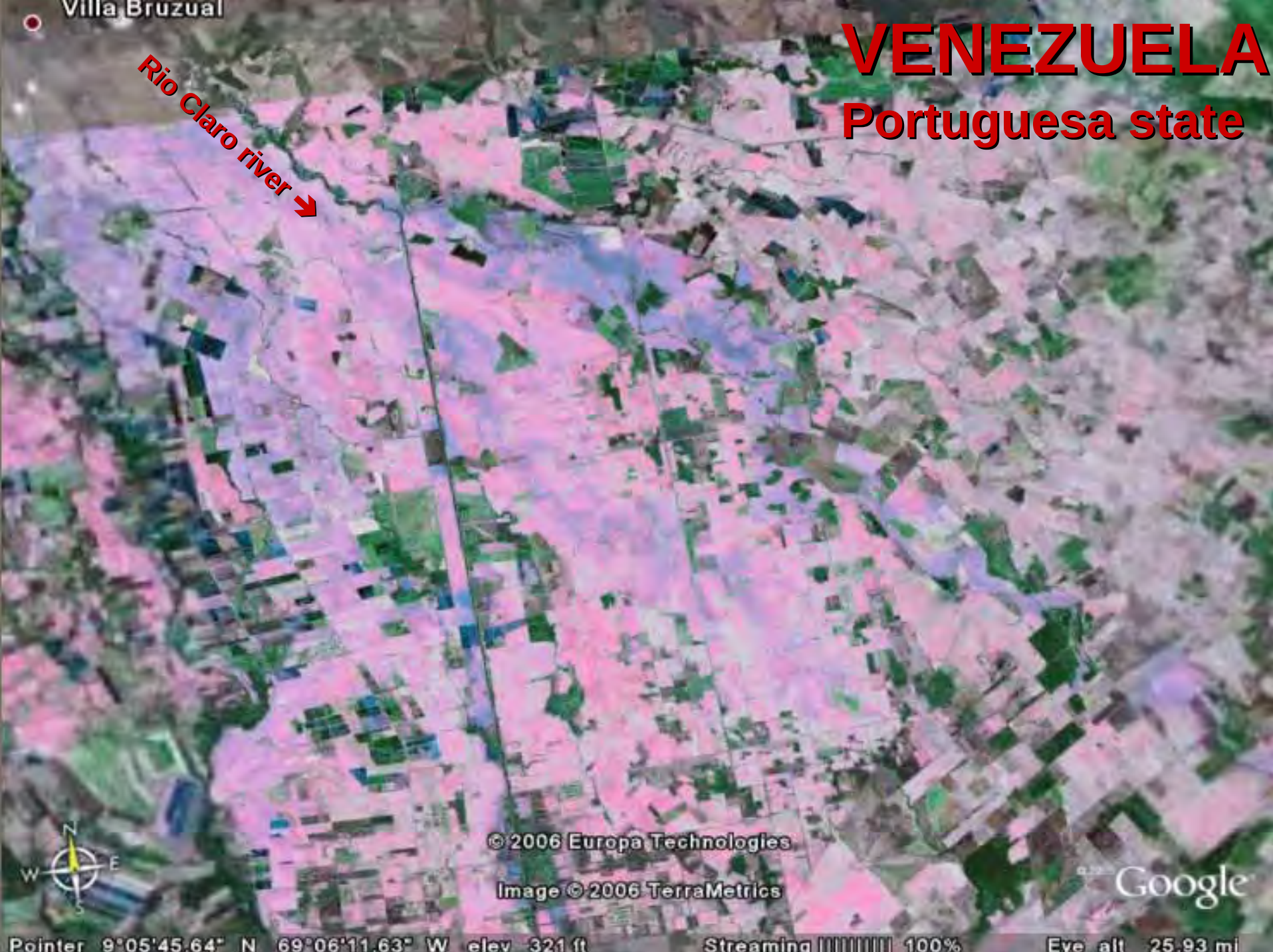
Villa Bruzual
Rio Claro river
VENEZUELA
Portuguesa state
© 2006 Europa Technologies
Image © 2006 TerraMetrics
Google
Pointer 9°05'45.64" N 69°06'11.63" W elev 321 ft
Streaming 100%
Eye alt 25.93 mi


VENEZUELA
Portuguesa state
Portuguesa
Guanare river
Barinas state
© 2006 Europa Technologies
Image © 2006 TerraMetrics
Google
Pointer 8°34'40.44" N 68°58'23.77" W elev 262 ft
Streaming
66%
Eye alt 42.70 mi

BOLIVIA

Major Crops (2005)

- Soybeans 1.700.000 t
- Potatoes 827.690 t
- Maize 686.110 t
- Rice 304.530 t
- Sunflower 170.000 t
- Wheat 107.870 t
- Sugar cane 4.800.000 t

Soybeans

- 1/3 of total planted area
- Expanded in the 1980s in Santa-Cruz (98% of agr.area), Tarija, Chuquisaca
- Cropped area (2005) – 890.000 Ha (2004 – 633.775 Ha)

Fertilizers Consumption, t (2002)

N – 6.195

P – 6.642

K – 904

Source: www.faostat.fao.org

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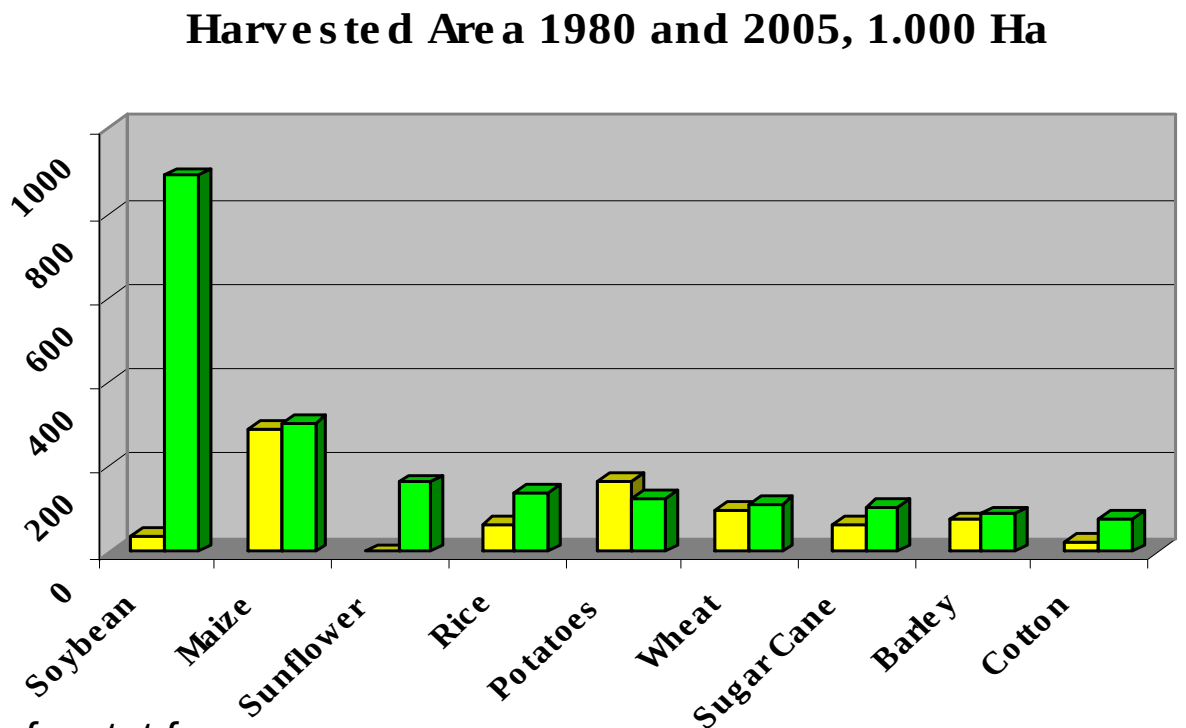
Dynamic of Major Crops Area in Bolivia



Source: www.faostat.fao.org

- Agriculture is diversified because of landscape variety. 7 crops: soybean, maize, sunflower, rice, potato, wheat, sugar cane occupy < 60% of arable area.
- Soybean became commercial crop #1 with 27,3% of total arable land.
- Along with soybean increased area under commercial crops: maize, sunflower, paddy rice, wheat, barley, cotton, sugar cane.
- Harvested area of potato, traditional subsistence crop, dropped.
- Commercial agriculture development occurred mostly due to colonization of the *Llanos Orientales region*.

The plains of *Oriente* Region of Bolivia

673.332 km² (61% of Bolivia); 3.873.225 inhabitants

- Departments **Beni** (213.564 km²), **Santa Cruz** (370.621 km²), **Chuquizaca** (51.524 km²), **Tarija** (37.623 km²)
- **Climate** ttransitional between Aw (typical savanna) and Cw (mesotermic, dry winter).
- T drops to +5 ° C, when the southern winds *surasos* blow.
- Rainfall, oscillating from 1400 to 800 mm/year, is a limiting factor.
- Villa-Montes (21°16') the record max. T for SA (>+50° C).
- **Soils** Alluvial and Podzolic on inundated parts of river valleys, lateritic soils on elevations.
- Erosion (piedmont), salinization (*Chaco Boreal*).
- *Beni plains* in the N. – ½ of Bolivia between the Andes piedmont , Mamore river and Brazilian shield. Excess of rainfall, except the *Mojos* savannas (12.000 km²) to the S. of 12°30'.
- *Santa Cruz* dpt. In the middle: fertile soils on dejection cones and river terraces (Piray, Rio-Grande). Japanese agricultural colonies near Yapacani (rice).
- *Chaco-Boreal* in the S. – arid, with sandy soils (except "pampa" islands and the *Issog* swamps).
- Brazilian shield fringes and the *Chiquitanos* ranges in the E. – analogues of cerrado of MG.

Source:

F.Ahlfeld. Geografia Fisica de Bolivia. La Paz, Cochabamba, 1973

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BOLIVIA
Santa Cruz
Guanare river
Image © 2006 TerraMetrics
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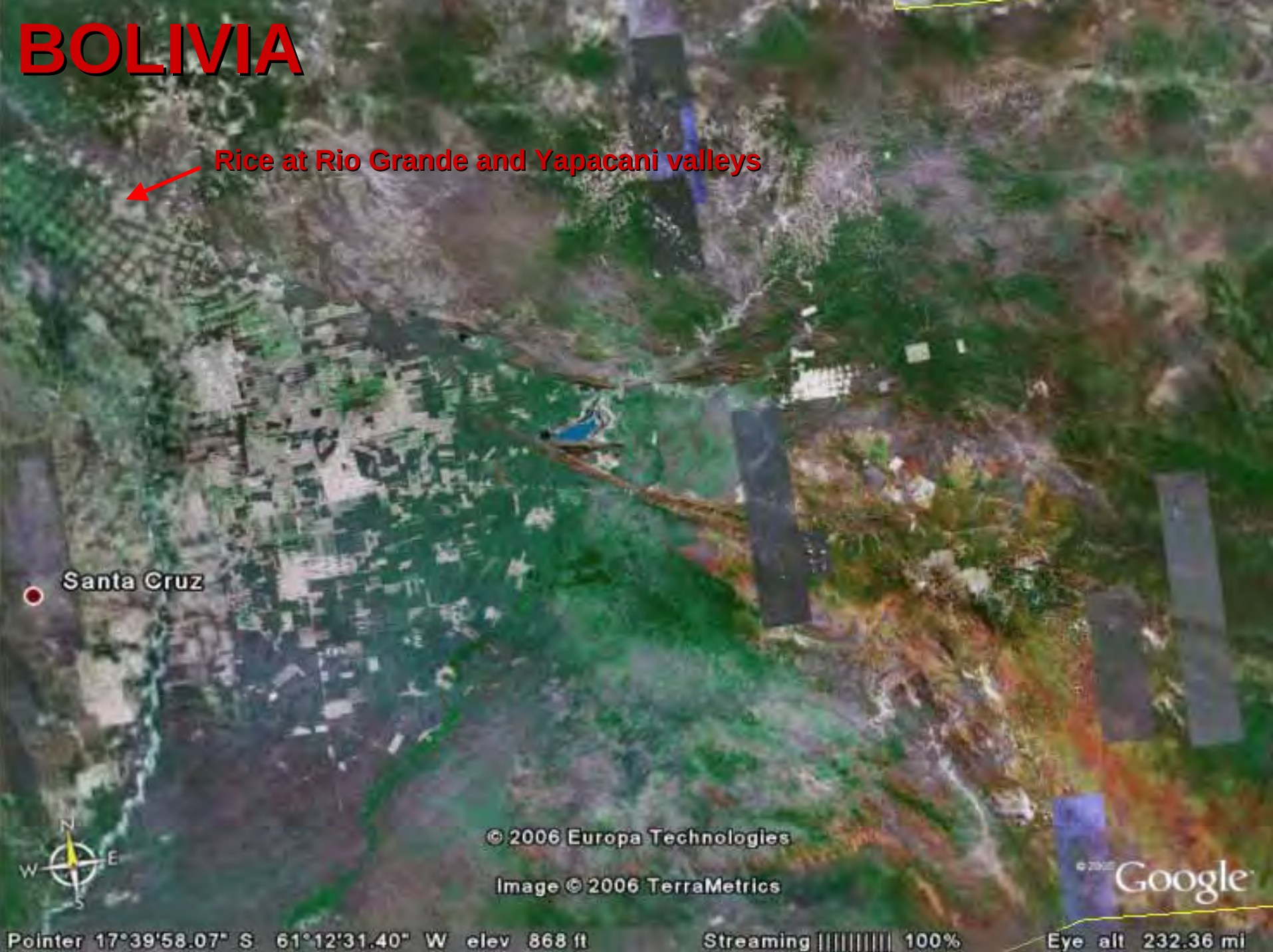
Google
Pointer 17°40'47.34" S 63°06'41.01" W elev 1245 ft
Streaming 100%
Eye alt 42.39 mi


BOLIVIA
Rice at Rio Grande and Yapacani valleys
Santa Cruz
© 2006 Europa Technologies
Image © 2006 TerraMetrics
Google
Pointer 17°39'58.07" S 61°12'31.40" W elev 868 ft
Streaming 100%
Eye alt 232.36 mi

PARAGUAY

Major Crops (2005)

- Soybeans 3.513.000 t
- Cassava 4.910.110 t
- Maize 830.000 t
- Wheat 630.000 t
- Rice 102.000 t
- Sugar cane 3.820.020 t

Soybeans

- 2/3 of total planted area; No-till, GM
- Cropped area (2005) – 1.935.700 Ha (2004 – 1.500.000 Ha)

Fertilizers Consumption, T (2002)

N – 34.934

P – 68.427

K – 49.807

Source: www.faostat.fao.org

Total NPK imports (2003)

USD 51.000.000 (94% from Brazil)

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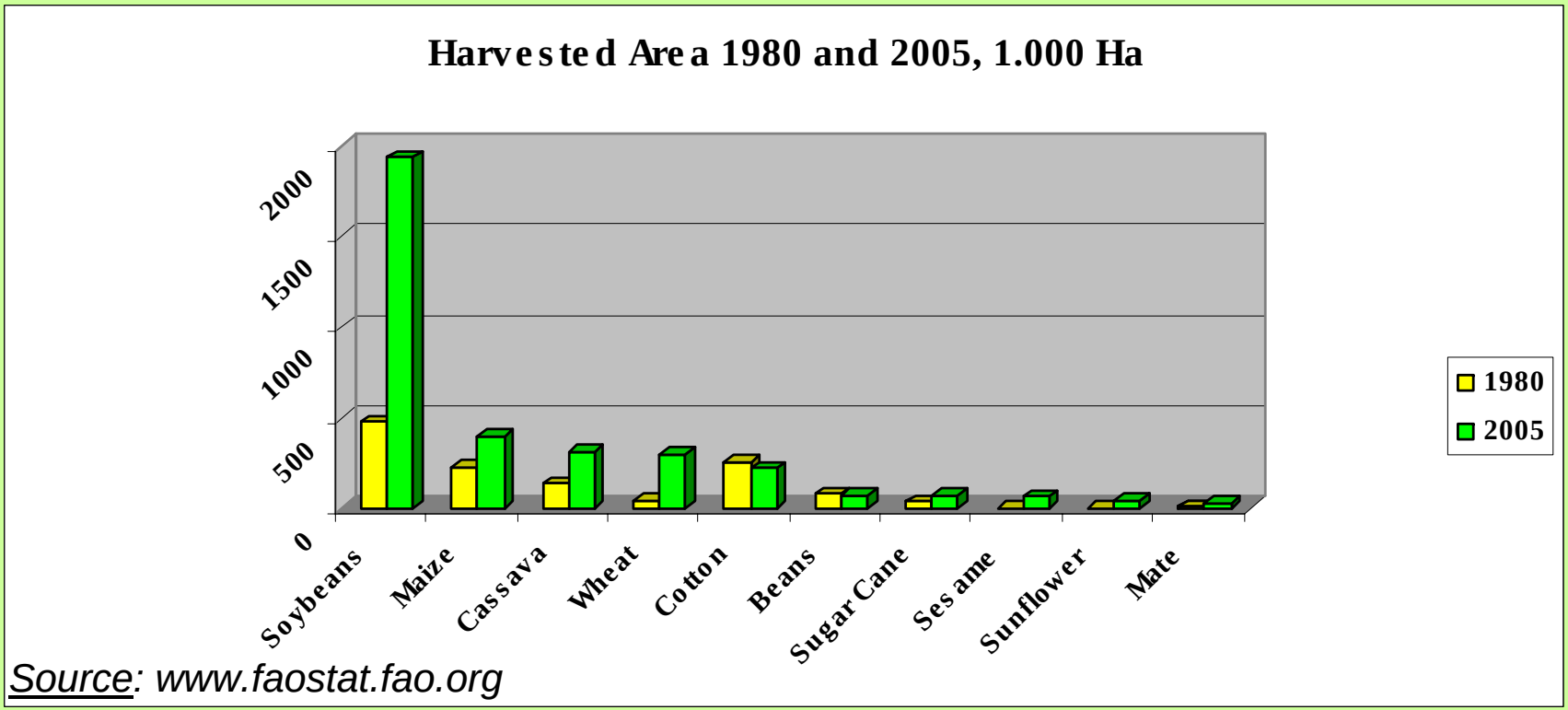
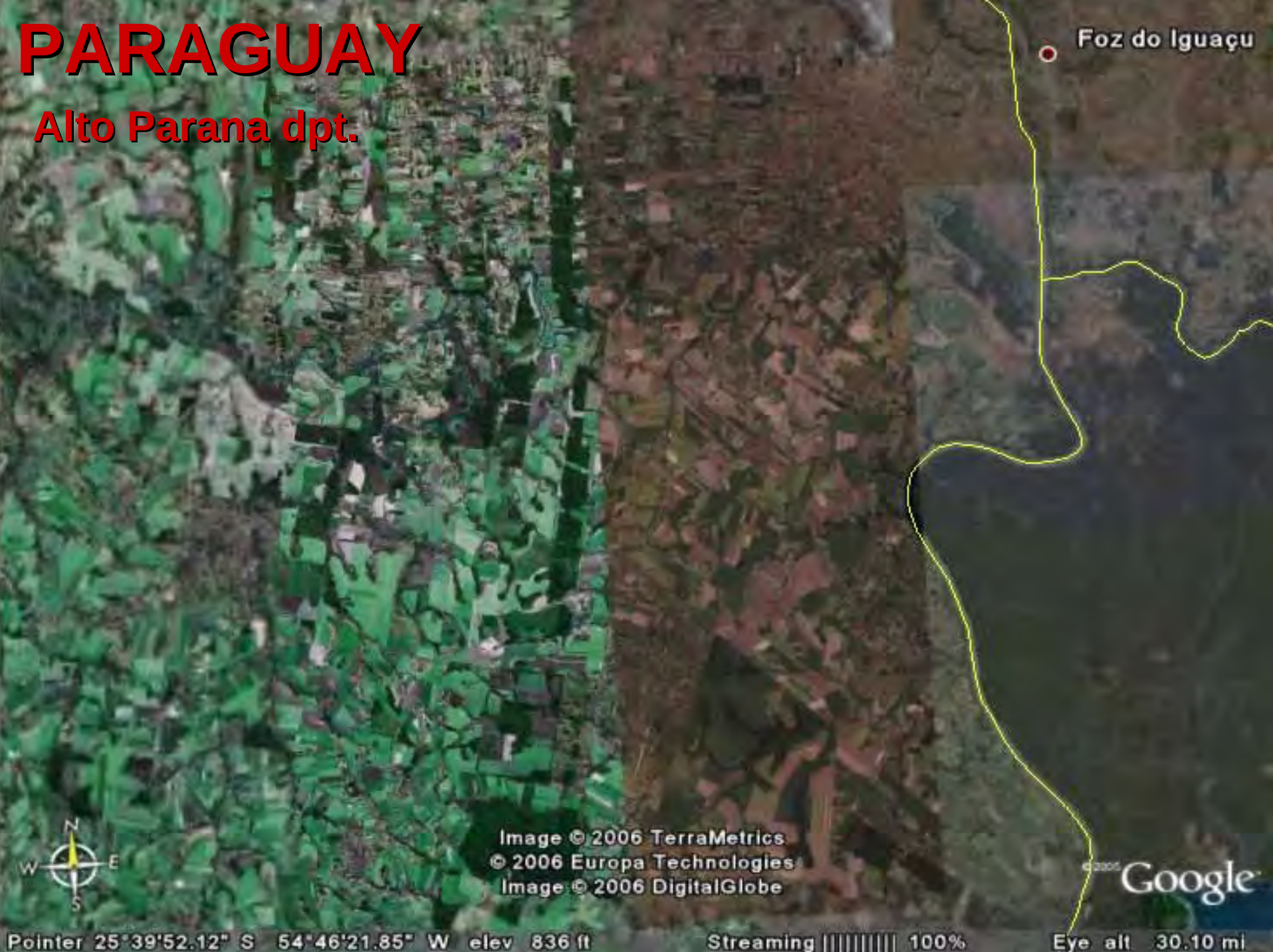
Dynamic of Major Crops Area in Paraguay



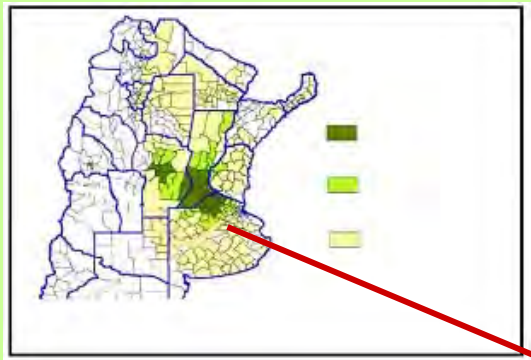
Source: www.faostat.fao.org

- Agricultural development in Paraguay depends on soybean expansion.
- Along with soybean, planted area of maize and wheat (grown in rotation with soybean) increased after 1980s (depts Canindeyu, Alto Parana, Itapua, Caaguazu, Caazapa)
- Soybean planters in Paraguay follows Brazilian and Argentinean experience.
- More than 200.000 Brazilian immigrants, or *brasiguayos*, produce soybeans in departments, bordering with Brazil.
- Soybeans are exported (and fertilizers imported) mostly through Brazil.


PARAGUAY
Alto Parana dpt.
Alto Paraná
Foz do Iguaçu
Image © 2006 TerraMetrics
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Google
Pointer 25°32'28.61" S 54°47'41.34" W elev 756 ft
Streaming 100%
Eye alt 34.19 mi


PARAGUAY
Alto Parana dpt.
Foz do Iguaçu
Image © 2006 TerraMetrics
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Google
Pointer 25°39'52.12" S 54°46'21.85" W elev 836 ft
Streaming 100%
Eye alt 30.10 mi

ARGENTINA



Major Crops (2005)

- Soybean 38.300.000 t
- Maize 19.500.000 t
- Wheat 16.000.000 t
- Sunflower 3.652.000 t
- Sorghum 2.900.000 t
- Potatoes 2.021.020 t
- Sugar cane 19.300.000 t

Soybeans

- ½ of planted area (14.070.000 Ha in 2005; 14,800,000 in 2004)
- Mostly GM, no-till
- Fertilized area in the 1990s 4%, now ½.

Fertilizers Consumption, T (2002)

N – 432.628

P – 283.300

K – 23.598

Source: www.faostat.fao.org

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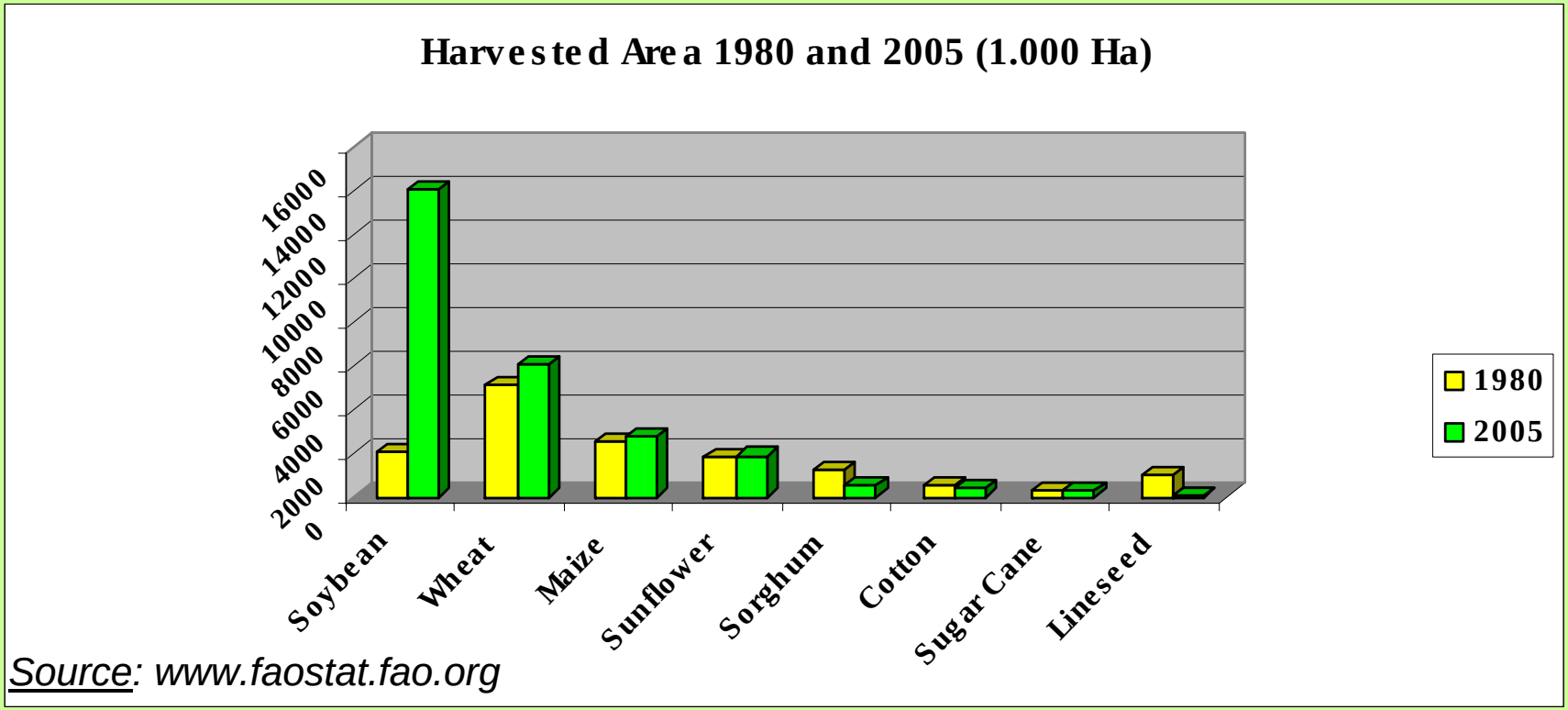
Dynamic of Major Crops Area in Argentina



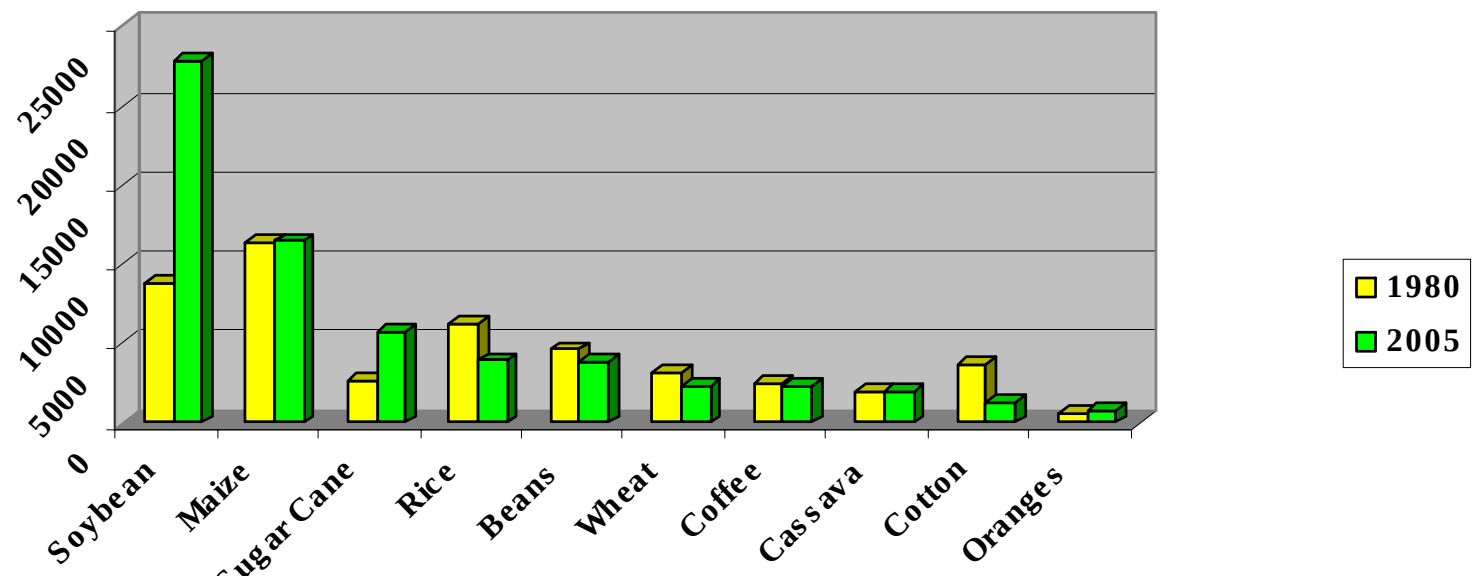
Source: www.faostat.fao.org

- 3 crops: soybean, wheat, maize occupy 80% of total planted area.
- Soybean is concentrated in *the Pampa* region (89% of the nat. cropped area), dominates in provinces Santa-Fe, San-Luis, Entre-Rios (60%),Chaco (79%), Santiago-del-Estero (75%, 93, 60, 79 and 70% of planted area respectively).
- Soybean expansion caused decrease of area of other grains (except wheat and maize), cotton plantations and pastures on plains to the N and NW of the *Pampa* region.
- 9 new grain/fertilizers terminals built on Parana near Rosario.


ARGENTINA
Santa Fe province
Rio Salado
Esperanza
Santa Fe
Image © 2006 TerraMetrics
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Google


ARGENTINA
Chaco province
Resistencia
Parana river
Image © 2006 TerraMetrics
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
Google

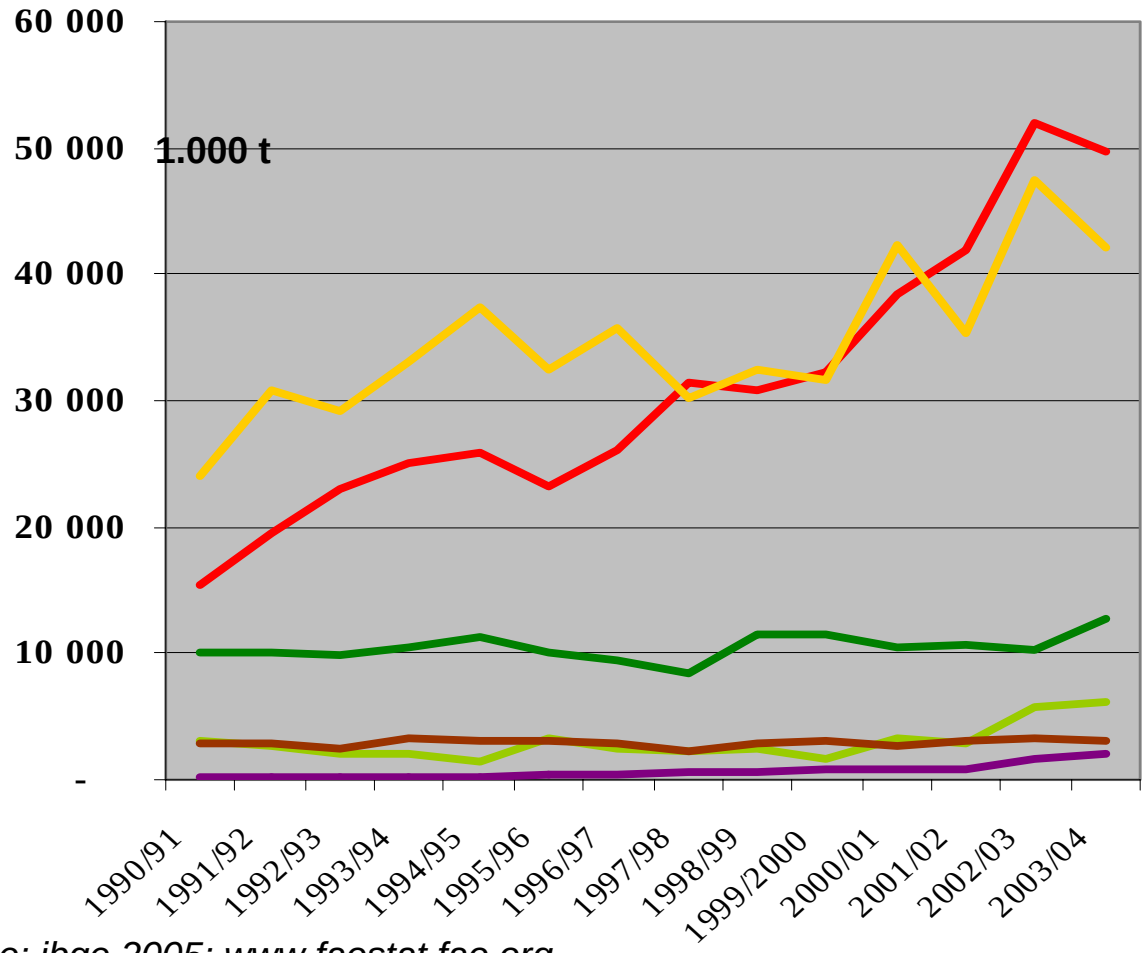
Dynamic of Major Crops Area in Brazil



Source: www.faostat.fao.org

- **Soybean and maize area shows a general trend of growth, oscillating due to market conditions.**
- **Major changes of soybean and maize affect marginal areas with worse natural conditions and logistics.**
- **Sugarcane area increases in Sao Paulo state, also in the *Cerrado* area.**
- **Fertilizing practices seek precision concepts; most of farmers use ready NPK mixtures without taking in consideration local soil characteristics.**

Brazil: Dynamic of Grains Production



Crop	2003	2004
Soybeans	51 919	49 205
Corn	48 327	41 864
Rice	10 335	13 251
Wheat	6 154	5 963
Beans	3 302	2 998
Sorghum	1 805	2 139

Source: ibge 2005; www.faostat.fao.org

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Brazil: Dynamic of Other Commercial Crops Production 1990, 2000 – 2004, 1.000 t

Crop	1990	2000	2003	2004	2004/03	2004/00
Sugarcane	262 674	326 121	396 012	410 983	4%	26%
Cotton	1 783	2 007	2 199	3 619	65%	80%
Tobacco (leafs)	445	580	656	928	41%	60%
Cashewnut	108	139	178	223	25%	61%
Coffee	2 930	3 807	1 987	2 476	25%	-35%
Coconut	477	1 952	2 834	2 900	2%	49%
Banana	5 616	5 777	6 801	6 603	-3%	14%
Tomato	2 261	3 005	3 709	3 420	-8%	14%
Oranges	14 016	17 064	16 918	18 257	8%	7%
Cassava	24 322	23 041	21 961	24 039	9%	4%

Source: ibge 2005; www.faostat.fao.org

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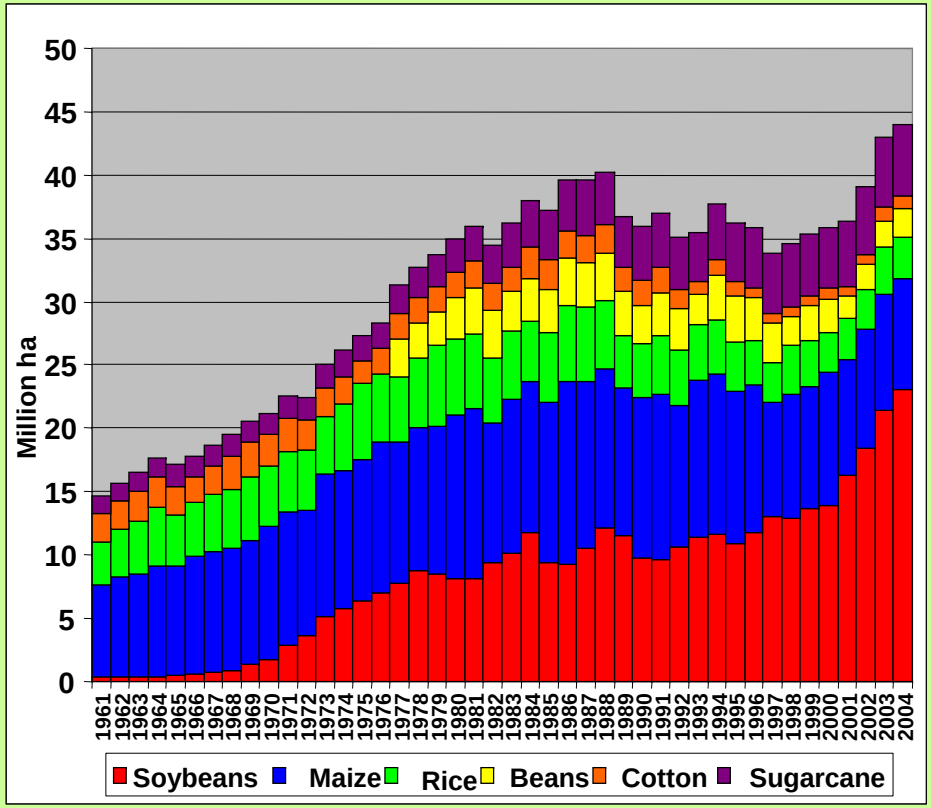
Land use in Brazil

	Million ha	%
Forested area	444	52
Cerrado (not colonized)	140	17
Pasture	177	21
Agricultural area	44	5
Other	43	5
TOTAL	848	100

USDA estimates (2004)

145-170 million ha in Brazil still suitable for agricultural colonization, including:
65 million ha – in the Cerrado,
10 million ha – in Amazonia,
70-90 million ha – conversion of pasture (20-30 million ha – in the Cerrado)

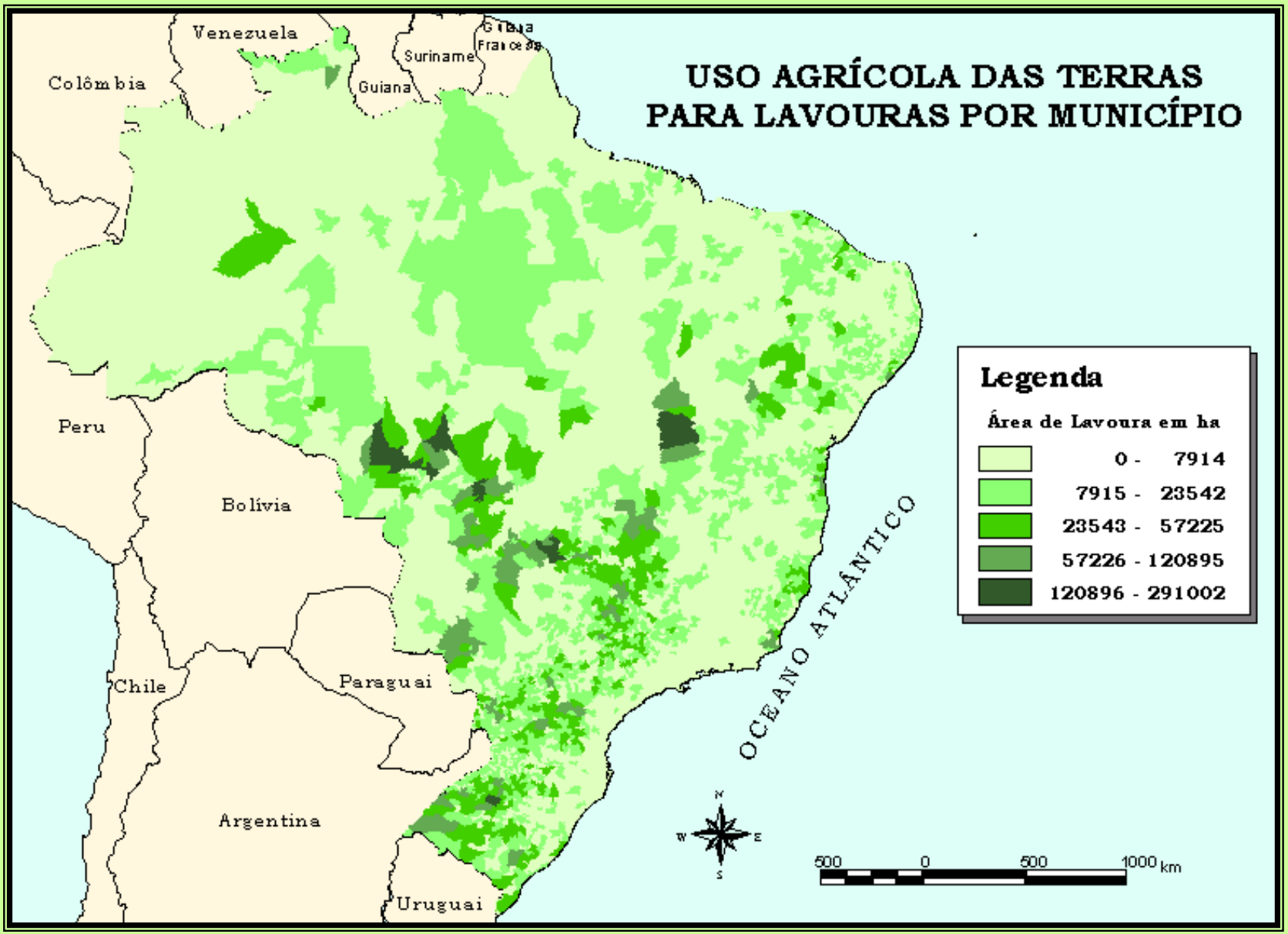
Structure of planted area, 2004



✓ Soybean area growth is related mostly with colonization of the Cerrado (savannah) Region and southern fringe of Amazonia.

✓ During 1980-2004 share of new colonized areas in the Cerrado (Center-West) in soybean production grew from 16% to 54%; share of the South region decreased to 46%

Brazil: area of agricultural land by municipio, 2003 (geographical concentration of agribusiness)

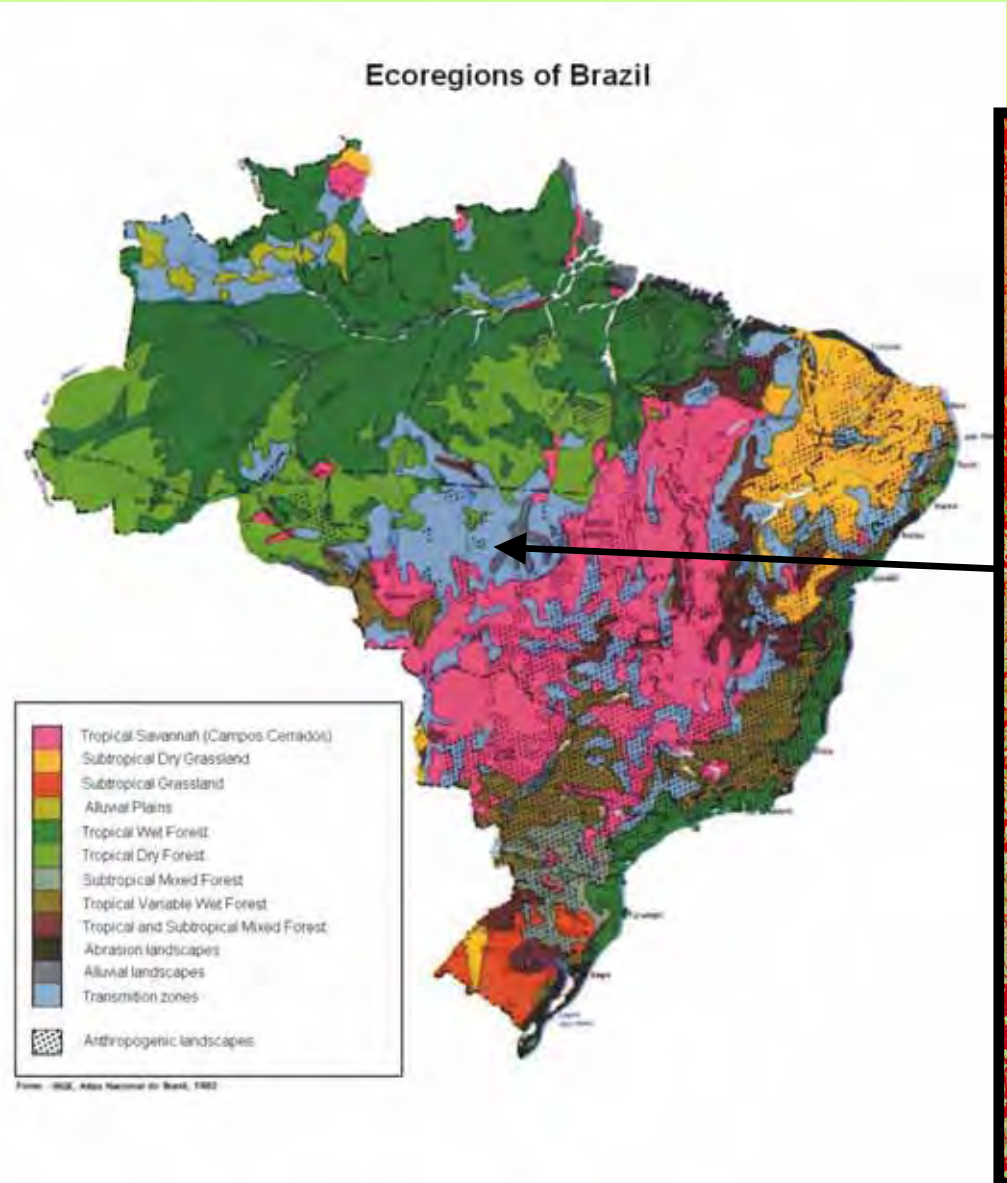


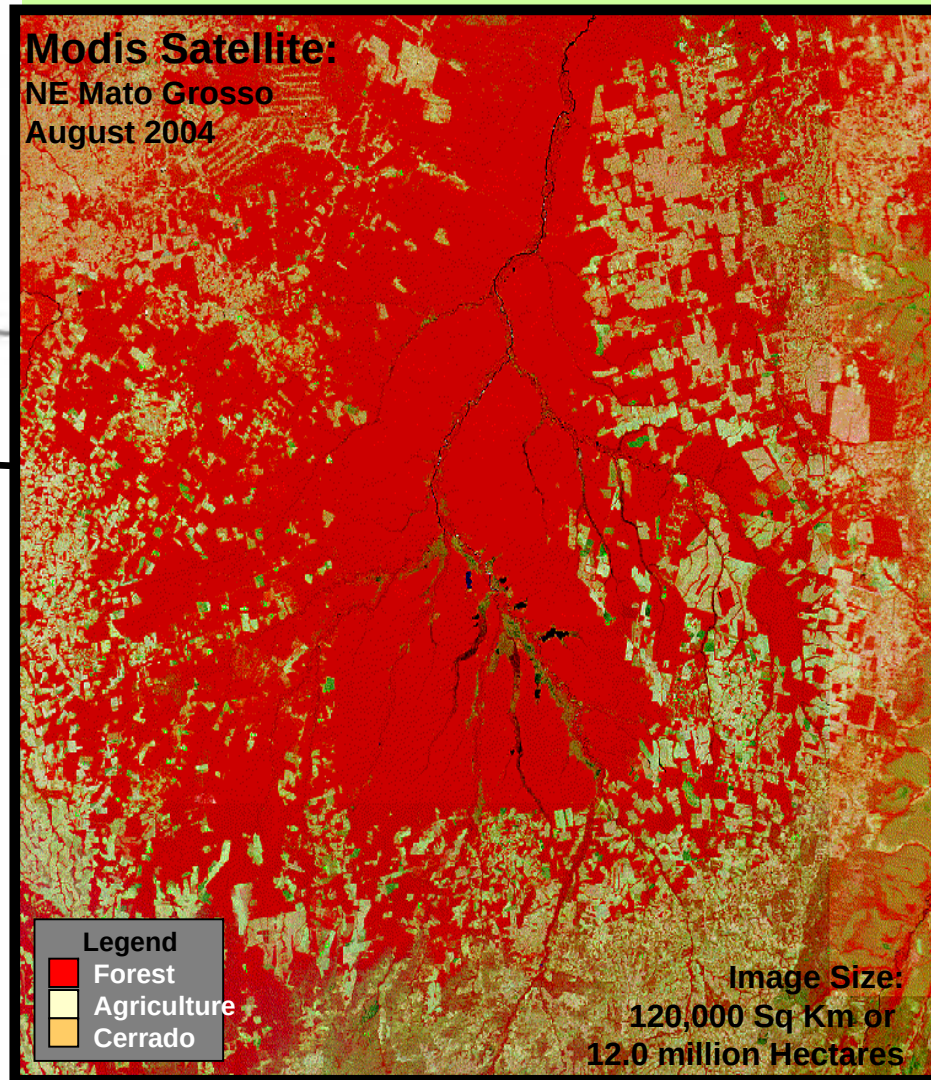
Brazil: localization of Main Crop Production Area

State	Sugar cane	Coffee	Soybean	Regions
Amazonas	0	0,1	0	North
Para	0	0	0	
Amapa	0,1	0,3	0	
Acre	0	5,9	0	
Roraima	0	0,1	0,1	
Rondonia	0	1,5	0	
Tocantins	0,1	0,1	0,1	
Maranhao	0,2	0,3	0,3	North East
Piaui	0,1	0	0,1	
Ceara	0,1	0	0	
Rio Grande de Norte	1,3	0,1	0	
Paraiba	1,3	0	0	
Pernambuco	5,1	0	0	
Alagoas	5,4	0,1	0	
Sergipe	0,6	0	0	
Bahia	0,2	0	0,5	
Minas Gearis	0,7	3,5	0,5	South East
Espirito Santo	0,6	4,9	0	
Rio de Janeiro	5,7	14,7	0	
Sao Paulo	4,2	1,2	0,3	
Parana	0,4	0,2	1,6	South
Santa Catarina	0,2	0,4	0,5	
Rio Grande do Sul	0,1	0	1,8	
Goias	0,4	0,1	1,8	Center West
Mato Grosso	0,4	0	2,6	
Mato Grosso do Sul	0,5	0,1	2,2	
Federal District	0,1	0	1,7	

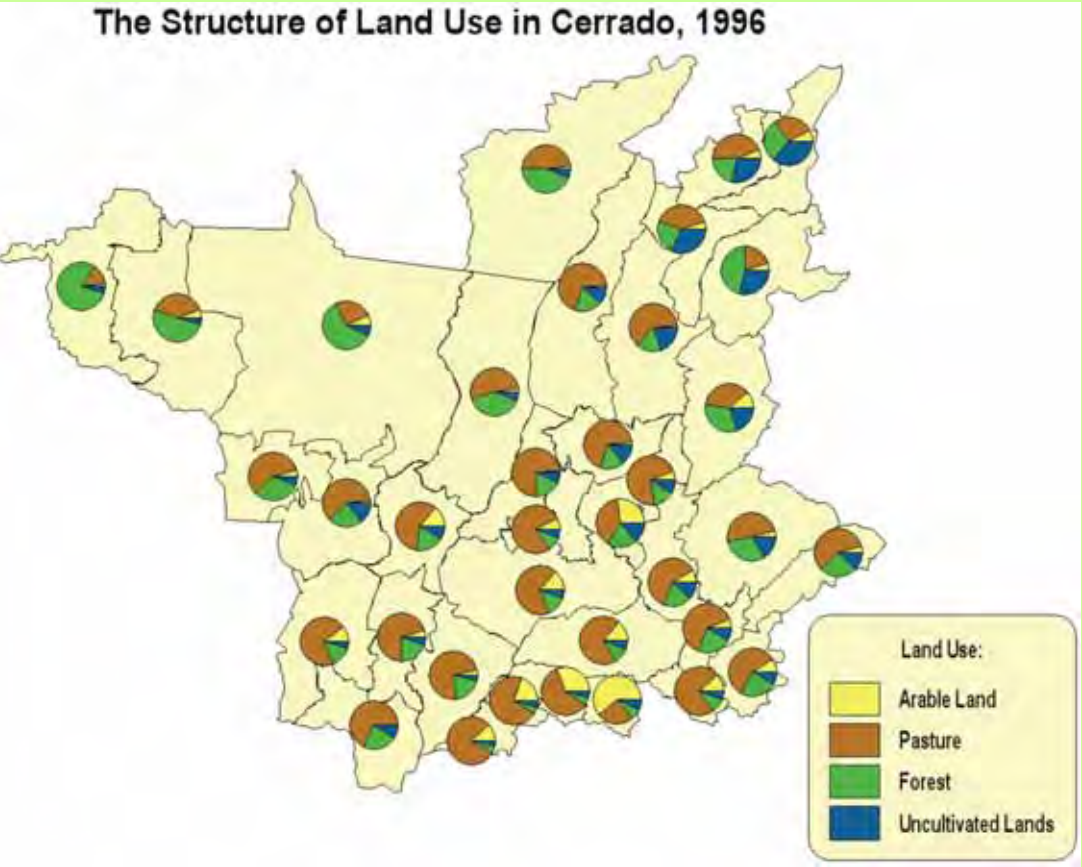
Source: Naumov A. 2005. Land Use in Brazil: Major Contemporary Changes and Their Driving Forces. - in Understanding Land-Use and Land-Cover Change in Global and Regional Context

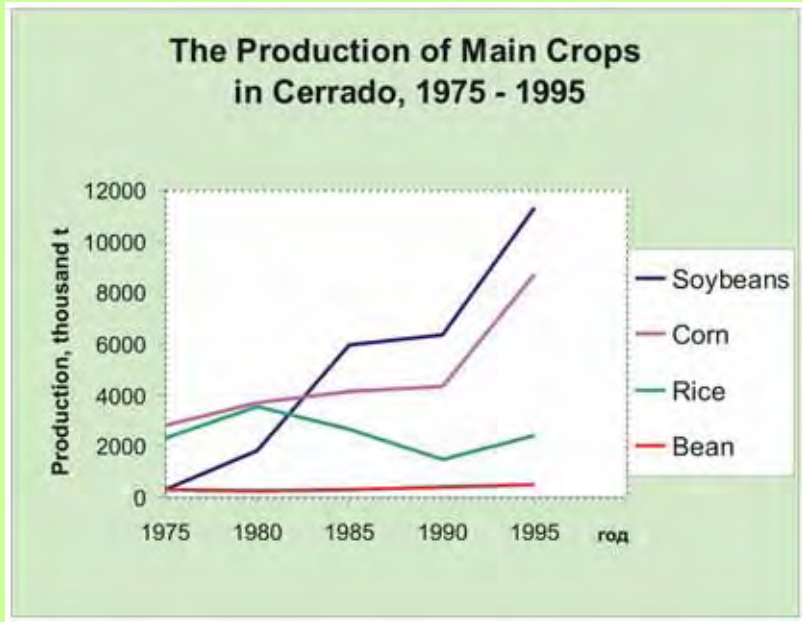
Brazilian Cerrado: in 1980-2000 more than 90.000.000 Ha were colonized





Land Use in Brazilian Cerrados





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BRAZIL
Goias state
Rio Verde
Image © 2006 TerraMetrics
© 2006 Europa Technologies
Google
Pointer 17°50'10.40" S 50°51'34.18" W elev 2397 ft
Streaming 100%
Eye alt 13.63 mi


BRAZIL
Mato Grosso do Sul state
Mato Grosso do Sul
Terenos
Campo Grande
Image © 2006 TerraMetrics
© 2006 Europa Technologies
Image © 2006 DigitalGlobe
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BRAZIL
West of Bahia state
(Luis Eduardo Magalhaes)
Image © 2006 TerraMetrics
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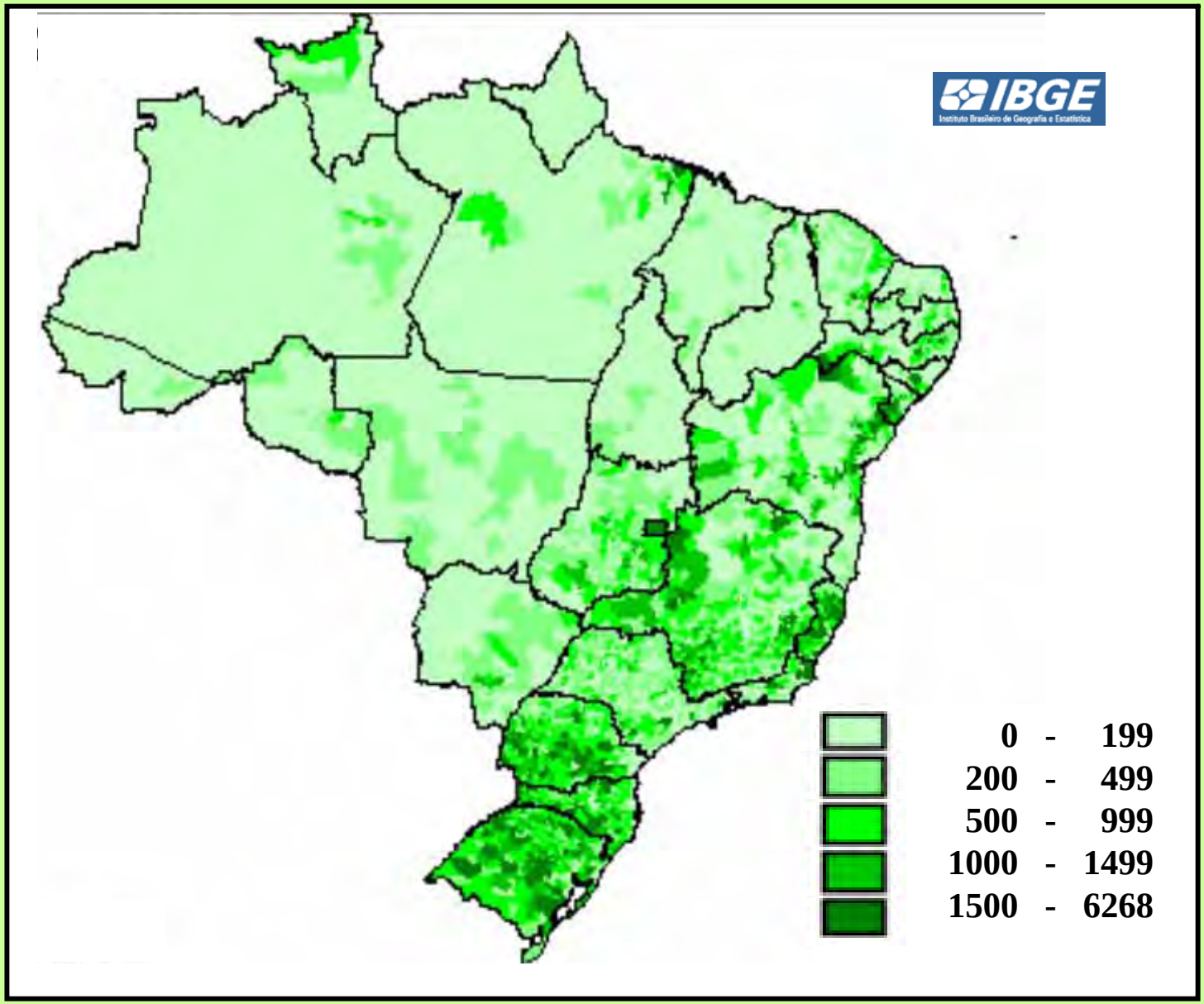
Brazil: Municipios with Systematic Use of Fertilizers

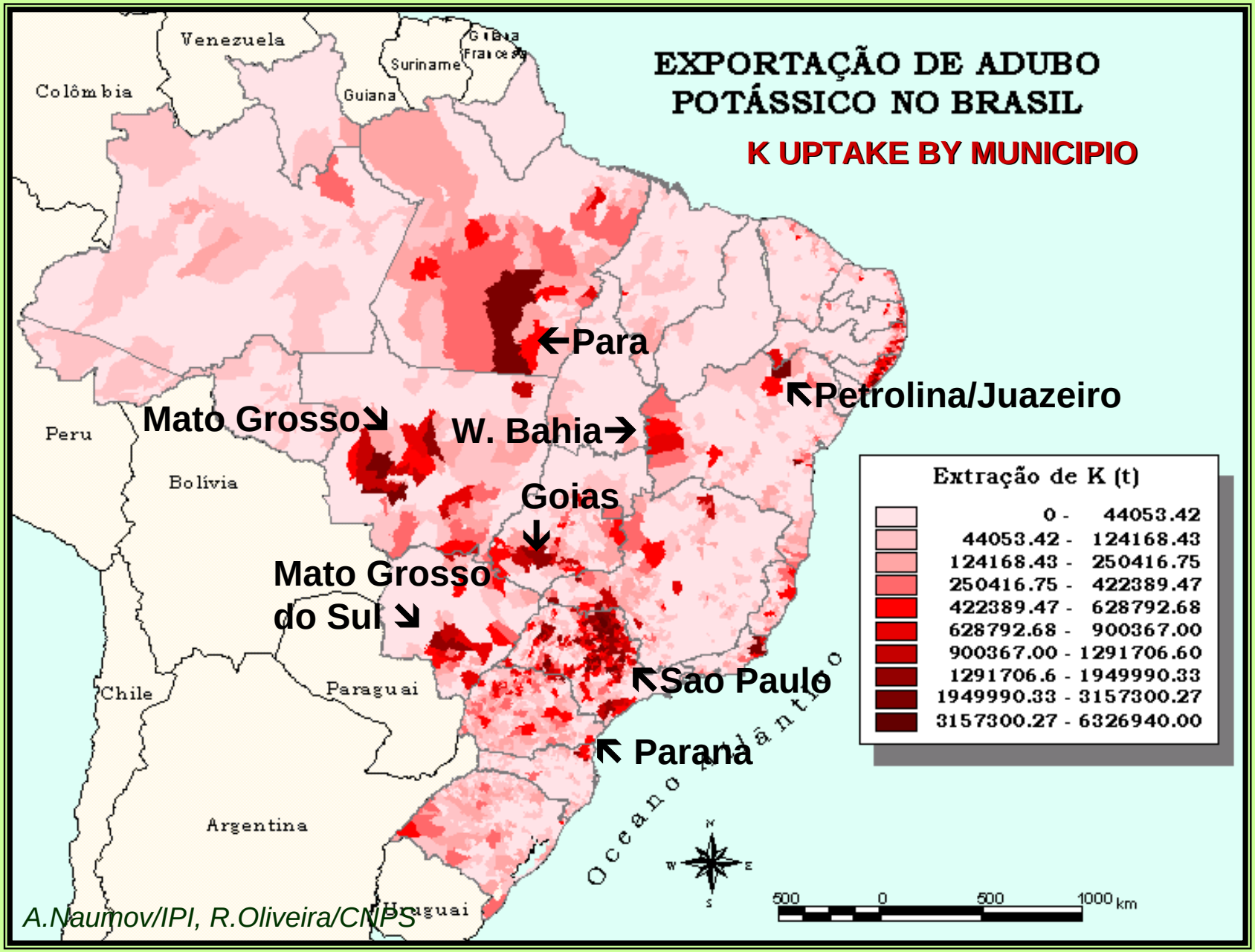


Source: IBGE. Agricultural census 1995/96

Brazil: Main Commercial Crops: Yield and K Uptake

Crops	Average yield, t/ha year^{-1}	Nutrients, kg by t					
		N	P	K	Ca	Mg	S
Cotton	2,13	23	4	16	8,4	3,7	7,7
Rice	3,09	12	3	3	1	1	0,7
Potato	16,35	3	0,3	4	0,2	0,2	0,2
Cocoa beans	0,3	32	6	48	1	2	1
Coffee	1,48	18	1,2	27	3,4	1,4	1,5
Sugarcane	68,51	1,2	0,2	1,1	0,1	0,2	0,2
Citrus	12,14	2,2	0,2	1,8	0,5	0,1	0,1
Eucaliptus	47,3	1,1	0,1	0,7	1,6	0,4	0,5
Beans	0,69	35	3,5	14,7	3,1	2,6	3,7
Cassava	13,2	3	0,3	3	0,6	0,3	0,1
Mango	27,28	1,3	0,2	1,6	-	-	0,2
Melon	12,95	2	0,5	2,4	-	-	-
Corn	2,62	20	4	5,5	0,1	1,8	1,7
Soybeans	2,37	60,6	5,2	18,7	1,9	2,2	3,2
Tomato	50,15	1,8	1	2,1	0,1	0,2	0,3
Wheat	1,95	22,5	4,5	13,5	1	3	1,3

Source: *Barbosa Filho (1987); Burton (1989), Castelane et al. (1991); Haag et al. (1991a), Haag et al. (1991b), IBGE (1996), Malavolta (1986); Malavolta and Violante Neto (1989); Malavolta et al. (1997); Oliveira and Thung (1988); Nakagawa (1991); Raij et al. (1997); Yamada and Lopes (1999).*



A.Naumov/IPI, R.Oliveira/CNPS

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IPI/EMBRAPA Field Experiments

2001- 2004

6 commercial crops (soybean, cotton, sugarcane, banana, cashew nut, coconut) + cover crops/ no-till

8 field experiments in 3 regions: SE, **NE**, **Center-West**

4 experiments - private farms (sugarcane, coconut, banana # 1, cotton/soybean #1); **3** - EMBRAPA stations; **1** - Goias University

End of experiments

2003: cotton/soybean # 1

2004: soybean/cotton # 2, cashew, coconut, banana # 1

2005: sugarcane

2006: banana # 2

Ongoing experiment (2004 +)

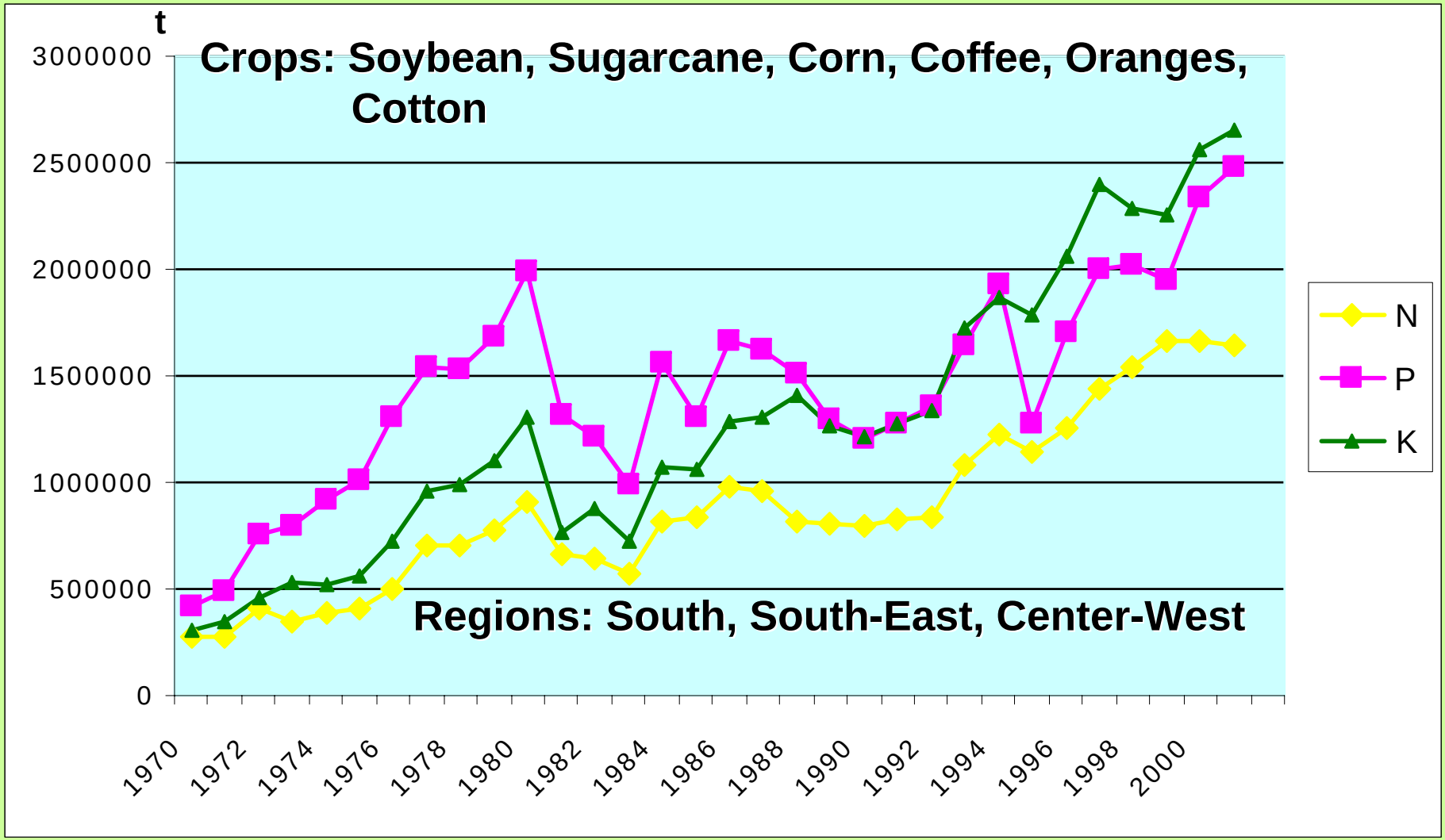
Soybean/maize (Rio Verde, Goias)

Ongoing experiments (2005 +)

No-till: W. Bahia (LEM)

Pastures: Sao Carlos, Sao Paulo

Brazil: N, P and K Consumption 1970-2002, t



Source: www.faostat.fao.org

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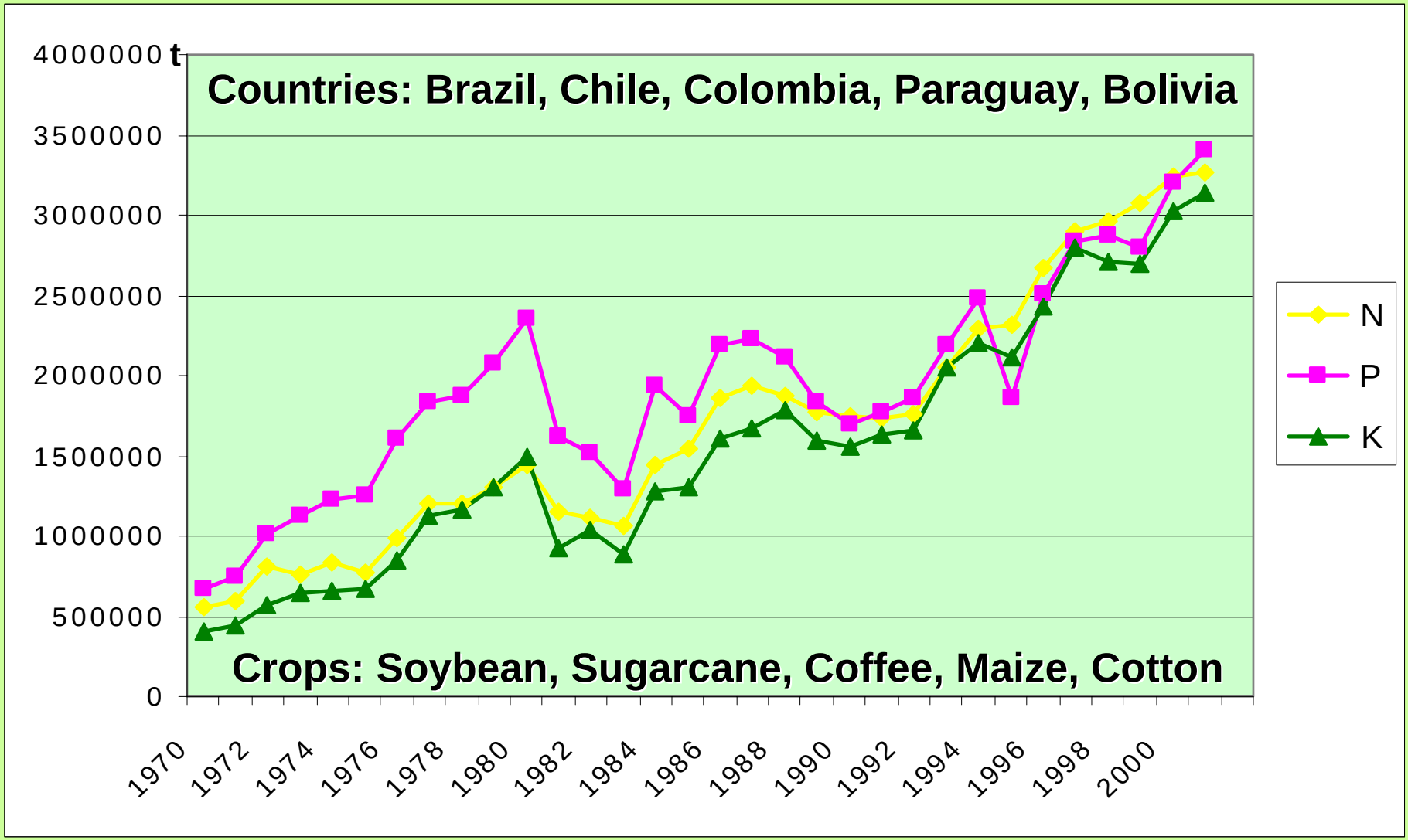
Brazil: Fertilizers imported in 1990, 2000-2004
1.000 t

Fertilizers	1990	2000	2003	2004	03/04
$(NH_4)_2SO_4$	634	1 662	1 785	1 562	-12%
Urea	57	1 320	1 909	1 751	-8%
NH_4NO_3	nd	352	469	237	-49%
SSP	74	294	342	427	25%
TSP	137	461	871	1 042	20%
MAP	62	1 224	1 901	2 166	14%
DAP	18	184	279	277	0%
KCl	1 847	4 197	5 934	6 433	8%
KSO_4	32	28	55	85	54%
K Saltpeter	49	107	165	177	7%
K Nitrate	4	31	30	33	9%
Complex	7	66	570	887	55%

[ANDA, 2005]

- In 2004 domestic production of KCl was 640,000,000 t (10% of total consumed)

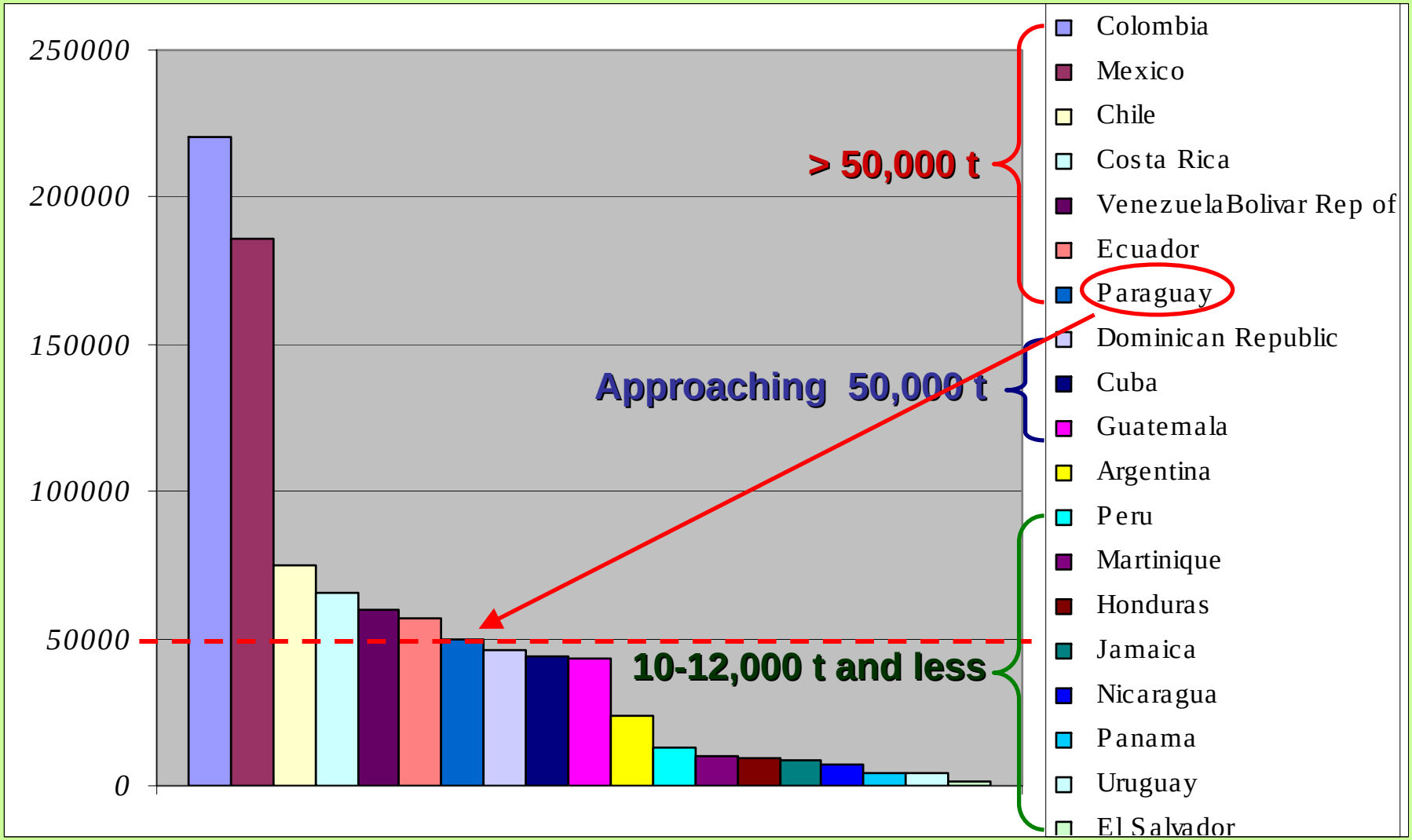
South America: N, P and K Consumption 1970-2002, t



Source: www.faostat.fao.org

Dr. A. Naumov
INTERNATIONAL POTASH INSTITUTE

LATIN AMERICA: POTASH CONSUMPTION, T *[FAO, 2002]*



Source: www.faostat.fao.org

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LATIN AMERICA: POTASH IMPORTS, 1.000 t K_2O

	2003	2004	2005
Brazil	3770,3	3817,5	2991,7
Colombia	216,2	222,2	244,9
Mexico	123,4	149,6	120,6
Ecuador	68,8	77,1	40,4
Venezuela	74,1	138,3	60, 4
Costa Rica	43,5	44,3	68,8
Guatemala	42,0	36,6	45,1
Dominican Rep.	24,4	28,2	21,7
Cuba	17,9	9,8	20,7
Honduras	15,0	18,9	23,6
Chile	34,6	18,2	25,6
Peru	20,3	32,0	34,5
Argentina	19,1	17,3	28,7
El Salvador	6,4	8,4	20,5
Uruguay	4,0	16,0	7,0

Bolivia?

Paraguay?

OBRIGADO!