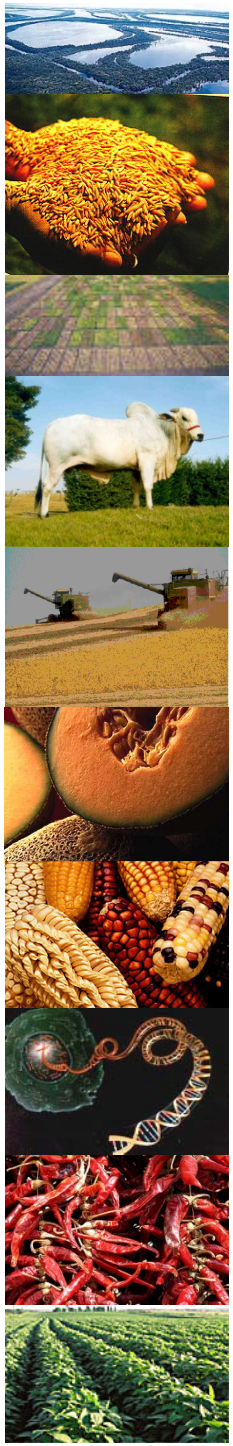


- Turning Science into Agribusiness -

The Development of Advanced Tropical Agriculture in Brazil

Maurício Antônio Lopes, PhD
Brazilian Agricultural Research Corporation – Embrapa
Embrapa Labex Program – Suwon, Republic of Korea

Special Lecture at the Department of Latin America Studies
Graduate School of International & Area Studies
Hankuk University of Foreign Studies
Seoul – Republic of Korea – November 2nd, 2010

There is a Brazil that most people know

Amazon forest

Soccer

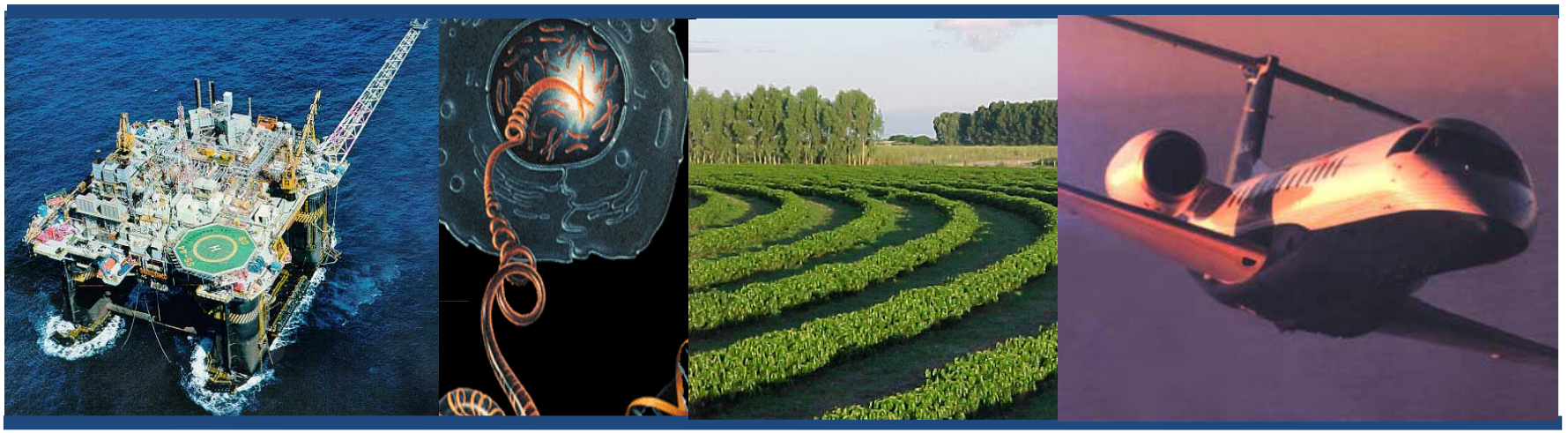
Carnival

Rio de Janeiro

It keeps being successful, but there is still more to know

Source: modified from MDIC

The Brazil you must know



Technology, Innovation, Competitiveness

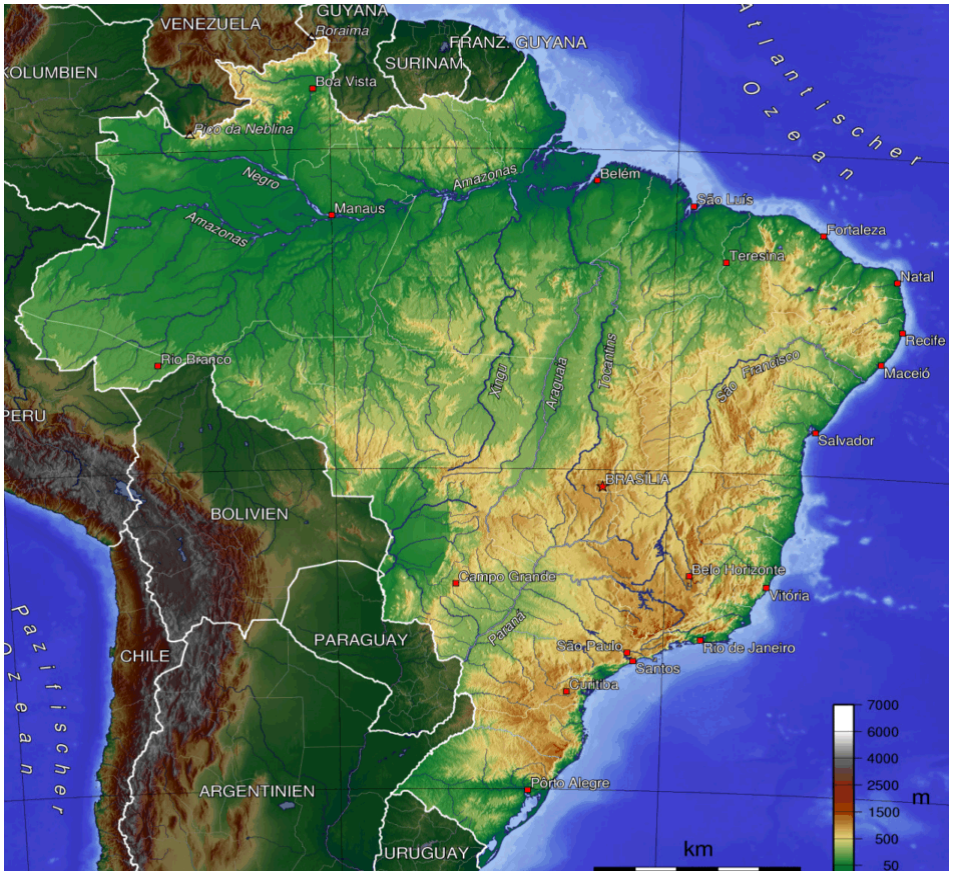
A strong academic base

10,000 doctors trained every year
16,000 scientific papers
Rank 13 in scientific publications
A growing intensity of industry R&D

Embrapa

Source: modified from MDIC

The Brazil you must know



The largest economy in South America

GDP: US$ 1.6 trillion (8th biggest economy)

Area: 8,514,000 km² (5th largest)

Population: 191.3 million (5th biggest population)

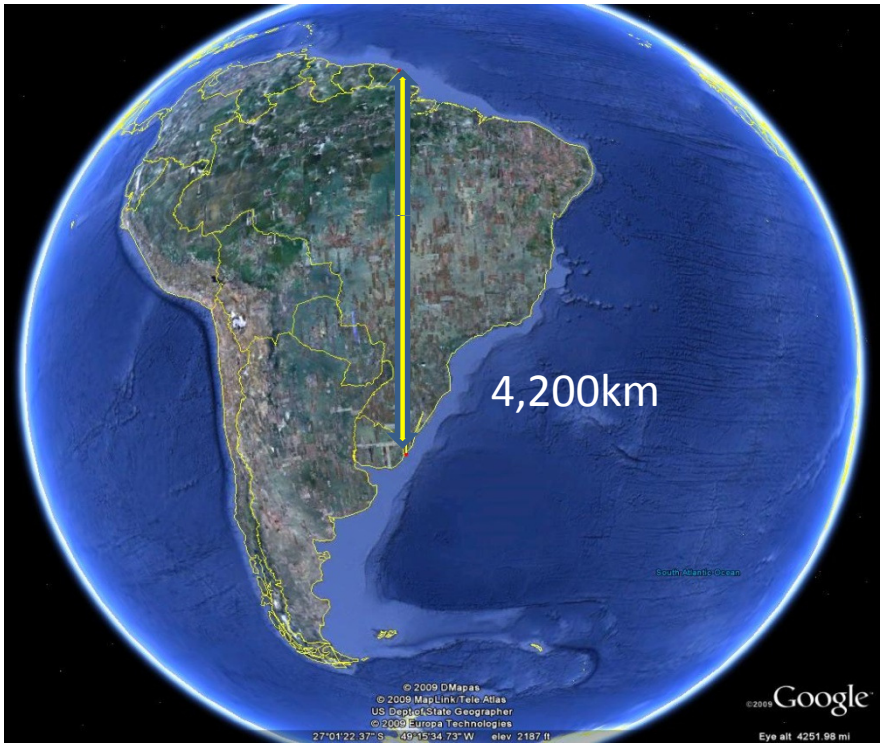
2009 exports: US$159 billion

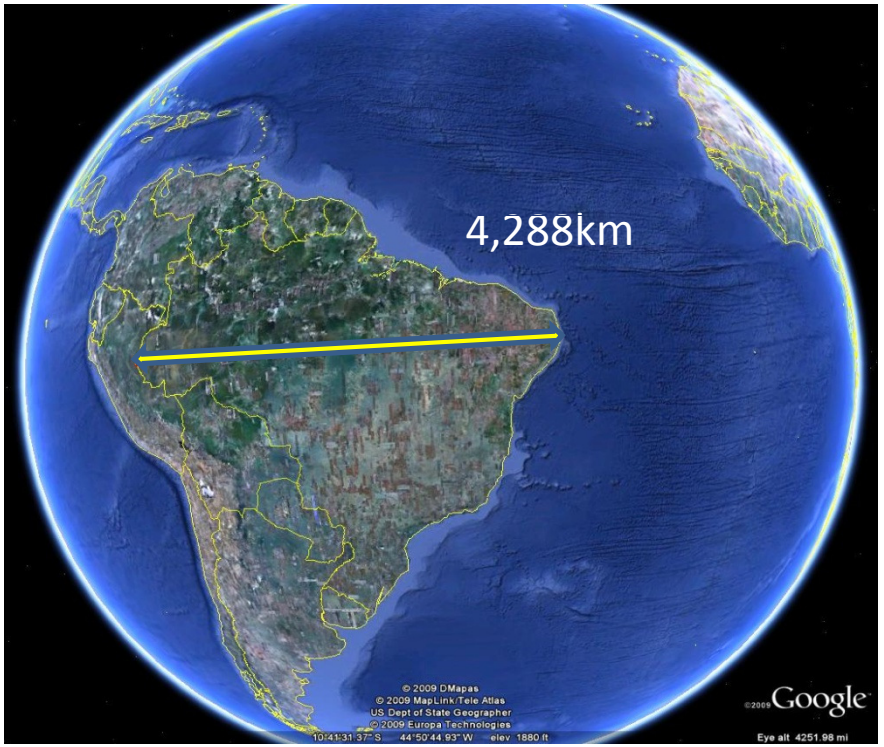
2009 imports: US$136 billion

Embrapa

The Brazil you must know

Great Environmental Diversity

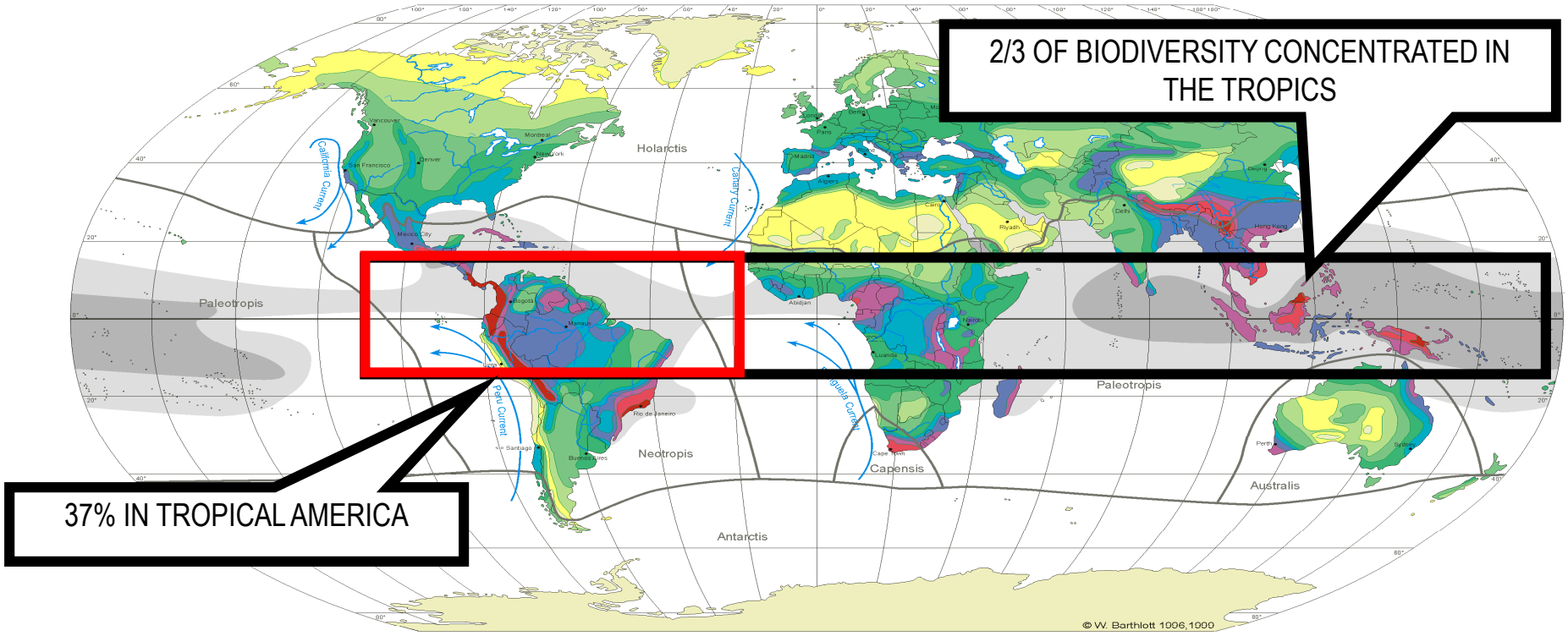




Embrapa

The Brazil you must know

A Mega-diverse Country



Barthlott, W., Biedinger, N., Braun, G., Feig, F., Kier, G. & J. Mutke (1999): Terminological and methodological aspects of the mapping and analysis of global biodiversity. In: Acta Botanica Fennica 162: 103-110.

The Brazil you must know

Source: WWF Amazon alive! A decade of discovery 1999-2009

It is estimated that the Amazon region has about 60,000 species of plants, of which 30,000 are higher plants, with more than 2,500 tree species.

The Amazonian forests, wetlands and savannas have at least 10000 plant species that are active carriers of medical, cosmetic and biological control agent.

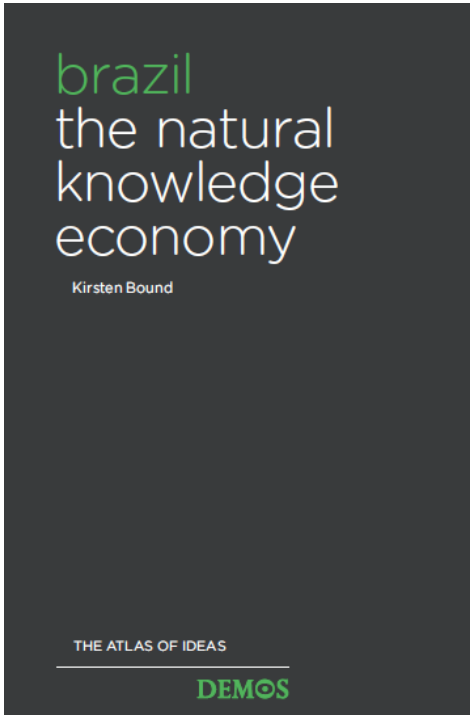
At least 300 species of edible fruits are found in the region.

Embrapa

The Brazil you must know

The Economist - Nov. 14-20, 2009

"A country with the world's largest freshwater supplies, the largest tropical forests, fertile land that in some places allows up to three harvests a year, and huge mineral and hydrocarbon wealth."



The Atlas of Ideas – Demos Institute, 2008

"It is helpful to think of Brazil as a 'natural knowledge-economy'… its innovation system is in large part built upon its natural and environmental resources, endowments and assets."

Embrapa

The Brazil you must know

npr

Scientists Help Make Brazil An Agriculture Dynamo

by JUAN FORERO

The Washington Post

Brazilian scientists turning nation into an agro-power

The Economist

Brazil's agricultural miracle

How to feed the world

The Christian Science Monitor

Farming superpower Brazil spreads its know-how

It is bringing the technologies of tropical farming to other parts of Latin America, and to Africa and Asia.

Brazilian agriculture

The miracle of the cerrado

Brazil has revolutionised its own farms. Can it do the same for others?

Embrapa

Tropical Agriculture in Brazil

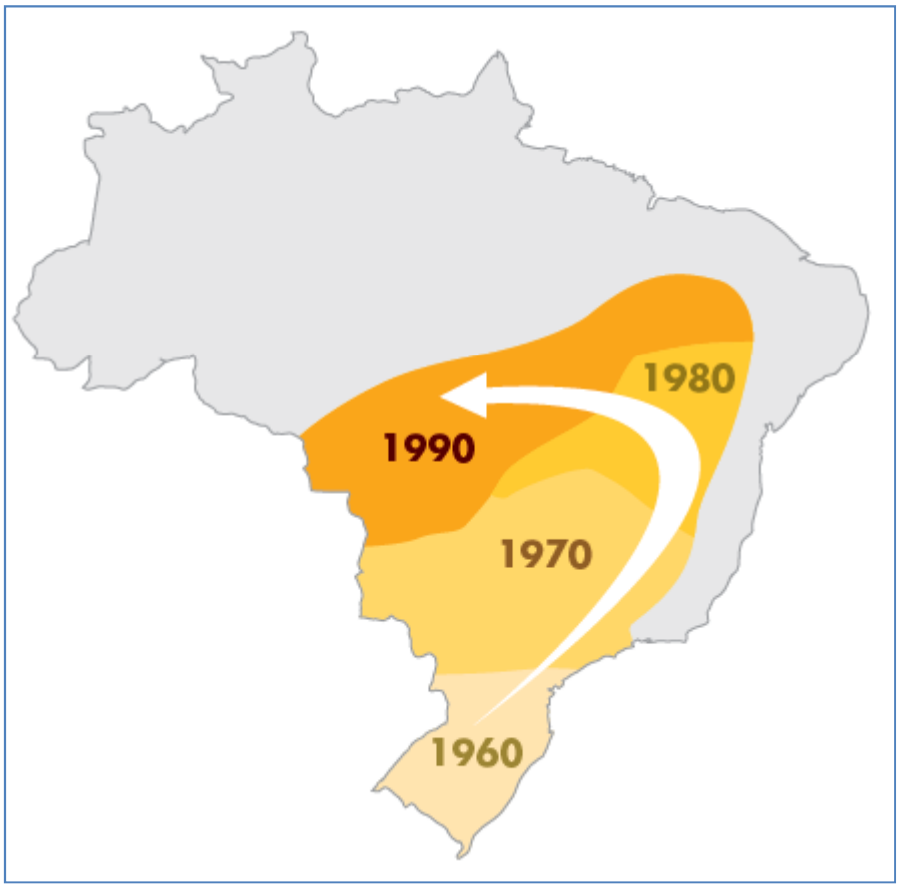
Turning Science into Agribusiness – Food, Feed, Fiber, Fuel

http://www.economist.com/node/16889019

http://www.economist.com/node/16886442

Embrapa

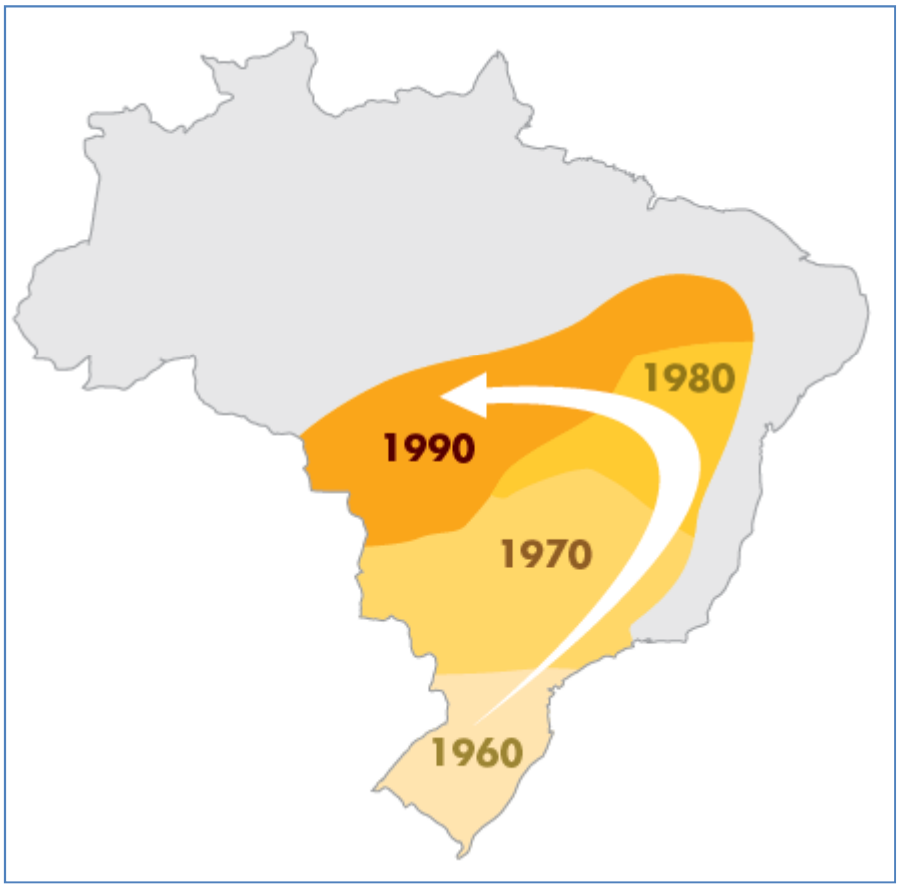
Recent Evolution of Agriculture in Brazil



Agricultural Expansion in Brazil

From the 1960´s to the 1990´s

Recent Evolution of Agriculture in Brazil

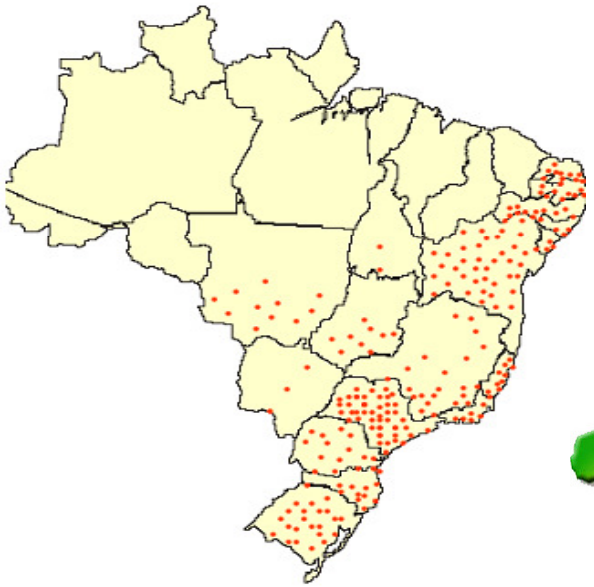


Brazilian Agriculture Before the 1970´s

- Low agricultural production and low yields
- Production concentrated in the South and Southeast Regions
- Constant food supply crisis and rural poverty
- Lack of specific knowledge in Tropical Agriculture
- Lack of adequate agricultural development policies

The Brazilian Agricultural Research System

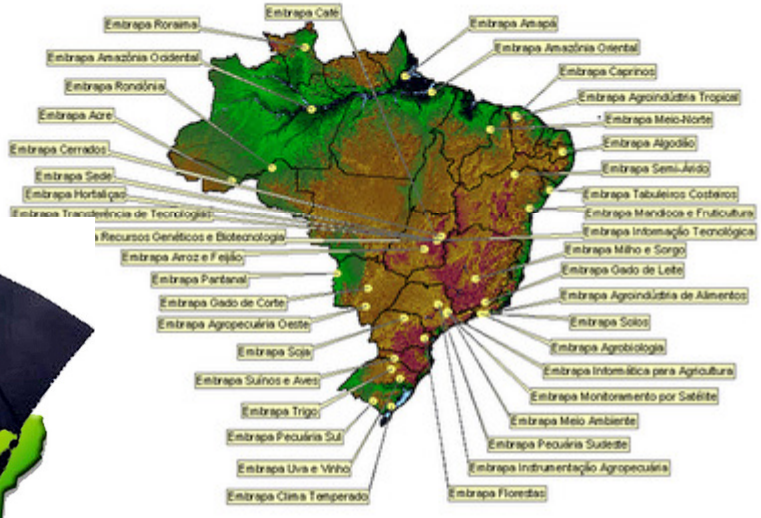
17 State Research Networks
OEPAS



CONSEPA
Conselho Nacional dos Sistemas Estaduais de Pesquisa Agropecuária

70 Agricultural Universities

The Brazilian Agricultural Research Corporation
45 Embrapa Centers



Private Sector

Brazil has also an active and growing private sector, which supplies technologies and technical assistance mainly in farm inputs and food processing

Embrapa

The Brazilian Agricultural Research Organization

Embrapa is the largest component of the Brazilian Agricultural Research System and…

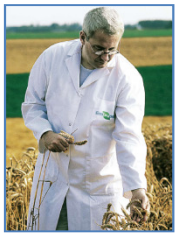
The largest agricultural R&D agency in Latin America in terms of both staff numbers and expenditure.

Embrapa is headquartered in the capital Brasilia and operates 45 research centers throughout the country.

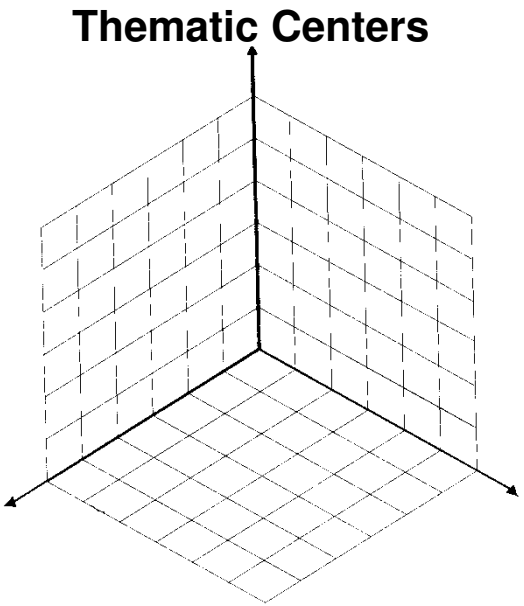
The Brazilian Agricultural Research Organization

1. Embrapa Algodão
2. Embrapa Arroz e Feijão
3. Embrapa Caprinos
4. Embrapa Florestas
5. Embrapa Gado de Corte
6. Embrapa Gado de Leite
7. Embrapa Hortaliças
8. Embrapa Mandioca e Fruticultura
9. Embrapa Milho e Sorgo
10. Embrapa Soja
11. Embrapa Suinos e Aves
12. Embrapa Trigo
13. Embrapa Uva e Vinho

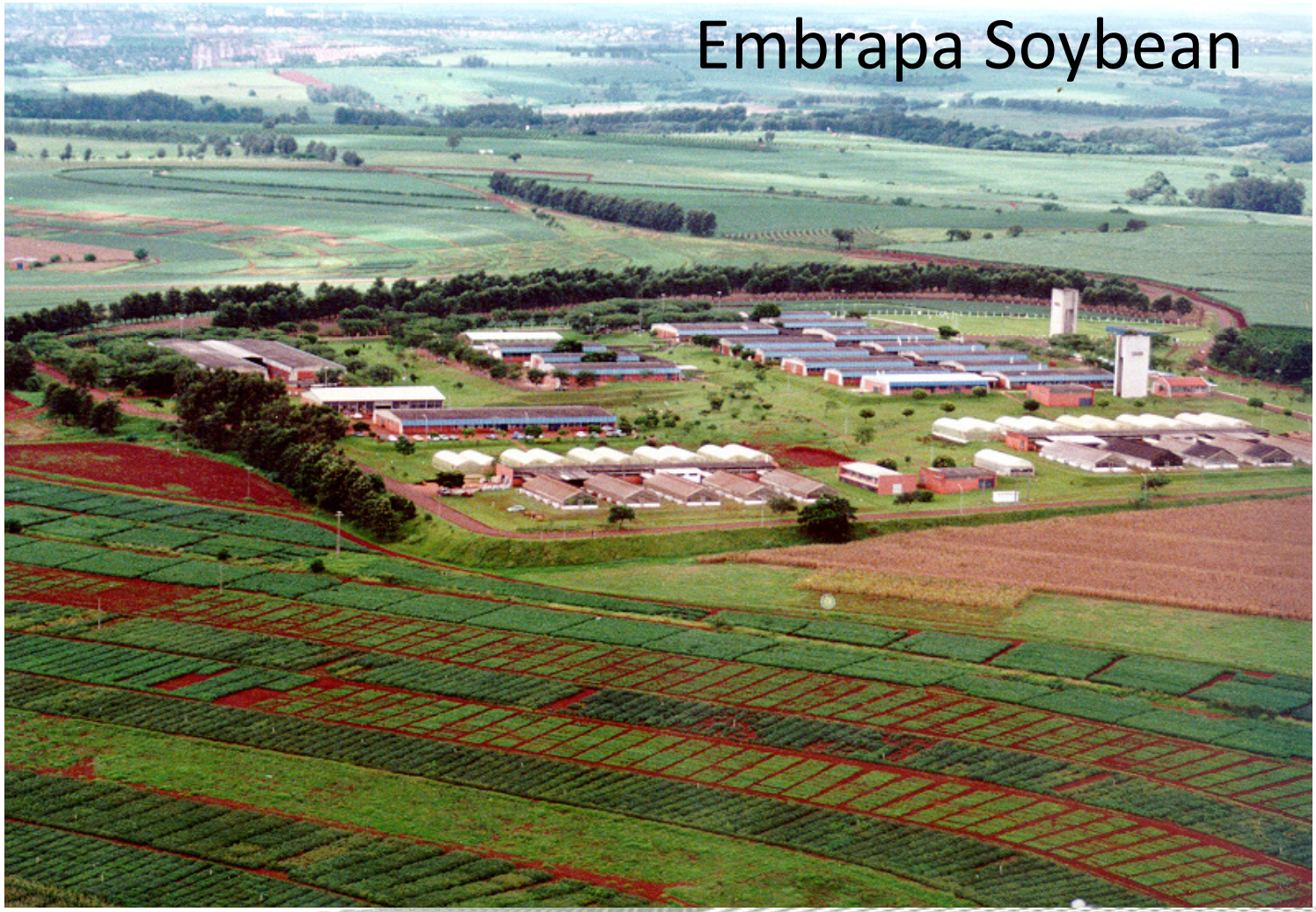
1. Embrapa Agrobiologia
2. Embrapa Agroindústria de Alimentos
3. Embrapa Agroindústria Tropical
4. Embrapa Informática Agropecuária
5. Embrapa Instrumentação Agropecuária
6. Embrapa Meio Ambiente
7. Embrapa Monitoramento por Satélite
8. Embrapa Recursos Genéticos e Biotecnologia
9. Embrapa Solos



1. Embrapa Acre
2. Embrapa Agropecuária Oeste
3. Embrapa Amapá
4. Embrapa Amazônia Ocidental
5. Embrapa Amazônia Oriental
6. Embrapa Cerrados
7. Embrapa Clima Temperado
8. Embrapa Meio-Norte
9. Embrapa Pantanal
10. Embrapa Pecuária Sudeste
11. Embrapa Pecuária Sul
12. Embrapa Rondônia
13. Embrapa Roraima
14. Embrapa Semi-Árido
15. Embrapa Tabuleiros Costeiros



The Brazilian Agricultural Research Organization

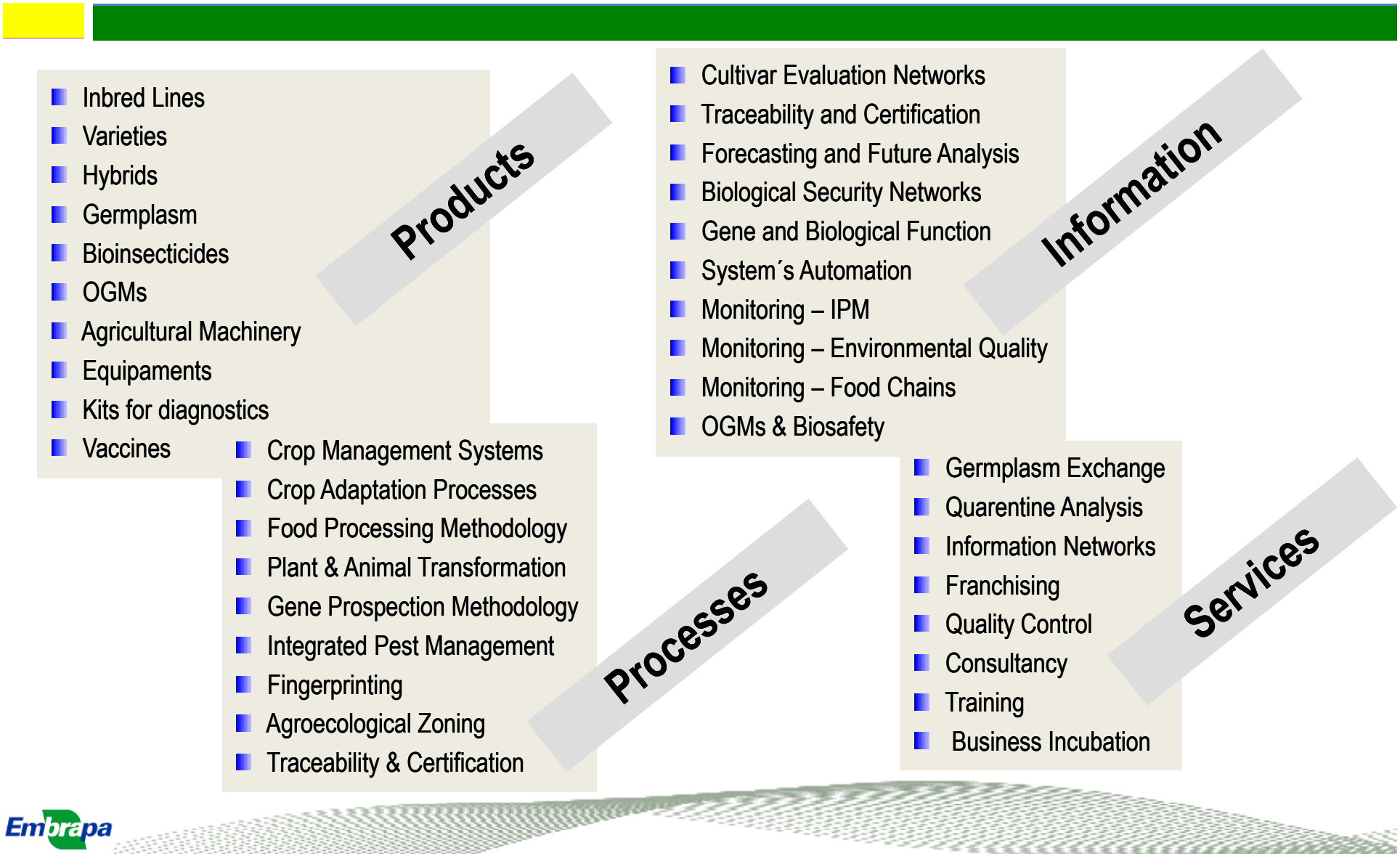


Embrapa

The Brazilian Agricultural Research Organization

Embrapa Genetic Resources and Biotechnology

Embrapa Innovation – A Comprehensive Portfolio



The Brazilian Agricultural Research System

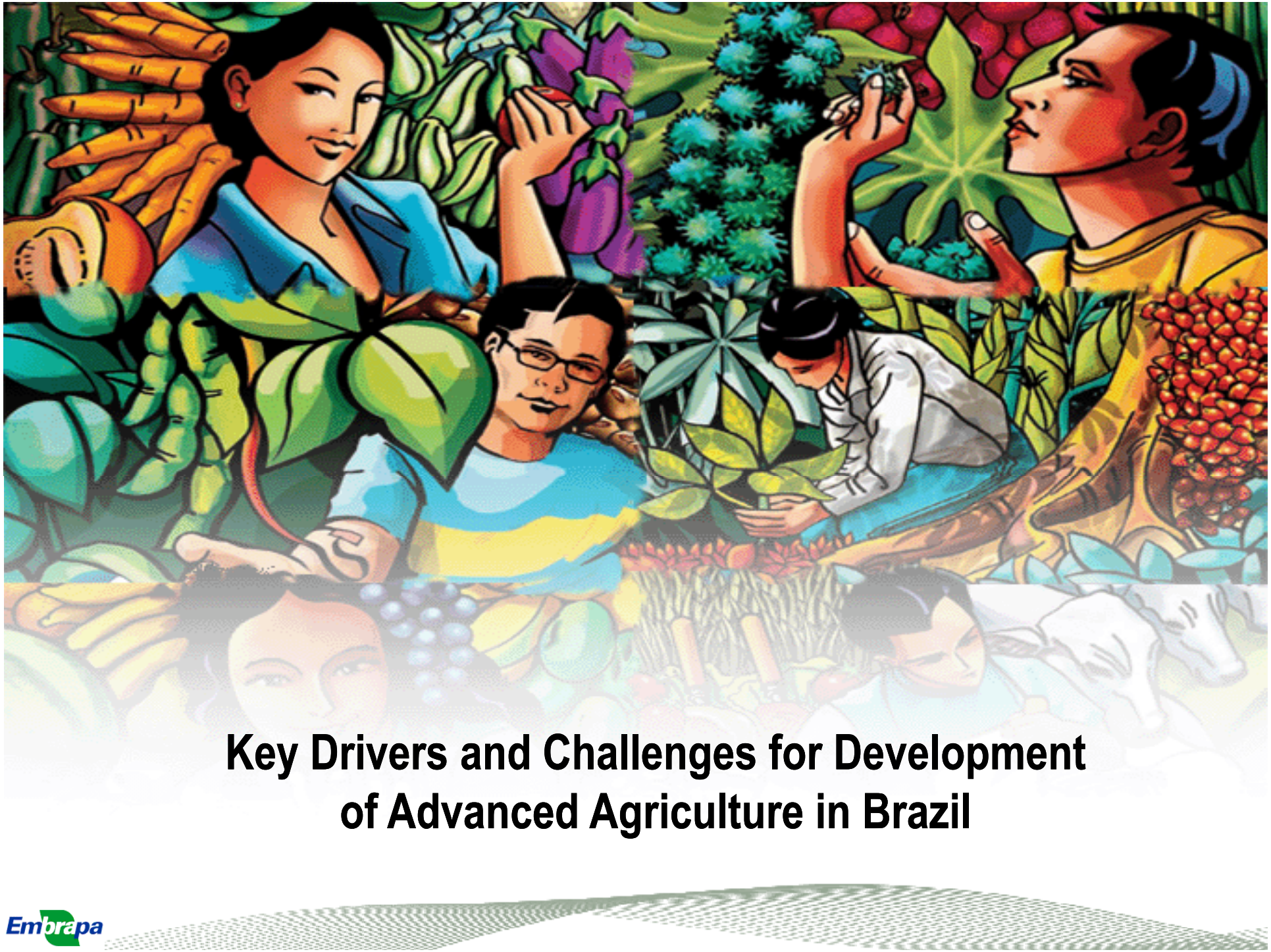
TABLE 1
Share of world publications

	1998-2002		2008-2007		Rank	
	Count	Share(%)	Count	Share(%)	Share	Growth
Plant & Animal Science	5,857	2.62	10,006	3.91	1	1
Agricultural Sciences	2,155	3.07	3,308	3.72	2	9
Microbiology	1,438	2.2	2,192	2.86	3	8
Environment/Ecology	1,353	1.47	3,209	2.63	4	2
Pharmacology & Toxicology	1,156	1.65	2,152	2.55	5	3
Neuroscience & Behavior	2,106	1.68	3,394	2.4	6	6
Physics	8.645	2.28	10,121	2.28	7	22
Immunology	725	1.28	1,225	2.11	8	5
Space Science	1,000	1.95	1,208	2.08	9	20
Biology & Biochemistry	3,189	1.29	5,240	1.97	10	7

“Brazil clearly has very real strength in life sciences, particularly related to natural resources… the country is strong in areas related to animal and plant biology, agriculture and veterinary science.

Its greater than 5% share of world publications has underpinned key economic sectors but also gives it the support base to develop its ‘natural knowledge’.”

Source: Global Research Report – Brazil, Research and collaboration in the new geography of science - Thomson-Reuters - http://researchanalytics.thomsonreuters.com/grr/



Key Drivers and Challenges for Development of Advanced Agriculture in Brazil

Embrapa

Development of Tropical Agriculture in Brazil

Key drivers of Agricultural Development in Brazil

<u>The development of science-based tropical agriculture</u>

Entrepreneurship of farmers

Government commitment and public policies

Availability of basic infrastructure

Large extension of arable land and adequate climatic conditions

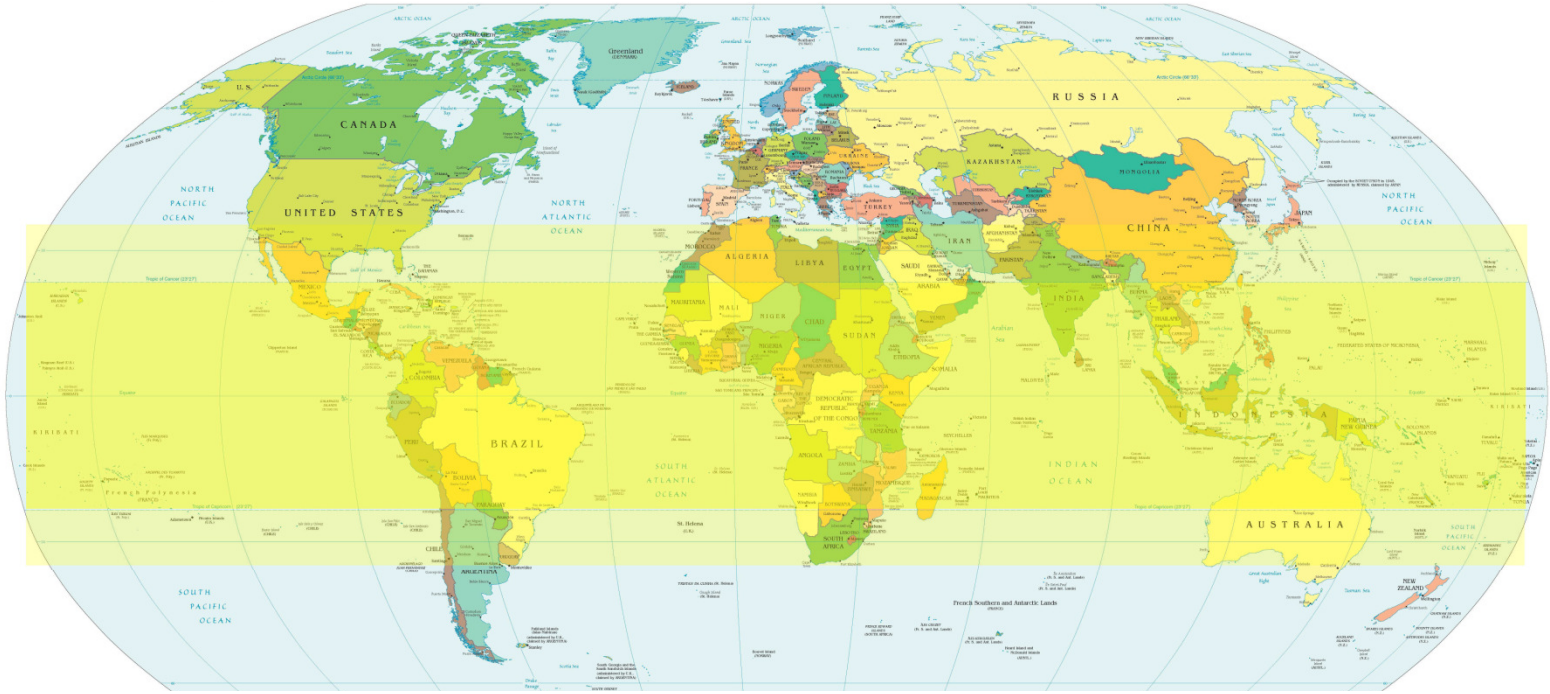
Landscape suitable for mechanization

Good physical characteristics of the soils

Availability of mineral resources (limestone and phosphate)

Source: Contini and Martha Jr., (2010)

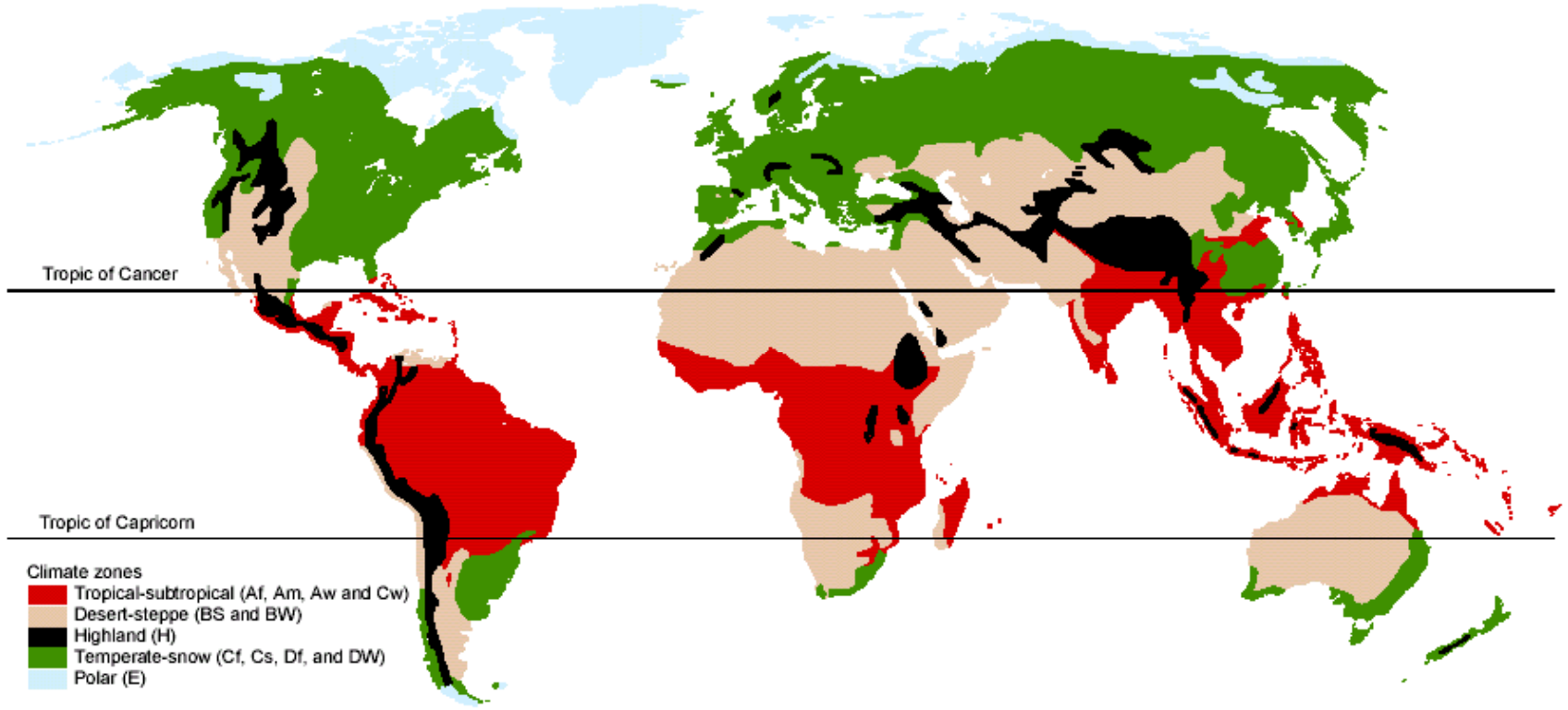
Development of Tropical Agriculture in Brazil



Most of the Brazilian Territory is Located in the Tropical Belt of the World

Embrapa

Development of Tropical Agriculture in Brazil



- Tropical zones are the most challenging to agriculture -

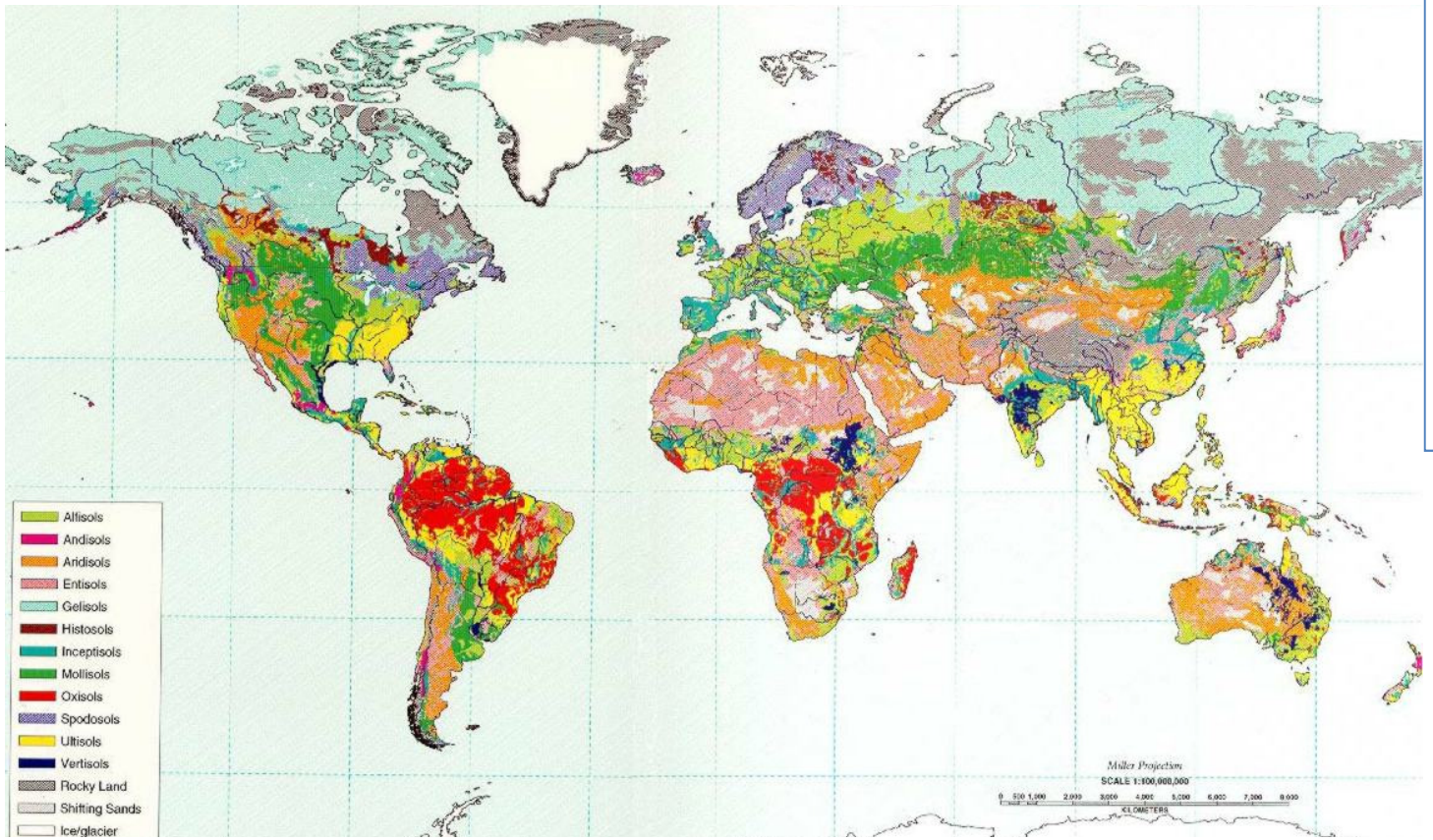
Intense biotic (pests) and abiotic (drought, soil acidity, low nutrients, etc) stresses.

All these challenges will be intensified with the global climatic changes.

Embrapa

Development of Tropical Agriculture in Brazil

World Distribution of Soils



Tropical Soils

Acid – 84%

Saline – 2%

Shallow – 7%

Flooded – 16%

No problem – 9%

Concentration of acidic and nutrient-poor soils in the tropics

http://www.nhq.nrcs.usda.gov/WSR/mapindx/metadata/Maps/ORDERS.JPG

Development of Tropical Agriculture in Brazil

Soil Erosion – Energy Use – Water Conservation

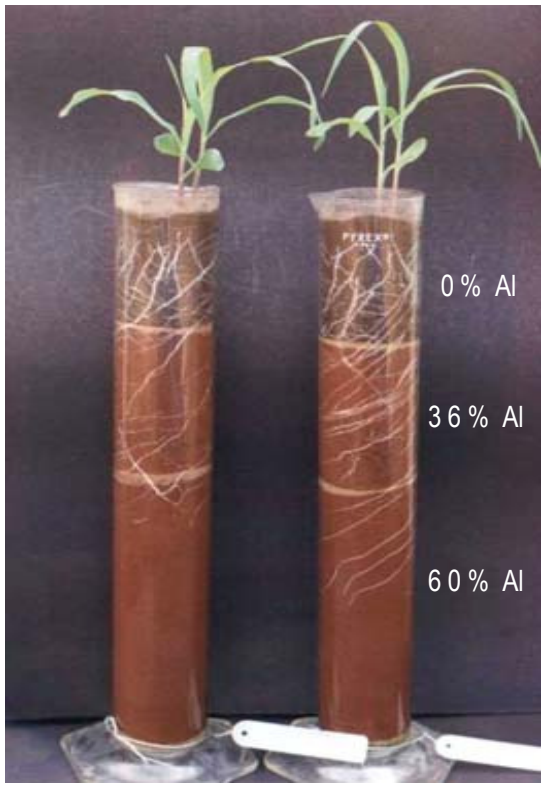




Source: Modified from Oliveira and Trecenti, 2009 – http://tinyurl.com/26ay4cm

Development of Tropical Agriculture in Brazil

Aluminum tolerance and phosphorus use efficiency – Adapting crops to the Brazilian Savannahs



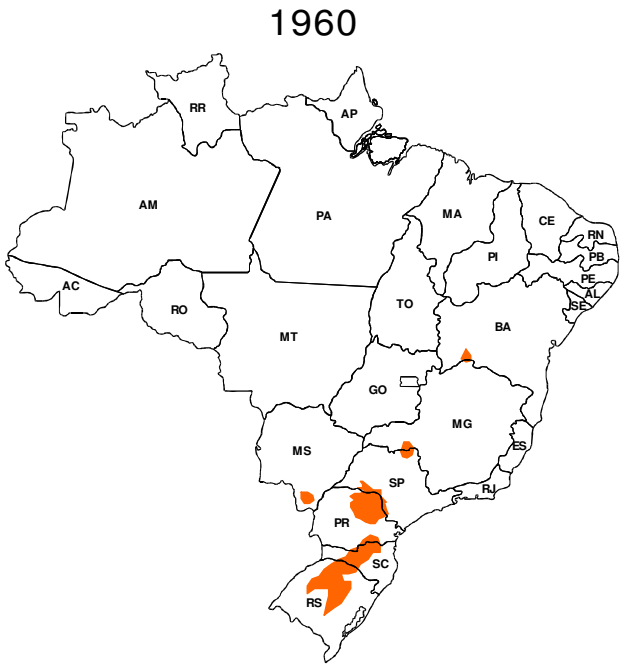
Embrapa

Development of Tropical Agriculture in Brazil

Many species important for food and agriculture not originally adapted to Brazil

http://www.ers.usda.gov/Amberwaves/june03/Features/PlantGeneticResources.htm

Development of Tropical Agriculture in Brazil



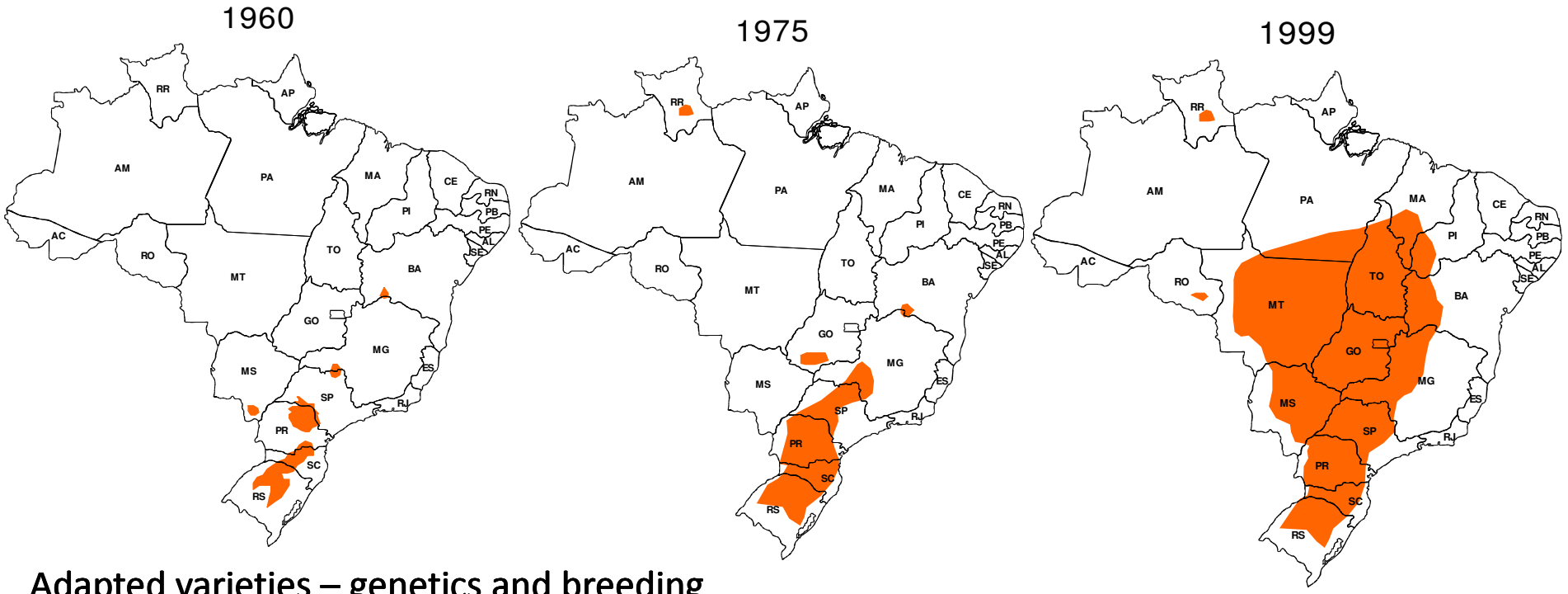
In the 1960´s soybean was adapted only to Southern Brazil

This crop specie was originated in China, in a temperate climate area

Source: Embrapa Soybean

Development of Tropical Agriculture in Brazil

Brazilian Scientists had to “Tropicalize” soybeans



Adapted varieties – genetics and breeding

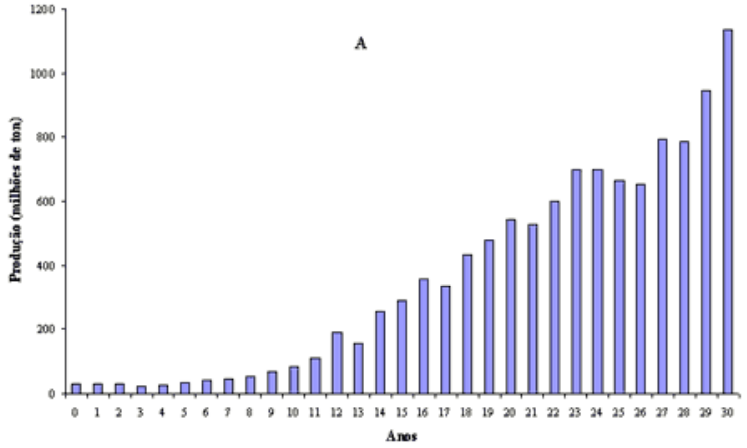
Biological nitrogen fixation

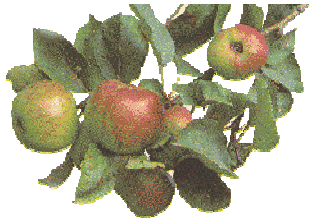
Minimum tillage - mechanization

Source: Embrapa Soybean

Development of Agriculture in Brazil

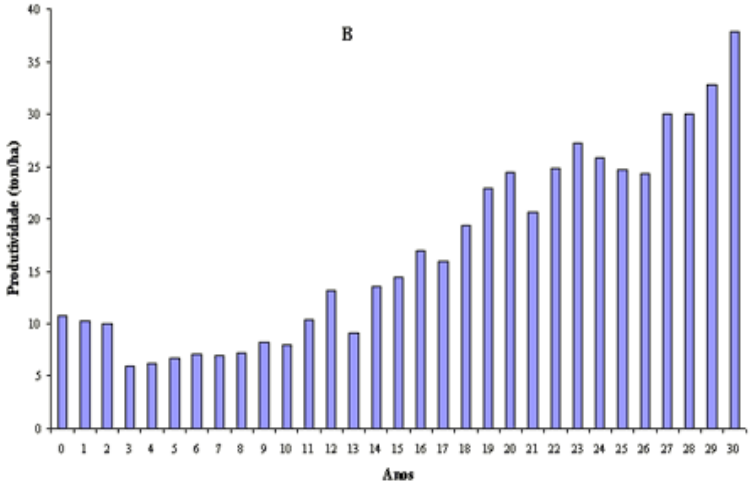
Adapting Apple Production Systems to Southern Brazil





Total production (A) and yield improvement (kg/ha) of apple in Brazil

1970 to 2000



Source: Ramalho, 2001

Domestic Animal Production Systems in Brazil

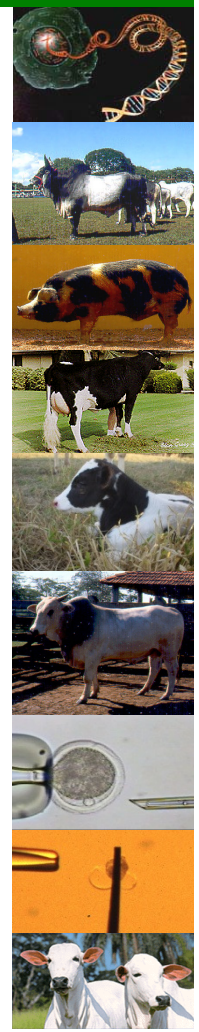
http://www.splice.com.br/english/conteudo/rastreamento.php

Introduction, Conservation and Use of Domestic Animal Genetic Resources in Brazil

Breeding and Genetics for Development of Tropically Adapted Breeds

Cattle
Poulty
Swine
...

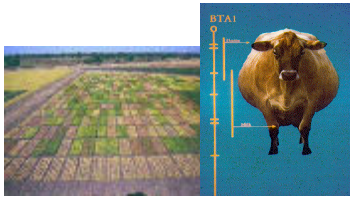
Meat – Milk – Eggs
...



Embrapa

Developing New, Cutting-Edge Tecnologies

Incorporating New Tools and Advances from Life Sciences to Agriculture



MOLECULAR TOOLS

MOLECULAR BREEDING

Molecular Markers/Maps
Genetic Resources Charc.
Gene/Trait Mapping
Function Characterization

GENETIC ENGINEERING

TRANSGENIC TECHNOLOGY

Biotic Stress Tolerance
Abiotic Stress Tolerance
Quality/Functionality
New Bioproducts

GENOMIC SCIENCES

GENOMICS PROTEOMICS

Coffee
Eucalyptus
Banana/Rice
Bovine & Others

ADVANCED REPRODUCTION

CLONING IN-VITRO FERTILIZATION

Animal Breeding
GR Conservation
Germplasm Enhancement
Biofactories

BIOSAFETY, BIOINFORMATICS, PROTEOMICS, METABOLIC ENGINEERING, ETC...

Embrapa

Developing New, Cutting-Edge Tecnologies

BASF and Embrapa's Cultivance®soybeans receive approval for commercial cultivation in Brazil

2010-02-05
P-10-148

- First genetically modified crop developed in Brazil to reach commercialization stage
- Market launch to take place after regulatory approval in key export markets

BASF and Embrapa's Cultivance® soybeans receive approval for commercial cultivation in Brazil

Cultivance® is the first genetically modified crop developed in Brazil, from laboratory to commercialization. The approval is the result of more than 10 years of successful cooperation between Embrapa and BASF, a global leader in providing agricultural solutions. The Cultivance® Production System combines herbicide-tolerant soybean varieties with BASF's broad spectrum imidazolinone class of herbicides, tailored to regional conditions. Photo: BASF - The Chemical Company, 2010

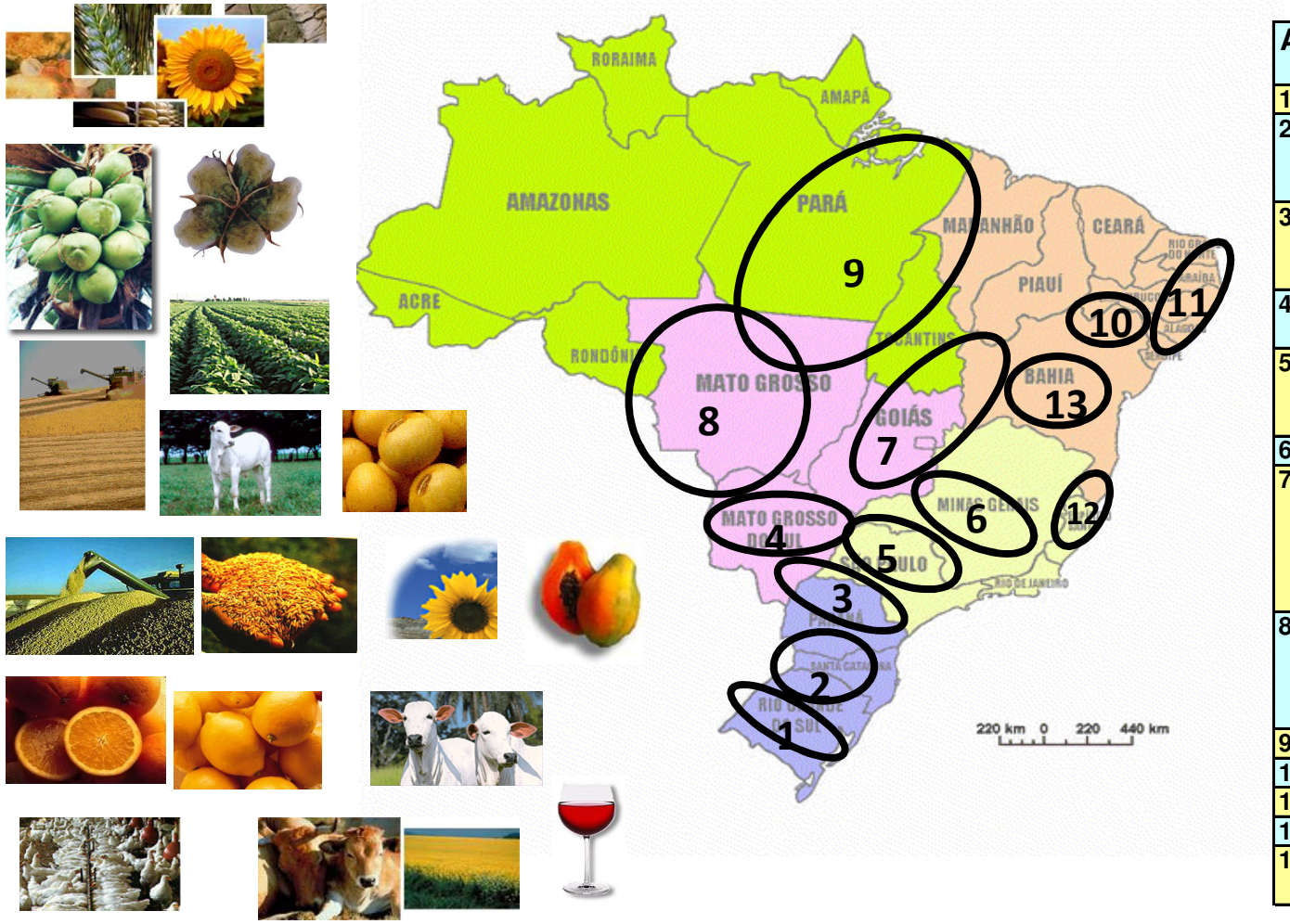
Source: http://www.basf.com/group/pressrelease/P-10-148

Major Impacts of Agricultural Innovation in Brazil

Embrapa

Development of Tropical Agriculture in Brazil

Scientific Innovation Helped Brazil to Develop a Diverse and Dynamic Agriculture



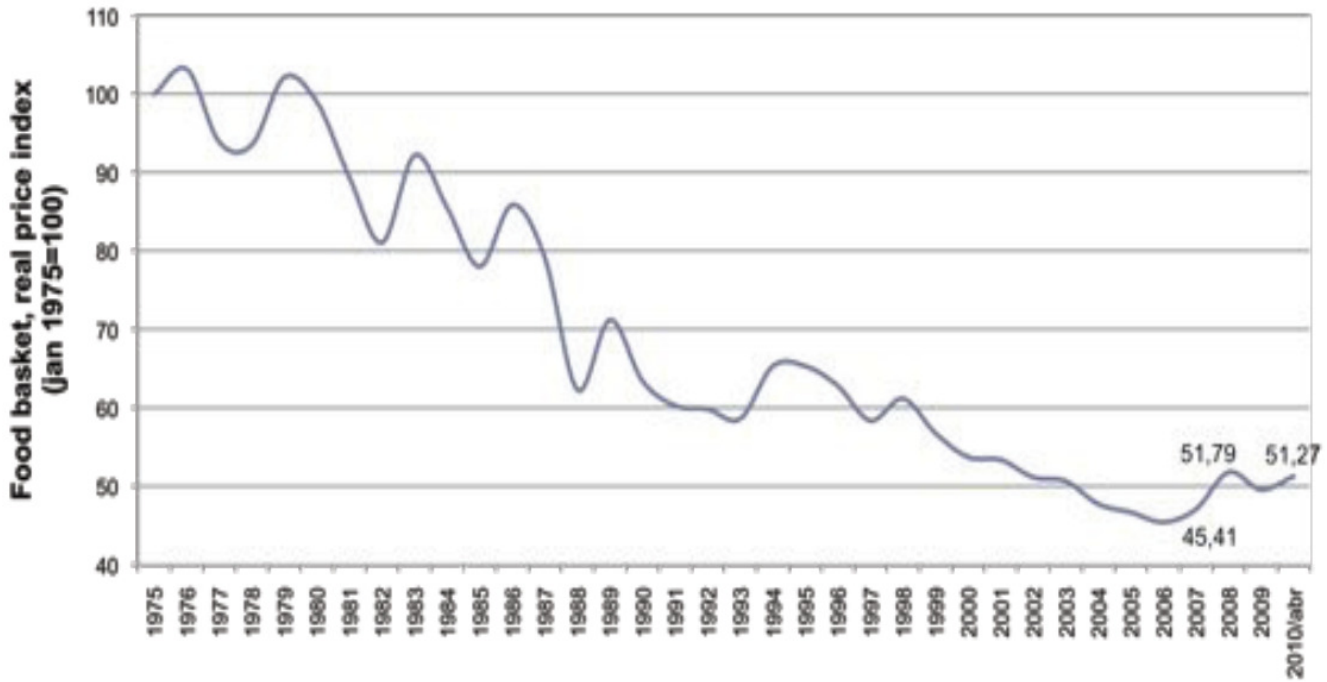
AREA/ MAIN CROPS	MM HA
1- FLOODED RICE	0.95
2- SOYBEAN	3.30
CORN	1.30
WHEAT	0.60
3- SOYBEAN	3.20
CORN	2.40
WHEAT	0.90
4- SOYBEAN	1.20
PASTURE	11.00
5- SUGARCANE	2.50
COFFEE	0.30
CITRUS	0.70
6- COFFEE	1.00
7- SOYBEAN	1.80
CORN	0.80
COTTON	0.10
DRYBEANS	0.20
PASTURE	9.00
8- SOYBEAN	3.30
COTTON	0.50
CORN	0.40
PASTURE	12.00
9- PASTURE	10.00
10- TROPICAL FRUITS	0.07
11- SUGARCANE	0.90
12- COFFEE	0.60
13- DRYBEANS	0.70
SOYBEAN	0.90

Development of Tropical Agriculture in Brazil

Agricultural Innovation Allowed Brazil to Become Food Secure in a Short Period of Time

Embrapa
Estudos Estratégicos e Capacitação

Food Basket: Real Prices, Jan/1975 – Apr/2010



Source: Martha Jr., data from Dieese (2010)

Development of Tropical Agriculture in Brazil

Agricultural Innovation Allowed Brazil to Become an Important Exporter

Exports

In 2008 Brazil exported more than 1500 types of agricultural products to foreign markets

Commercial partners

Around 79% of the Brazilian food production is consumed domestically and 21% is shipped to over 212 foreign markets

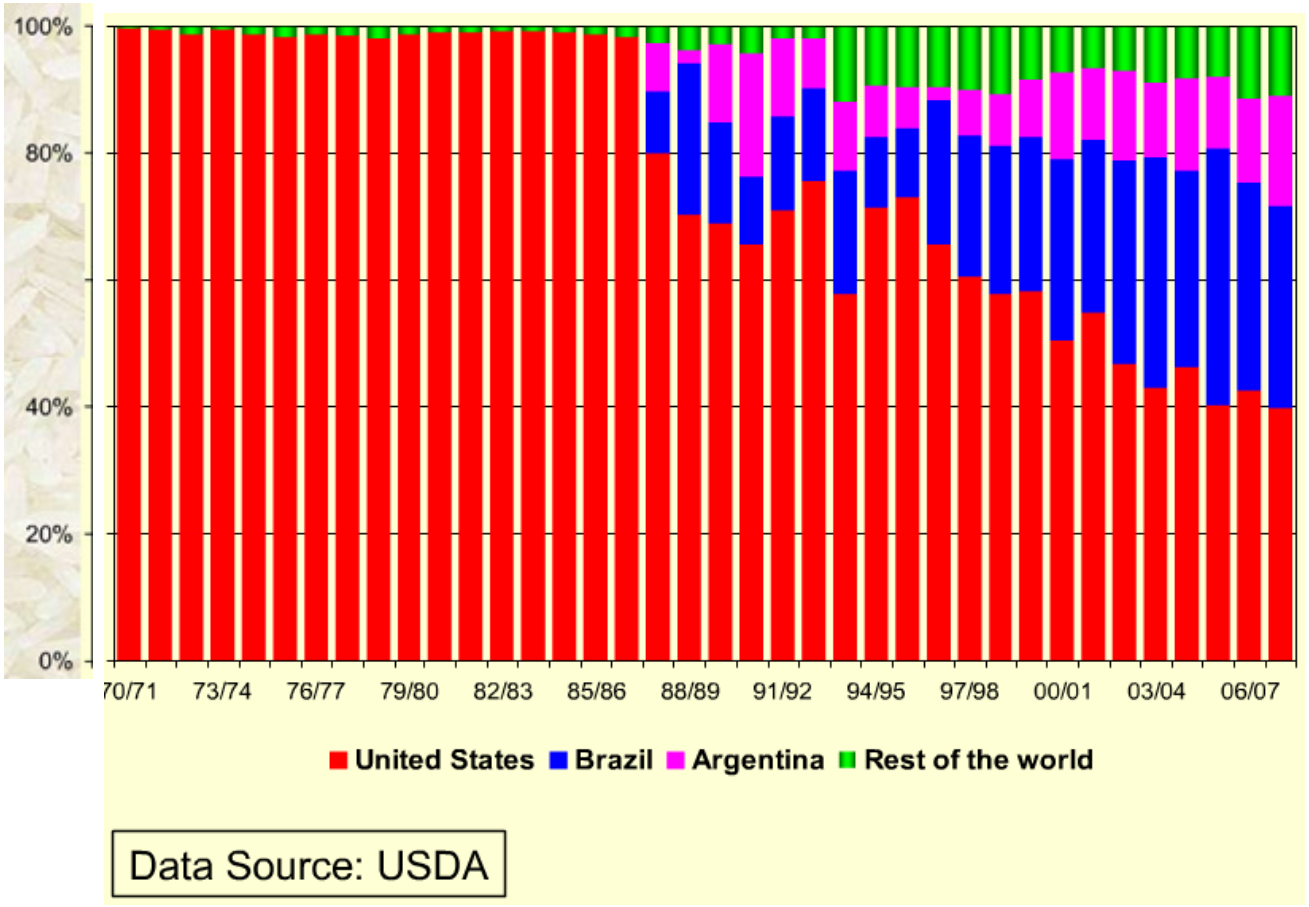
Product	Production	Exports
Sugar	1st	1st
Orange juice	1st	1st
Coffee	1st	1st
Beef	2nd	1st
Soybean	2nd	1st
Tobacco	3rd	1st
Broiler	3rd	2nd
Corn	3rd	4th

Source: SPA/MAPA (Agricultura Brasileira em Números)

Embrapa

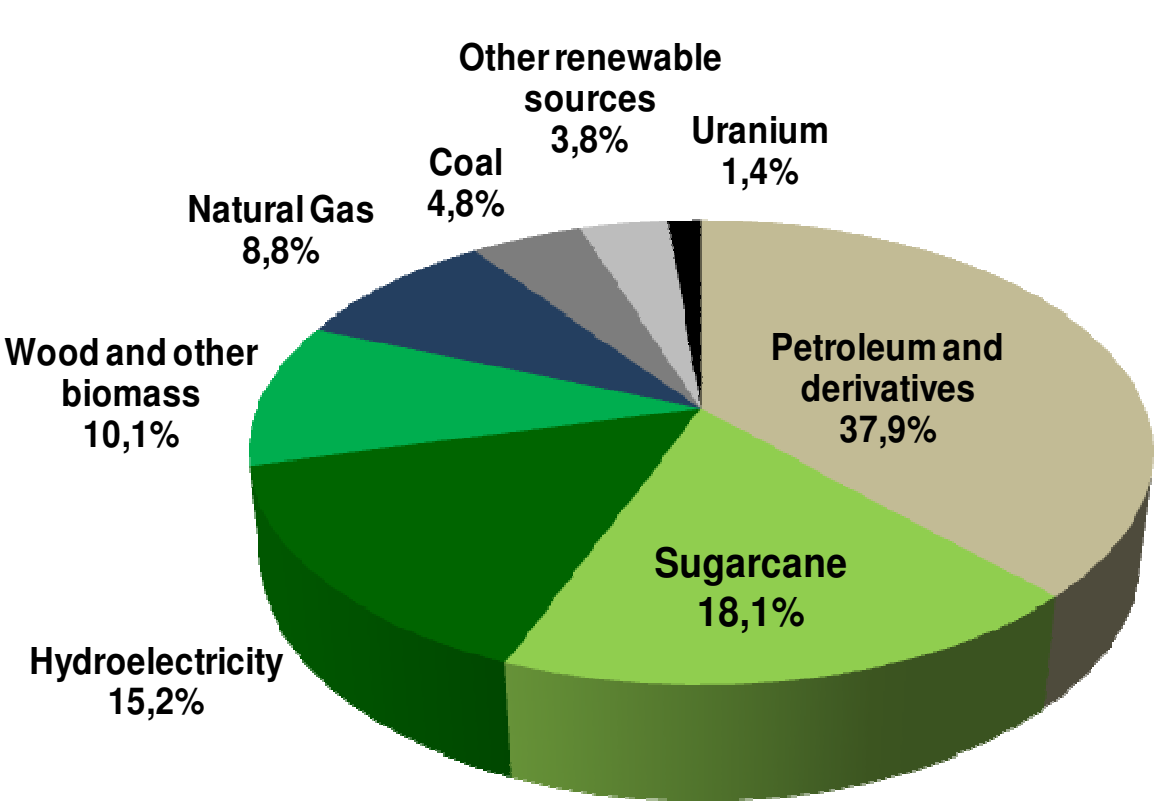
Development of Tropical Agriculture in Brazil

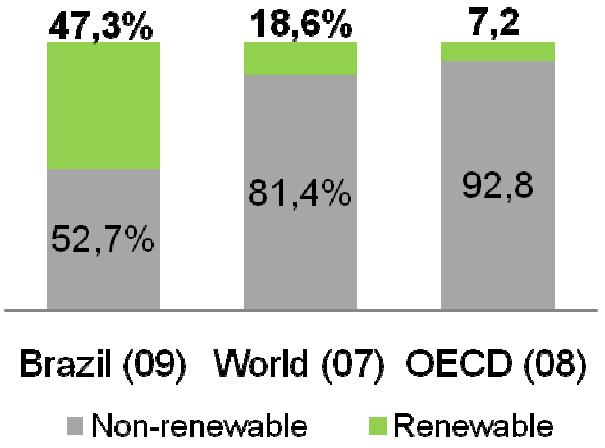
Changes in the global soybean market



Development of Tropical Agriculture in Brazil

Agricultural Innovation Helped Brazil to Develop a Clean Energy Matrix





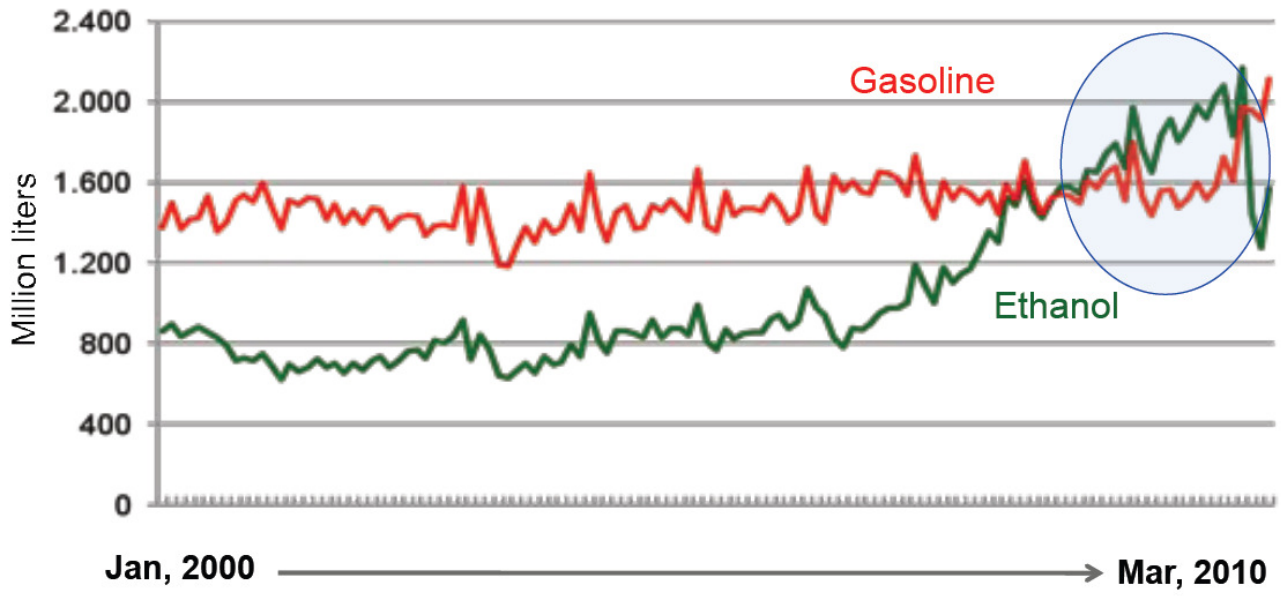
Source: BEN (2010). Elaboration: UNICA

Development of Tropical Agriculture in Brazil

'In Brazil, Gasoline is Becoming the Alternative Fuel'

Embrapa
Estudos Estratégicos e Capacitação

Consumption of Gasoline and Ethanol in Brazil



Source: ANP. Elaboration: UNICA.

Tropical Agriculture and Natural Resources Conservation and Use in Brazil

Embrapa

Brazil, the "Natural Knowledge-Economy"

"We are used to thinking of knowledge economies and natural resource economies as being at two ends of a continuum of economic development."

Brazil is bound to break this logic...

"Growing scientific and technological capability is not separate from, or in opposition to, natural resources and endowments, but integrally linked to them.

From hydropower to biofuels and agriculture, from biodiversity development to the climate change properties of the Amazon rainforest, Brazilian innovation is at its best when applying the ingenuity of its people to its natural assets."

Embrapa

Source: The Atlas of Ideas – Demos Institute, 2008

Conservation Strategies

Protected Areas

Brazil has a total of over 90 million ha in Protected Areas within the National System of Conservation Units (SNUC)

65 mi ha under the stewardship of the Federal Government, and 28 mi are under the stewardship of State Conservation Agencies.

SNUC also includes municipal and private protected areas.

Source: MMA/Brazil

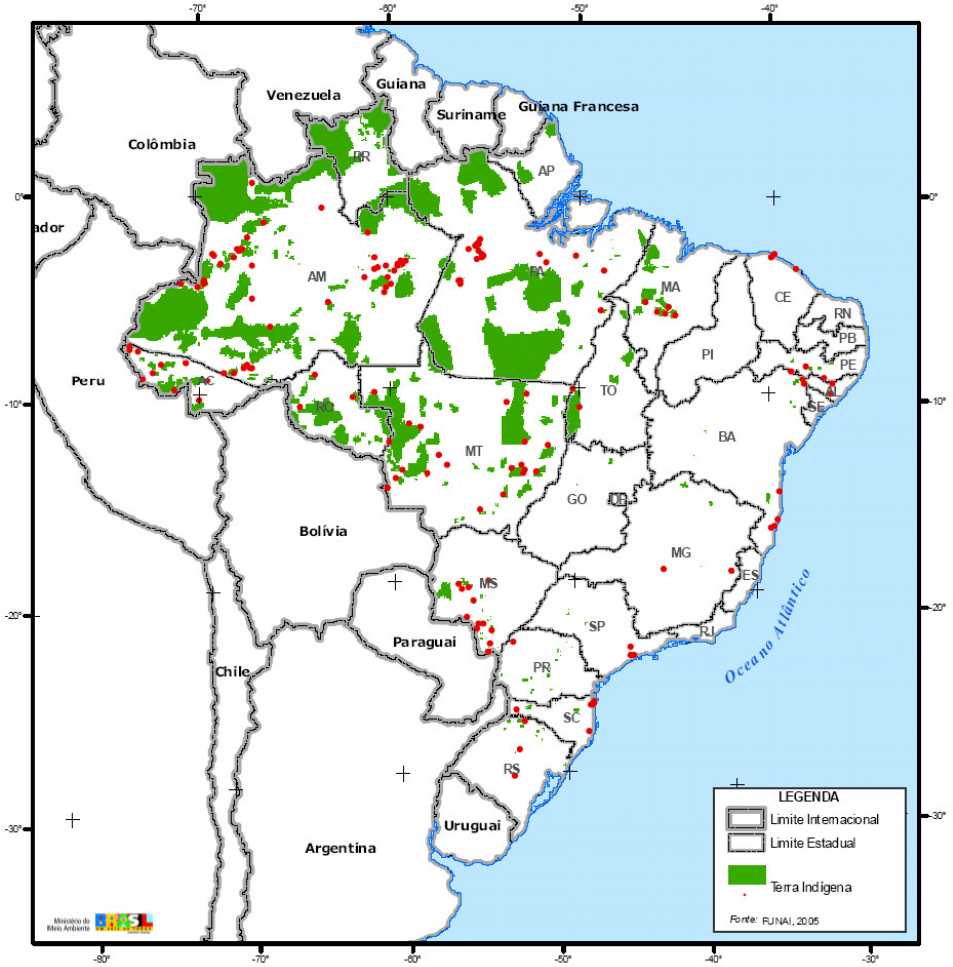
Conservation Strategies

Indigenous Lands

Brazil has reserved over 110 million hectares as Indigenous Lands, which also play a key role as protected areas for biodiversity.

Together, the SNUC and the Indigenous Lands cover more than 200 million hectares (or about 23% of the Brazilian Territory).

Additionally, our Forestry Code requires each private property to set aside as Areas for Permanent Protection the natural vegetation along rivers, slopes, mountains and habitats for endangered species.



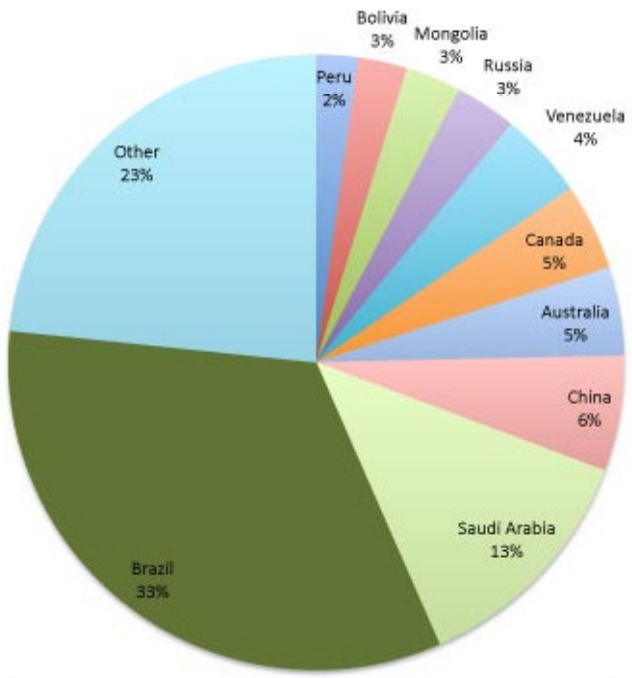
580 Indigenous Lands
~ 110 millions ha
11,58% Brazilian Territory

Source: MMA/Brazil

Conservation Strategies

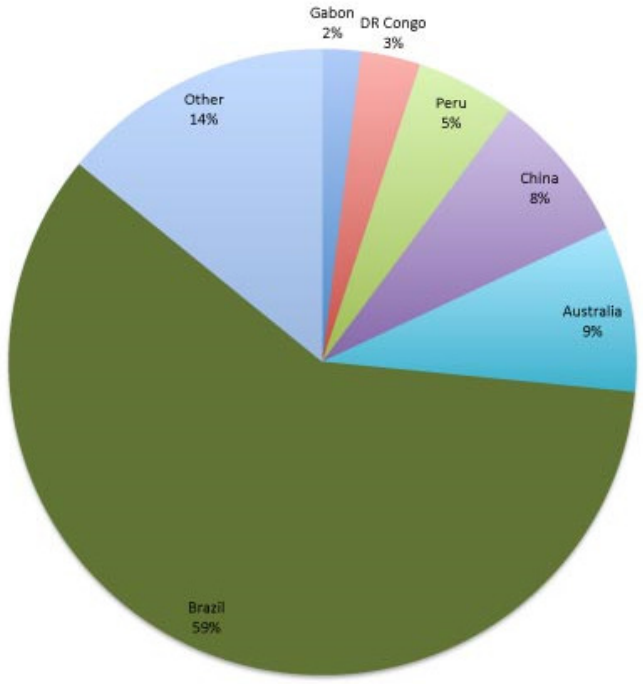
Brazil now has the largest area of protected land (2.52 million sq km), according to the UNEP-WCMC data.

Share of terrestrial protected areas, established since 1990



mongabay.com using UNEP World Conservation Monitoring Centre data

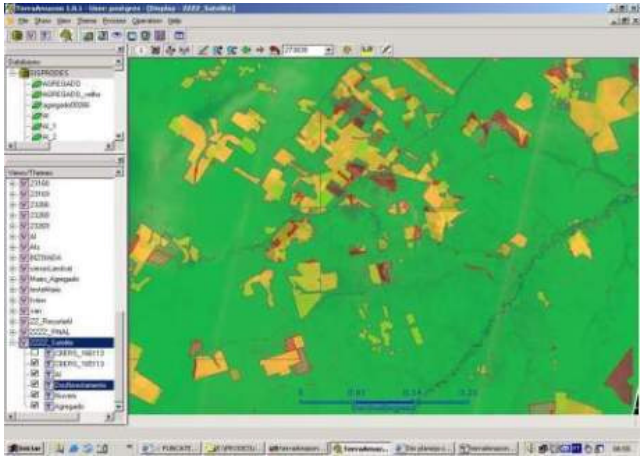
Share of terrestrial protected areas, established since 2000

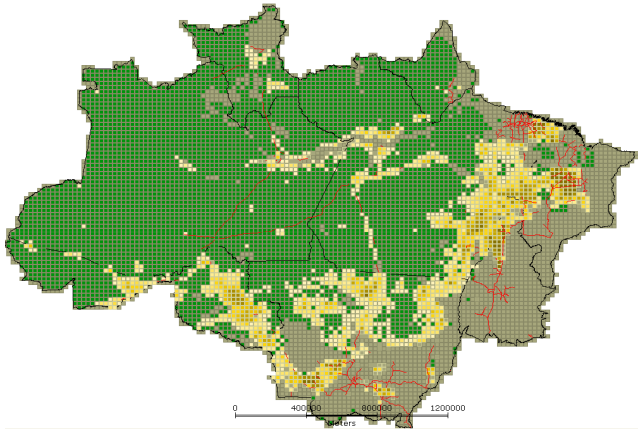


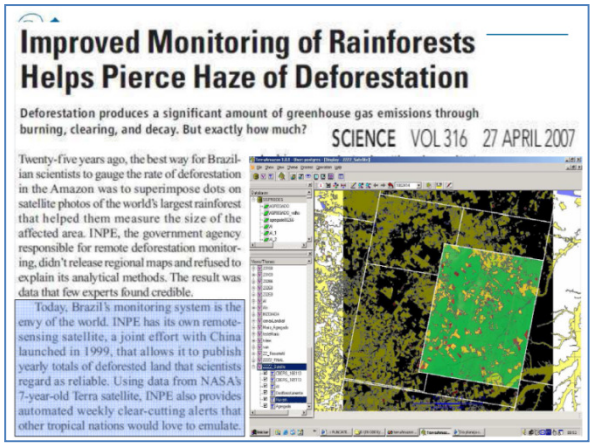
mongabay.com using UNEP World Conservation Monitoring Centre data

Monitoring and Reducing Deforestation

Monitoring Amazon deforestation: PRODES







Improved Monitoring of Rainforests Helps Pierce Haze of Deforestation

Deforestation produces a significant amount of greenhouse gas emissions through burning, clearing, and decay. But exactly how much?

SCIENCE VOL 316 27 APRIL 2007

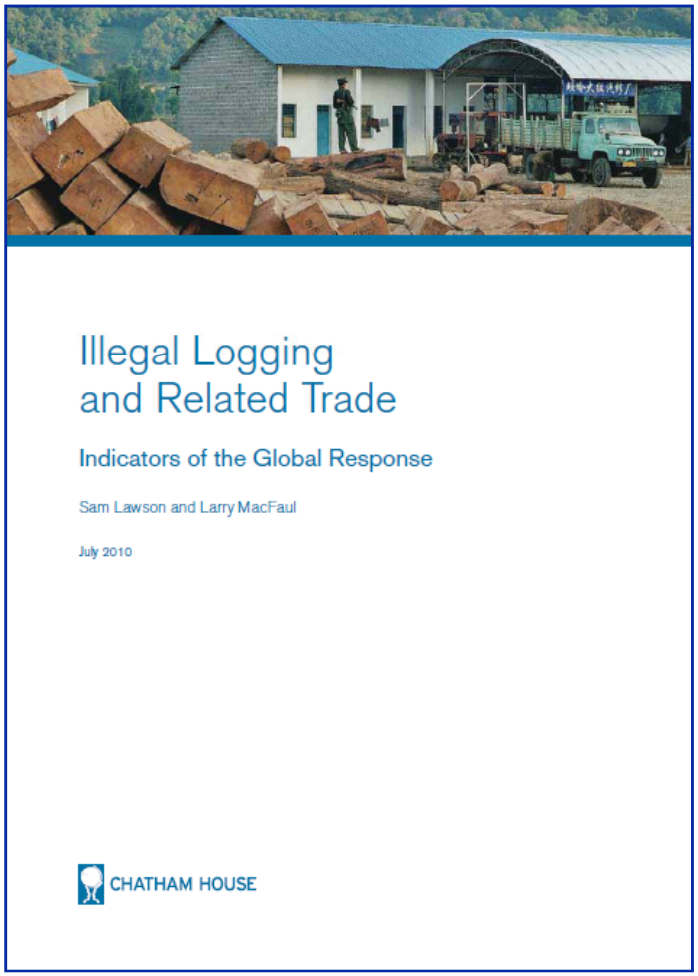
Twenty-five years ago, the best way for Brazilian scientists to gauge the rate of deforestation in the Amazon was to superimpose dots on satellite photos of the world's largest rainforest that helped them measure the size of the affected area. INPE, the government agency responsible for remote deforestation monitoring, didn't release regional maps and refused to explain its analytical methods. The result was data that few experts found credible.

Today, Brazil's monitoring system is the envy of the world. INPE has its own remote-sensing satellite, a joint effort with China launched in 1999, that allows it to publish yearly totals of deforested land that scientists regard as reliable. Using data from NASA's 7-year-old Terra satellite, INPE also provides automated weekly clear-cutting alerts that other tropical nations would love to emulate.

Brazil is the world leader in use of satellite images to monitor deforestation in the tropics

Source: INPE.

Monitoring and Reducing Deforestation

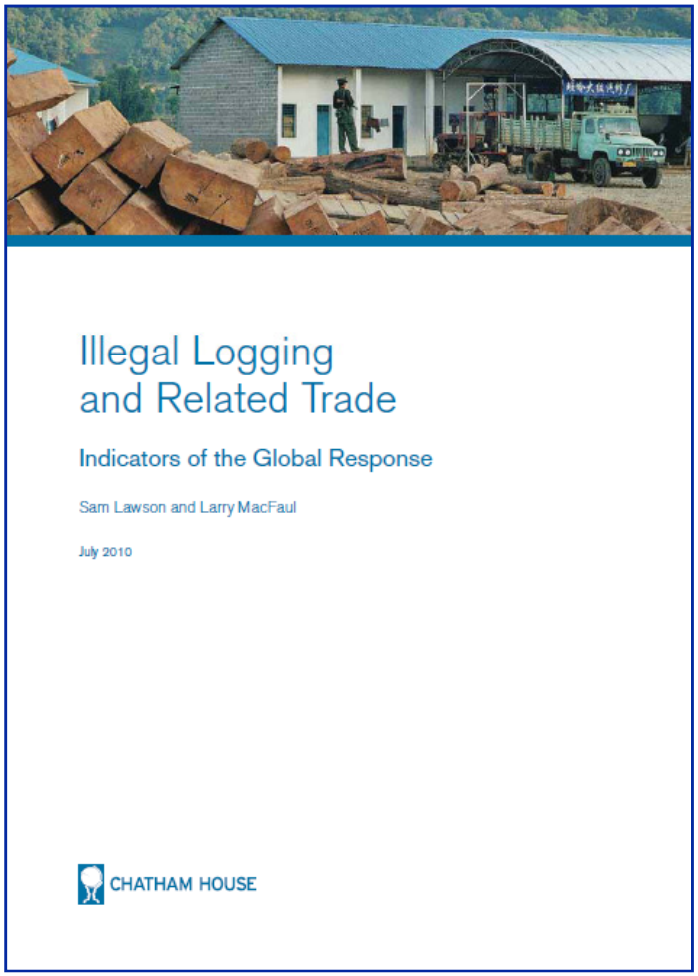


Illegal logging is estimated to have fallen during the last decade between 50 and 75 per cent in the Brazilian Amazon;

Brazil scored the highest in many important areas of the government response, thanks to a major overhaul of laws, policies and regulations during the last five years.

Source: Illegal Logging and Related Trade - Indicators of the Global Response
Sam Lawson and Larry MacFaul, July 2010
Chatham House, UK.

Monitoring and Reducing Deforestation



The country is particularly strong in relation to high-level policies, timber tracking, resource allocation and transparency;

Wood-balance analysis indicates that illegal logging has fallen by 54–75 per cent in the Brazilian Amazon over the last ten years;

The greatest reductions have occurred in the last five years, and show a close correlation with a dramatic fall in deforestation rates.

Source: Illegal Logging and Related Trade - Indicators of the Global Response
Sam Lawson and Larry MacFaul, July 2010
Chatham House, UK.

Monitoring and Reducing Deforestation

Source: http://photos.mongabay.com/08/1212target_deforestation_brazil.jpg

How Sustainable is Agriculture in Brazil?

Embrapa

Sustainable Agriculture

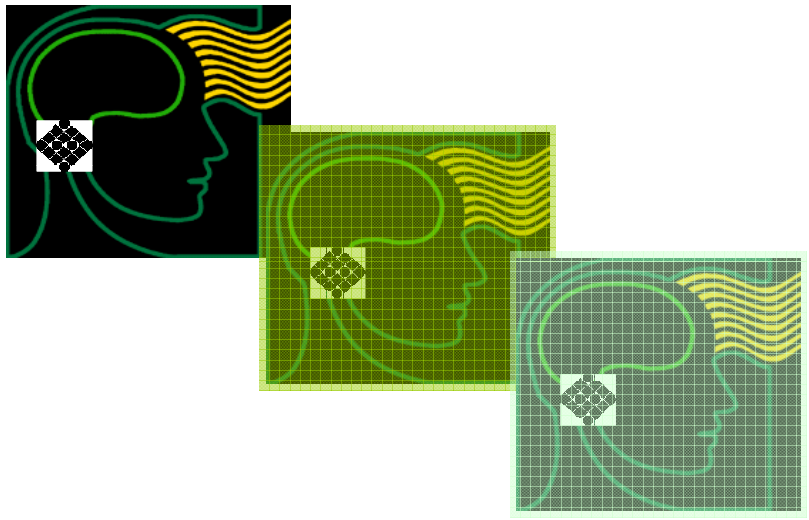
Sustainable development is one of the most challenging goals for mankind, and is vital to Brazil!

Embrapa

Sustainable Agriculture

"No concise, universally acceptable definition of sustainable agriculture has yet emerged.

This is so because sustainability is often viewed as a management philosophy rather than a method or process of operation and, as such, acceptance or rejection of any definition is linked to one´s value system."

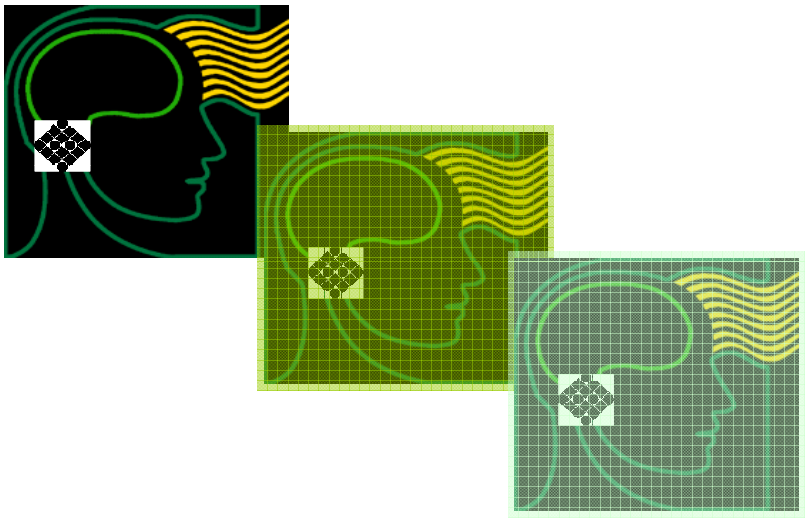


Source: Heitschimidt et al, 1996, cited by Contini and Martha Jr., (2010)

Sustainable Agriculture

"However, it is well accepted that sustainability's dimensions – technical, economic, social and environmental – must be always pursued.

These dimensions have strong interdependence linkages and, ideally, should be simultaneously met. "

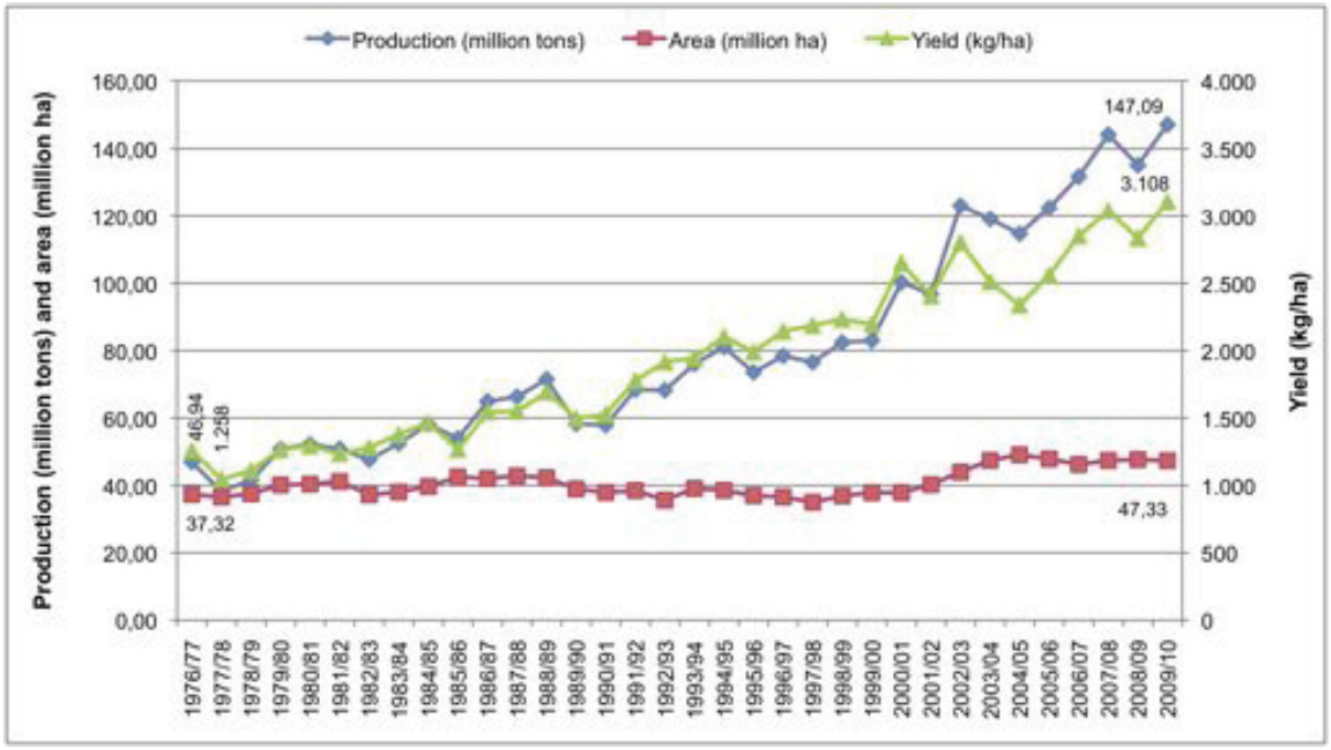


But we should keep in mind that it is not a trivial task to design strategies that always return win-win situations, e.g., simultaneous gains in all sustainability dimensions…

Source: Contini and Martha Jr., (2010)

Evolution of Agricultural Systems in Brazil

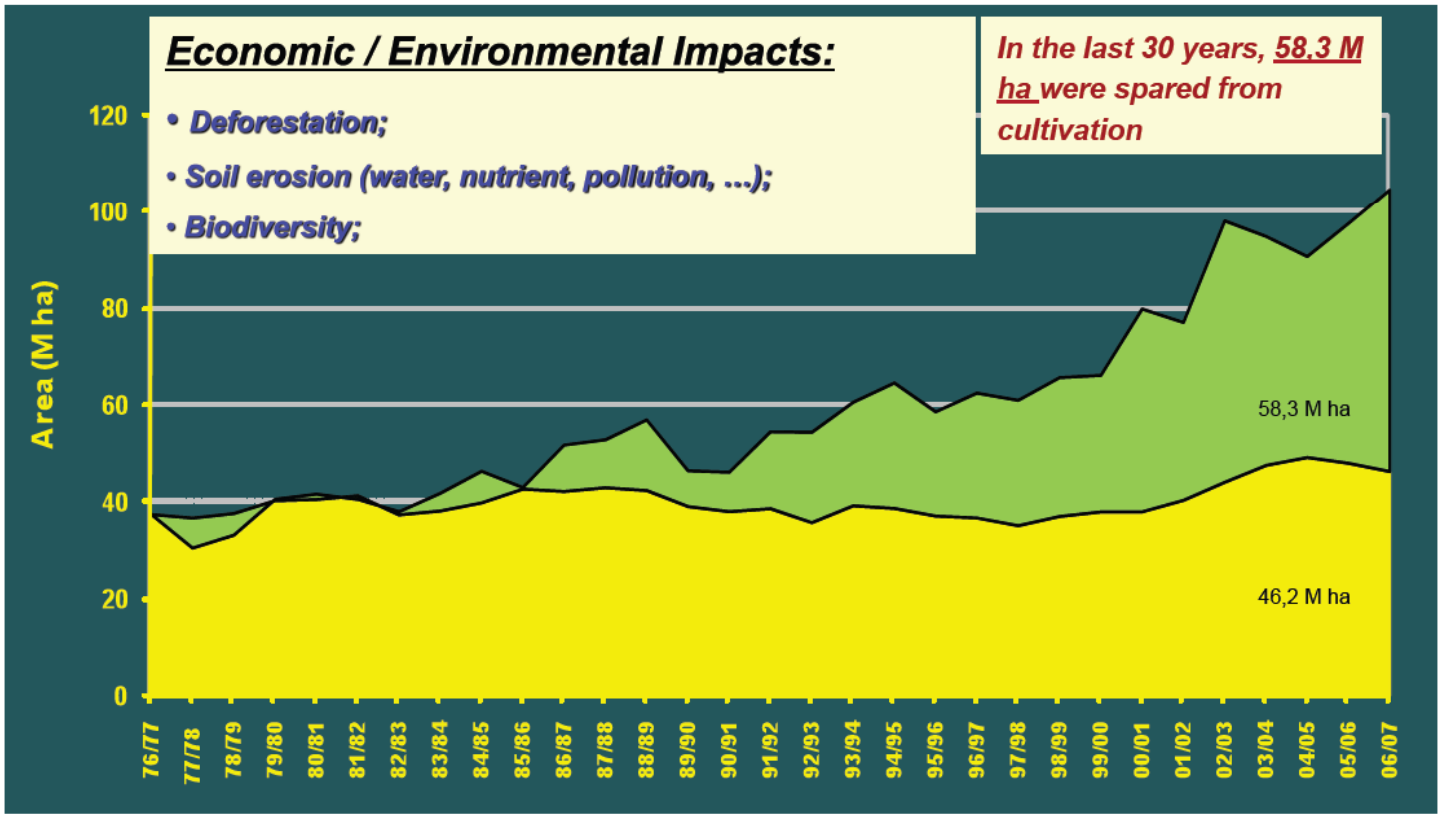
Evolution of grains and oilseeds production (million metric tons), yields (Kg/ha) and area (million hectares) in Brazil from 1975 to 2010.



Source: Contini and Martha Jr., data from CONAB (2010)

Evolution of Agricultural Systems in Brazil

Without advances in crop productivity and increased agricultural system´s efficiency, additional 58 million ha would have been necessary to reach today´s production



Source: G.B. Martha Jr., (2008), data from Conab (2007)

Legal Restrictions to Land Utilization

Region	Legal Reserve	Land Available for economical use
Amazon Forest	80%	20%
Savannas neighboring Amazon	35%	65%
Other areas	20%	80%

- Brazil has the largest extension of arable lands in the world;
- Brazil contains the greatest diversity of ecosystems and unique biodiversity;
- Brazilian legislation protects preserved areas of all biomes.

Also, it is mandatory to preserve river banks, areas around lagoons, lakes or water reservoirs, peaks, among others.

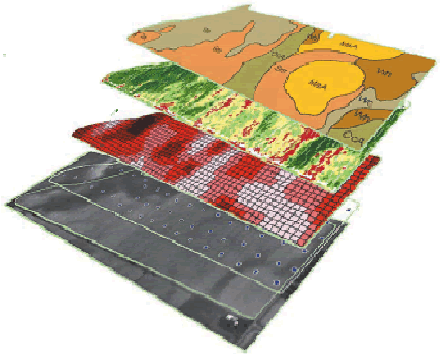
Source: MAPA, 2010

Conservation Agriculture in Brazil

In the last decades, farmers are steadily adopting conservation practices, such as no-till planting, and more resource-efficient processes, such as integrated crop-livestock systems

Embrapa

Good agricultural Practices – A priority!!

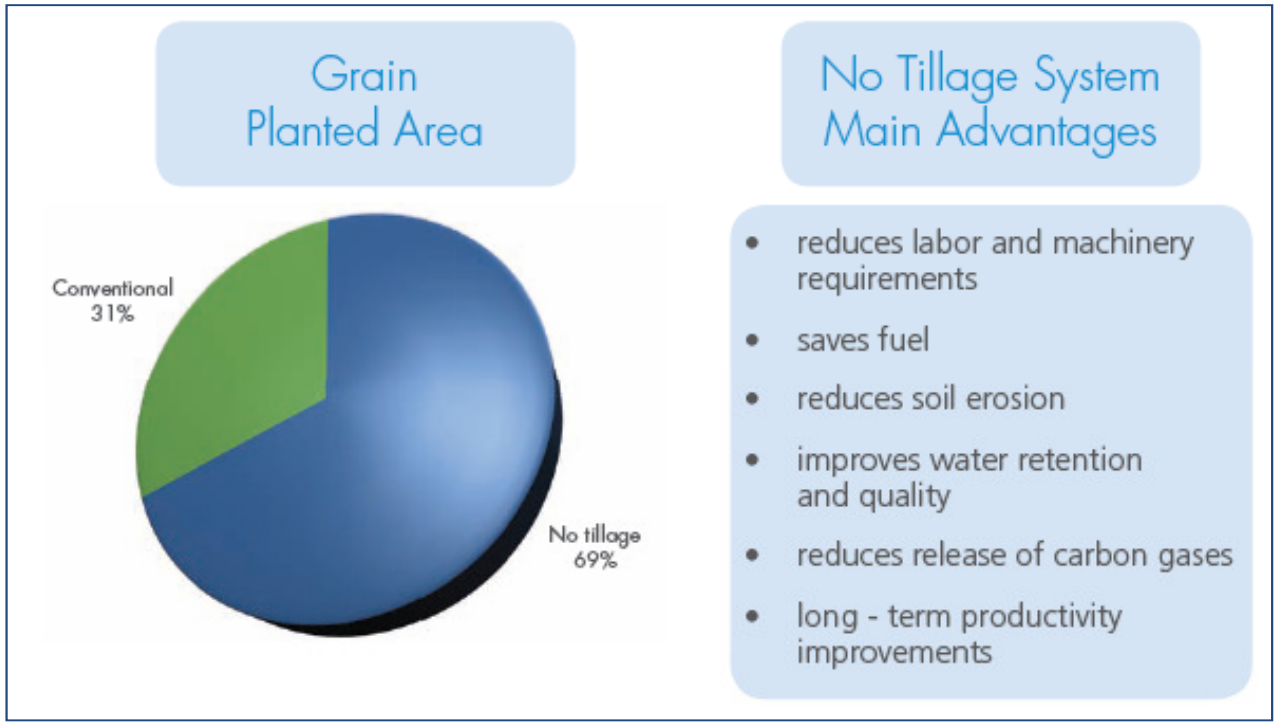


- Use of varieties adapted to local soil and climate conditions;
- Integrated crop-livestock-forestry production systems;
- No Tillage System (saves energy, controls erosion);
- Use of clean energy sources:
  - agrienergy: biofuels, biodigesters, wind and solar energy;
- Use of alternative techniques that dispense agricultural chemicals (biological control and integrated pest management);
- Adoption of micro basins as the basic planning units for rural land use.

Embrapa

Source: MAPA, 2010

Conservation Agriculture

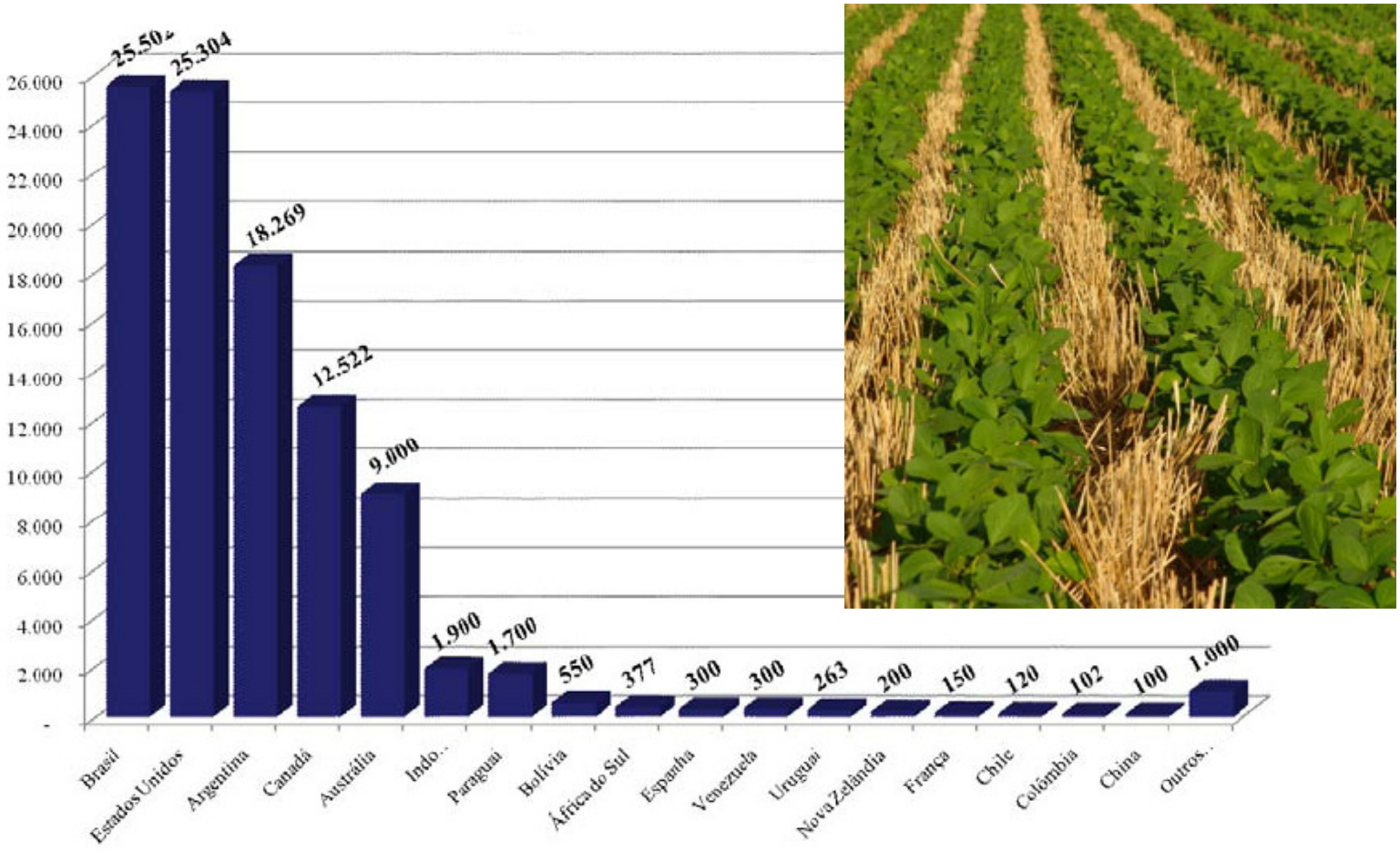


No tillage system is a way of growing crops without disturbing the soil through ploughing. It has increased fast in Brazil and is largely used in grain production.

Source: MAPA, 2010

Conservation Agriculture in Brazil

Cultivated area under no-tillage systems around the world (1000 ha)



Source: Federação Brasileira de Plantio Direto na Palha – FEBRAPDP, 2006

Conservation Agriculture in Brazil

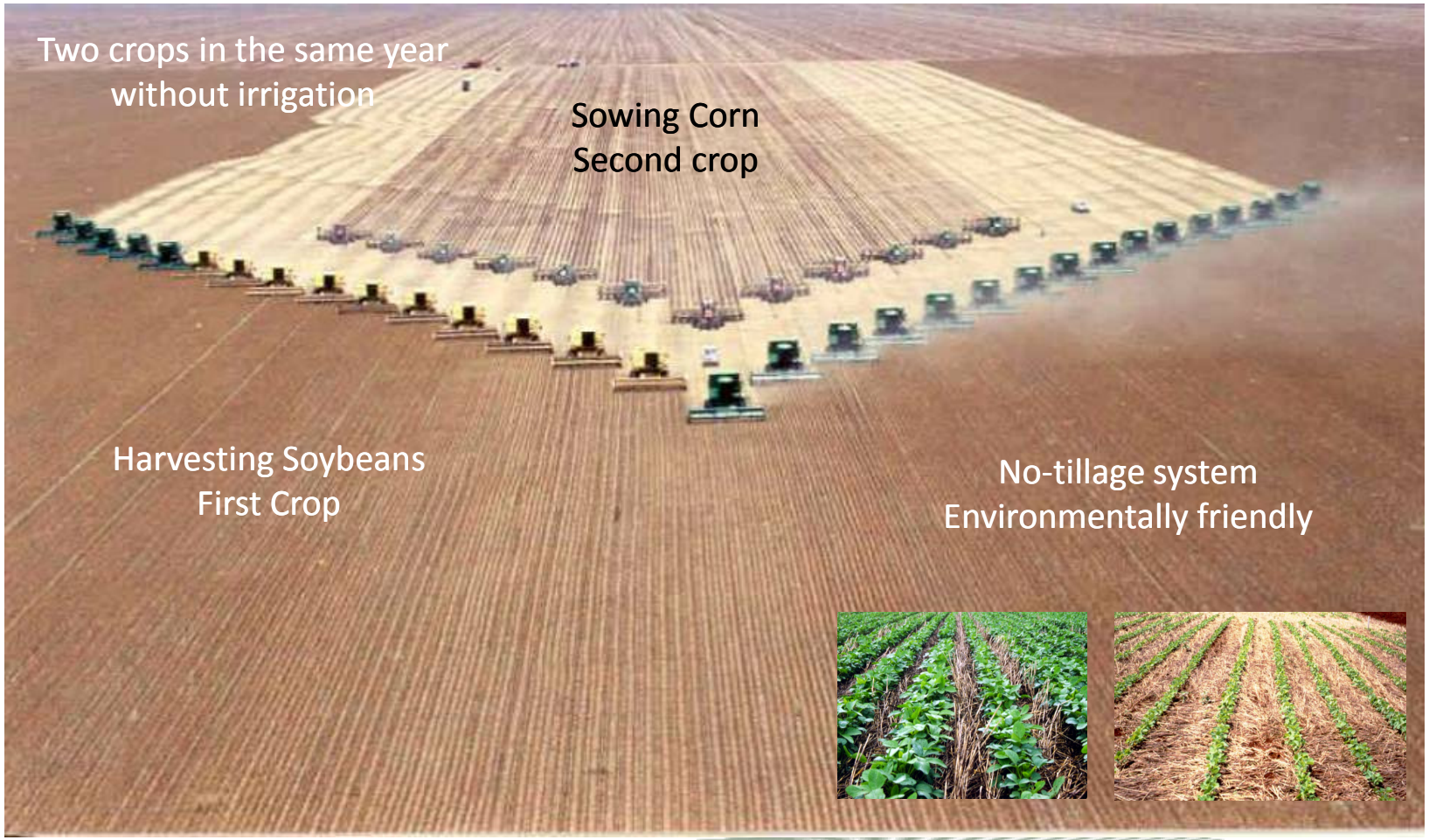
Drastic reduction in soil erosion – improved chemical, physical and biological properties

Reduction in energy use - Agriculture is becoming a major “producer” of clean water

Source: Modified from Oliveira and Trecenti, 2009 – http://tinyurl.com/26ay4cm

Conservation Agriculture in Brazil

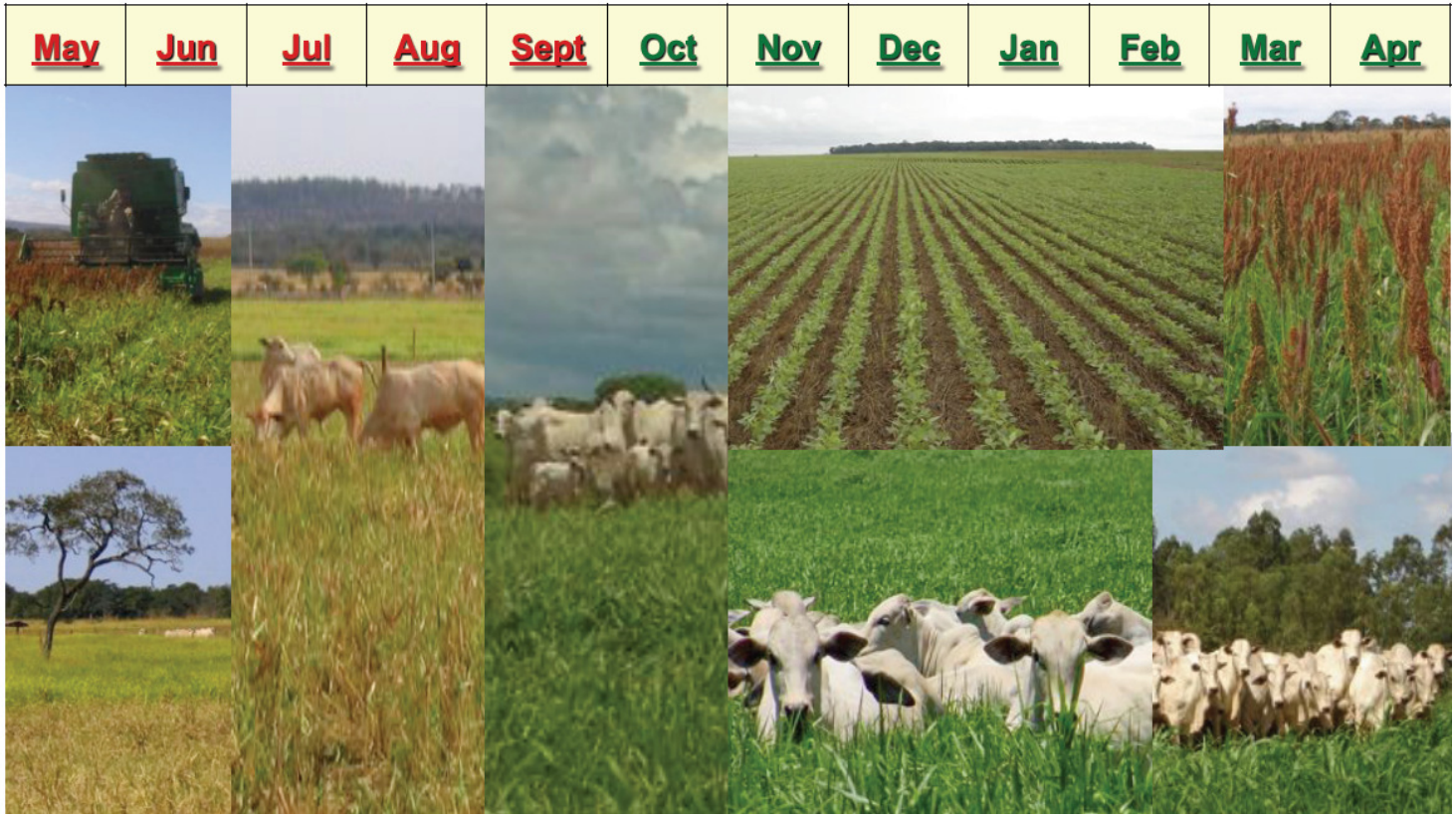
Double Cropping Systems - Corn after Soybean



Embrapa

Conservation Agriculture in Brazil

Integrated Crop-Livestock Systems



Source: Contini and Martha Jr., 2010

Conservation Agriculture in Brazil

Avoiding deforestation by intensification of use of areas already opened

Under the Brazilian Climate Change Law, from December 2009, 15 million hectares of degraded land (mostly pastures) will be recovered.

iLPF
Integração Lavoura-Pecuária-Floresta

Source: Contini and Martha Jr., 2010 and Martha Jr., 2010

Conservation Agriculture in Brazil

Intensification of land use with integrated crop-livestock-forest systems
Large Scale Operations

Source: MAPA, 2010 – Photos by Votorantin Metais

Conservation Agriculture in Brazil

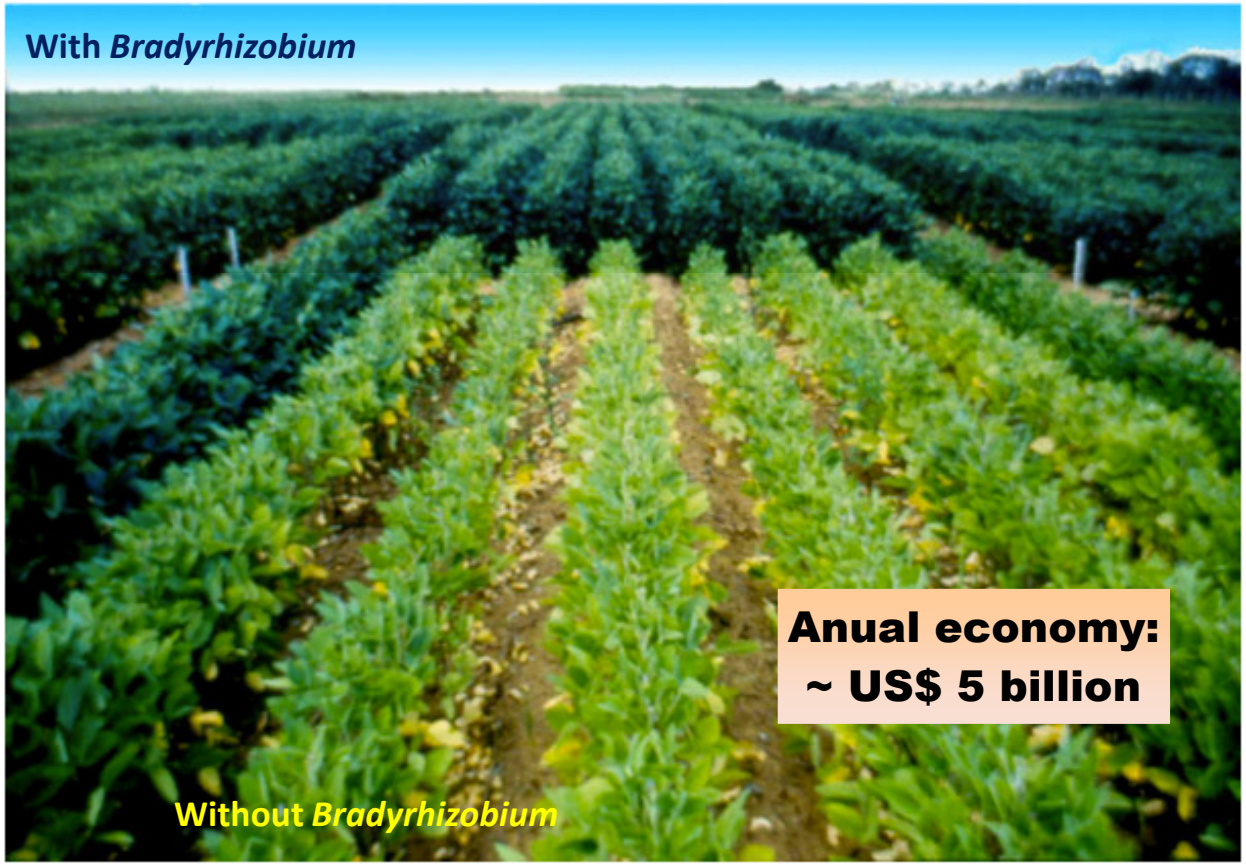
Intensification of land use with integrated crop-livestock-forest systems
Technologies Adapted to Small Scale Farming Systems

Source: MAPA, 2010 – Photo by APDC

Biological Nitrogen Fixation

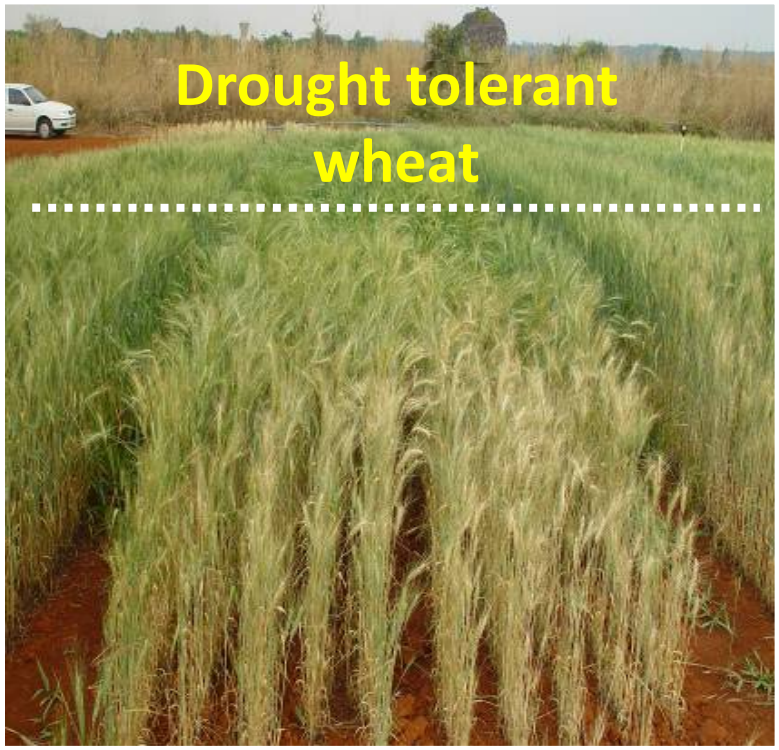
Brazil has become the world leader in replacing N fertilizers by biological N_2 fixation (BNF).

Nitrogen fixation occurs in nodules on legume roots (Source: FAO, Rome)



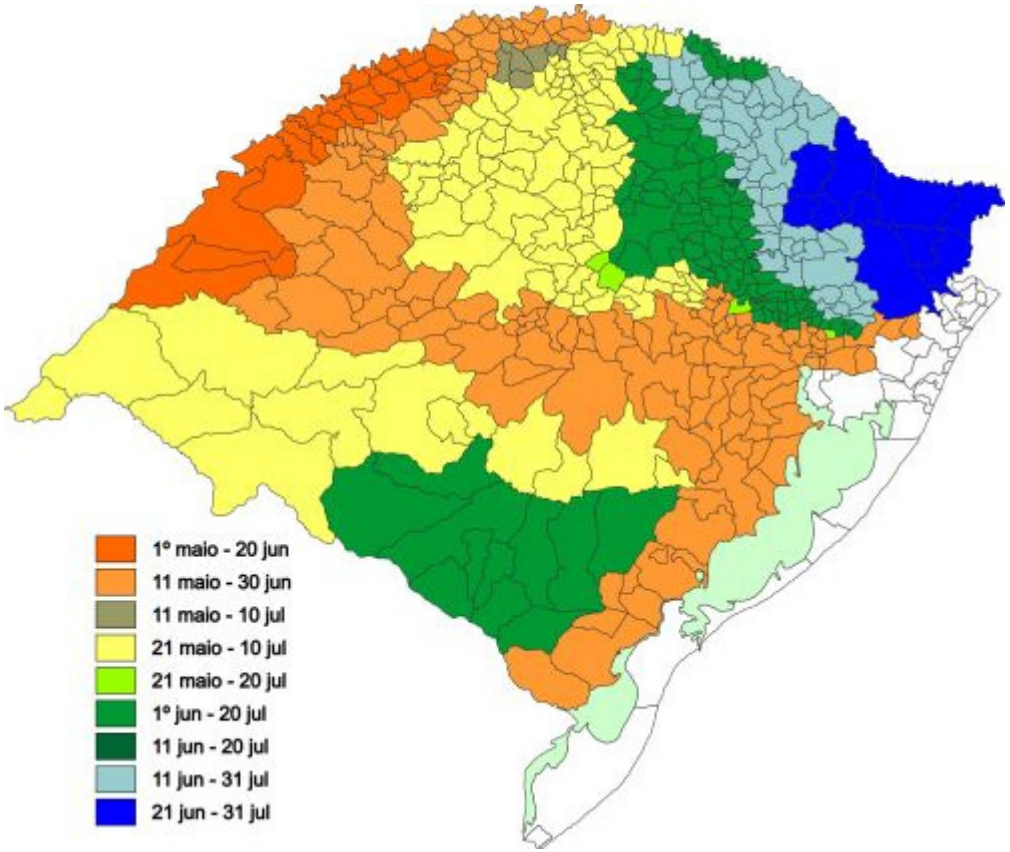
Source: Contini and Martha Jr., 2010

Genetic Resources, Breeding and Crop Adaptation



Source: Martha Jr., 2010

Agricultural Zoning Program



http://sistemasdeproducao.cnptia.embrapa.br/FontesHTML/Trigo/CultivodeTrigo/zoneamento.htm

To reduce climatic risks, Brazil has implemented in 1996 its Agricultural Zoning Program.

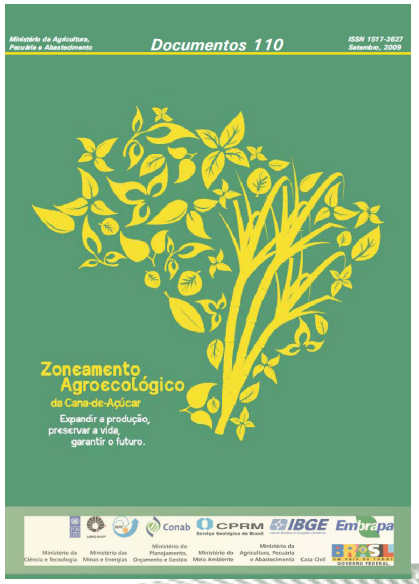
It analyzes the parameters related to soil, climate and plants, using mathematical and statistical models to determine the probability of occurrence of adverse climatic events that may cause crop losses.

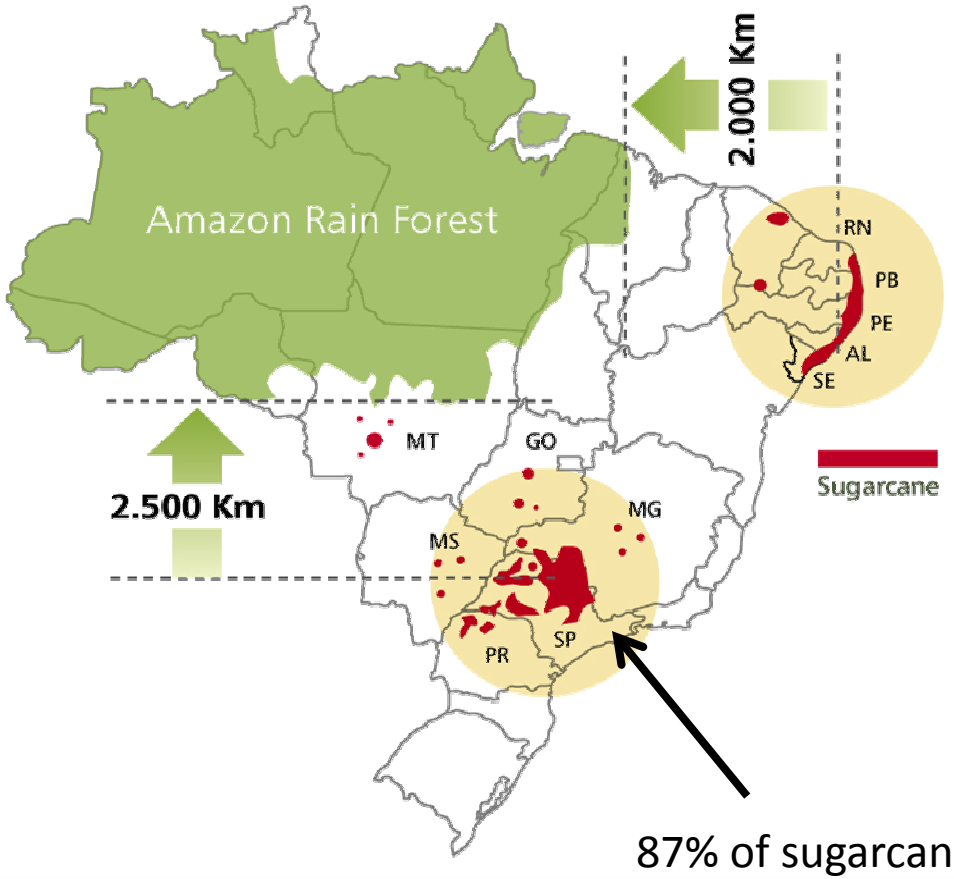
It allows definition of planting calendars to guarantee at least 80% probability of having an adequate water supply for a diverse group of crops without artificial irrigation.

Agroecological Zoning Plan for Sugarcane Expansion

Brazil is using Zoning Technology to Manage Sugarcane Expansion

Sugarcane for ethanol production occupies 1.5% of Brazil´s arable land





87% of sugarcane production

Embrapa

http://www.cnps.embrapa.br/zoneamento_cana_de_acucar/ZonCana.pdf

Source: UNICA.

Sugarcane Zoning in Brazil

Brazil is using Zoning Technology to Manage Sugarcane Expansion

Brazilian regulations…

1. **Prohibit:**

- Sugarcane plantation in sensitive biomes such as the Amazon forest and Pantanal wetlands.
- Sugarcane cultivation on native vegetation (e.g., cerrado, grasslands)

2. **Authorize:**

- **64.7 million** hectares for sugarcane expansion; equivalent to **7.5%** of the Brazilian territory (currently **0.9% of the area** is used for sugarcane)

http://www.cnps.embrapa.br/zoneamento_cana_de_acucar/ZonCana.pdf

Monitoring Crop Expansion in Sensitive Areas

Sources: Ministry of Agriculture, Brazilian Institute of Geography and Statistics

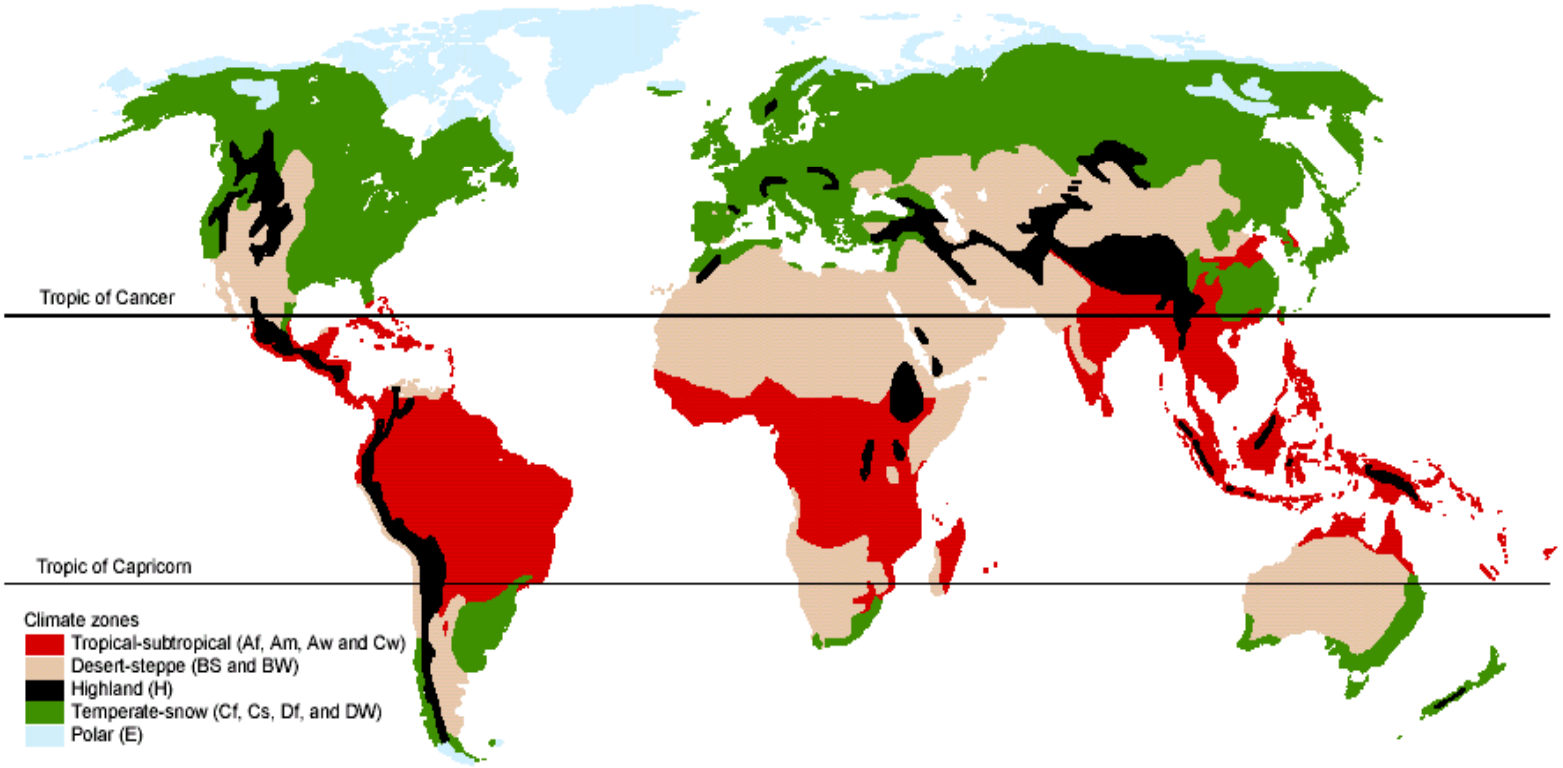
Since 2006, private representatives of the soybean segment declared a "moratorium" to the soybean produced in the Amazon Biome - a comprehensive commitment prohibiting to buy or sell grain produced in the region.

Satellite monitoring controls the origin of the product helping ensure rain forest protection.

Source: Brazil and agribusiness at a glance / Ministry of Agriculture, Livestock and Food Supply, 2010.

Agroecological Zoning and Climate Change

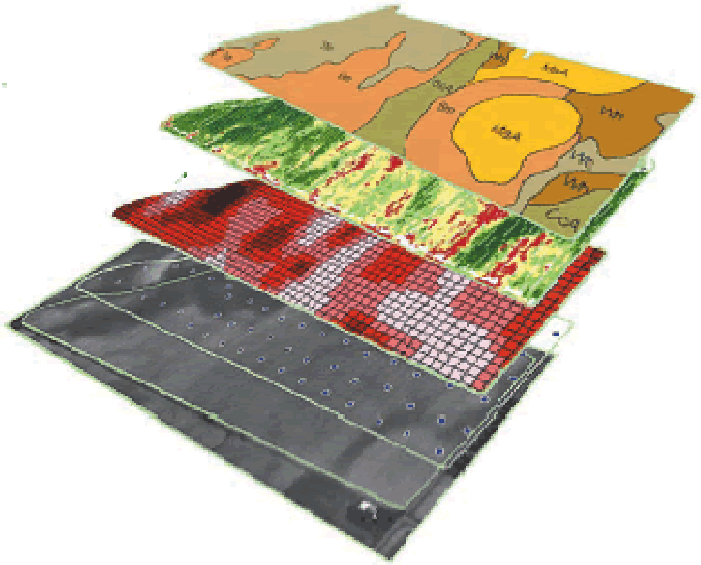
Climate change will impose additional stresses to many delicately balanced agro-ecosystems, especially in tropical areas, where significant intensification of biotic and abiotic stresses is expected in the next decades.



Embrapa

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil

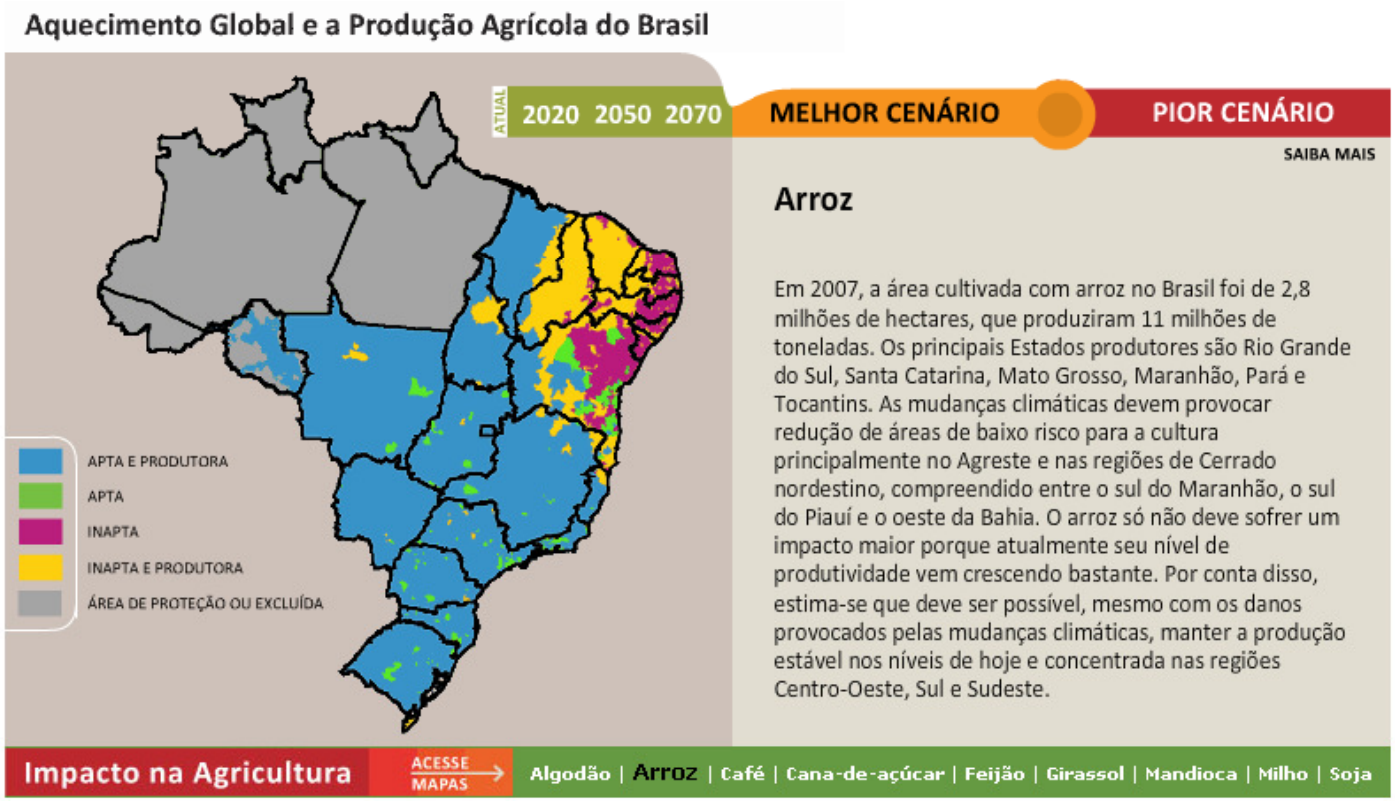
Anticipating potential challenges for

cotton

Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



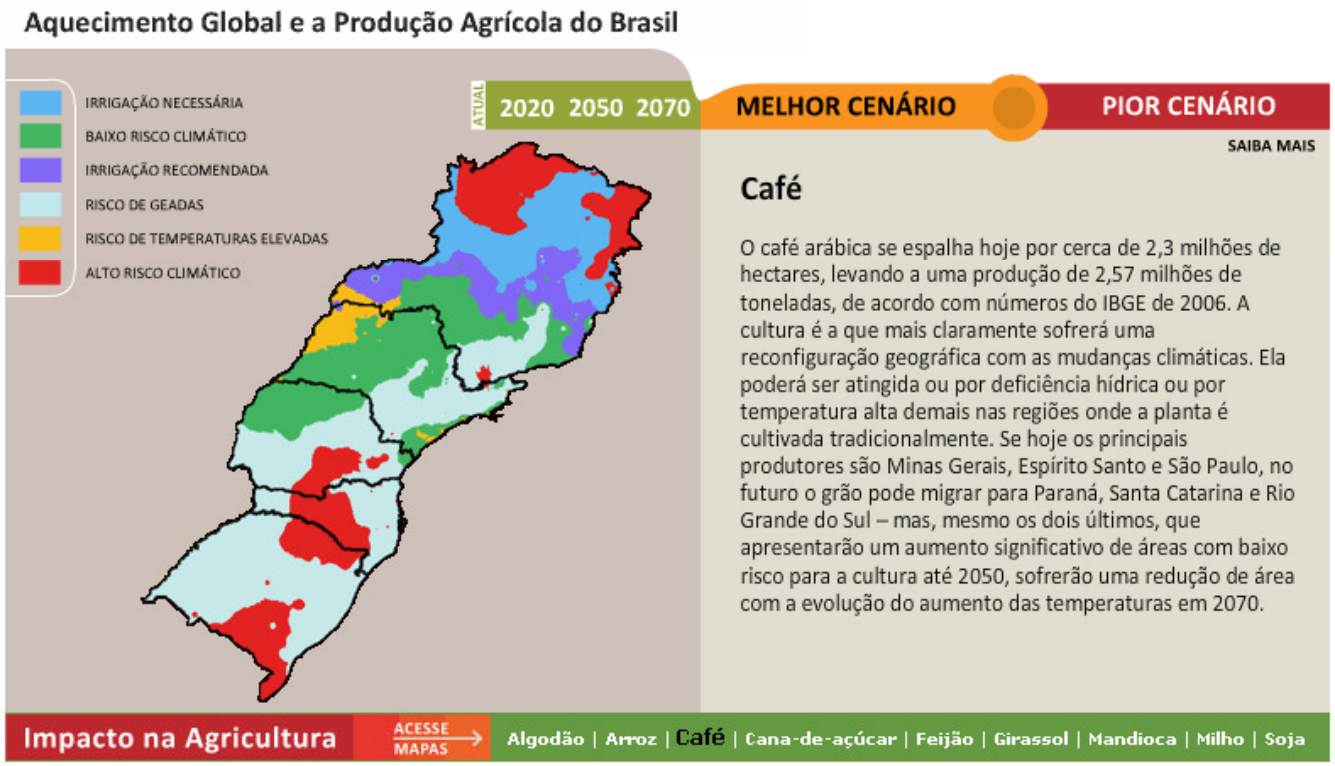
Anticipating potential challenges for

rice

Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



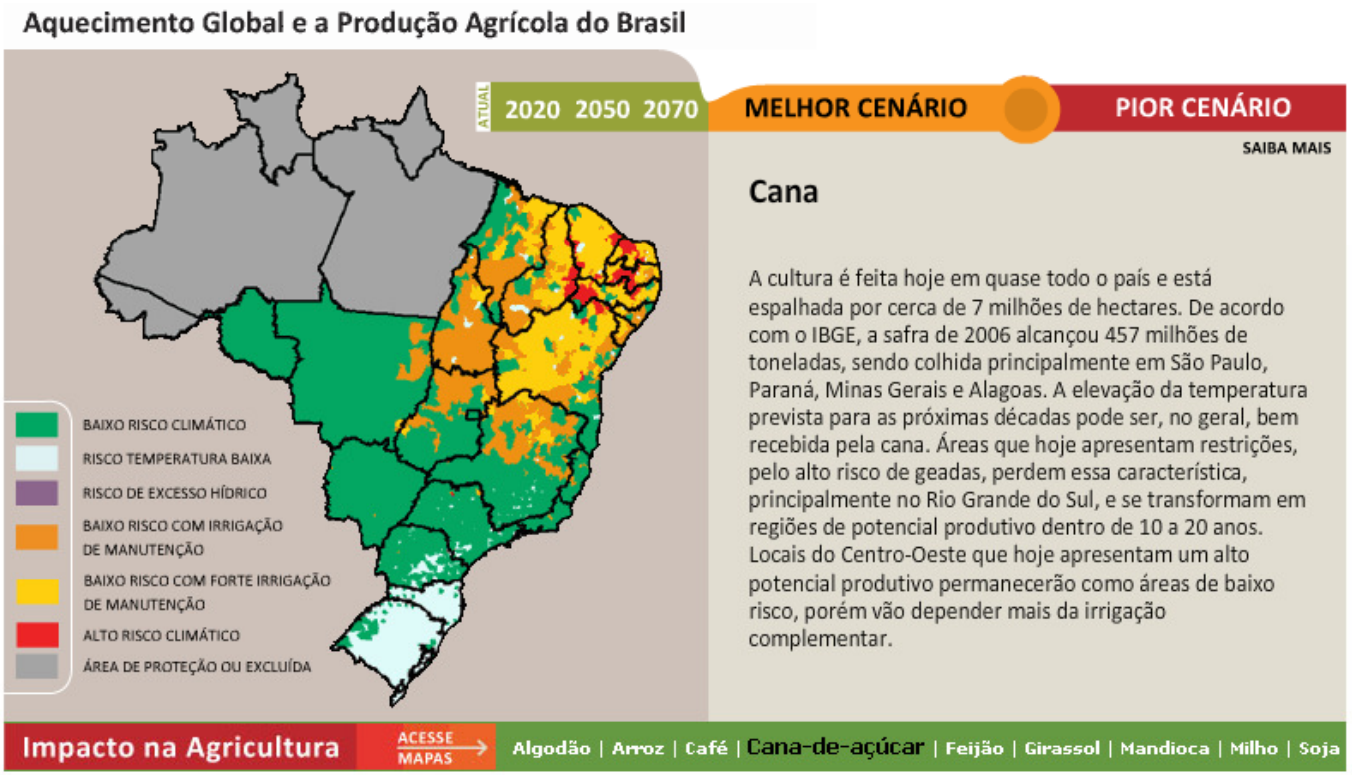
Anticipating potential challenges for

coffee

Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



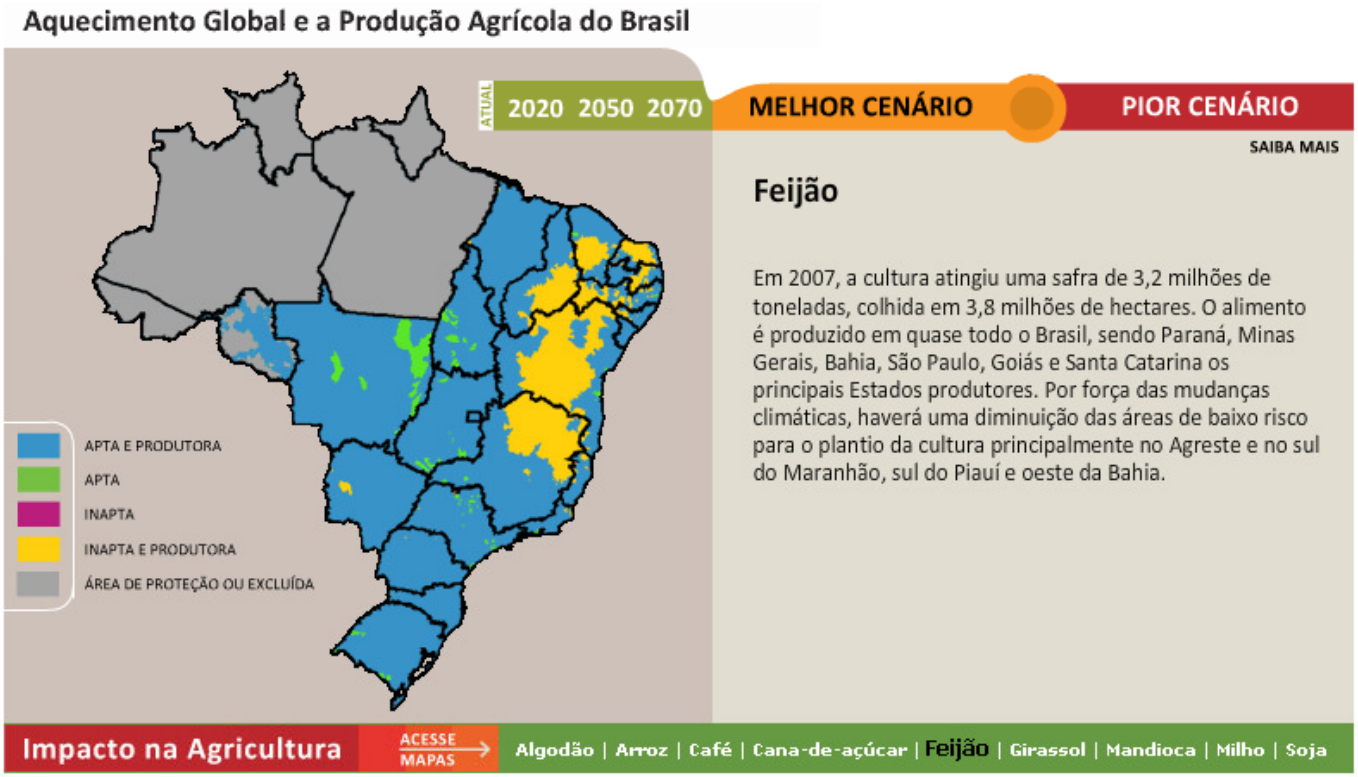
Anticipating potential challenges for

sugarcane

Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



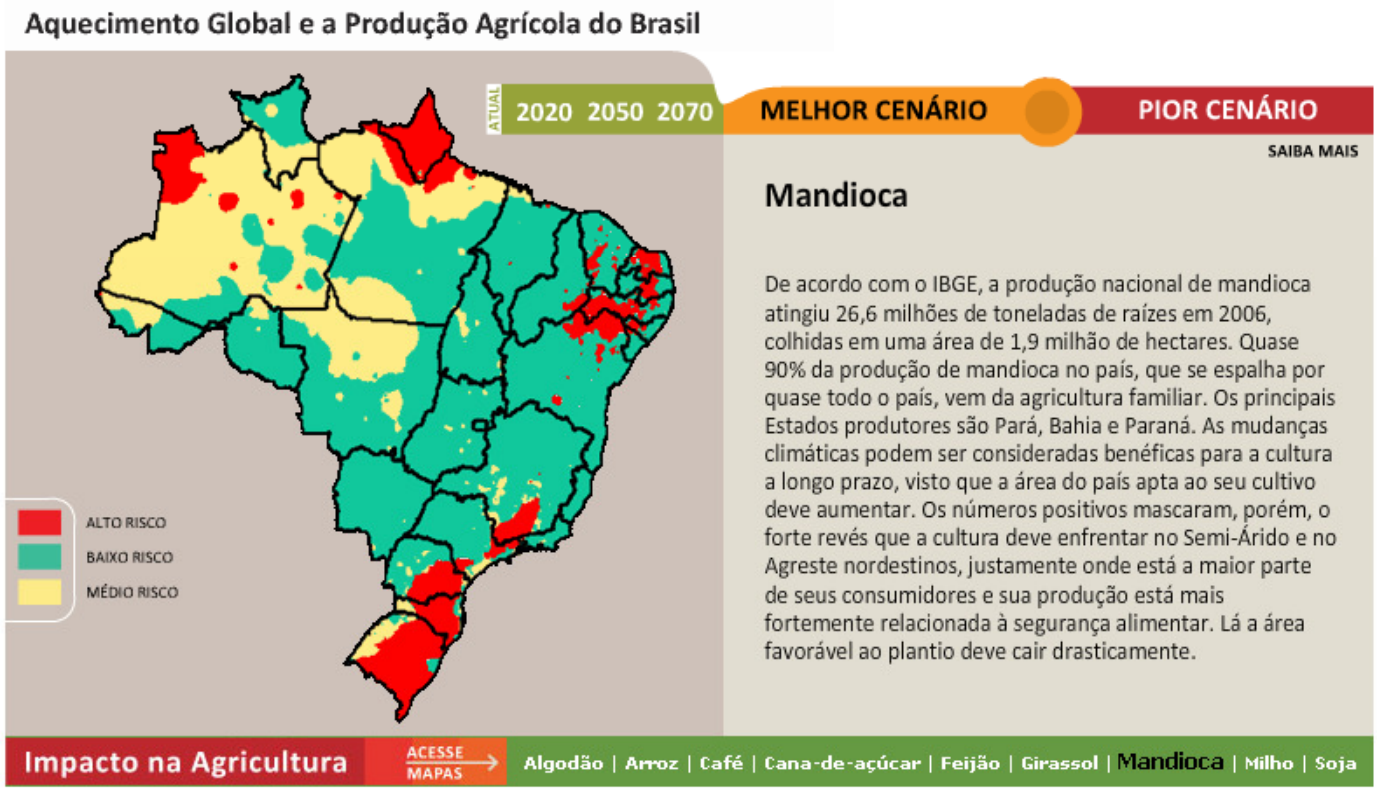
Anticipating potential challenges for

common beans

Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



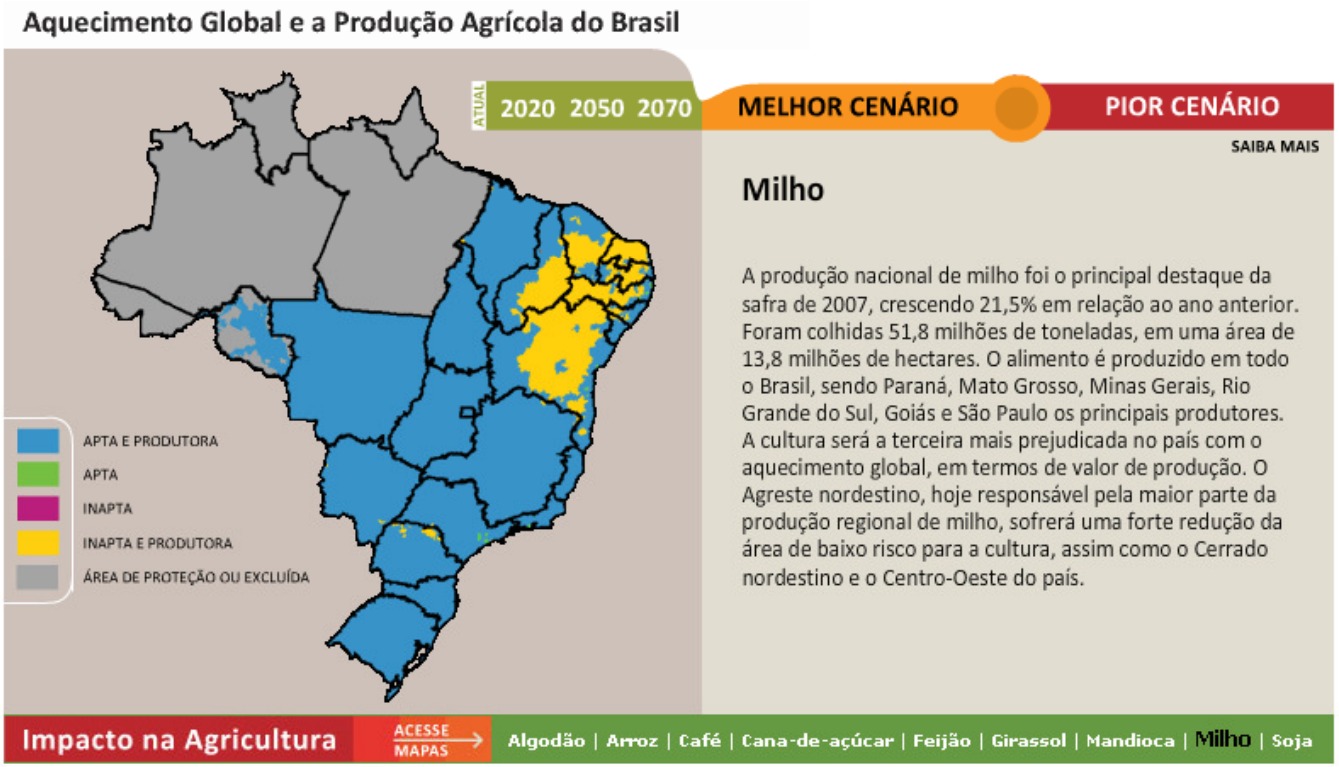
Anticipating potential challenges for

cassava

Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



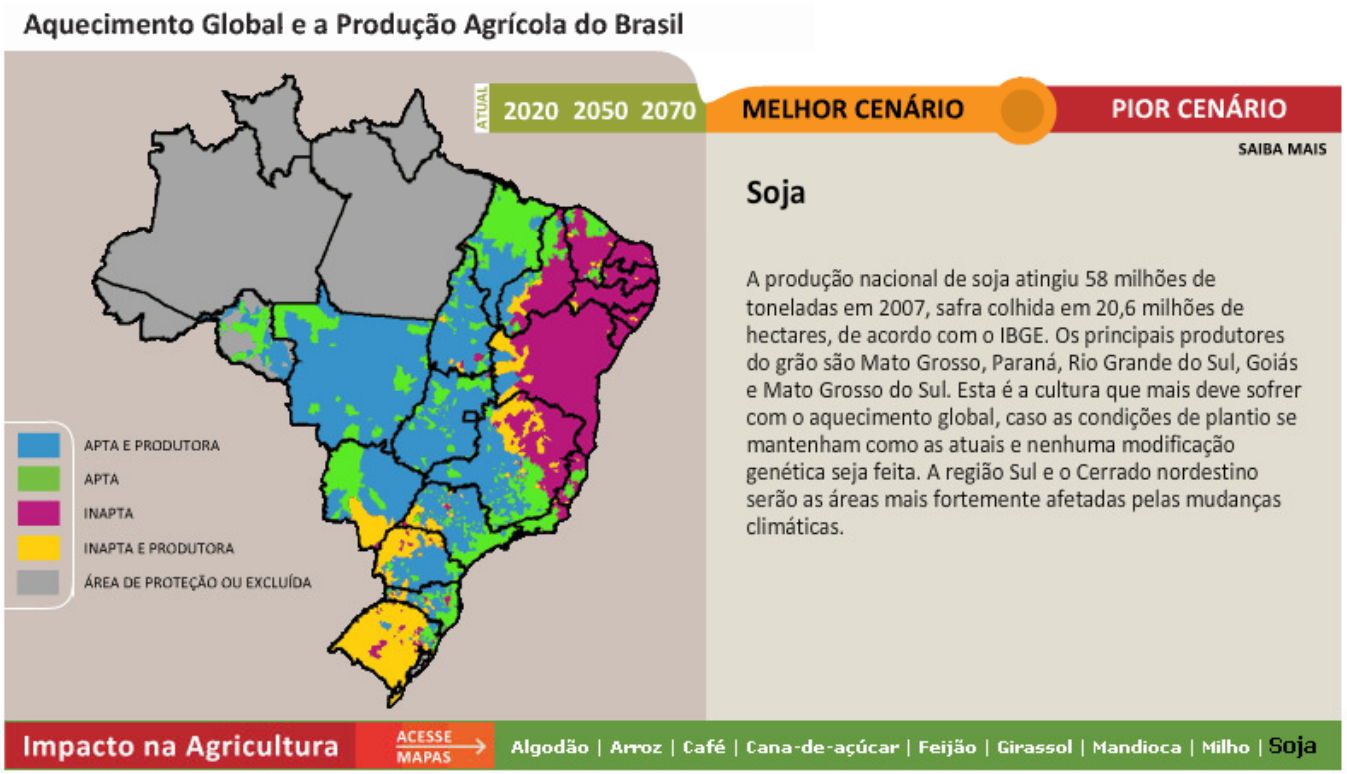
Anticipating potential challenges for

maize

Source: http://www.climaeagricultura.org.br/index.html

Agroecological Zoning and Climate Change

Climate Change and the new geography of agricultural production in Brazil



Anticipating potential challenges for

soybeans

Source: http://www.climaeagricultura.org.br/index.html

Brazilian Agriculture in Numbers

Embrapa

Brazilian Agriculture in Numbers

Source: http://labexkorea.files.wordpress.com/2010/08/brazilian-agribusiness-at-a-glance1.pdf

The Brazilian Ministry of Agriculture, Livestock and Food Supply (MAPA) has published, through its Secretariat of International Relations, the brochure "Brazilian Agribusiness at a Glance".

It highlights the main Brazilian agricultural products, such as grain, meat, sugarcane, coffee, milk and fruits, and issues related to renewable energy, sustainable agricultural production and foreign investment opportunities in Brazil.

The slides that follow are a sample of data available in this recent publication.

Brazilian Agriculture in Numbers

2009 ranking: Brazilian Production and Exports

Main Products	Production	Exports	Number of Markets	Exports US$ Billion
Sugar	1st	1st	124	8.378
Coffee	1st	1st	81	3.762
Orange Juice	1st	1st	75	1.619
Soybean	2nd	2nd	46	11.413
Beef	2nd	1st	142	4.118
Tobacco	2nd	1st	100	2.992
Ethanol	2nd	1st	48	1.338
Broiler	3rd	1st	146	5.307
Corn	4th	3rd	49	1.259
Pork	4th	4th	81	1.225

Sources: USDA, Ministry of Agriculture

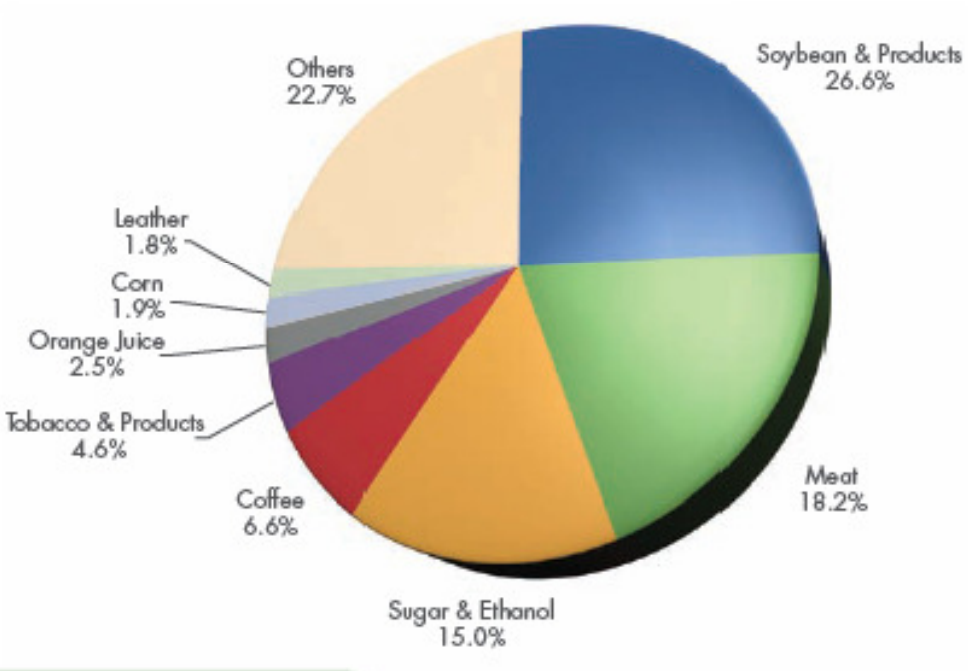
Brazil plays a leading role as a global supplier of agribusiness products, exporting for more than 180 markets.

Embrapa

Source: MAPA, 2010

Brazilian Agribusiness Export

Main Products



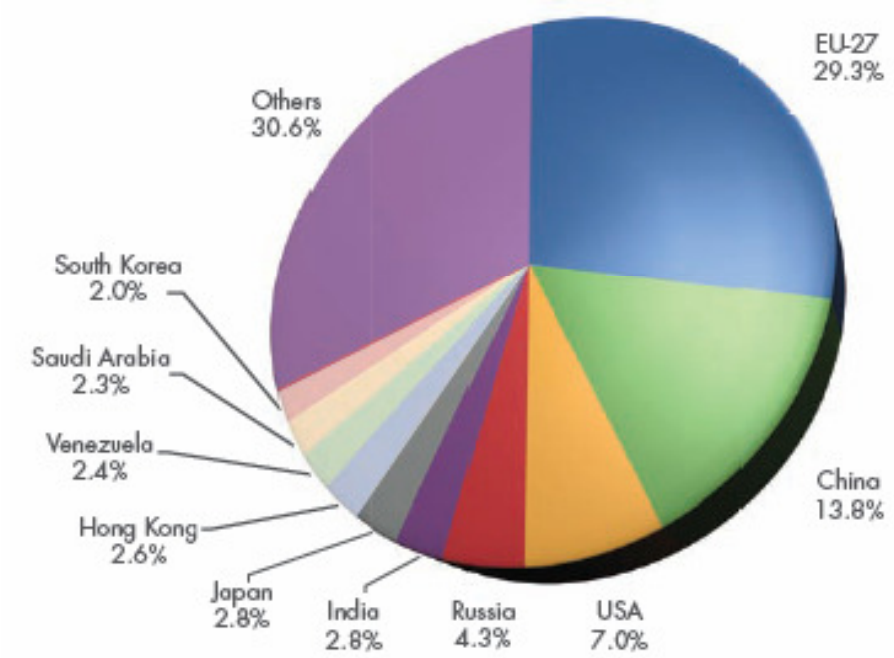
Total: US$ 64.8 billion

Source: Ministry of Development, Industry and Foreign Trade – 2009
Elaboration: Ministry of Agriculture

Source: MAPA, 2010

Brazilian Agribusiness Exports

Main Destinations



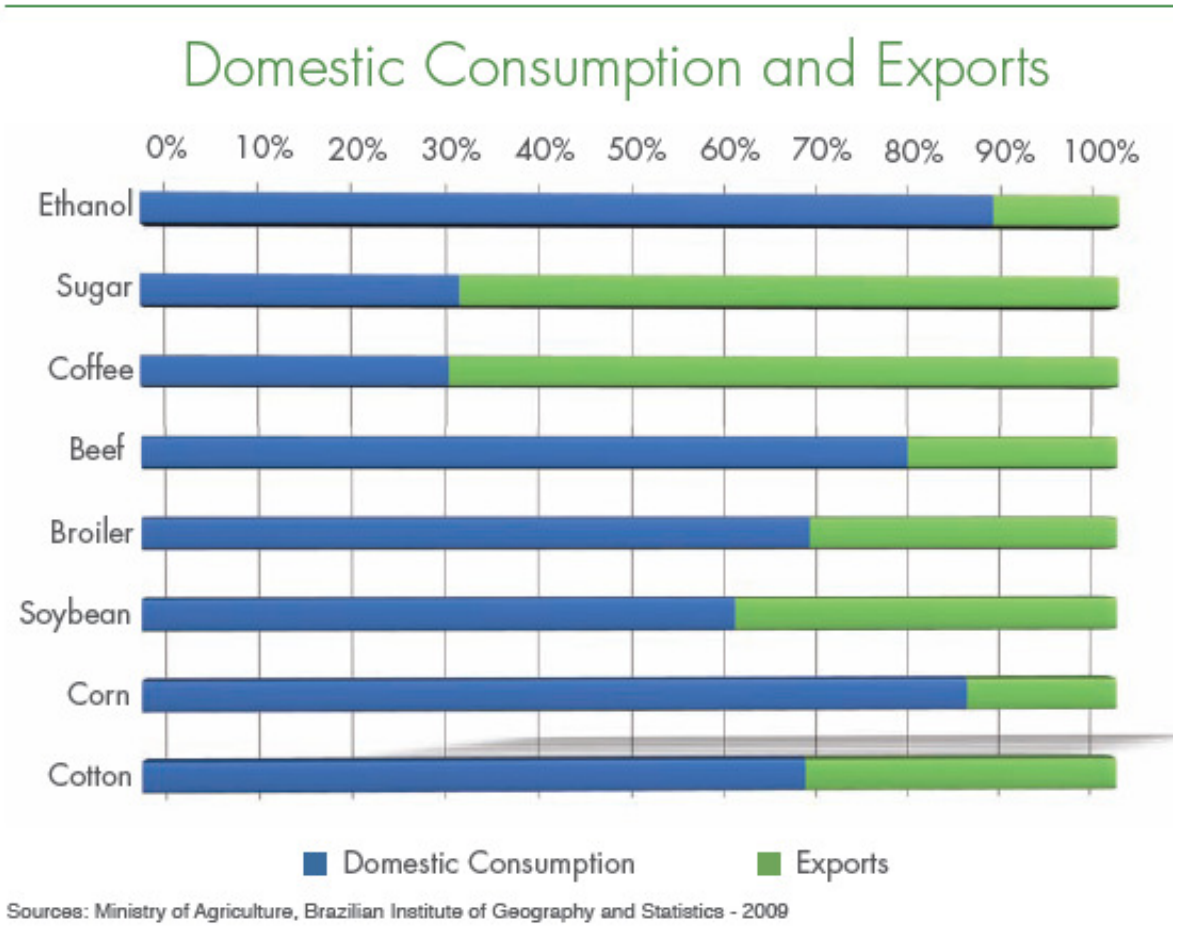
Total: US$ 64.8 billion

Source: Ministry of Development, Industry and Foreign Trade – 2009
Elaboration: Ministry of Agriculture

Embrapa

Source: MAPA, 2010

Brazilian Internal Consumtion and Exports



Sources: Ministry of Agriculture, Brazilian Institute of Geography and Statistics - 2009

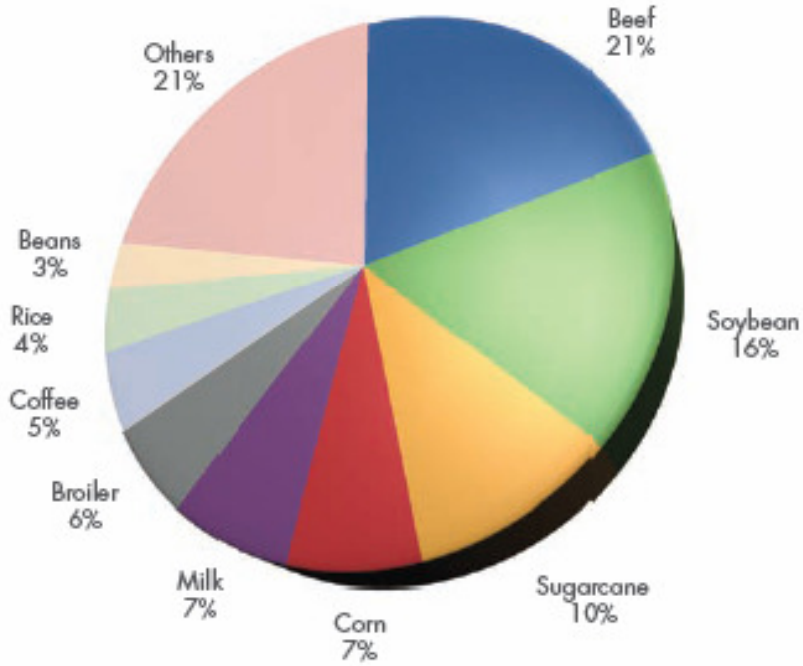
Roughly 70% of the Brazilian agricultural production aims the national market.

Domestic demand ensures critical mass for market predictability, enabling expansion planning.

Source: MAPA, 2010

Major Agricultural Products in Brazil

Production – Gross Value

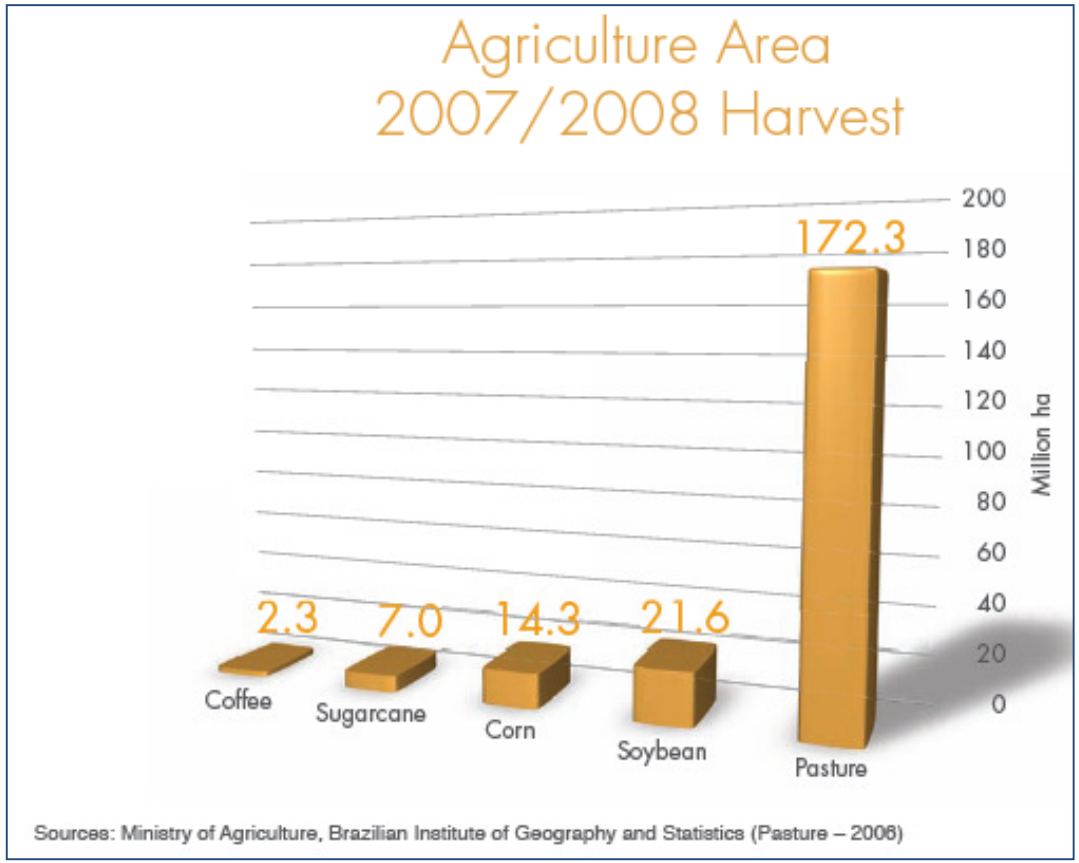


Total: US$ 170 billion

Source: Brazilian Confederation of Agriculture and Livestock – June 2009

Source: MAPA, 2010

Land Utilization by Agriculture in Brazil



Pasture lands occupy nearly 70% of the total area dedicated to agricultural production.

Pasture productivity is still low – 1 head per hectare.

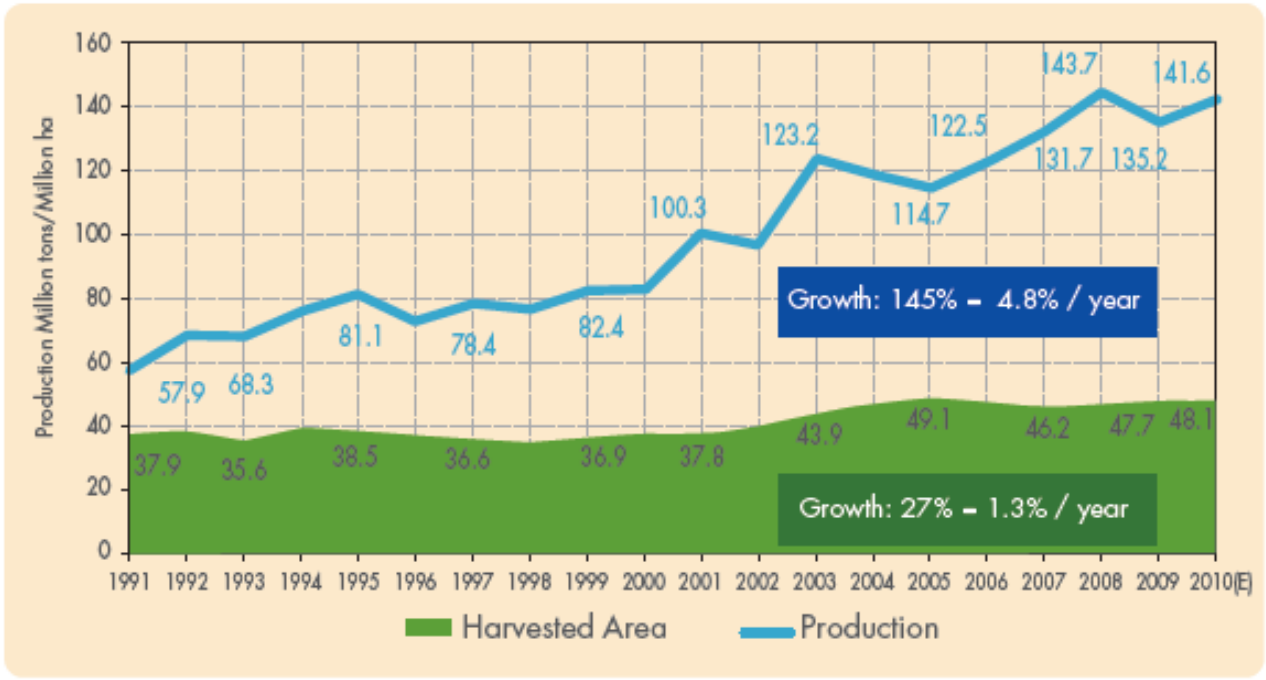
Improvements on cattle raising enable agriculture growth over these areas.

Source: MAPA, 2010

Agricultural Products Highlights

Source: MAPA, 2010

Brazilian Agribusiness - Grain Production and Area



Source: National Company of Food Supply

Increase in grain production over the last 20 years has been a result of increased productivity.

Grain volume has increased by 2.5 in the period, while the harvested area has grown less than 30%.

Source: MAPA, 2010

Brazilian Agriculture – Grain Production

Main Grains

Product	Area (1,000 ha)	% of Total Grain Area	1,000 Tons
Soybean	21,743	42%	57,166
Corn	14,171	38%	51,004
Bean	4,147	3%	3,491
Rice	2,909	9%	12,602
Wheat	2,396	4%	5,884
Cotton	843	2%	1,891

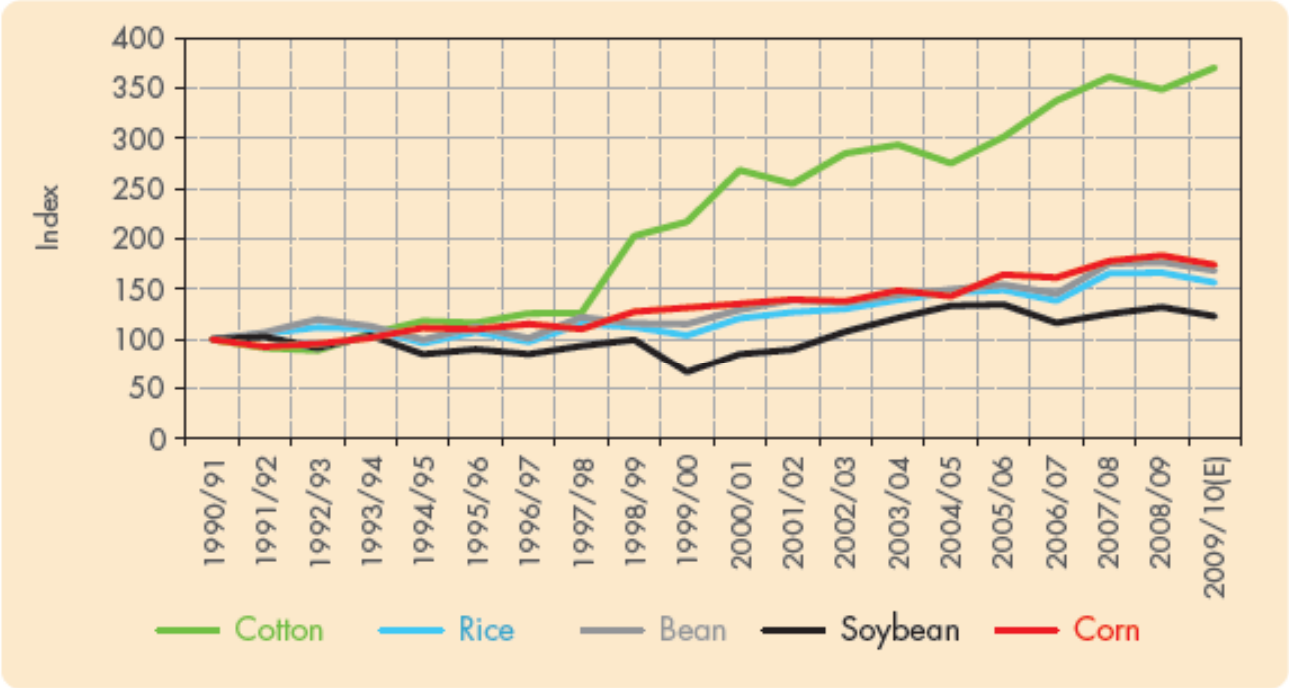
Source: National Company of Food Supply - 2009

Grain crops' increasing productivity allows supply of domestic market while Brazil stands out as a big exporter of soybean, corn and cotton.

Embrapa

Source: MAPA, 2010

Grain Productivity Evolution Index

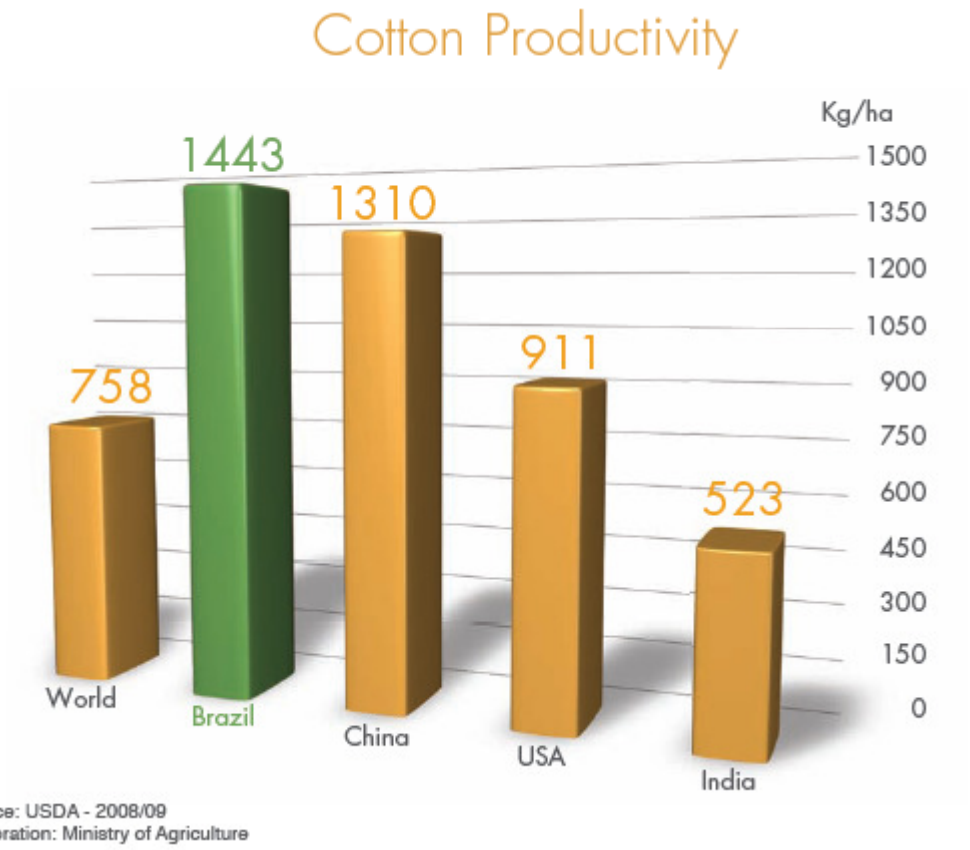


Source: National Company of Food Supply

Grain productivity has been increasing in Brazil over the years, as a result of technology use and best practices dissemination.

Source: MAPA, 2010

Brazilian Agribusiness - Cotton

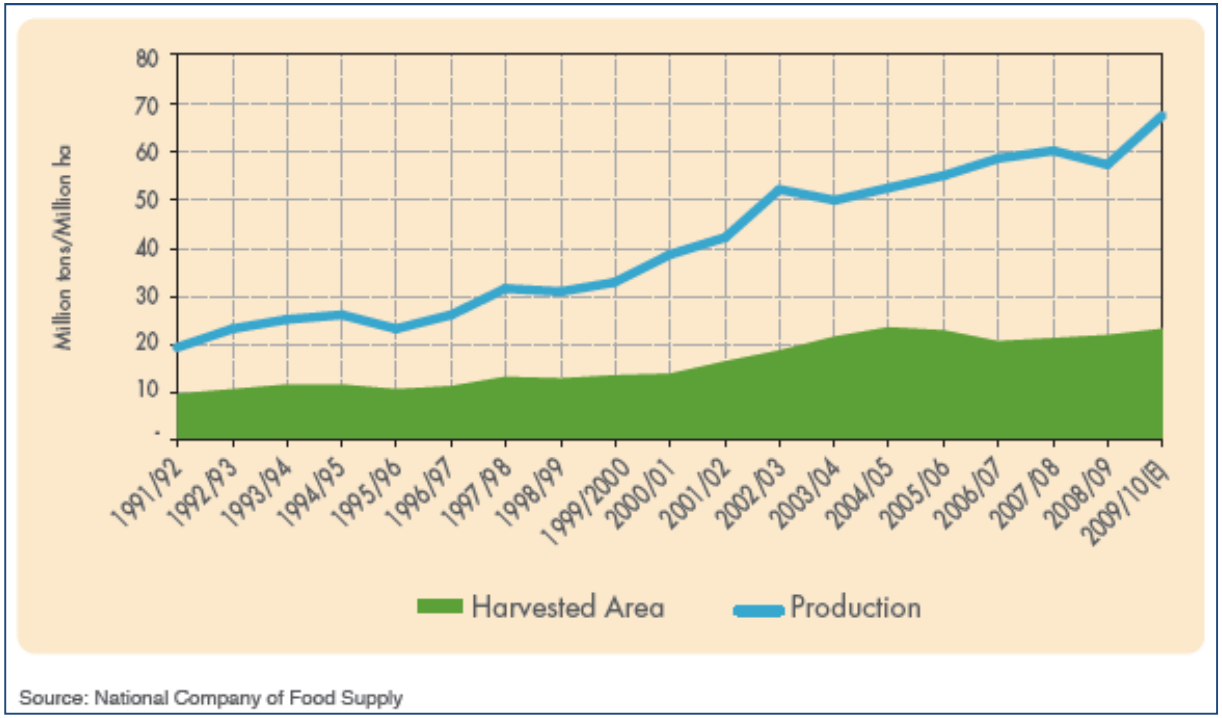


In 2008/2009 harvest, Brazilian cotton producers reached the highest productivity in the World.

High-quality, competitive product that stands out from the top 5 global producers.

Source: MAPA, 2010

Soybean – Production and area

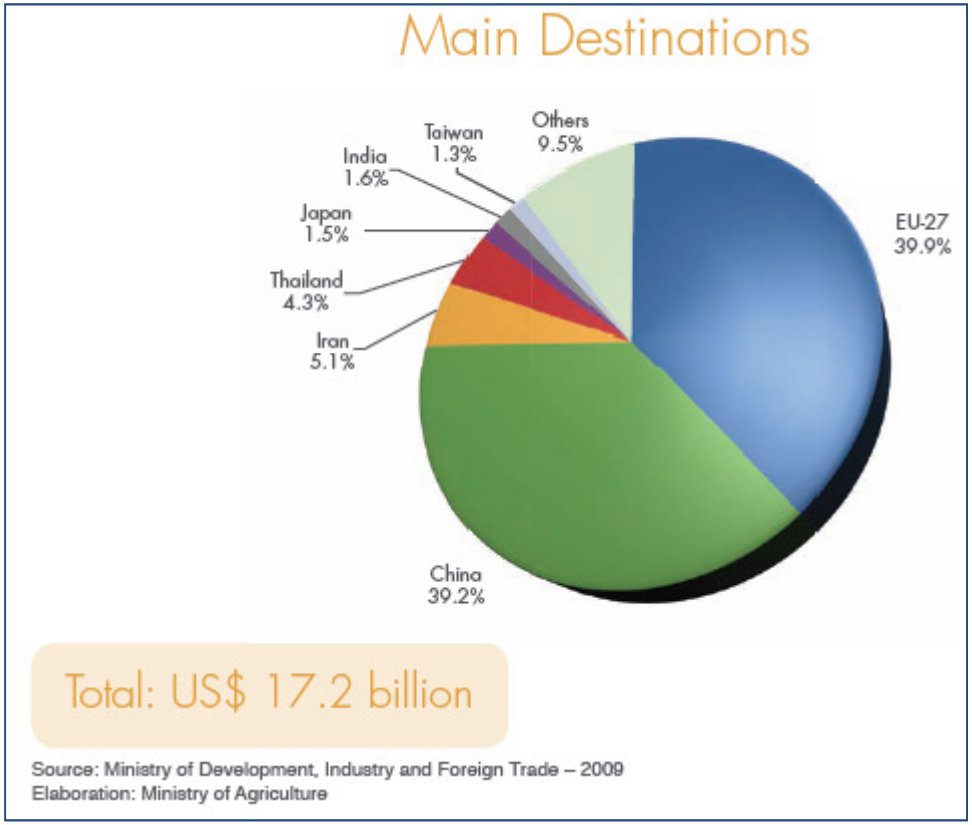


Soybean is the major agricultural crop in Brazil. Its production increase has been a result of high levels of productivity.

Over the last 20 years, soybean volume has increased by 3.5, filling up domestic consumption and enabling Brazil to reach the second world exporter position.

Source: MAPA, 2010

Soybean Exports – Grain, meal and oil

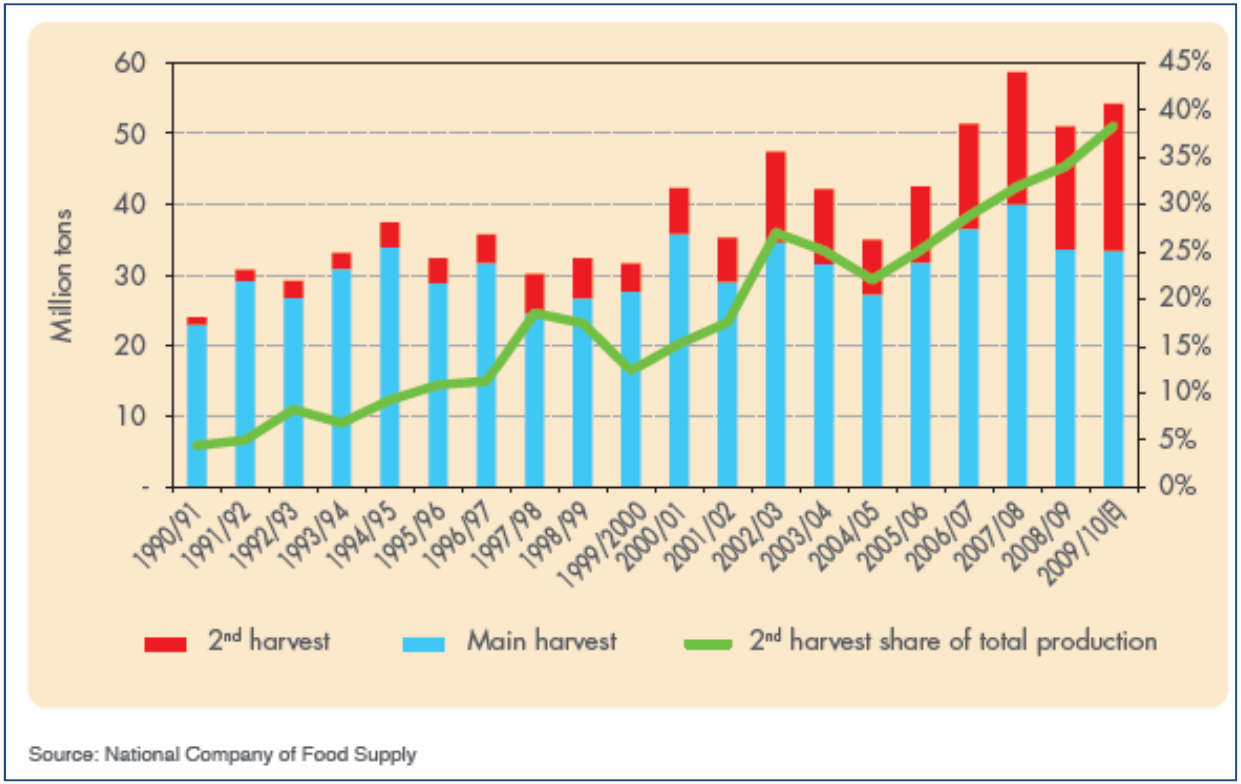


Although China and the European union were the destinations for 79% of soybean and its products' exports in 2009…

… dozens of other markets also imported from Brazil.

Source: MAPA, 2010

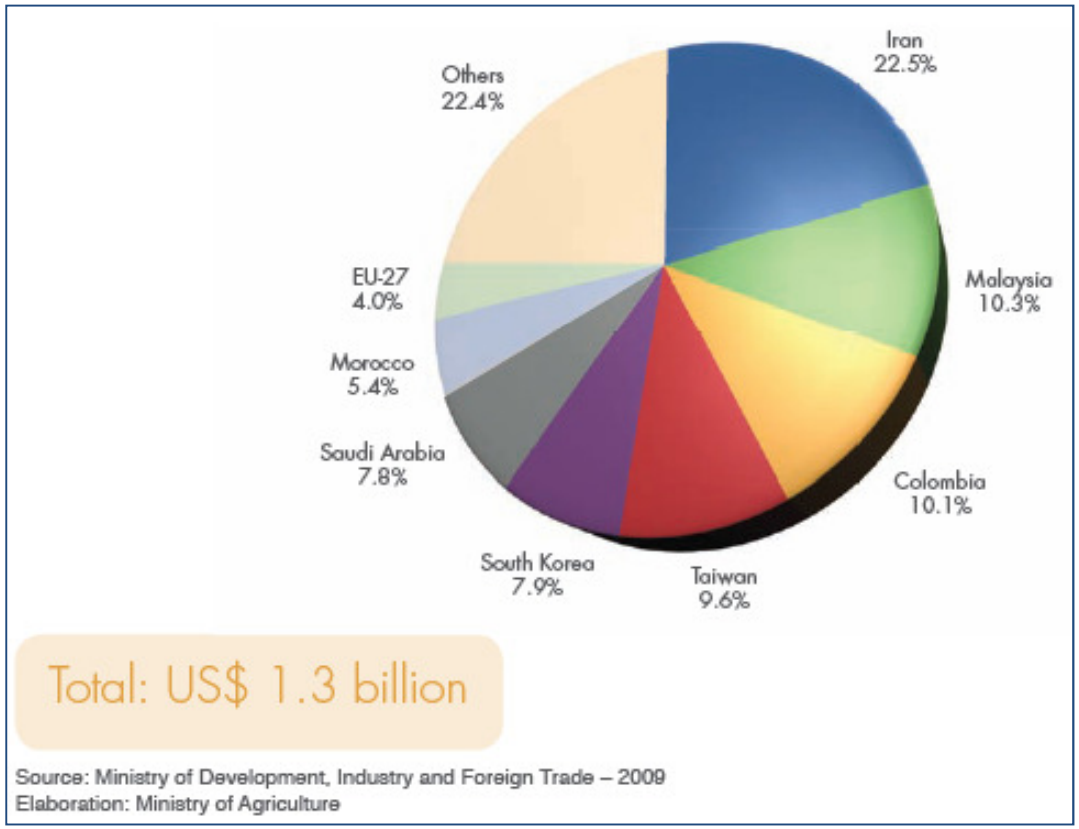
Corn – Double Cropping



The increasing production of corn from double cropping, planted after the soybean summer crop, reduces fixed costs, boosts the growth of the meat industry in Brazil and, at the same time, allows the country to become a relevant exporter in these segments.

Source: MAPA, 2010

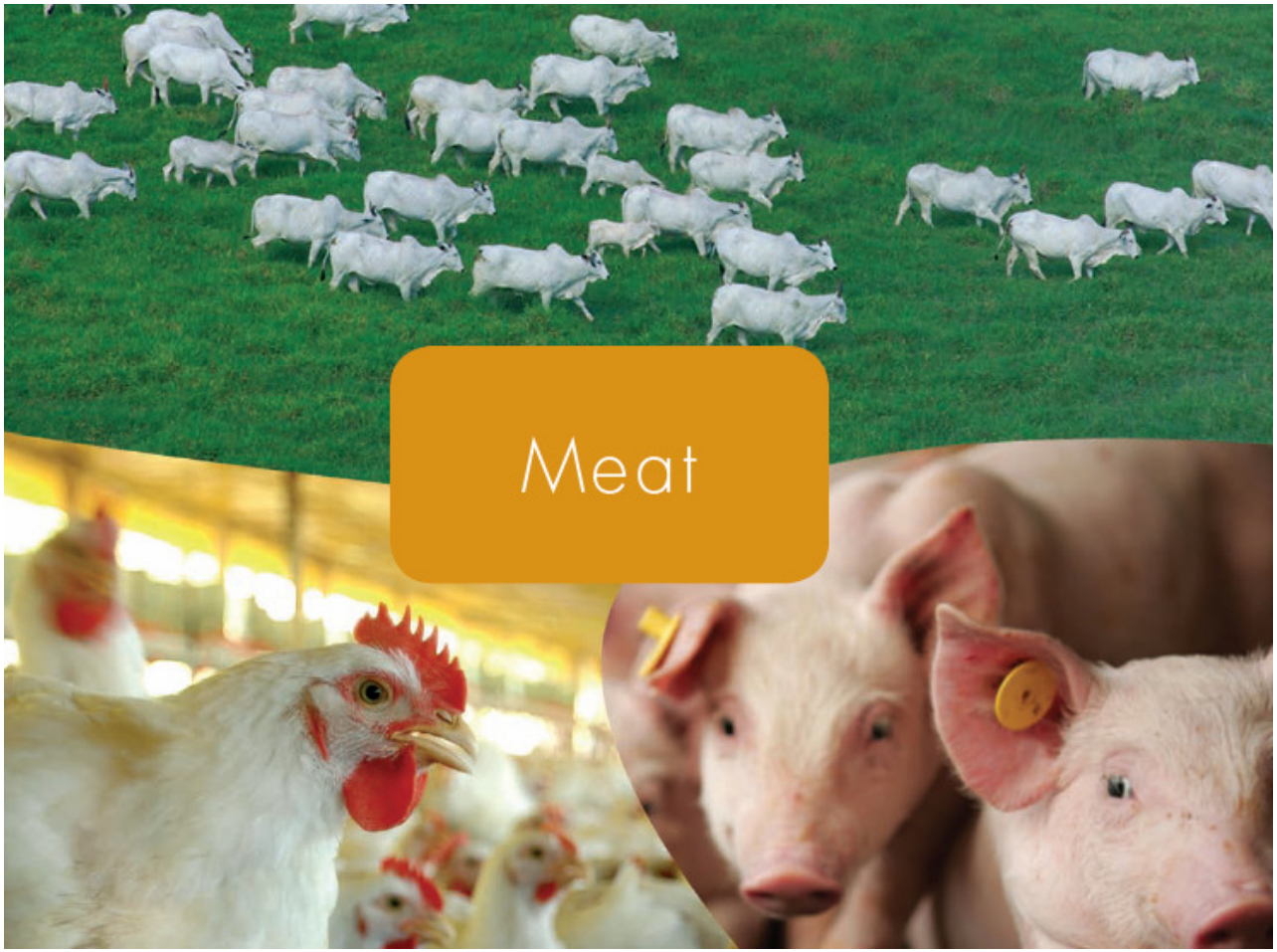
Brazilian Agribusiness - Corn



Corn Exports
Main Destinations

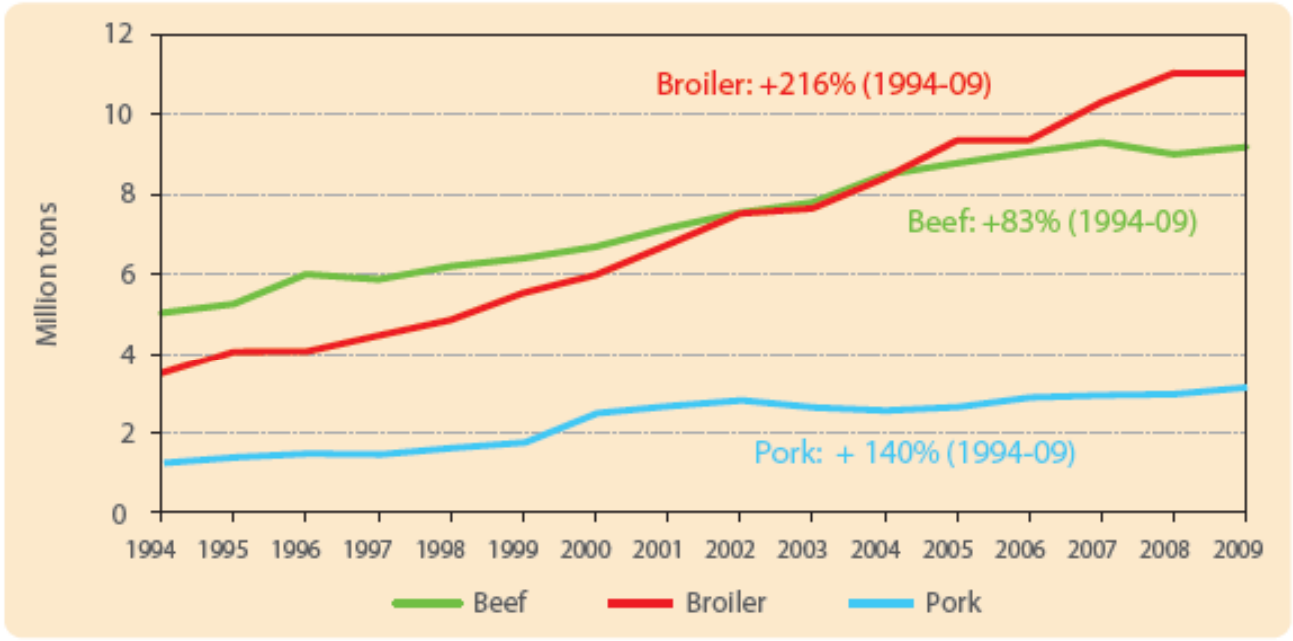
Source: MAPA, 2010

Agricultural Products Highlights



Source: MAPA, 2010

Meat Production in Brazil

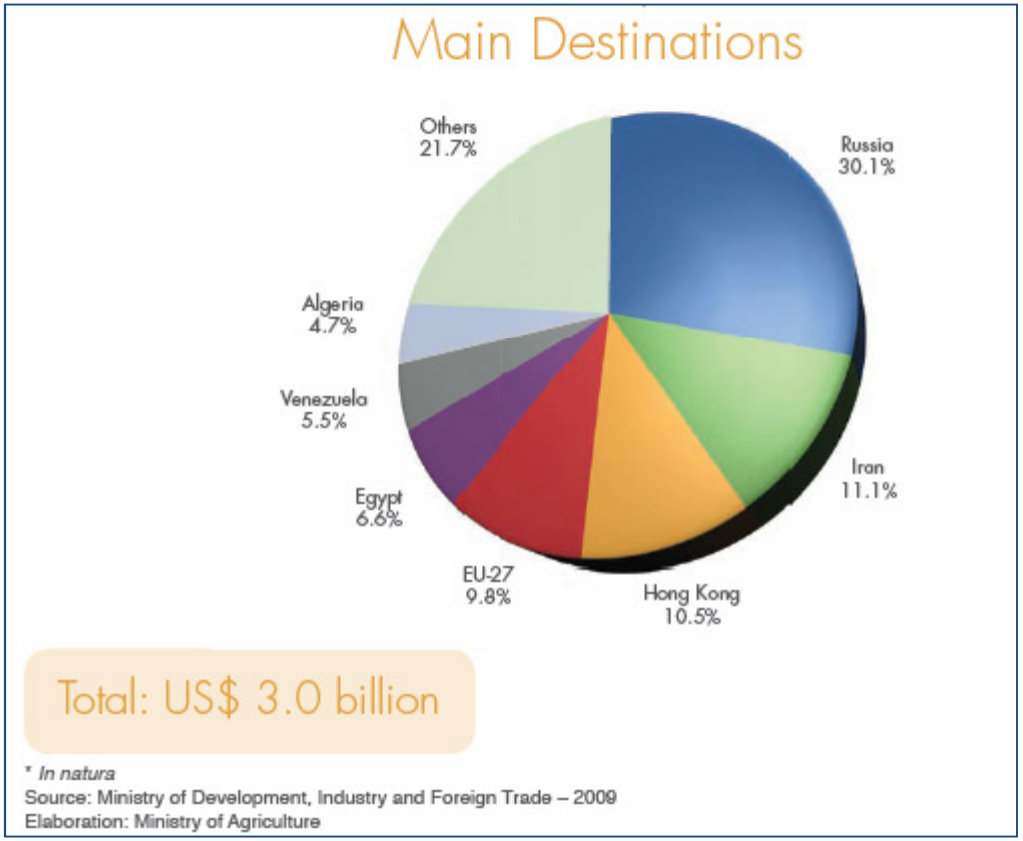


Sources: ABIEC, ABEF, UBA, ABIPECS
Elaboration: Ministry of Agriculture

The combined expansion of the meat production and industrialization in Brazil leveraged the country to the #1 position in exports worldwide, while keeping up with the domestic market, which presents a high and growing per capita consumption (more than 80kg/inhabitant/year).

Source: MAPA, 2010

Beef Exports

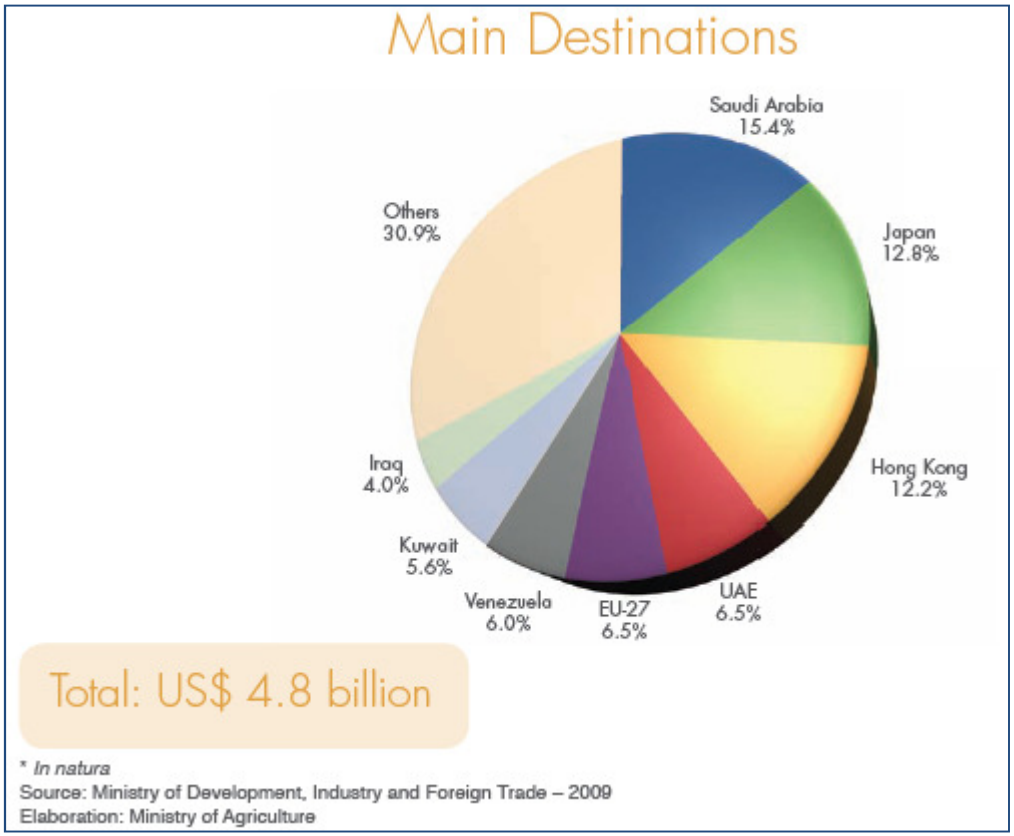


Brazil is the worldwide leading supplier of beef and Halan beef.

Brazilian beef is recognized as a "green beef", since most cattle is raised free, in vast open pastures.

Source: MAPA, 2010

Broiler Exports



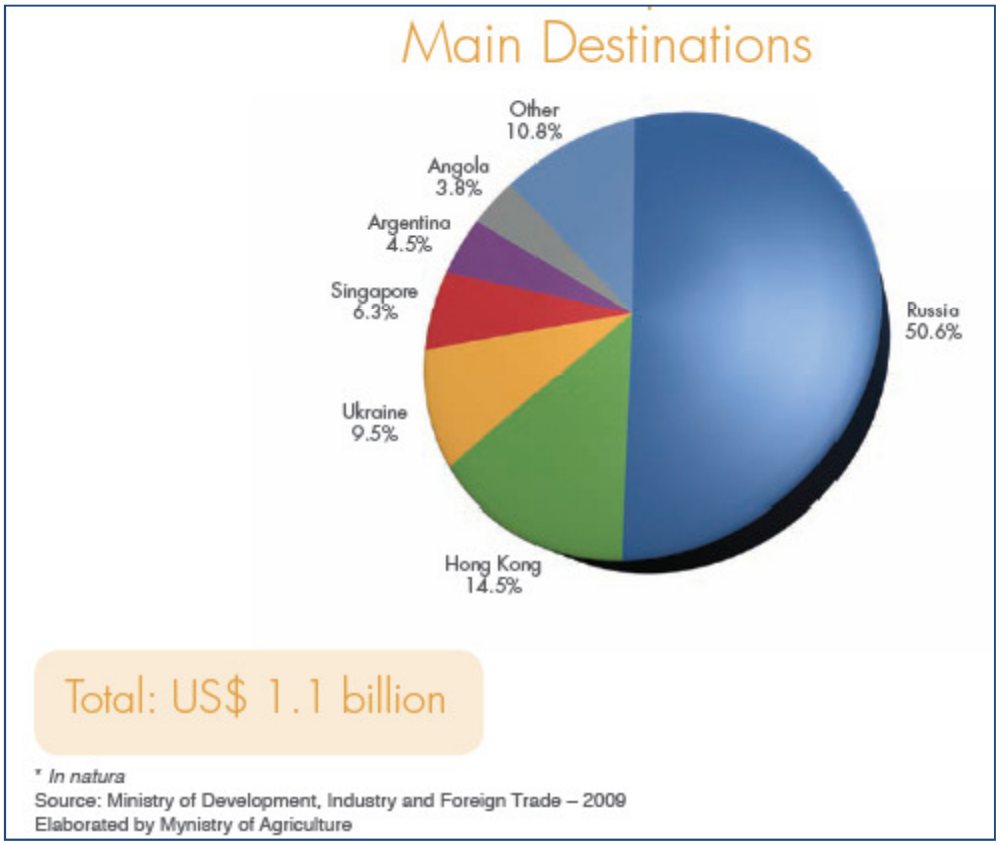
Brazilian chicken is present in the meals of consumers of most markets in the world.

The integration of the productive chain, from egg to tailored cuts, make the Brazilian chicken products competitive and adaptable to each and every market niche.

Brazil is the biggest world exporter of both broiler and Halal broiler.

Source: MAPA, 2010

Pork Exports



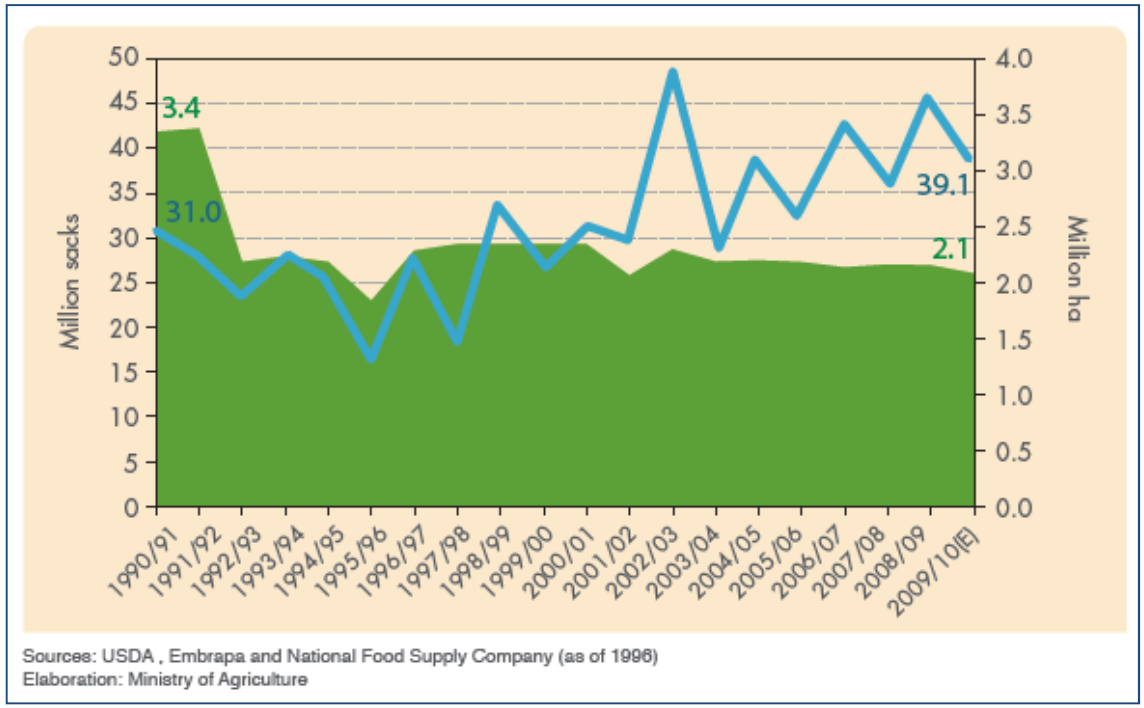
The Brazilian integrated pork productive system results in high quality goods, according to the world's most rigid standards.

Source: MAPA, 2010

Agricultural Products Highlights

Source: MAPA, 2010

Coffee: Production and area



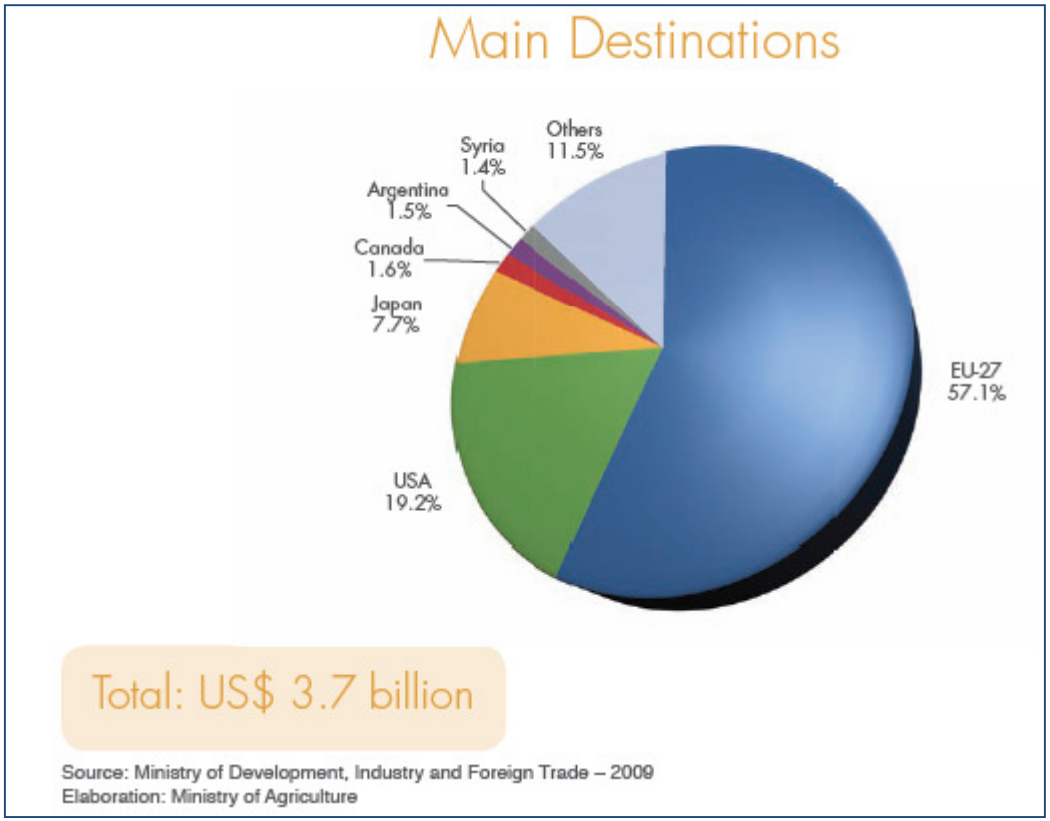
Sources: USDA , Embrapa and National Food Supply Company (as of 1996)
Elaboration: Ministry of Agriculture

Brazil is the world's leading exporter of coffee.

Over the last 20 years, investment in technology has increased production by 26%, while area has decreased by 38%.

Source: MAPA, 2010

Coffee Exports



Brazil exports mainly arabic coffee. Europe is its main market.

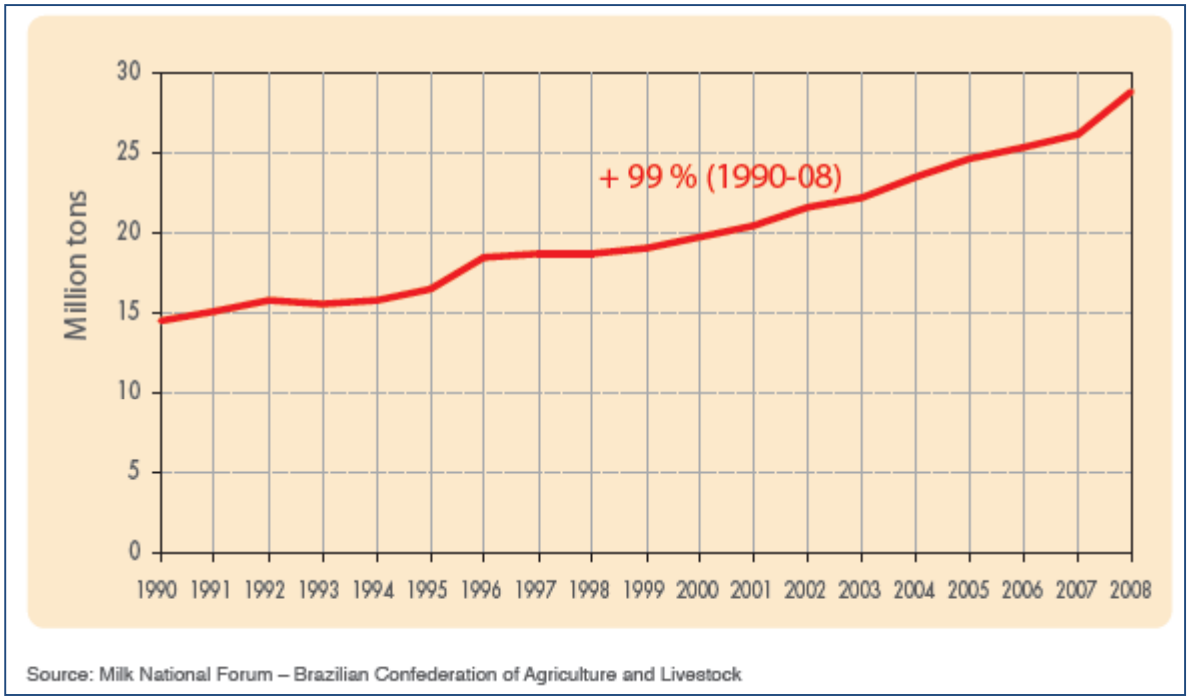
Yet, under different brands and presentations, the Brazilian coffee can be savored by consumers all over the world.

Source: MAPA, 2010

Agricultural Products Highlights

Source: MAPA, 2010

Milk Production



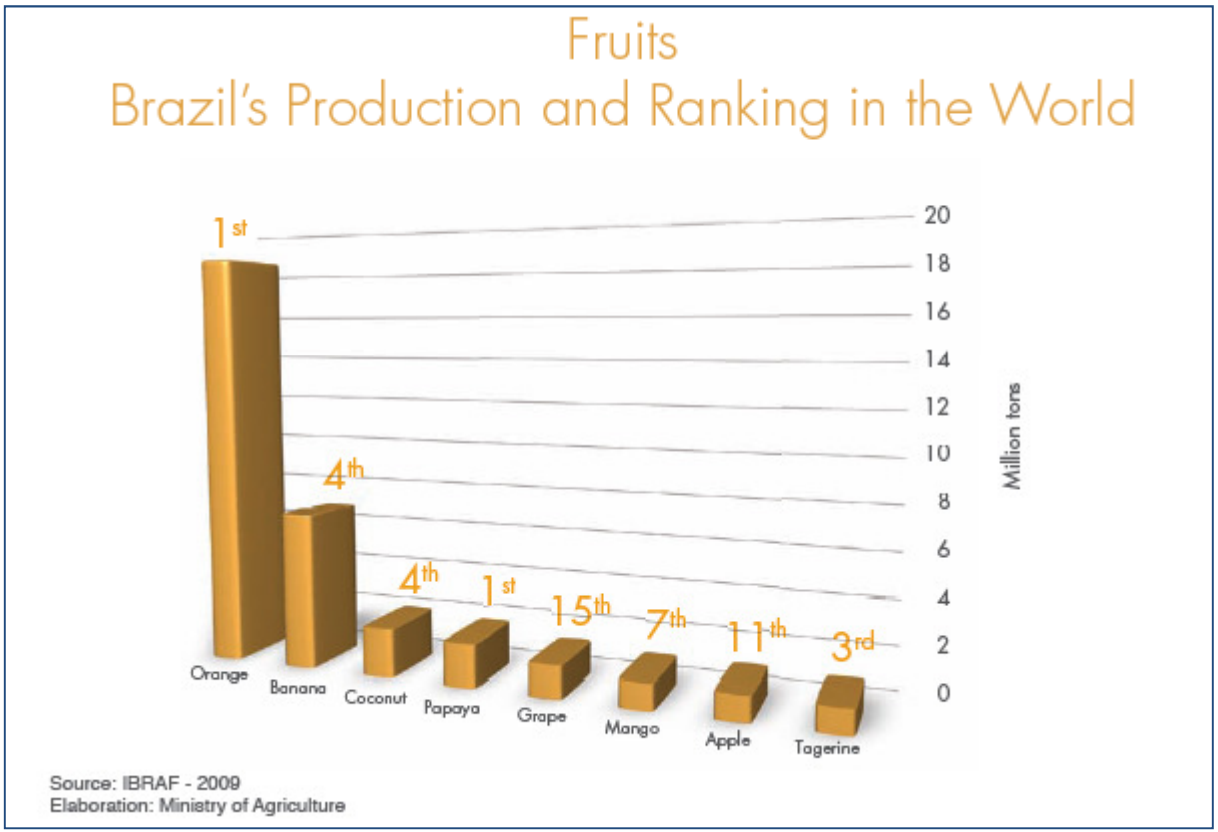
The increasing milk production in Brazil made the country self-sufficient and also an exporter of dairy products.

Source: MAPA, 2010

Agricultural Products Highlights

Source: MAPA, 2010

Fruit Production

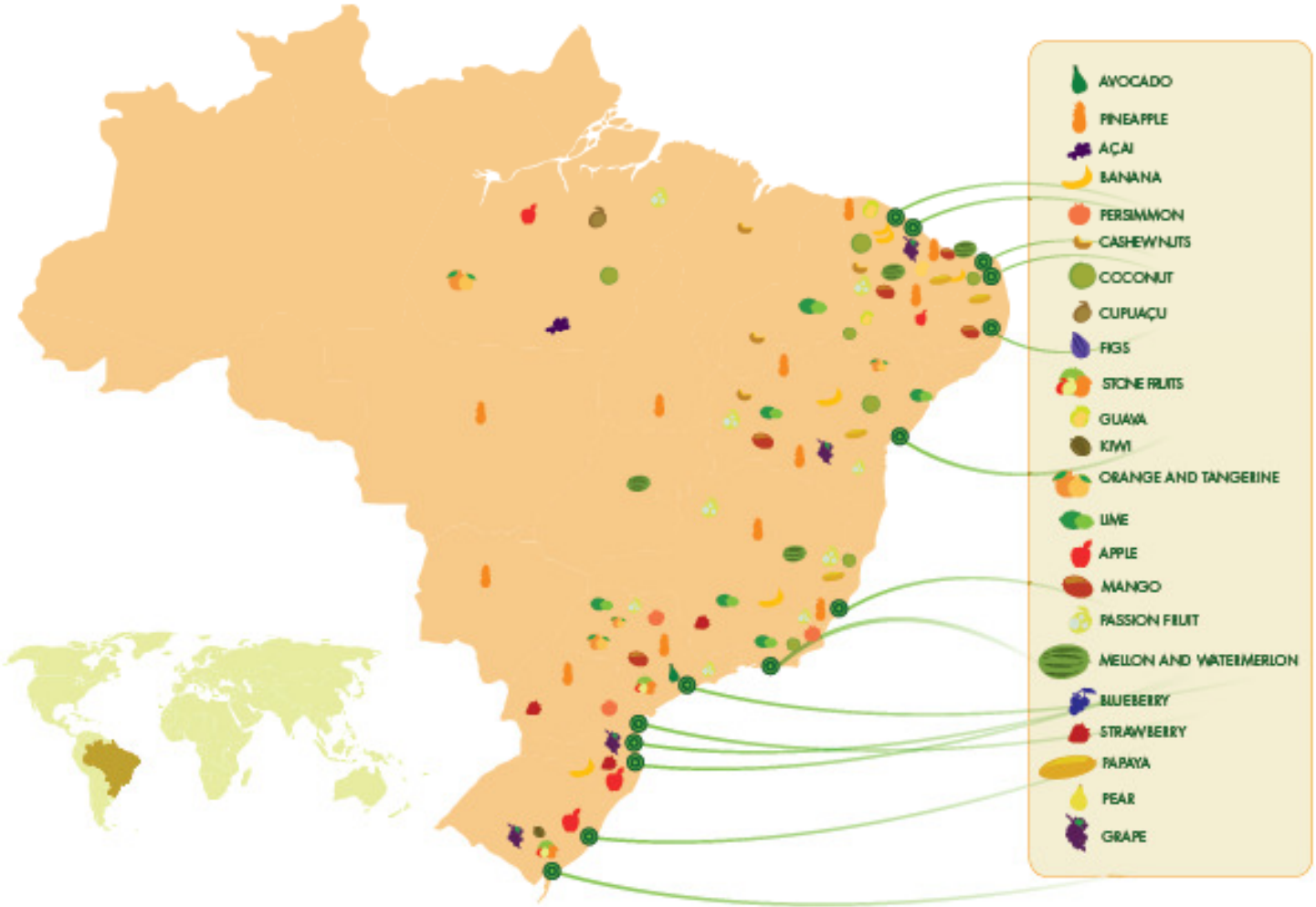


Brazilian climate diversity allows the production of several types of fruits in distinctive regions of the country.

It is also possible to produce in different seasons of the year, especially under irrigation.

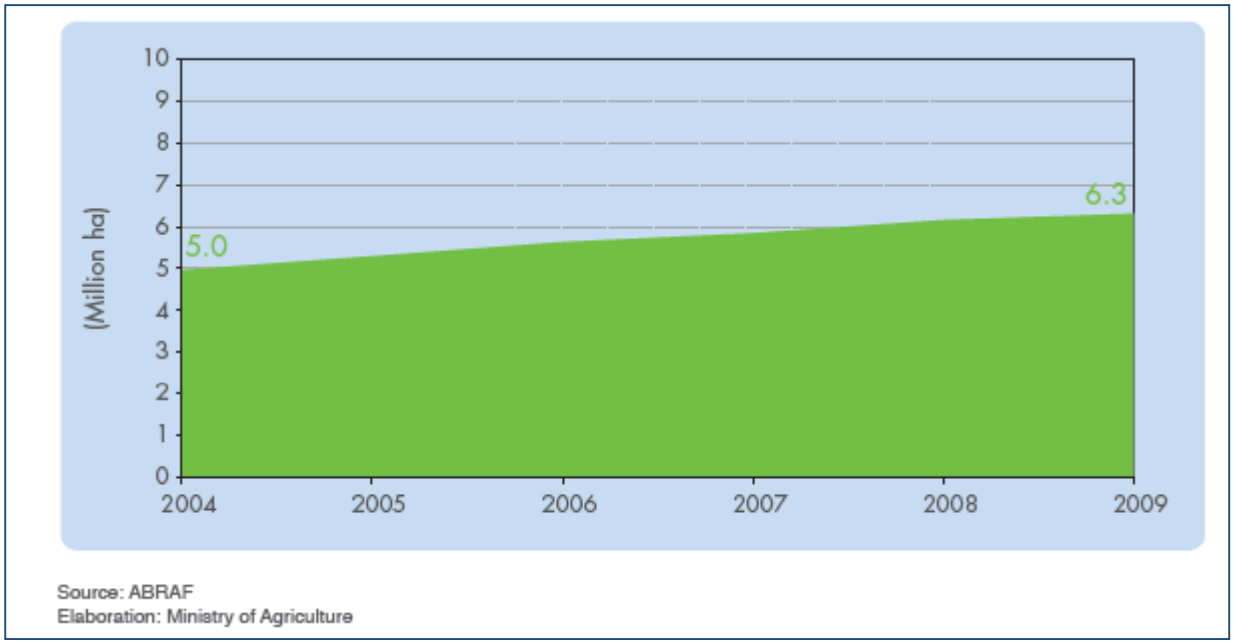
Source: MAPA, 2010

Fruits – Diversity and Production Map



Source: MAPA, 2010

Forestry Planted area



Brazil is an important exporter of wood, wood products and celulose.

It has leadership in the hardwood pulp market.

Wood and paper industries in Brazil are based on planted forests.

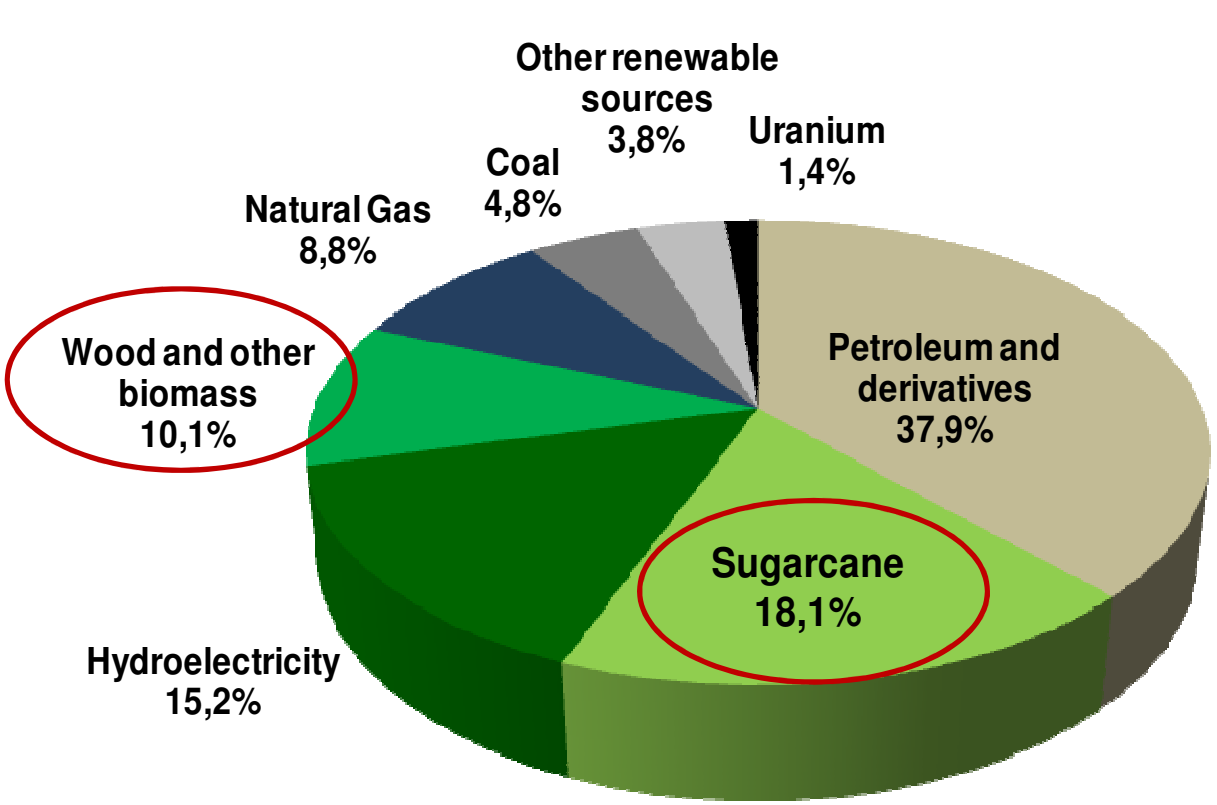
Source: MAPA, 2010

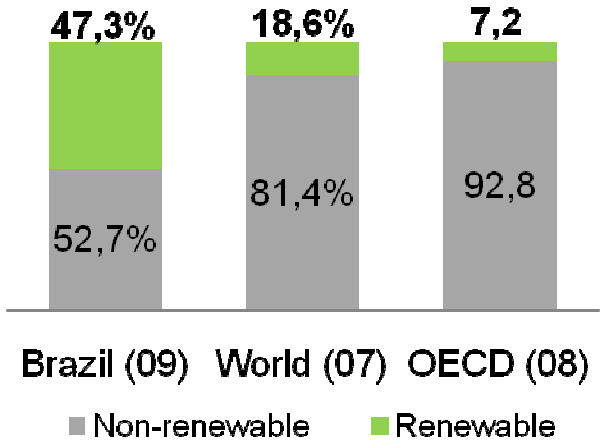
Agriculture and Energy Security in Brazil

Embrapa

Brazilian Agriculture: Food, Feed, Fiber and Fuel

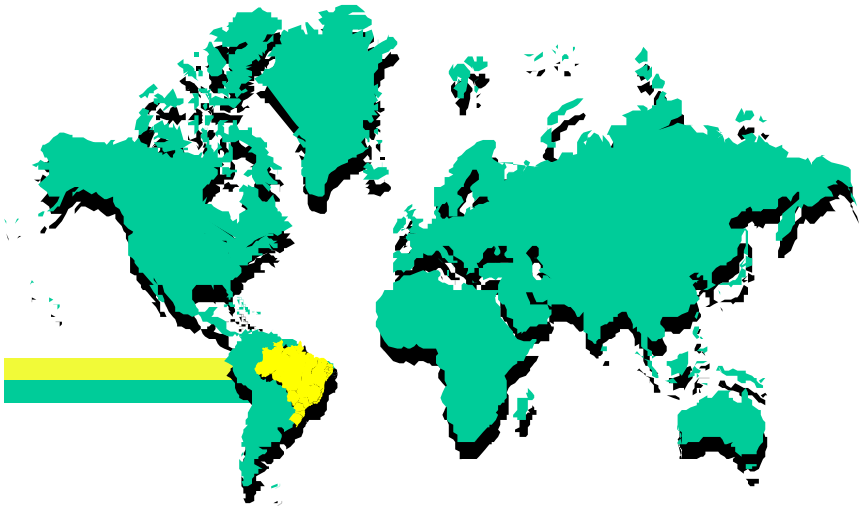
Brazilian Energy Matrix





Source: BEN (2010). Elaboration: UNICA

Strong Public Policies Towards Bioenergy



- **Environmental gains**
  - carbon sequestration
  - lower level of emissions
- **Sustainability - Renewable**
  - short production cycle
  - whole process controlled by man
- **Social aspects**
  - generation of new jobs
  - better income distribution
- **Economic aspects**
  - a new global energy demand
  - strong impacts on commerce & trade

Mapa AGROENERGIA

Embrapa

Sugarcane as an Energy Crop in Brazil

Developing Ethanol as a Large Scale Bioenergy Source in Brazil

Brazil has been experimenting with sugarcane ethanol as an auto fuel since the beginning of last century

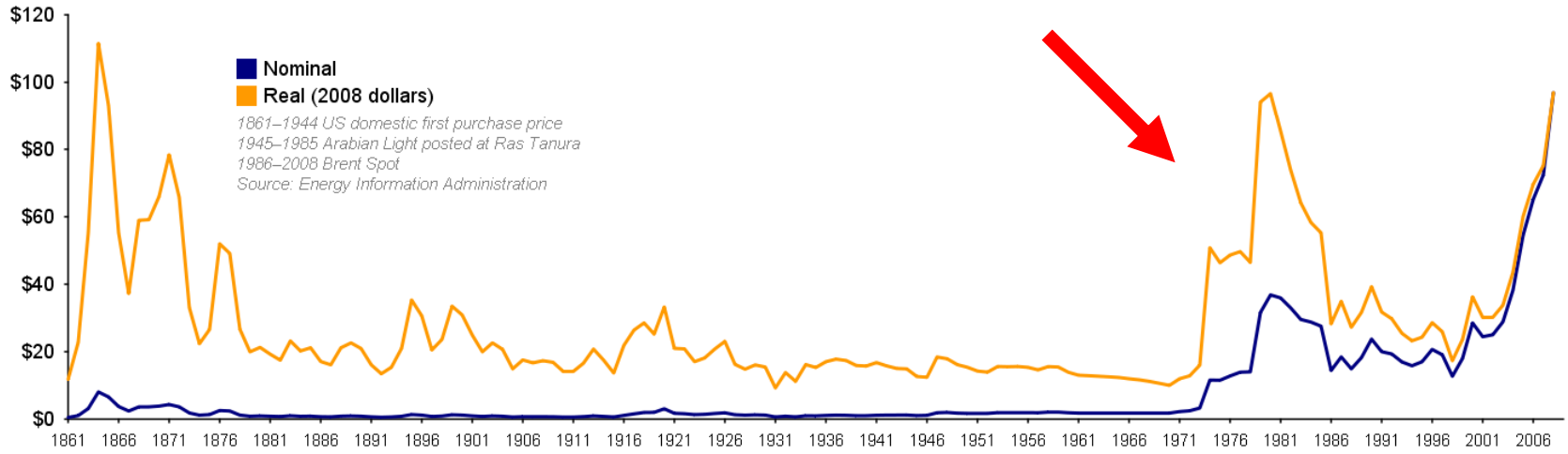
First Brazilian car fuelled by a blend of ethanol and gasoline - 1925

Embrapa

Sugarcane as an Energy Crop in Brazil

Developing Ethanol as a Large Scale Bioenergy Source in Brazil

Key driver was the energy crisis of 1973/1974 - huge increase in oil import costs



Graph of oil prices from 1861–2007, showing a sharp increase in 1973/1974, and again during the 1979 energy crisis. The orange line is adjusted for inflation.

Source: Energy Information Administration
http://upload.wikimedia.org/wikipedia/commons/8/87/Oil_Prices_1861_2007.svg

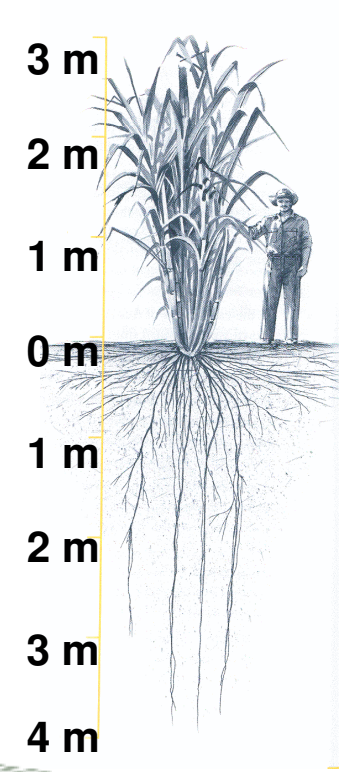
Embrapa

Agricultural Products Highlights

Source: MAPA, 2010

Sugarcane as an Energy Crop in Brazil

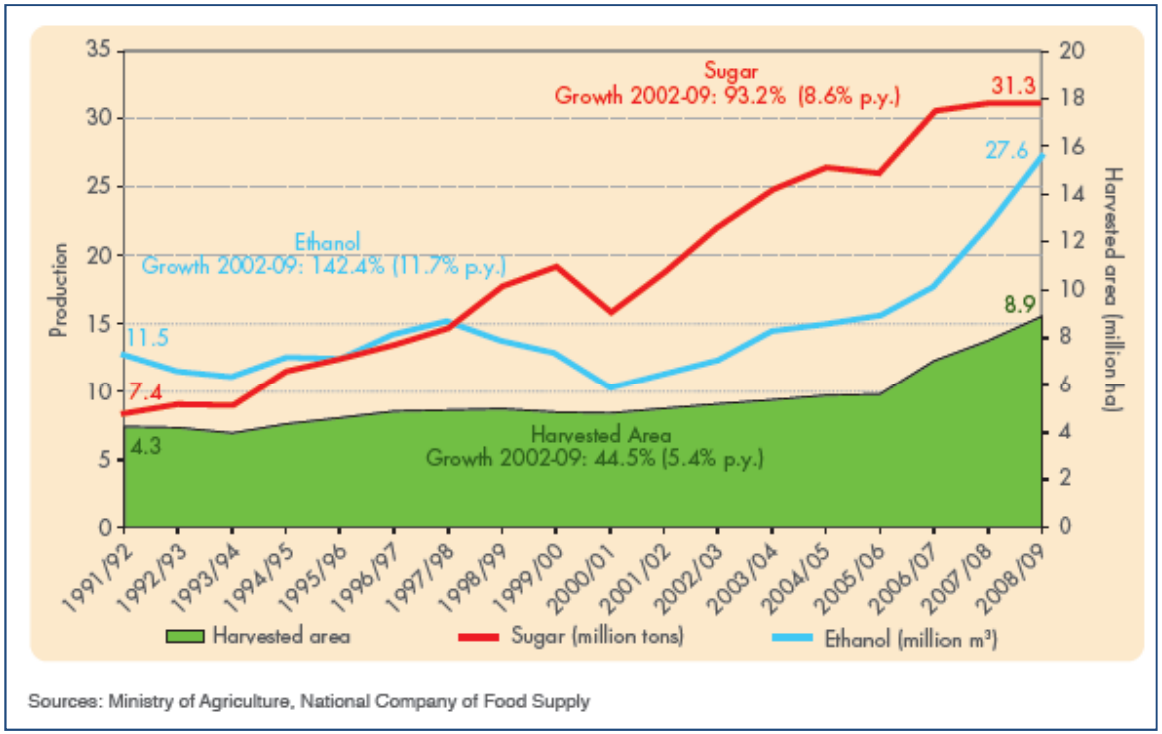
Sugarcane is the main source of bioenergy in Brazil



Sugarcane has been cultivated in Brazil since 1532 as sugar was one of the first commodities exported to Europe by the Portuguese settlers

Embrapa

Sugar and Ethanol: Production and area



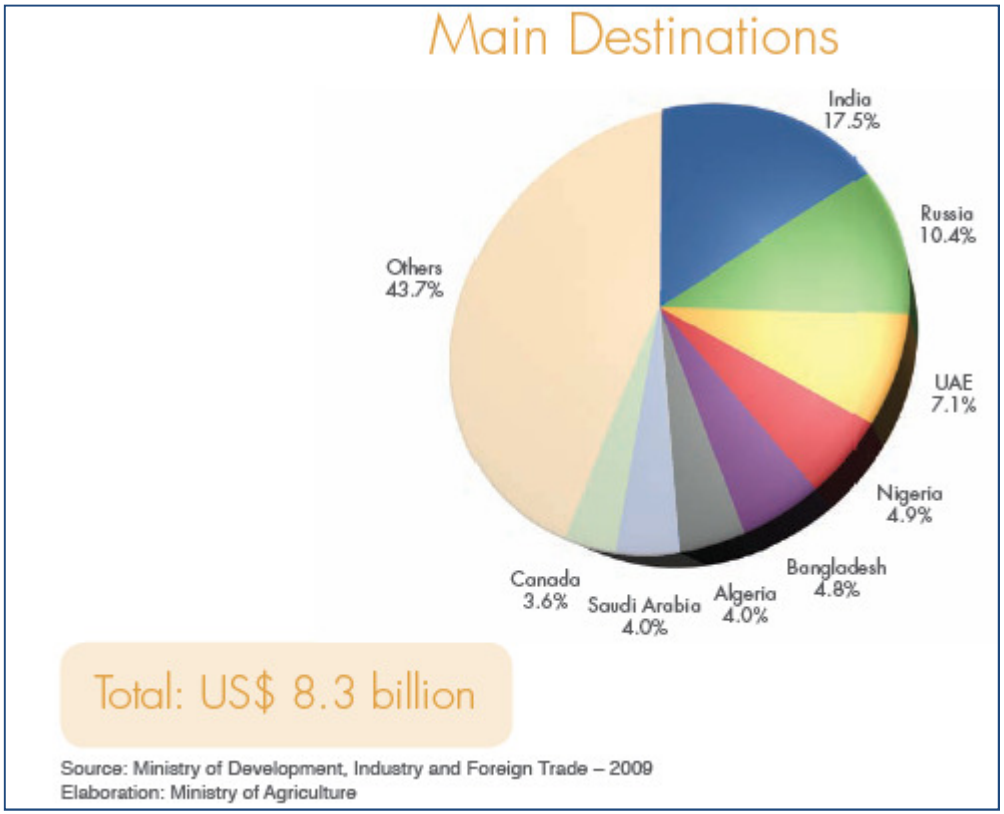
Sugarcane can be transformed in sugar and ethanol, besides other sub-products, such as fertilizer and electricity (from bagasse).

In Brazil, production of food, feed, fiber and fuel can increase substantially, coexisting in environmentally friendly manners.

Embrapa

Source: MAPA, 2010

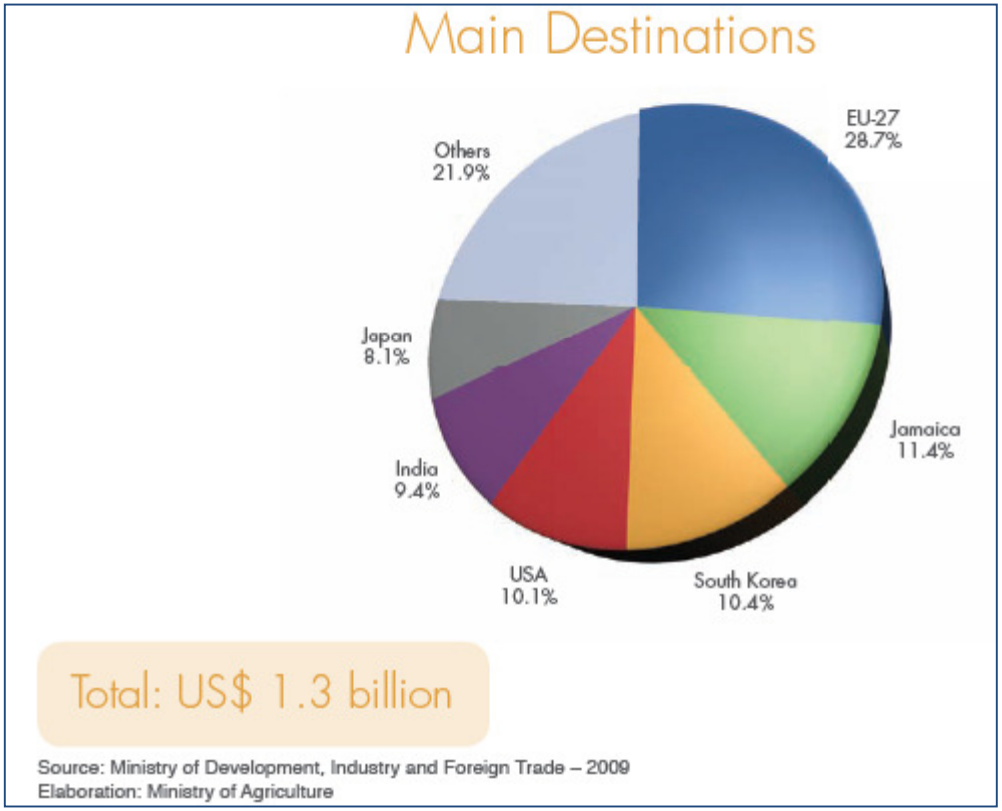
Sugar Exports



Brazil is the #1 exporter of sugar, accounting for almost half of the world's market.

Source: MAPA, 2010

Ethanol Exports

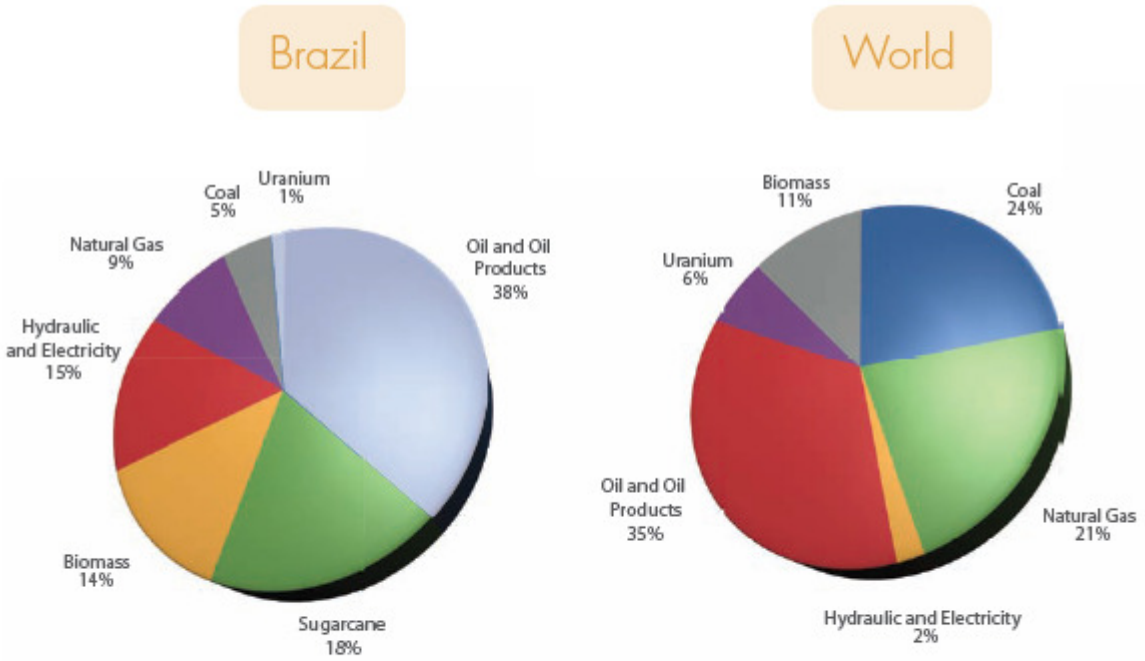


Brazil leads the exports of ethanol, although 90% of its production is consumed domestically.

The use of ethanol as fuel reduces the emission of pollutants.

Source: MAPA, 2010

Energy mix



Share of renewable energy in the total primary energy: 47%

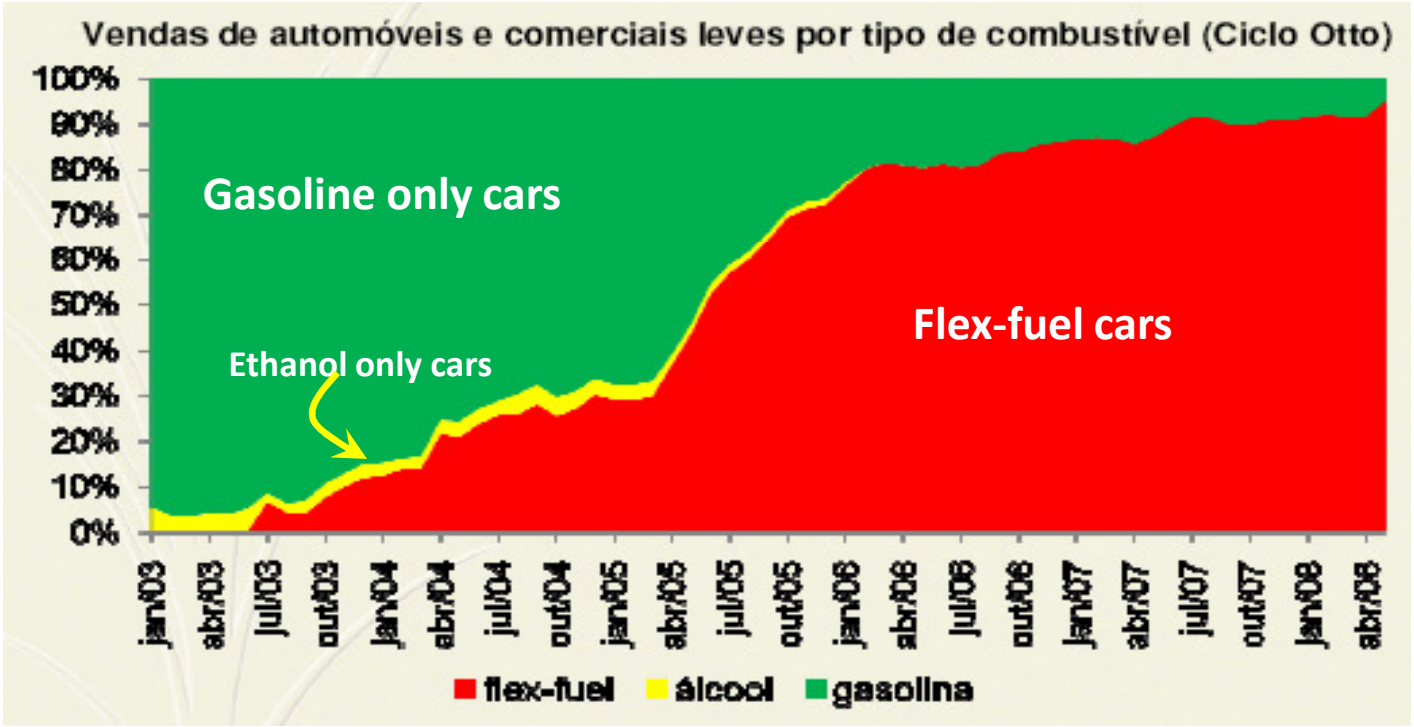
Source: Ministry of Energy and Mining – 2009
Elaboration: Ministry of Agriculture

Almost half of the sources of the Brazilian energy matrix are renewable, sugarcane being the most important one.

Source: MAPA, 2010

Breakthrough – “Flex-Fuel” Engine Development

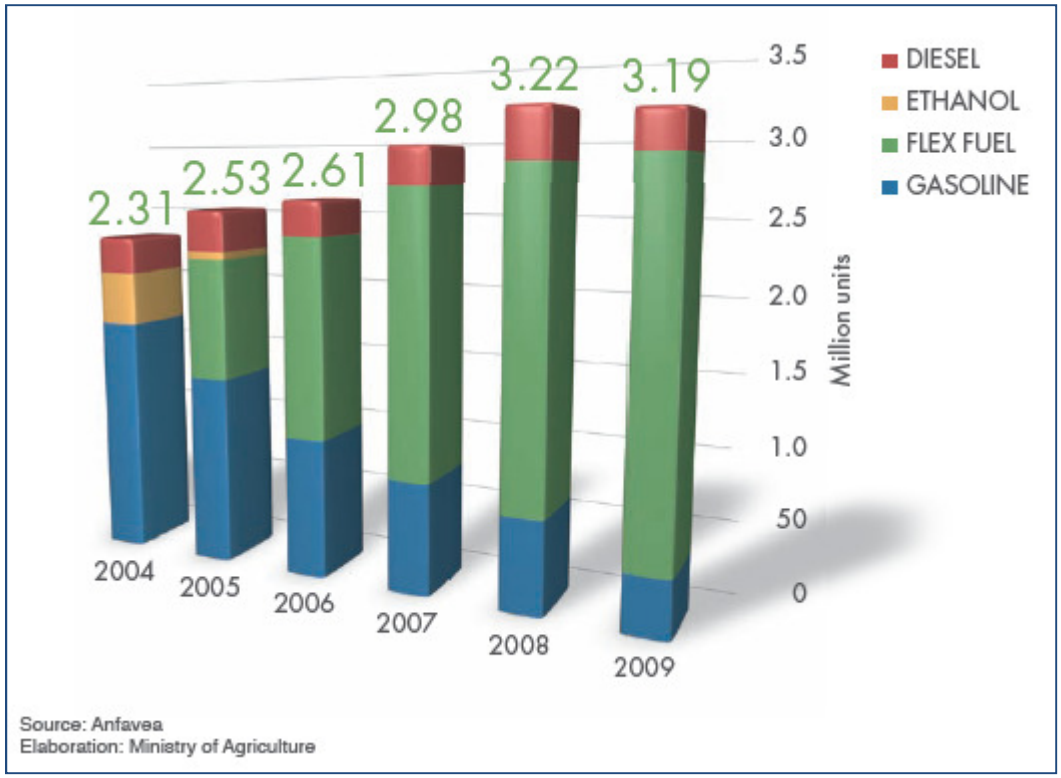
More than 95% of cars sold in Brazil are Flex-Fuel



Source: ANFAVEA and UNICA, 2008

Embrapa

Flex-fuel Cars – Evolution



Flex-fuel technology allows the use of gasoline, ethanol or its mixture at any proportion.

Currently, more than 10 million cars in Brazil have flex-fuel engines.

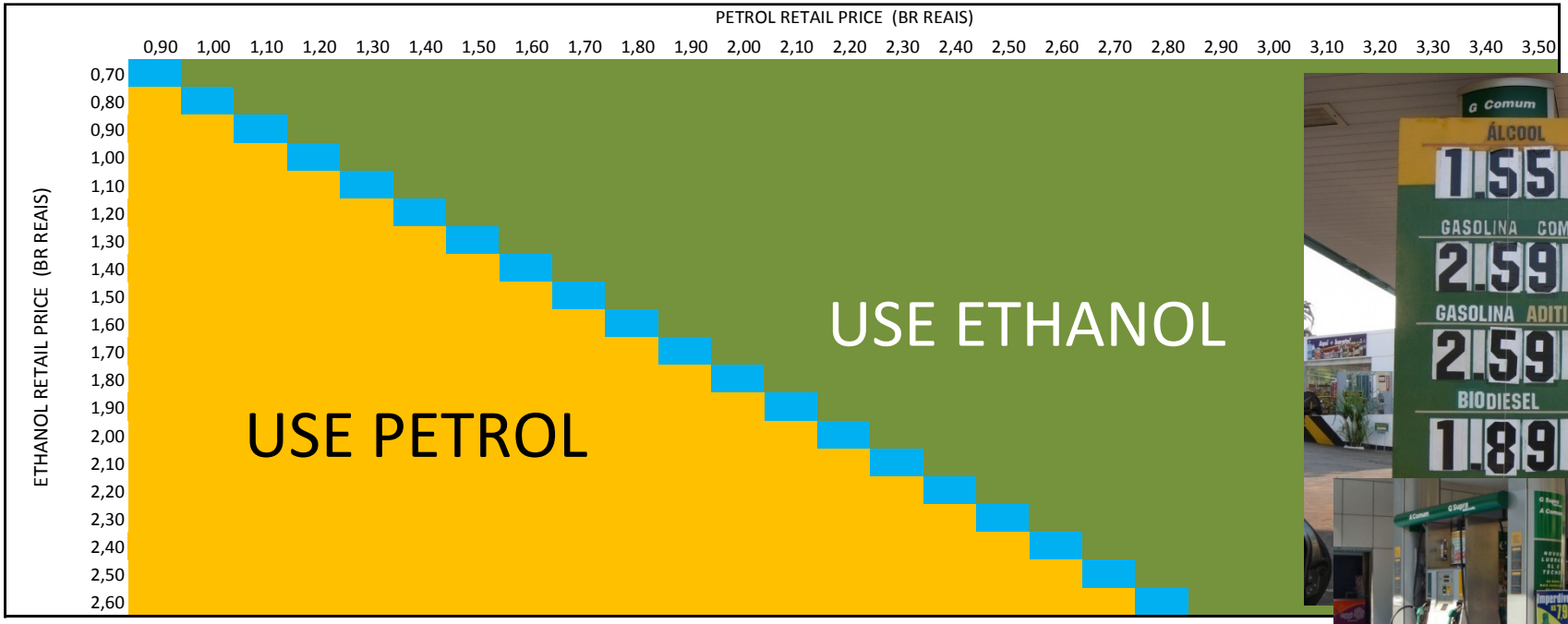
Ethanol is also being used as fuel for Formula Indy competition cars, as well as trucks and airplanes.

Source: MAPA, 2010

Expansion of Sugarcane Ethanol Demand in Brazil

The Evolution of Logistics and Distribution

Brazil has 33,000 gas + ethanol stations (out of 36,000)

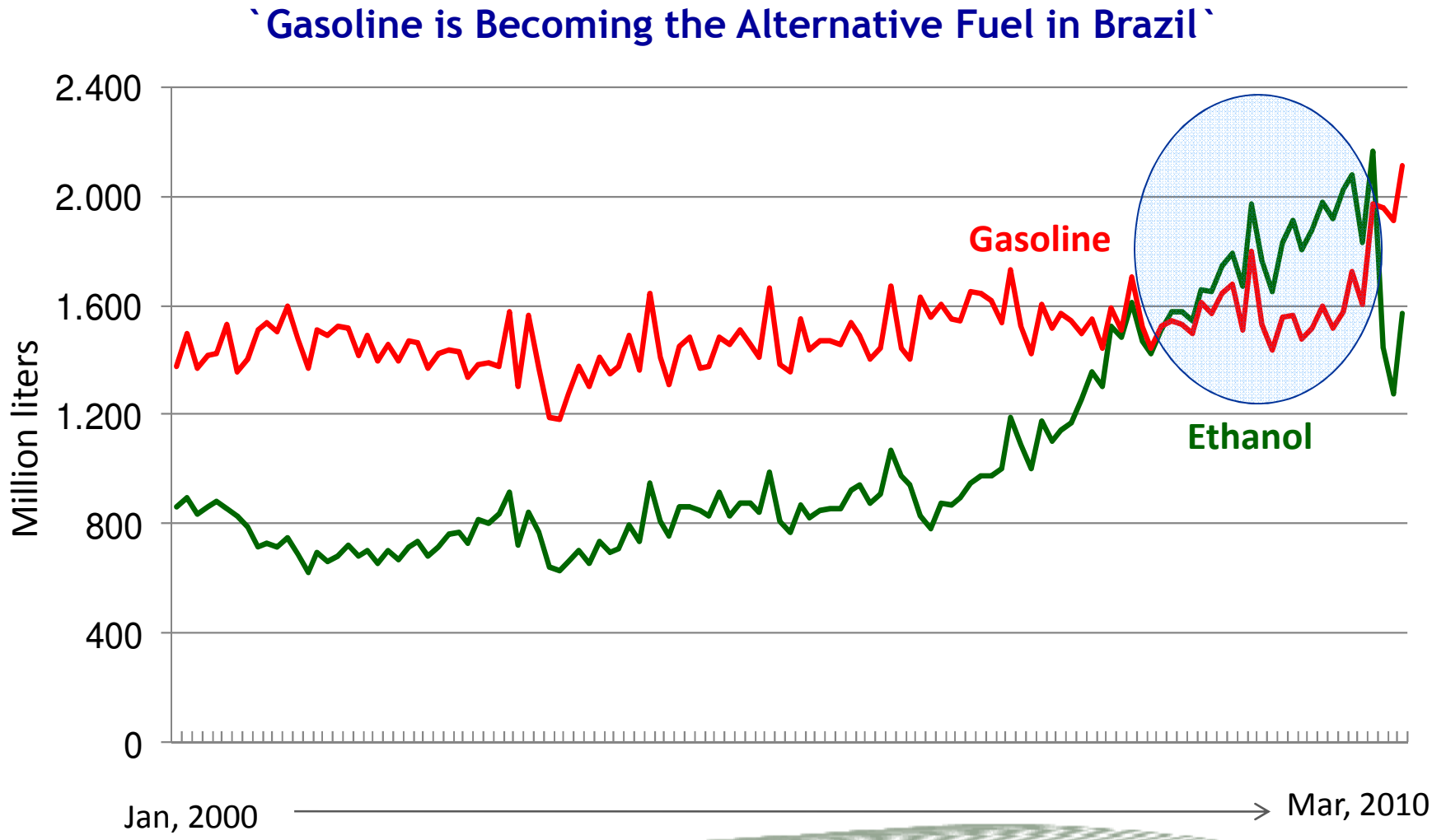


Source: Amatucci & Spers, 2008

Consumer choice: decision table to be used in the petrol station.
Source: based in a GM table distributed to flex car owners.

Embrapa

Expansion of Sugarcane Ethanol Demand in Brazil



Source: ANP. Elaboration: UNICA.

Sugarcane Etanol as Energy Source in Brazil

Ethanol Use not limited to cars

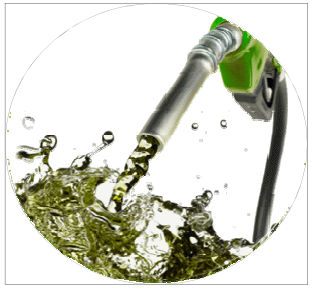
Ethanol-powered buses (E95) - still a pilot project in Brazil

Flex-fuel motorcycles

Brazilian-made crop dusting planes running on ethanol

Production of diesel from sugarcane at commercial scale by 2010

Biobutanol



Production of bioplastics

Source: UNICA.

Sugarcane as anEnergy Crop in Brazil

Sugarcane Bagasse as Energy Source in Brazil



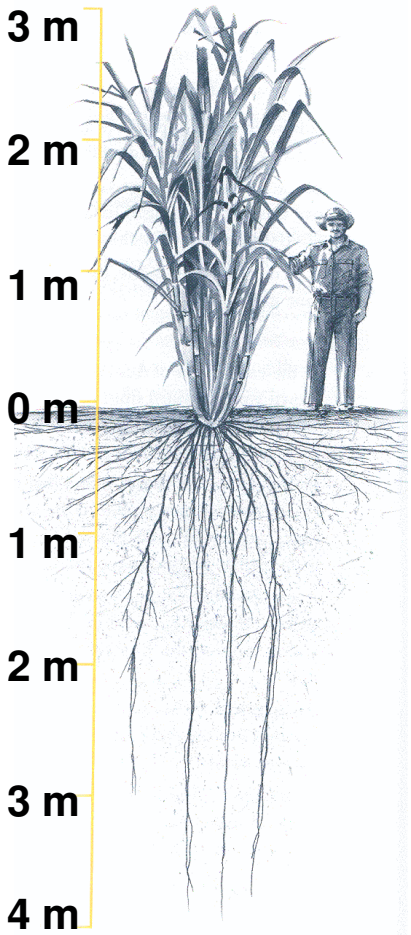

Mills and distilleries also generate electric and mechanical power, most of it for self consumption. That is equivalent to 3% of the electric power consumed in the Brazil.

For every additional 100 million tons of sugar-cane, 12.6 million tons of CO_2 equivalent worth of emissions could be avoided using ethanol, the bagasse and the additional electric power surplus.

Embrapa

Sustainability of Sugarcane Ethanol

Sugarcane is one of the most sustainable energy factories in the world



Productivity

Favorable energy balance

Significant carbon emission reduction

Competitive fuel for consumers

Clear contribution to energy security

Embrapa

Other Alternative Biofuels in Brazil - Biodiesel -

Figure 7. Biodiesel sources according to Brazilian regions.

Biodiesel production in 2008:
1,166 billion liters

Law 11.097/2005:

2005 to 2007

(2% permitted) => 0 – 840 million liters

2008 to 2012

(3% mandatory)

(5% permitted) => 1,3 – 2,5 billion liters

From 2013 on

(5% mandatory) => 2,5 billion liters

Embrapa

Other Alternative Biofuels in Brazil - Biodiesel -

Potentially Sustainable Energy Sources

Brazil has around 100 oil plants in the Cerrado and the Amazon Biomes with potential to be developed as oil crops for energy and other industrial purposes

Acrocomia aculeata (macauba palm)	***Licania rigida*** (oiticica)
Astrocaryum murumuru (murumuru)	***Mauritia flexuosa*** (buriti palm)
Astrocaryum vulgare (tucumã)	***Maximiliana maripa*** (inaja palm)
Attalea geraensis (indaiá-rateiro)	***Oenocarpus bacaba*** (bacaba-do-azeite)
Attalea humillis (pindoba)	***Oenocarpus bataua*** (patauá)
Attalea oleifera (andaiá)	***Oenocarpus distichus*** (bacaba-de-leque)
Attalea phalerata (uricuri)	***Paraqueiba paraensis*** (mari)
Caryocar brasiliense (pequi)	***Sesamum indicum*** (benneseed)
Cucumis melo (melon)	***Theobroma grandiflorum*** (cupuassu)
Jatropha curcas (pinhão-manso)	***Trithrinax brasiliensis*** (carandaí)
Joannesia princeps (cutieira)	

Source: Nass et al. (2007)

Agriculture and Investment Opportunities in Brazil

Embrapa

Investment Opportunities

Source: MAPA, 2010

Investment Opportunities

Strong, Thriving Economy & Institutional Framework

New social and economic paradigms, with:

- Social inclusion and income distribution;
- Upgrowth of the middle class, ensuring solid and diversified domestic demand;
- Investment enhancement;
- Stable, consolidated democracy, legal and institutional framework;
- Infrastructure long-term investment program with strategic actions;
- Sustainable growth based on macroeconomic prudential policies;
- Inflation under control (efficient inflation target regime);
- Robust fiscal rules (primary surplus & continuous reduction of public deficit);
- Low external vulnerability.

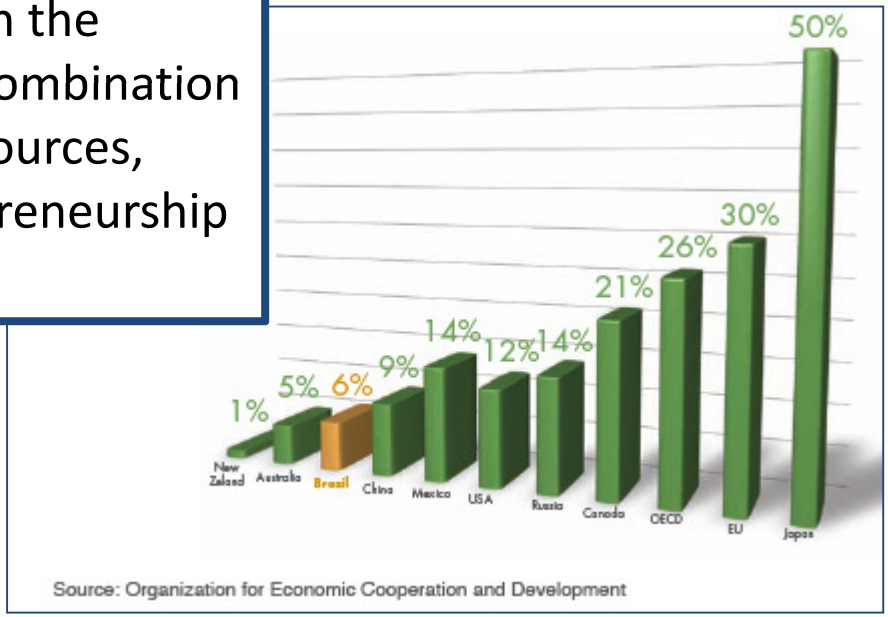
Embrapa

Source: MAPA, 2010

Producer Support Estimate - (Public Support to Farmers)

OECD shows that Brazilian government subsidies to farmers are among the smallest vis-a-vis to other countries.

Brazil's competitiveness in the international arena is due to a combination of the country's natural resources, investments in R&D and entrepreneurship of its producers.



Source: MAPA, 2010

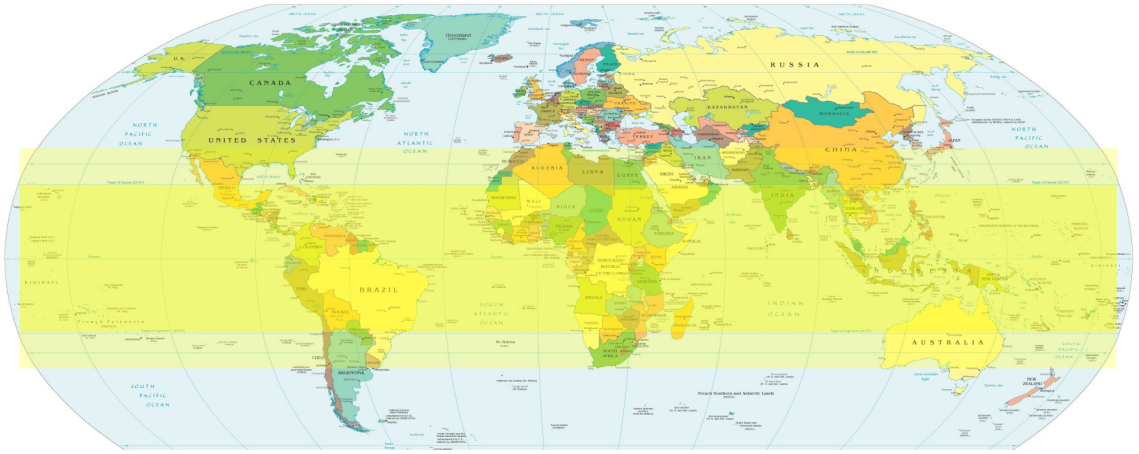
Foreign Investment in agribusiness

The agribusiness productive chains offer several possibilities for foreign investors:

- Direct Investment on Projects (Transportation, Storage, Harbourage);
- Contract Farming (Payment in Products);
- Capital Markets (Stocks, Investment Funds);
- Partnerships and Joint Ventures.

Source: MAPA, 2010

Foreign Investment in agribusiness

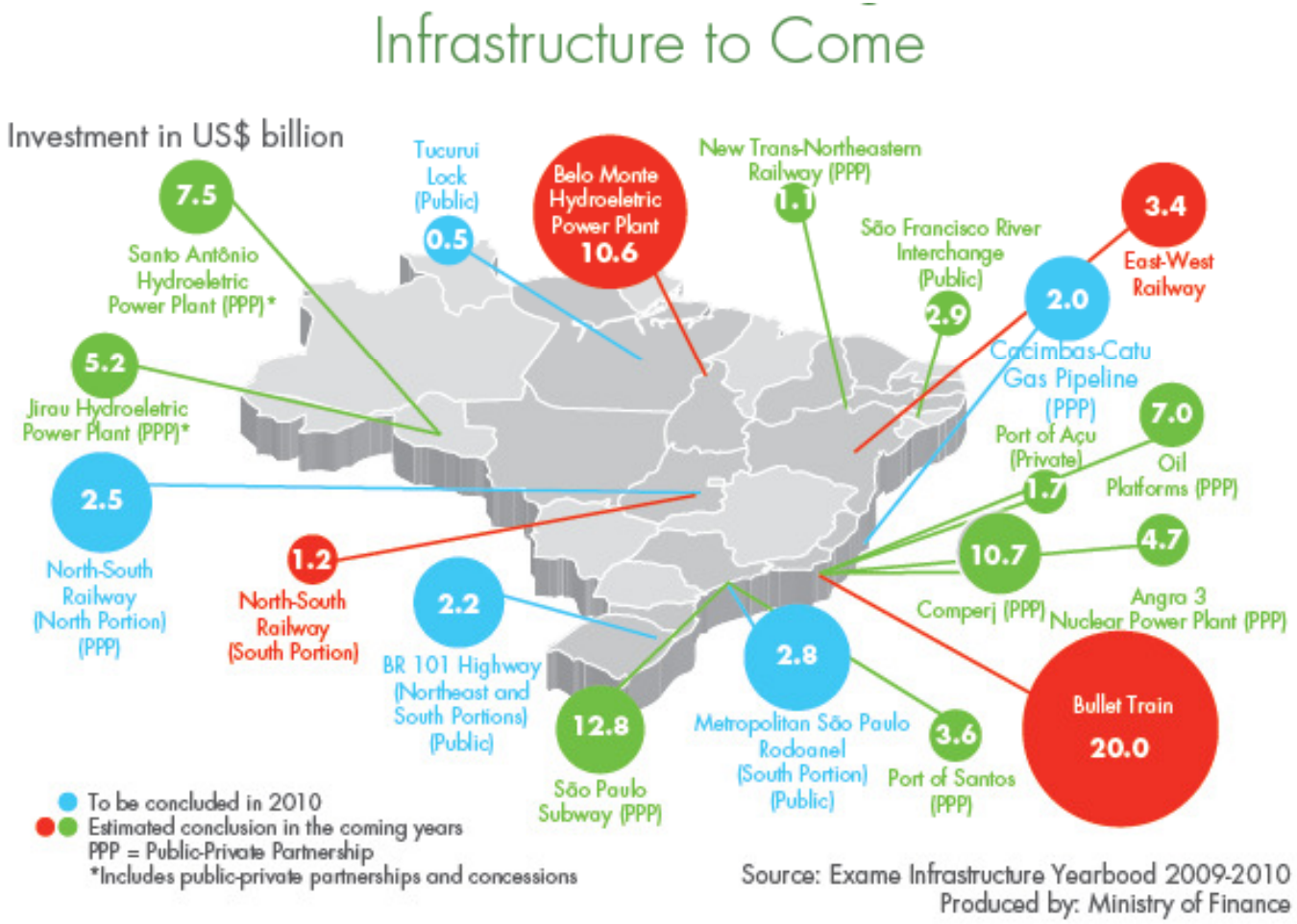


Leadership in Development of Tropical Technology for Agriculture

- Continuous & persistent public and private investments on R&D;
- Opened partnerships with other countries;
- Expressive results on productivity;
- Efficient use of natural resources.

Source: MAPA, 2010

Better Infrastructure - Accelerated Growth Programme



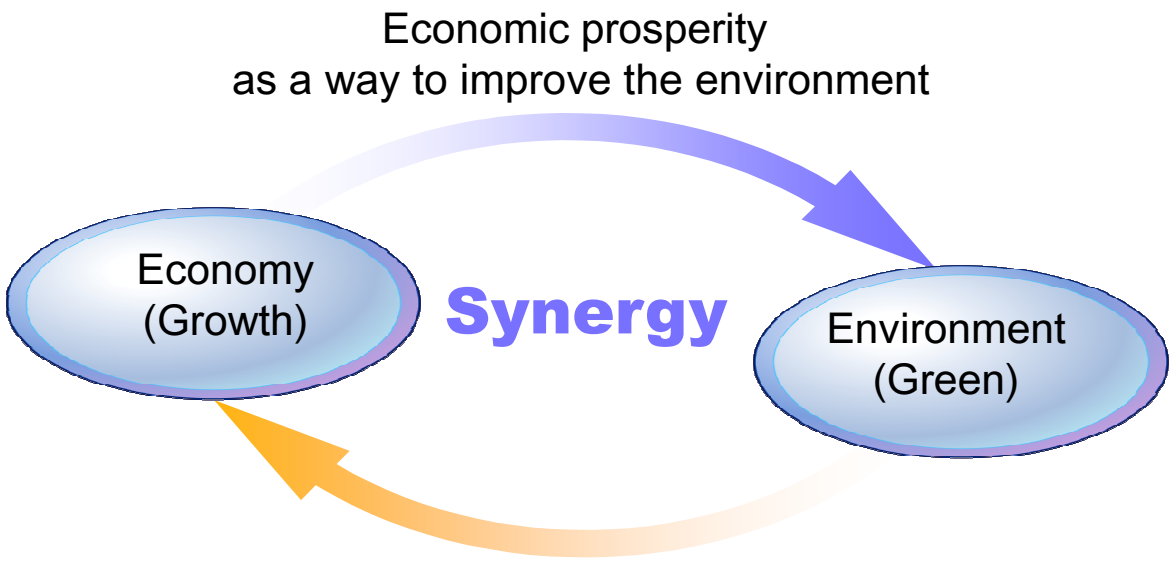
Source: MAPA, 2010

Agriculture and Global Green Growth

Embrapa

Brazilian Agriculture: Pathways to the Future

"Green" & Growth not as substitutes but as complements in development



Source: Modified from UNEP, 2010

Brazilian Agriculture: Pathways to the Future

"Chemicals"

"Environmental Services"

"Fiber"

"Food"

"Biomass"

Natural resources must be seen as the basis for a revolution in the frontier of science…

"Carbon Sink"

… as well as a unique opportunity to build harmony between development and environmental conservation.

"Energy"

"Pharma"

"Water"

"Traditional Knowledge"

"Genetic Resources"

"Forests"

Brazilian Agriculture: Pathways to the Future

Agriculture must not be seen as a problem, but as a solution and key component in the path towards a more sustainable future.

Embrapa

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