Brasil

BRAZILIAN AGRICULTURAL RESEARCH CORPORATION

Embrapa

Science, Technology and Innovation for Conservation and Sustainable Use of Natural Resources in the Brazilian Amazon

Maurício Antônio Lopes, PhD

Embrapa Labex Program – Suwon, Republic of Korea

About Brazil

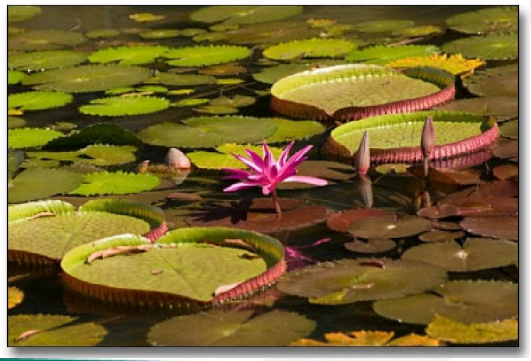
Soccer Carnival Coffee Rio de Janeiro...





Amazon Rainforest





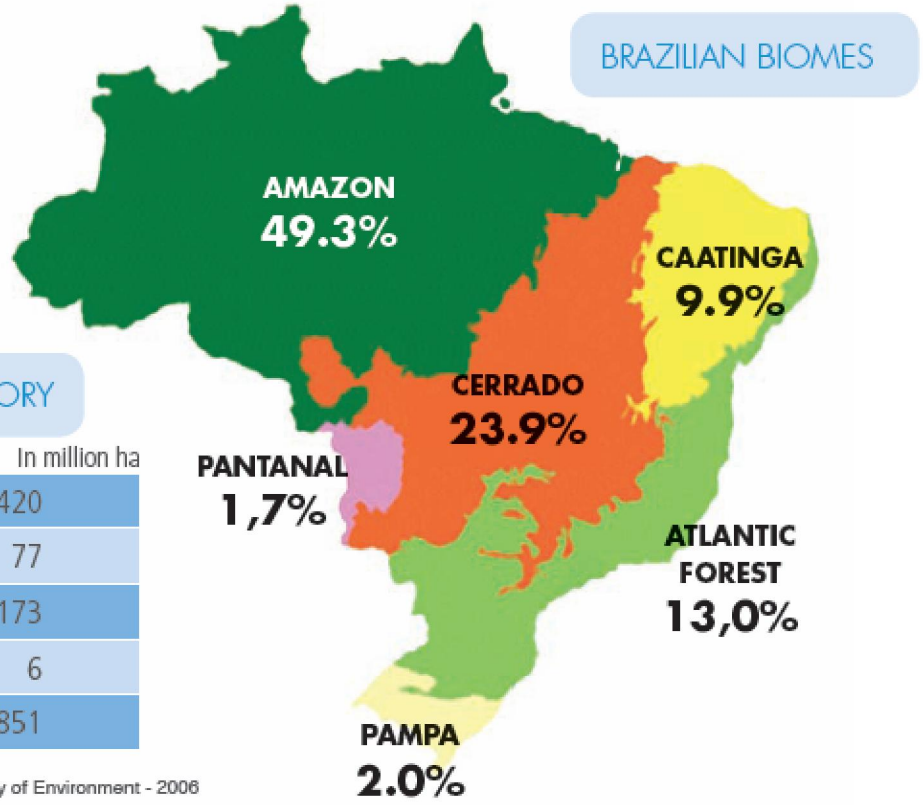
About the Amazon

The Amazon is the most important biome in the South American continent

- 9 COUNTRIES
- 7.000.000 KM ^{2}
- 1/20 GLOBAL SURFACE
- 2/5 SOUTH AMERICA
- 1/5 GLOBAL FRESH WATER
- 1/3 GLOBAL FORESTS
- 3 TIME ZONES
- 2 HEMISPHERES

Source: Lessa, 2007

About the Amazon



BRAZILIAN TERRITORY

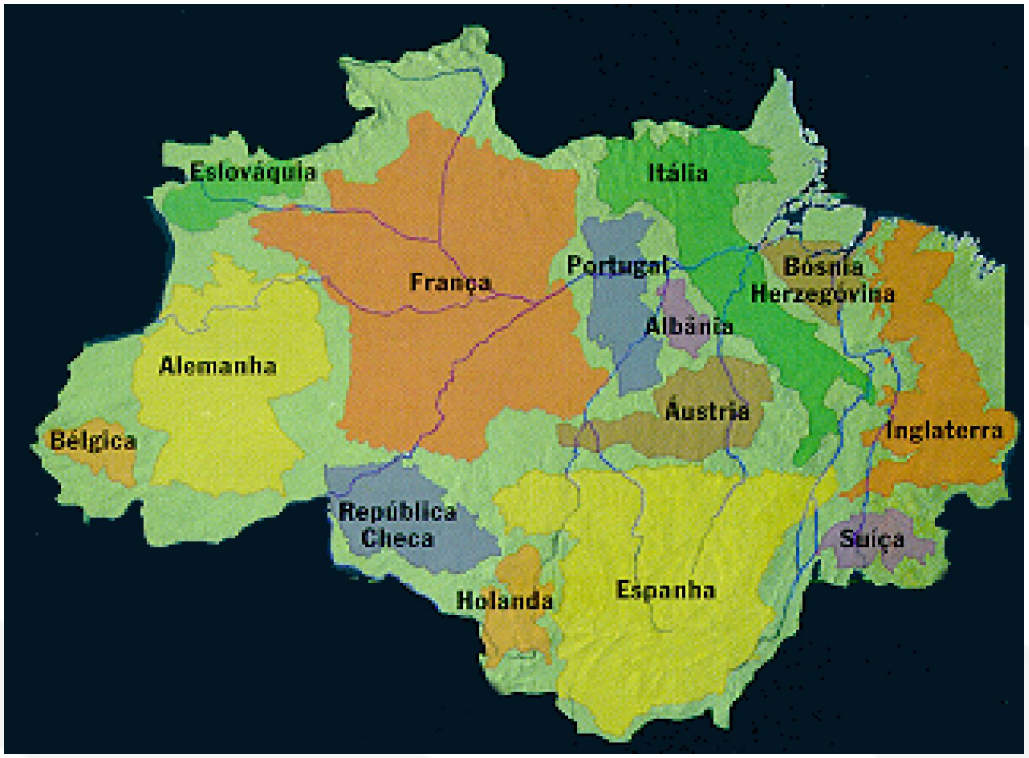
In million ha

Amazon Biome	420
Crops	77
Pastures	173
Planted Forests	6
Brazil	851

Sources: Ministry of Agriculture; Ministry of Environment - 2006

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

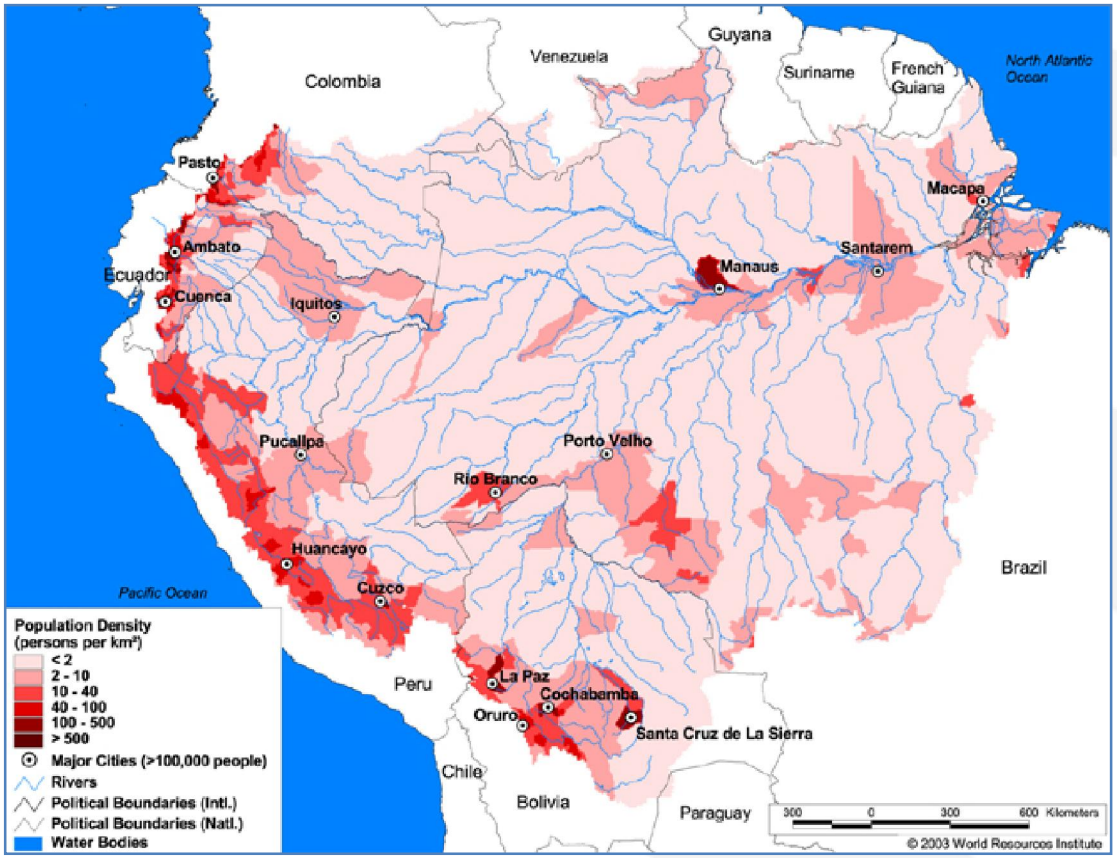
About the Amazon



Amazon is the biggest land biomme of Brazil and larger in area than many countries combined

Source: Lessa, 2007

Amazon Population



Population Density

Basin Area :
6,145,186 sq. km.

Average Population Density:
4 people per sq. km.

Number of Large Cities
(>100,000 people): 16

Source: Ingol, 2008

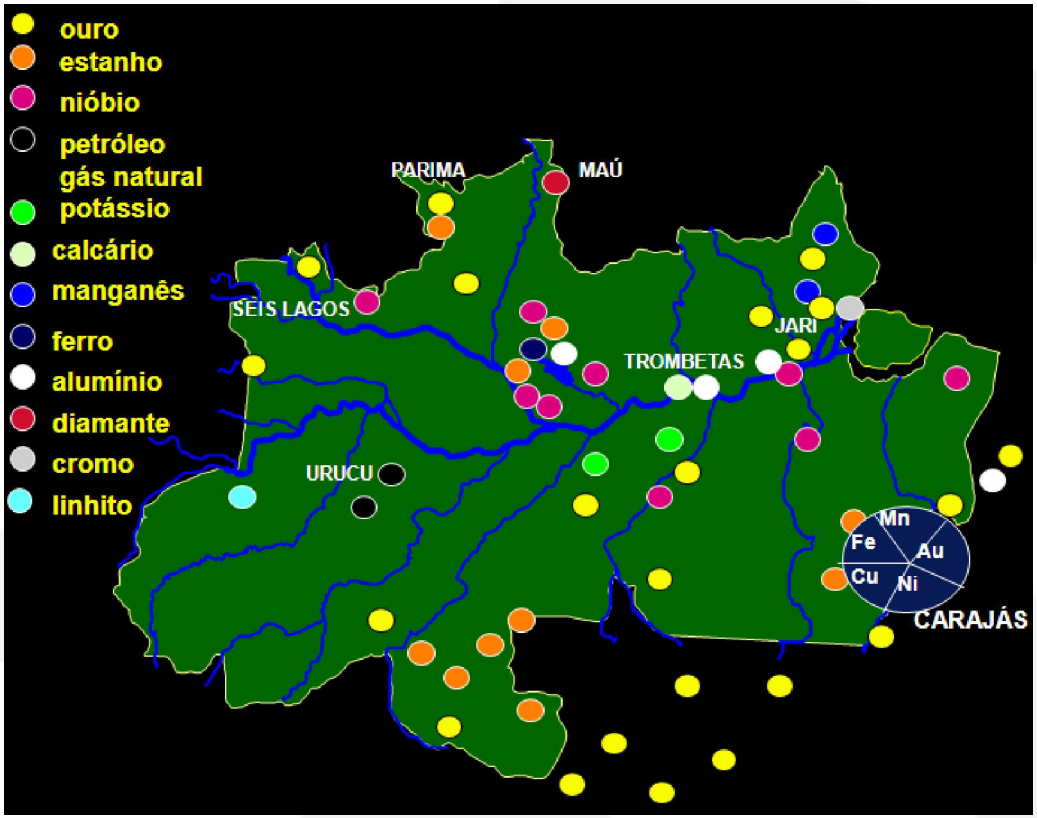
Amazon Geography

Elevations

The area covered by the Amazon River and its tributaries can be multiplied by three from the dry season (~ 110.000 km²) to the wet season (up to 350.000 km²).

Amazon Mineral Resources

The Brazilian Amazon is rich in various mineral resources such as petroleum, natural gas, iron, gold, etc.



Source: Lessa, 2007

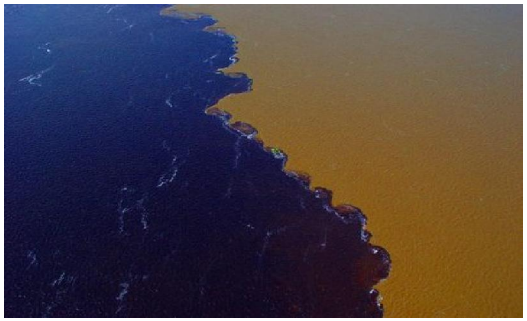
Amazon Water Resources

The Amazon river has the largest drainage basin in the world, accounting for approximately one-fifth of the world's total river flow

- Largest in volume flow: 210,000 M^3/sec
- 6,200 km^2 drainage area
- 6,500 km in length.
- 20% of the freshwater in the world.
- Precipitation: 200 mm to 6000 mm per year

Source: Sterling, 1979.

Amazon Wonders

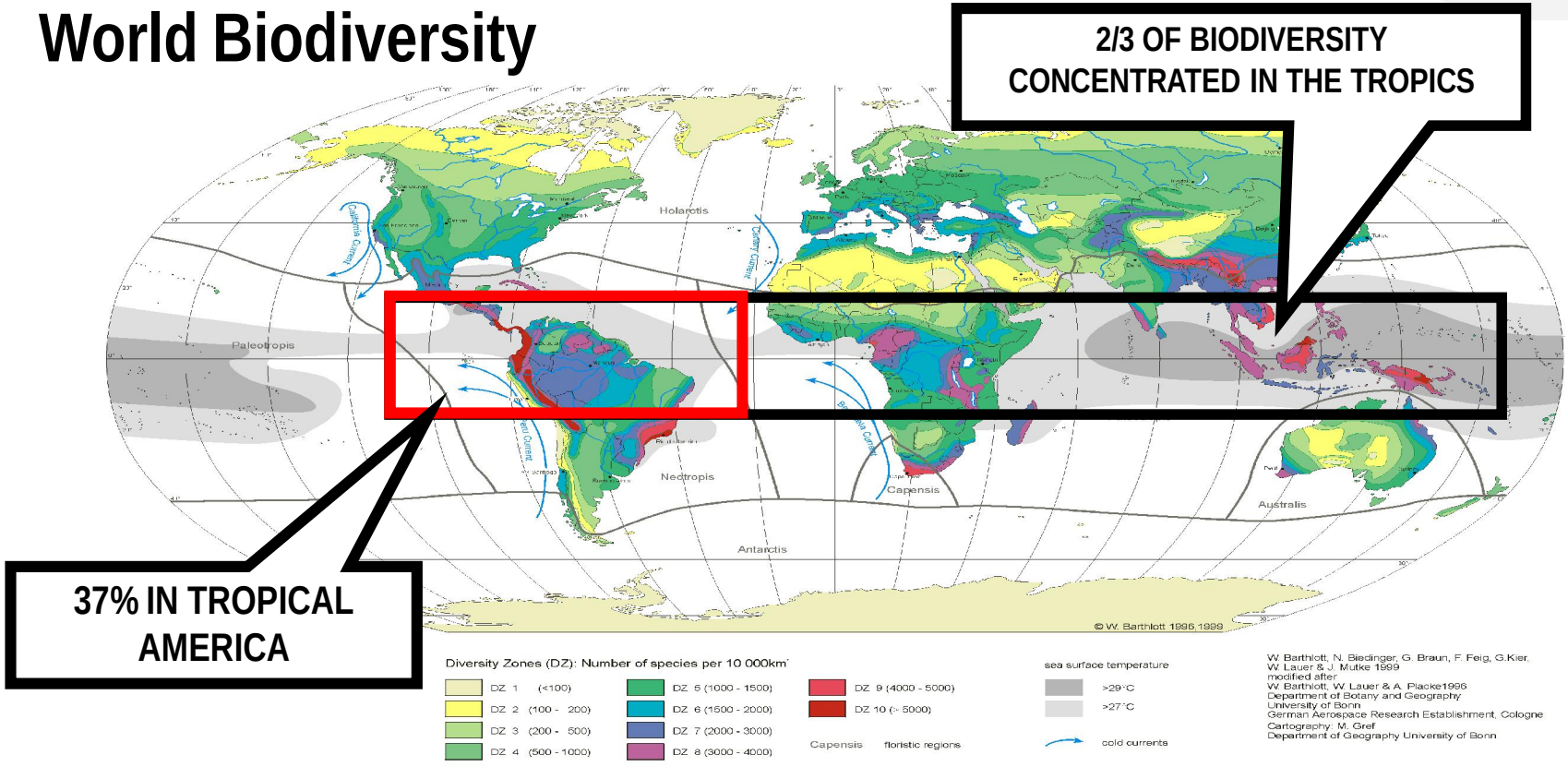



Fascinating natural wonders…

“Meeting of the waters” of Rio Negro and Rio Solimões, near Manaus

Amazon Biodiversity

World Biodiversity



Source: 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.

Brazilian Biodiversity

COUNTRY	Plants	Mammals	Birds	Reptile	Anfibian
Brasil	1	1	3	5	2
Colômbia	2	4	1	3	1
Indonésia	3	2	5	4	6
China	4	3	8	7	5
México	5	5	10	2	4
África do Sul	6	14	11	9	15
Venezuela	7	10	6	13	9
Equador	8	13	4	8	3
Peru	9	9	2	12	7
Estados Unidos	10	6	12	16	12
Papua Nova-Guiné	11	15	13	10	10
Índia	12	8	7	6	8
Austrália	13	12	14	1	11
Malásia	14	11	5	14	14
Madagascar	15	17	17	11	13
Congo (ex-Zaire)	16	7	9	14	16
Filipinas	17	16	16	7	17

Source http://www.ib.usp.br/gra/ffa/ffa-biosfera-megadiversidade.htm

Brazilian Biodiversity

COUNTRY	Plants	Mammals	Birds	Reptile	Anfibian
Brasil	1	4	3	5	2
Indonésia	2	2	1	6	11
África do Sul	3	14	17	14	17
Colômbia	4	12	5	11	1
Austrália	5	1	2	1	5
Papua Nova Guiné	6	9	10	13	8
México	7	3	6	2	5
China	8	7	9	7	4
Madagascar	9	7	8	3	3
Índia	10	11	12	4	10
Malásia	11	14	16	15	14
Venezuela	12	17	13	16	13
Peru	13	10	7	10	12
Filipinas	14	5	4	8	16
Equador	15	16	14	9	7
Estados Unidos	16	6	11	12	9
Congo (ex-Zaire)	17	12	15	17	15

Source http://www.ib.usp.br/gra/ffa/ffa-biosfera-megadiversidade.htm

World Classification Endemic Species

n Biodiversity

gion has about 60,000 species of plants, of
nts, with more than 2,500 tree species.

of arthropods (insects, spiders, centipedes,
s of fish and 300 mammals.

The Amazonian forests, wetlands and savannas have at least 10 000 plant species that are active carriers of medical, cosmetic and biological control agent.

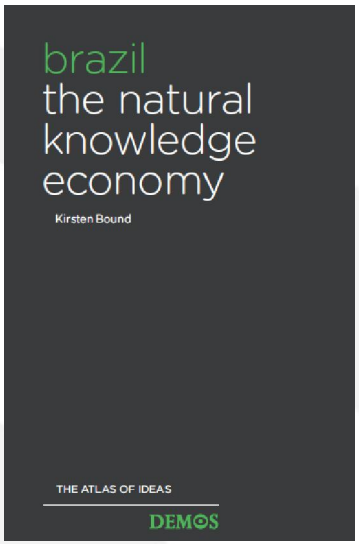
At least 300 species of edible fruits are found in the region.

Source: Albagli, 2001. (http://ftp.mct.gov.br/CEE/revista/rev12.htm)

Brazil, the “Natural Knowledge-Economy”

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.”

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...

We think scientific and technological capability is not in opposition to natural resources and endowments, but integrally linked to them.

“Brazilian innovation is at its best when applying the ingenuity of its people to its natural assets.”

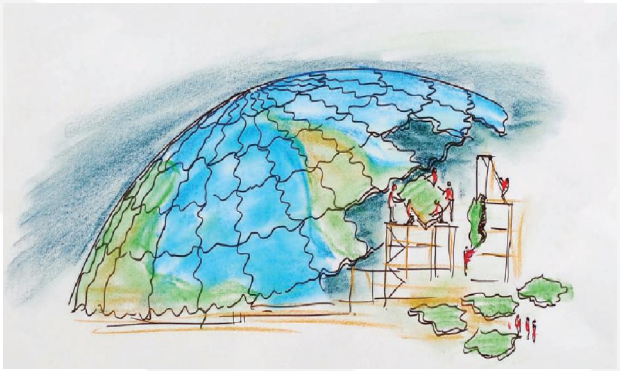
The Atlas of Ideas – Demos Institute, 2008

Brazil, the “Natural Knowledge-Economy”

We believe the development model to be pursued in the Brazilian Amazon must be innovative and unique!

We understand that the challenge of transforming the natural capital of the Amazon in economic and social gains in an environmentally sustainable manner is not trivial…

“There is no "model" the be copied, because there is no tropical country with a developed economy based in diversified and sustainable use of natural resources, particularly forest-based.”



http://www.altfutures.com/pubs/Foresight_For_Smart_Globalization.pdf

Source: SPBC, 2008.

Science, Technology and Innovation for the Amazon

"Water"

"Environmental Services"

"Fiber"

"Food"

The Amazonian natural heritage and the environmental services it provides must be seen as the basis for a revolution in the frontier of science…

"Biomass"

"Carbon Sink"

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

"Green Growth"

"Energy"

"Pharma"

"Traditional Knowledge"

"Genetic Resources"

"Forests"

Brasil

Official Sponsor / 主要赞助

VALE 淡水河谷

Partners / 合作伙伴

BNDES Eletrobras EMBRAER

Realization / 实现

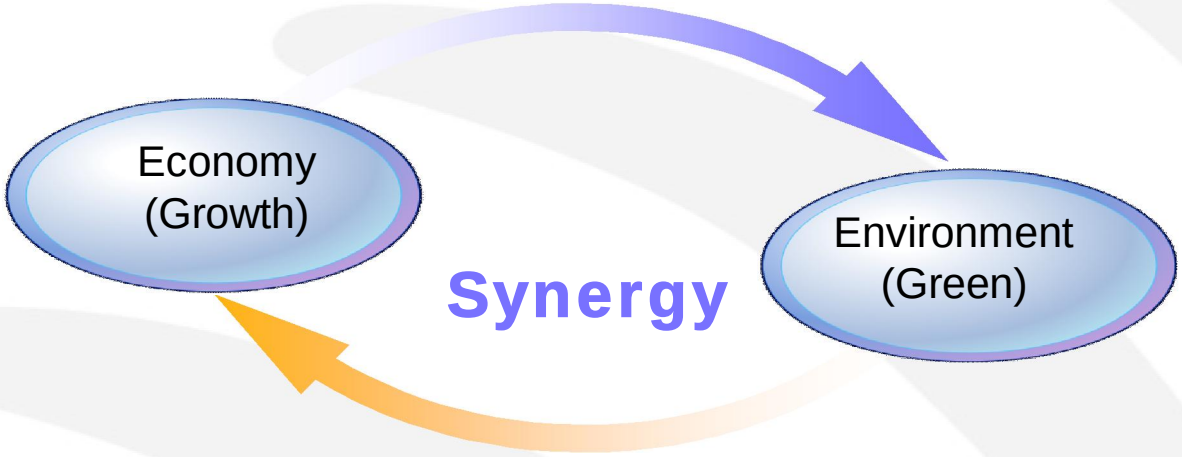
ApexBrasil

Coordination / 协作

A Vision for the Future: "Green Growth"

"Green & Growth must not be seen as substitutes but complements in Amazon development"

Economic prosperity
as a way to improve the environment



Environment as a new
opportunity of economic prosperity and growth

Source: adapted from UNDP, 2010.

Brazil, the “Natural Knowledge-Economy”


editorial

Ready for the best

The large investments in research and education made in recent years have provided Brazilian scientists with the conditions to achieve scientific excellence.

Brazil is the largest country in South America, with an area covering more than half of the continent. It has the fifth largest population in the world with close to 193 million inhabitants. It's a land of natural resources and is famous for its art, music and sporting excellence. A recent focus in *The Economist* describes it as a country with huge potential that has always struggled to deliver[1]. But now the time for achievement seems to have arrived.

During the past 15 years, Brazil's economy has been growing steadily — it was barely affected by the global recession — and there is no sign that this will change any time soon. In this issue we take a closer look at how the economic growth has influenced science in the country.

Many will argue that current president Luiz Inácio Lula da Silva owes most of his political and economical success to his predecessor, Fernando Henrique Cardoso. But even those who were most sceptical at the time of Lula's election have to recognize that his government has made a strong effort to develop science. The interview with the present Minister for Science and Technology, Sergio Machado Rezende[2], and the Commentary by Ado Jorio and colleagues at the University of Minas Gerais[3] provide an overview of the concerted effort to target excellence in both research and education. Funding has increased substantially, reaching 1.45% of gross domestic product in 2008 (ref. 4), which is still much lower than in the United States or Japan (around 3%), but is comparable to China (roughly 1.5%) and approaches the European average (1.9%). Moreover, new research centres have been created and existing ones expanded, while the number of academics and students have increased substantially, in an attempt to reach the necessary critical mass for research in the future.

Efforts to boost the level of scientific productivity have been made particularly in research areas where the country already has a strong tradition. An example is the creation of a new bioethanol institute, a field in which Brazil has been a leader for a long time, particularly since the use of flex-fuel cars was made mandatory after the oil crises of 1973. The use of biofuels is still controversial, as many criticize its effects on biodiversity and on deforestation, and the indirect consequences on the life of local populations. But it would be unrealistic to expect the country to give up this resource at this stage, particularly in light of the announced intentions to maintain a low level of carbon emissions. On the other hand, the attempt to use scientific means to study ways to improve and optimize the production has to be appreciated, especially as the government has also committed to seriously reduce deforestation.

In the field of materials science, a noticeable effort was the creation of the Materials Metrology Division as part of Inmetro (the National Institute of Metrology). According to the director, Carlos Achete, the division was founded in 2003 to become a leading materials science institute, specialized in the synthesis and properties of nanoparticles. Investments of around $20 million were made to improve equipment, and large incentives such as the granting of competitive salaries were also made to attract capable scientists. In addition, strong emphasis was placed on collaboration with scientists abroad in an attempt to gain international visibility as well as capitalize on the expertise of foreign scientists.

The challenge for the next few years will be to make the leap towards the highest levels of scientific excellence. Although productivity in terms of papers published and overall citation numbers has increased substantially in the past few decades, the impact of the results is still well below that of the United States or Western European countries. According to a recent report by Thomson Reuters, the average citation in all fields of research between 1998 and 2008 was 5.58, while it was over 14 for the United States, more than 12 for England, over 11 for Germany and more than 10 each for Italy and France[5].

Clearly it is mainly a question of time. Research in Brazil is after all just a few decades old. Not too long ago many university departments did not have any means to do research at all, and it was only very recently that the necessary infrastructure was implemented. What is undeniable is the awareness of the need to improve, especially in terms of visibility of the results. For example, the National Council of Technological and Scientific Development has introduced a programme of productivity fellowships, which affect both salaries and research funds of individual researchers[6]. The positive aspect of this project is that the fellowships are granted not only on the basis of number of publications and citations, but attention is also given to the specific contributions that a researcher has provided by a piece of work. Emphasis is also put on educational aspects, taking into account for example the number of PhD students supervised.

Lula's government will reach the end of its mandate at the end of 2010, and it is probably too early to envisage what the new candidates for the presidency will propose for science. But it is hard to imagine that the achievements made so far will be undone, whoever the new leader will be. Lula has even signed a series of bills to safeguard the future of the investments made by his government[7]. The years to come promise to bring interesting developments, and we are eager to learn what those will be.

References
1. http://go.nature.com/GCTbv
2. Nature Mater. 8, 525–531 (2010).
3. Sena, A., Schmitt, F. C., Amorim, I. F. & Machado, M. Nature Mater. 8, 526–531 (2010).
4. http://go.nature.com/cYHNV
5. http://sciencewatch.com/dr/sta/2010/08aug10/
6. http://www.cnpq.br/normas/rn_06_014_anexo1.htm
7. Nature 462, 674–675 (2010).

NATURE MATERIALS | VOL 9 | JULY 2010 | www.nature.com/naturematerials 527

© 2010 Macmillan Publishers Limited. All rights reserved

...and Brazil already has capacity to pursue this vision!

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

“Brazil clearly has very real strength in life sciences, particularly related to natural resources. It really is the ‘natural knowledge’ economy… “

Source: Thomson Reuters, 2009

“The large investments in research and education made in recent years have provided Brazilian scientists with the conditions to achieve scientific excellence.“

Source: Nature Materials, 2010

Brasil

Official Sponsor / 主赞助商: VALE 淡水河谷

Partners / 合作伙伴: BNDES, Eletrobras, EMBRAER

Realization / 实现: ApexBrasil

Coordination / 协作

Science, Technology and Innovation for the Amazon

Critical mass and scientific capacity are important...

…but an effective innovation strategy for the Amazon must be based on a multidimensional strategy!

Brasil

Official Sponsor / 主要赞助商 VALE 淡水河谷

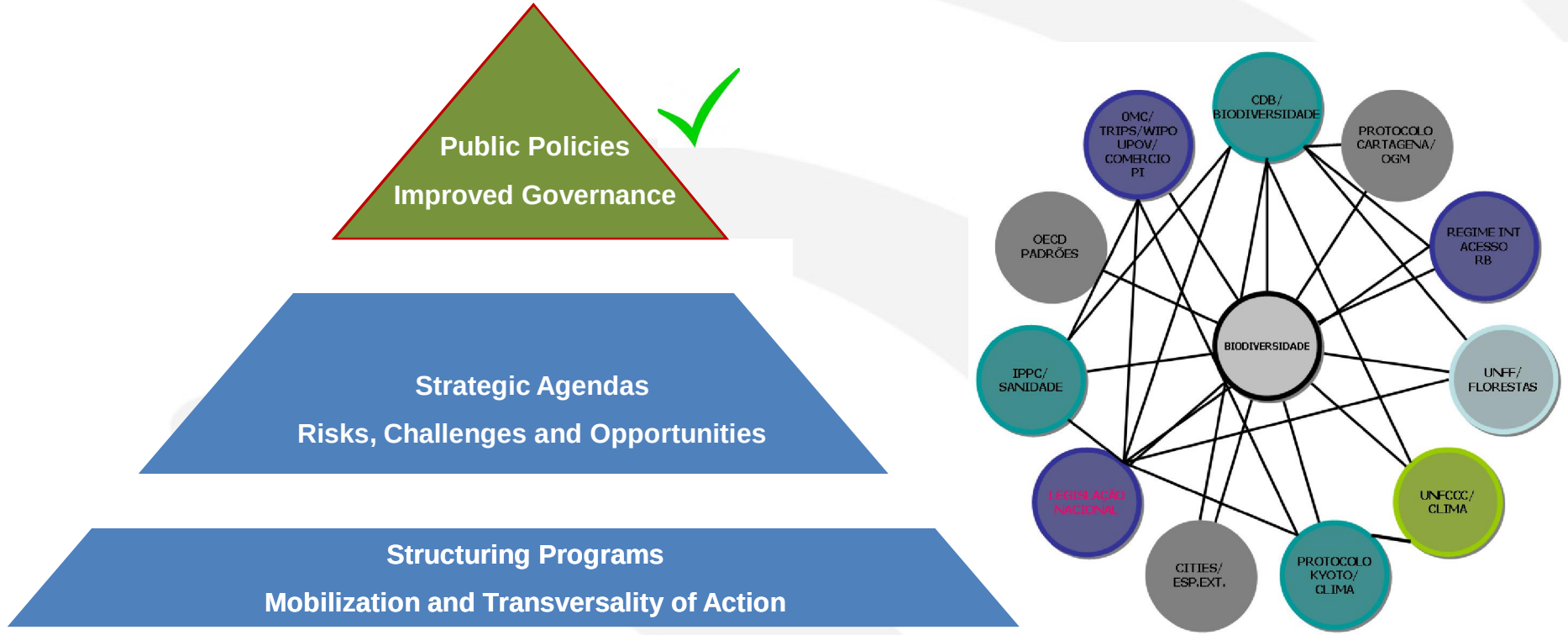
Partners / 合作伙伴 BNDES Eletrobras EMBRAER

Realization / 实现 ApexBrasil

Coordination / 协作

Science, Technology and Innovation for the Amazon

Brazil is contributing to international policy dialogue, formulation and implementation, identifying opportunities to promote a sustainable development of the Amazon Region.



Brasil

VALE

BNDES Eletrobras EMBRAER

ApexBrasil

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

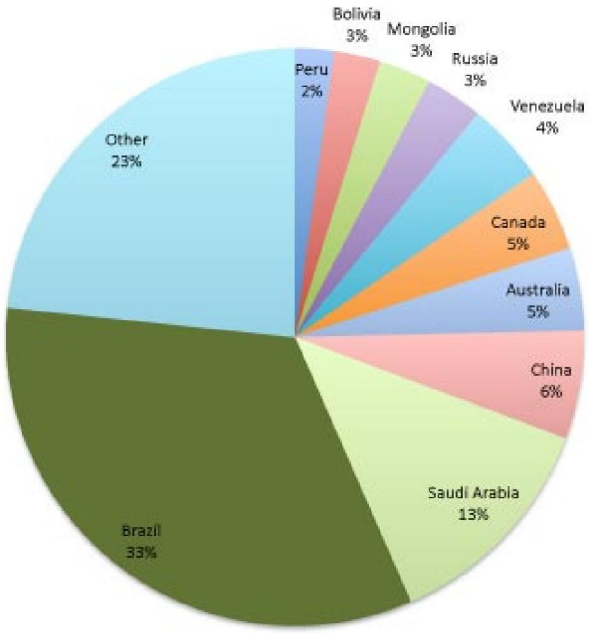
Source: MMA/Brazil

Conservation Strategies

Brazil is the world champion in conservation!!

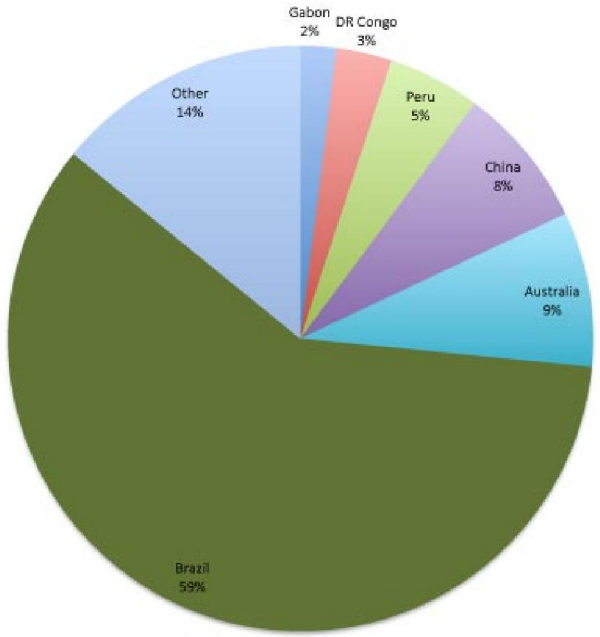
The country has now the largest area of protected land (2.52 million sq km), according to the UNEP-WCMC data.

Share of terrestrial protected areas, established since 1990



mongabay.com using UNEP World Conservation Monitoring Centre data

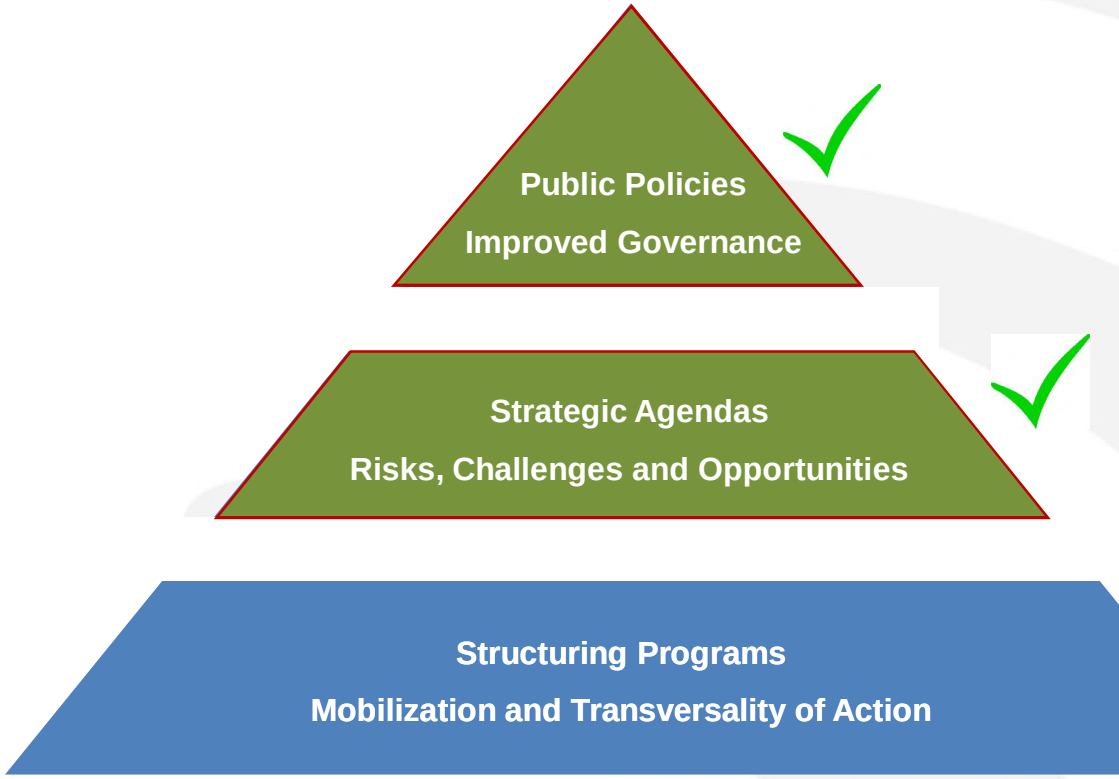
Share of terrestrial protected areas, established since 2000

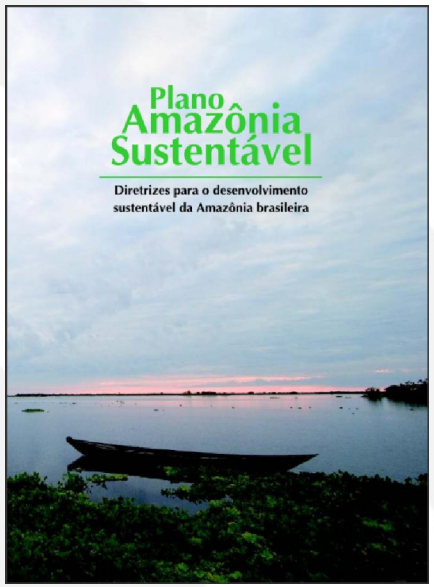


mongabay.com using UNEP World Conservation Monitoring Centre data

Science, Technology and Innovation for the Amazon

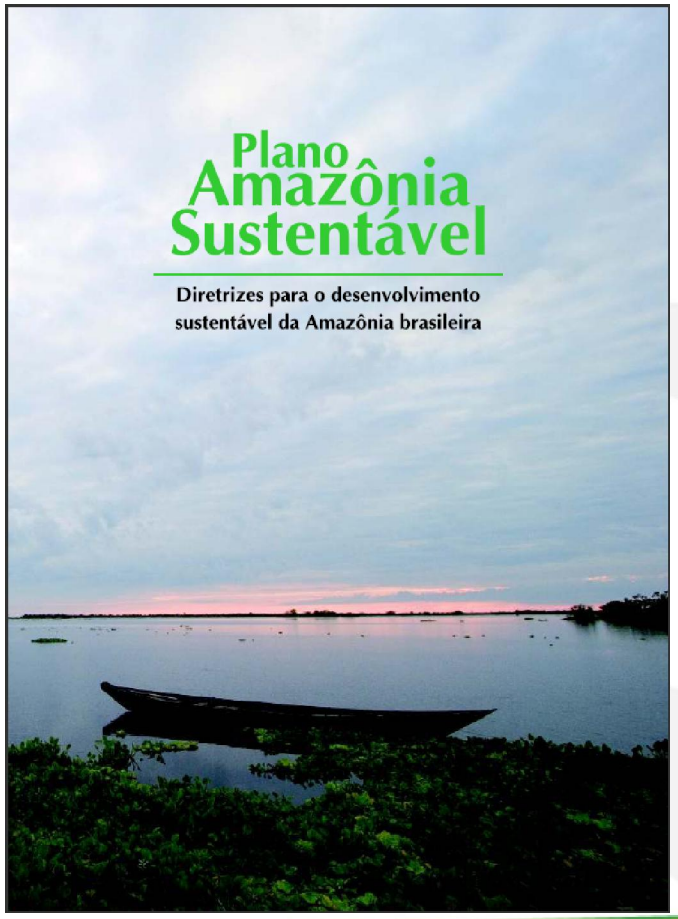
Brazil is defining national policies and strategies to promote sustainable development schemes and to improve infrastructure to integrate the Amazon into the broader economy.





“Brazil forging its own path for developing the Amazon”

Public Policies for the Amazon



“Brazil forging its own path for developing the Amazon”

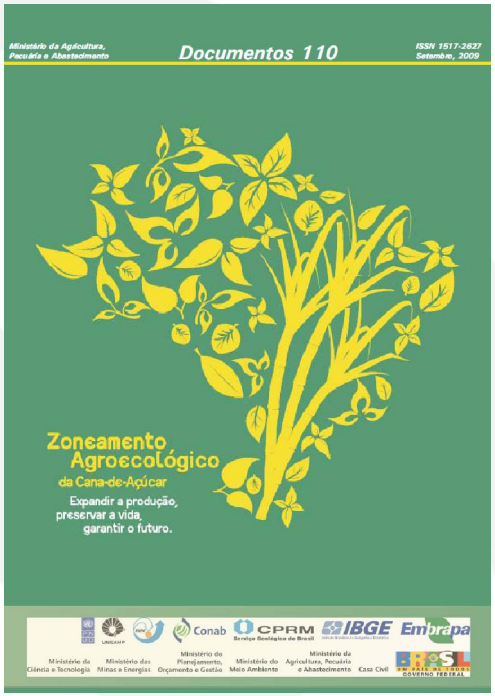
The **Sustainable Amazon Plan** is designed to enhance conservation and sustainable use of resources, to create jobs, generate economic growth and reduce social inequalities for the more than 23 million people living in the Amazon.

Emphasis in promoting sustainable development schemes and improving infrastructure to integrate the region into the broader economy.

Financial incentives for environmental performance
Monitoring and tracking mechanisms
Training and capacity building
Improved governance

Science, Technology and Innovation for the Amazon

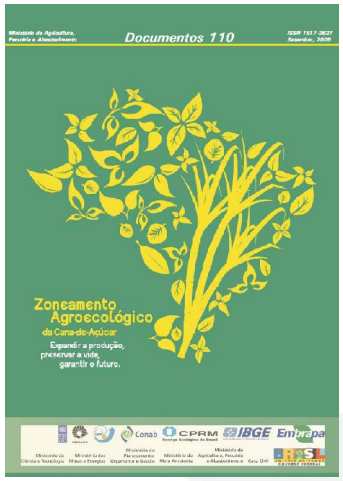
Brazil increases environmental preservation measures using zoning technology developed by Embrapa



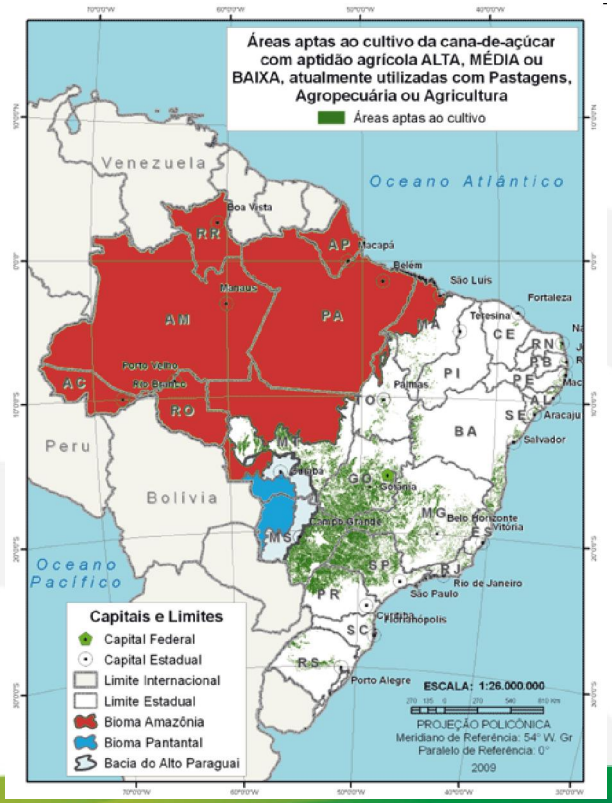
Source, Embrapa, 2009

Science, Technology and Innovation for the Amazon

Brazil increases environmental preservation measures using zoning technology developed by Embrapa



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



A recent Bill makes indigenous lands – including the Amazon, Pantanal, and Upper Paraguay River Basin regions – off-limits for the sugarcane industry expansion.

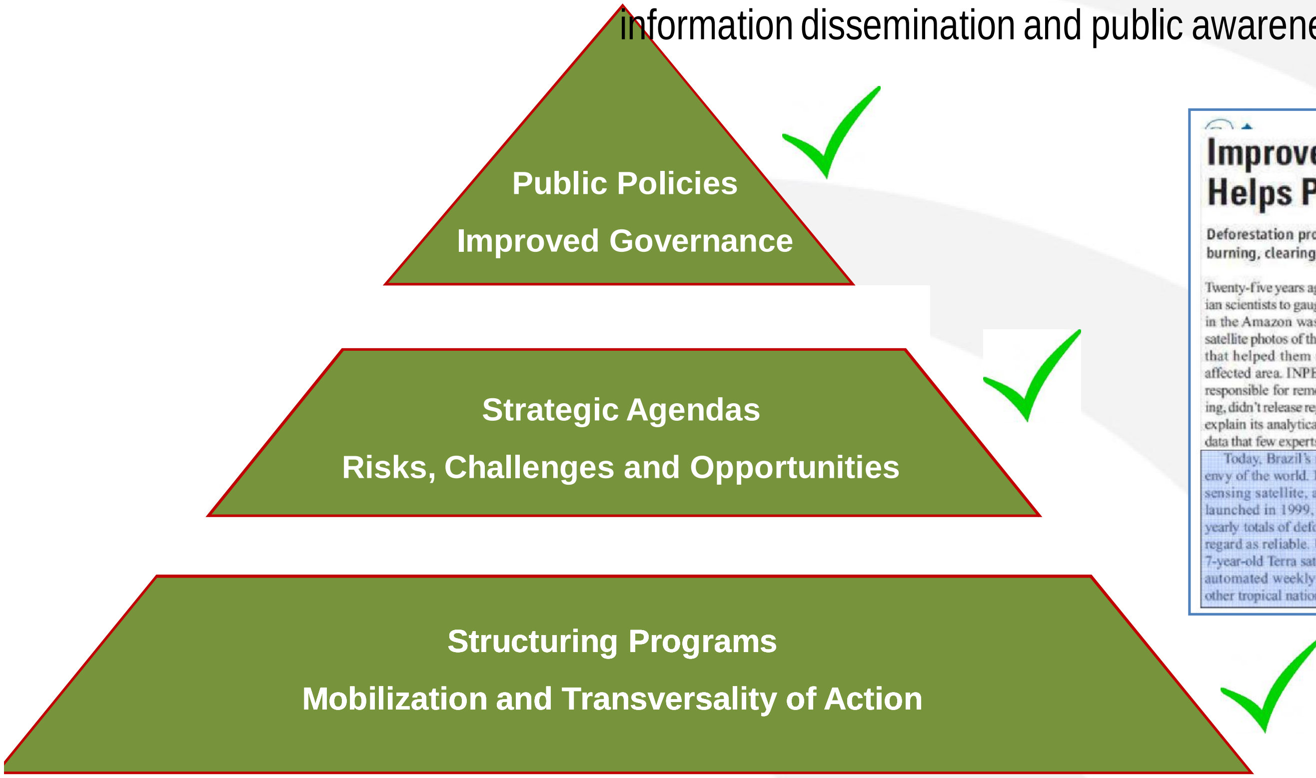
A zoning plan developed by Embrapa establishes that areas for cultivation of sugarcane may reach a maximum of 64 million hectares.

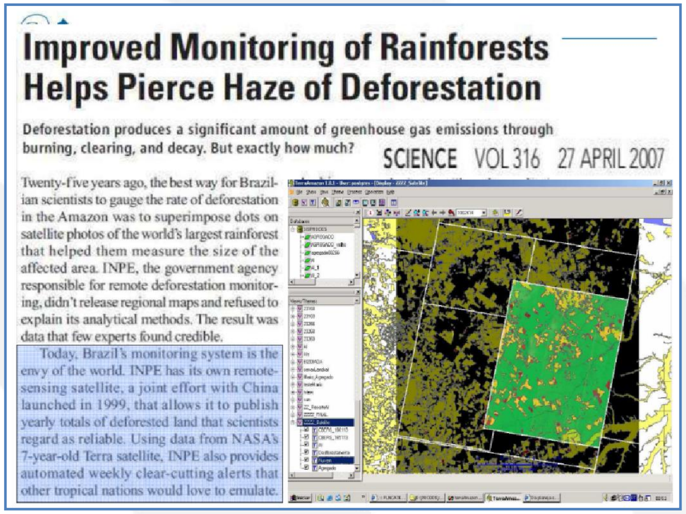
Embrapa

Science, Technology and Innovation for the Amazon

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

Information for strategic decisions by deforestation control agencies, better efficiency in law enforcement, Immediate information dissemination and public awareness





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?

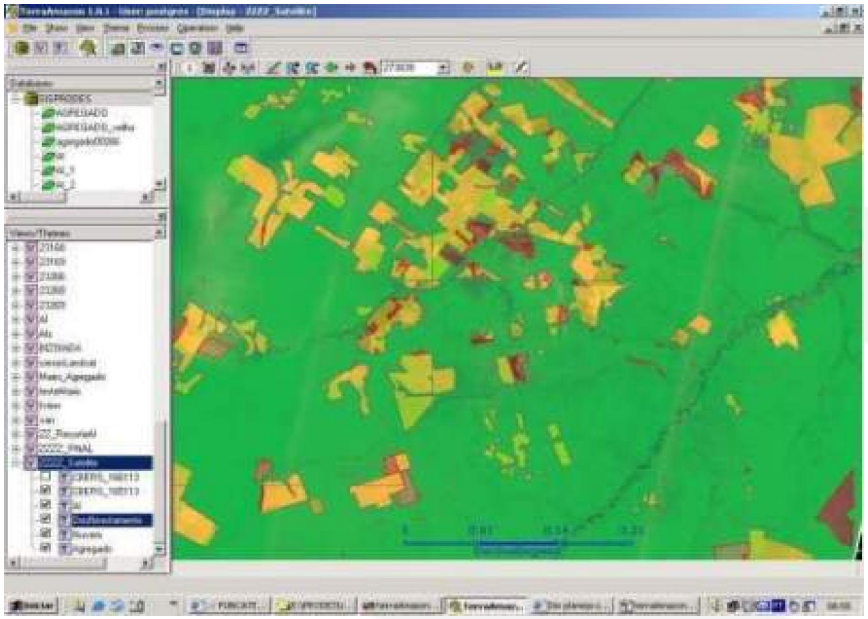
SCIENCE VOL 316 27 APRIL 2007

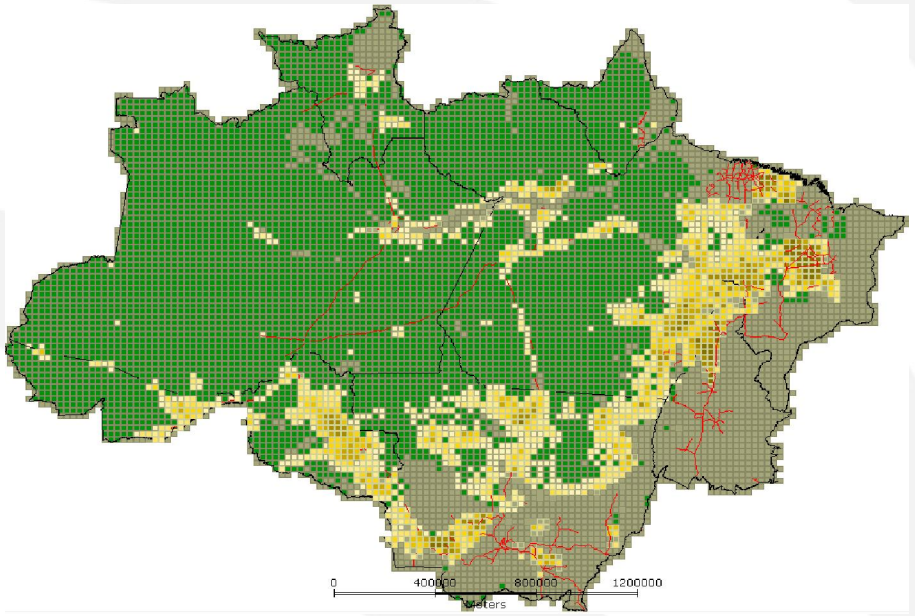
Twenty-five years ago, the best way for Brazilian scientists to gauge the rate of deforestation in the Amazon was to superimpose dots on satellite photos of the world's largest rainforest that helped them measure the size of the affected area. INPE, the government agency responsible for remote deforestation 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.

Science, Technology and Innovation for the Amazon

Monitoring Amazon deforestation: PRODES

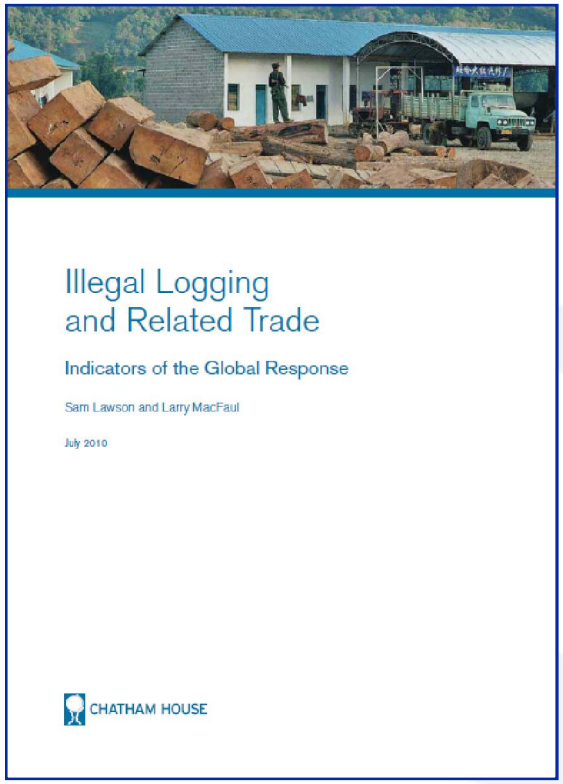




Brazil is the world leader in use of satellite images to monitor deforestation in the tropics

Source: National Institute for Space Research (INPE)

Science, Technology and Innovation for the Amazon



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

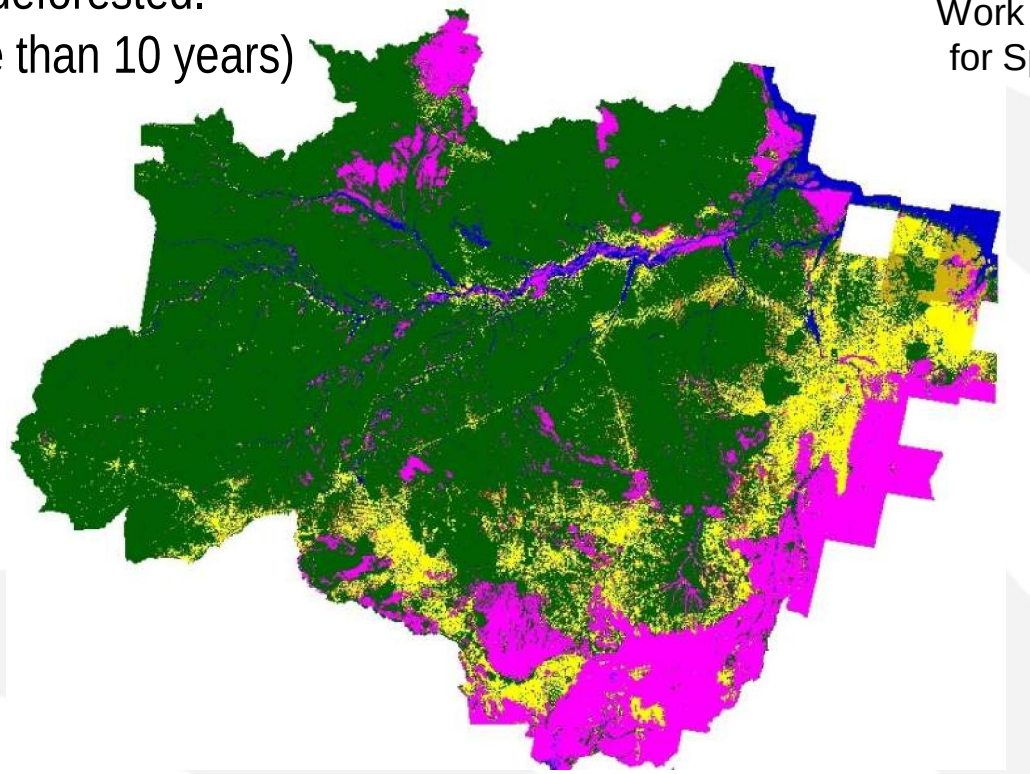
"Brazil scored the highest in many important areas of the government response, thanks to a major overhaul of laws, policies and regulations during the last five years"

"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.

Science, Technology and Innovation for the Amazon

700.000 Km^2 deforested.
(450.000 km^2 more than 10 years)



Work of the National Institute for Space Research (INPE) and Embrapa.

Strong emphasis in defining the best use for these areas

Source, INPE, 2009

Science, Technology and Innovation for the Amazon

"Soybean is no longer an issue for the Amazon Biome deforestation".

Minister of Environment of Brazil

Since the "moratorium", soybean area decreased to 0.27% of the Amazon Biome.

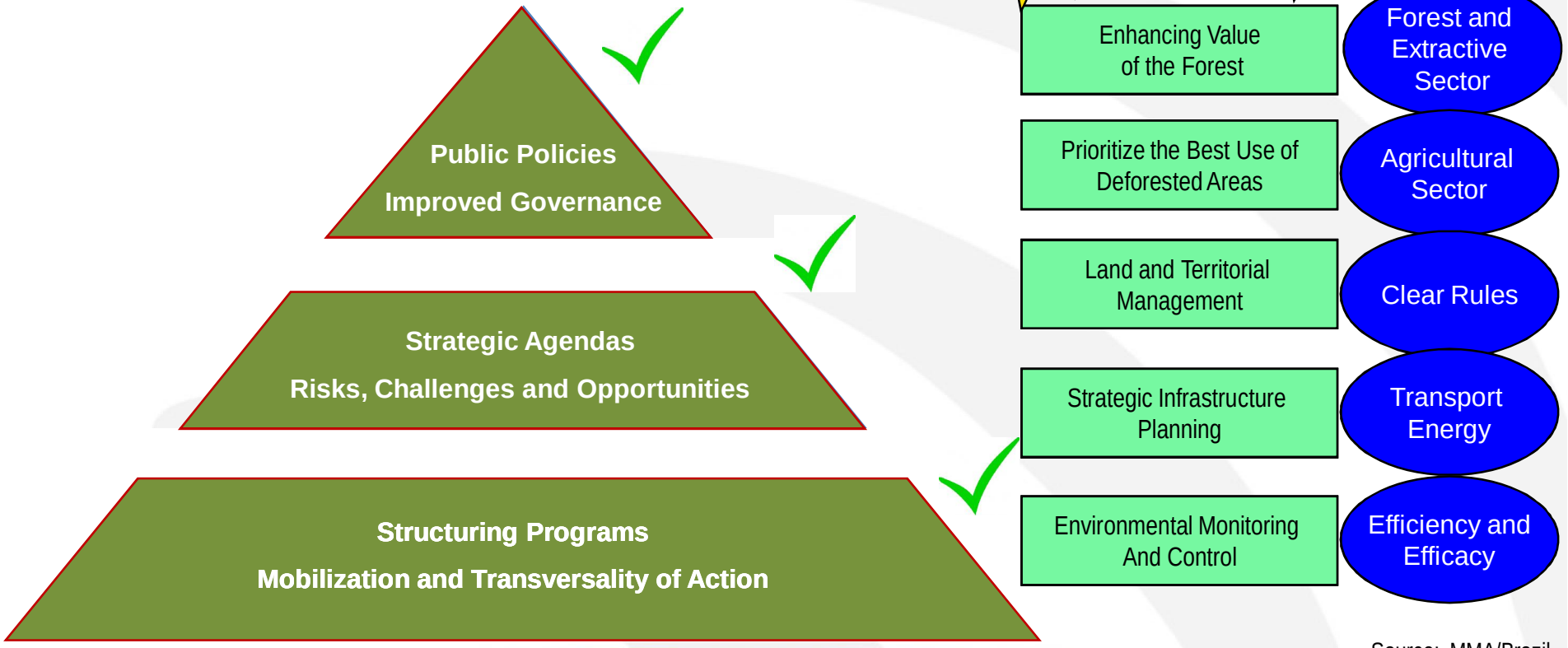
Since 2006, private representatives of the soybean segment declared "moratorium" to the soybean produced in the Amazon Biome - a comprehensive commitment prohibiting to buy or sell the product of such region.

Satellite monitoring controls the origin of the product and ensures the rain Forest protection.

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

Science, Technology and Innovation for the Amazon

Integrated and Sustainable Management Programs – Ministry of Environment



Source: MMA/Brazil

Science, Technology and Innovation for the Amazon

Integrated and Sustainable Management Programs

Global Environment Facility

OTCA GEF PNUMA OEA

PROYECTO GEF AMAZONAS

LBA

PPBio

projeto geoma

Brasil

VALE

BNDES Eletrobras EMBRAER

ApexBrasil

Science, Technology and Innovation for the Amazon

Integrated and Sustainable Management Programs

Project GEF Amazon. OTCA/GEF/PNUMA/OEA. Integrated and sustainable management of transboundary water resources in the Amazon River basin. United Nations Environment Programme (UNEP). Oct 2005.

Strengthen the institutional framework for planning and executing, in a coordinated and coherent manner, activities for the protection and sustainable management of water resources in the Amazon Basin in the face of impacts caused by human action and ongoing climatic changes being experienced in the Basin.

Science, Technology and Innovation for the Amazon

The Brazil Integrated Management of Aquatic Resources in the Amazon Region Project aims to support the mainstreaming of a multi-stakeholder, integrated management approach to the conservation and sustainable use of freshwater biodiversity in public policies and programs in the Brazilian Amazon River Basin.

http://web.worldbank.org/external/projects/main?pagePK=64283627&piPK=73230&theSitePK=40941&menuPK=228424&Proje
d=P066535

Science, Technology and Innovation for the Amazon

Amazon and Climate Change

The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA)

Public Policies

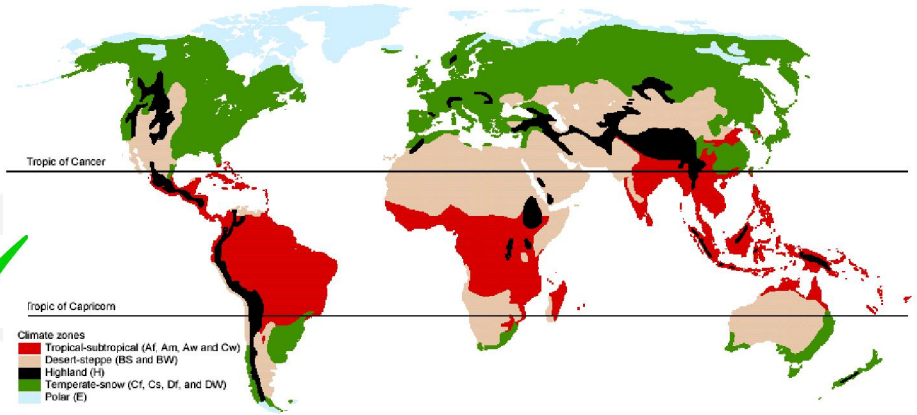
Improved Governance

Strategic Agendas

Risks, Challenges and Opportunities

Structuring Programs

Mobilization and Transversality of Action



Global Changes and Intensification of Stresses

Loss of Diversity - Environmental Services

Brasil

VALE

BNDES Eletrobras EMBRAER

ApexBrasil

Science, Technology and Innovation for the Amazon

http://lba.cptec.inpe.br/lba/index.php?lg=eng

The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) is an international research initiative led by Brazil.

LBA is designed to create the new knowledge needed to understand the climatological, ecological, biogeochemical, and hydrological functioning of Amazonia…

the impact of land use change on these functions, and the interactions between Amazonia and the Earth system.

Science, Technology and Innovation for the Amazon

Social Diversity in the Amazon

Source: Pommez, 2003.

Science, Technology and Innovation for the Amazon

Etnobiology (Biodiversity and Social Diversity)

Source: Embrapa Genetic Resources and Biotechnology

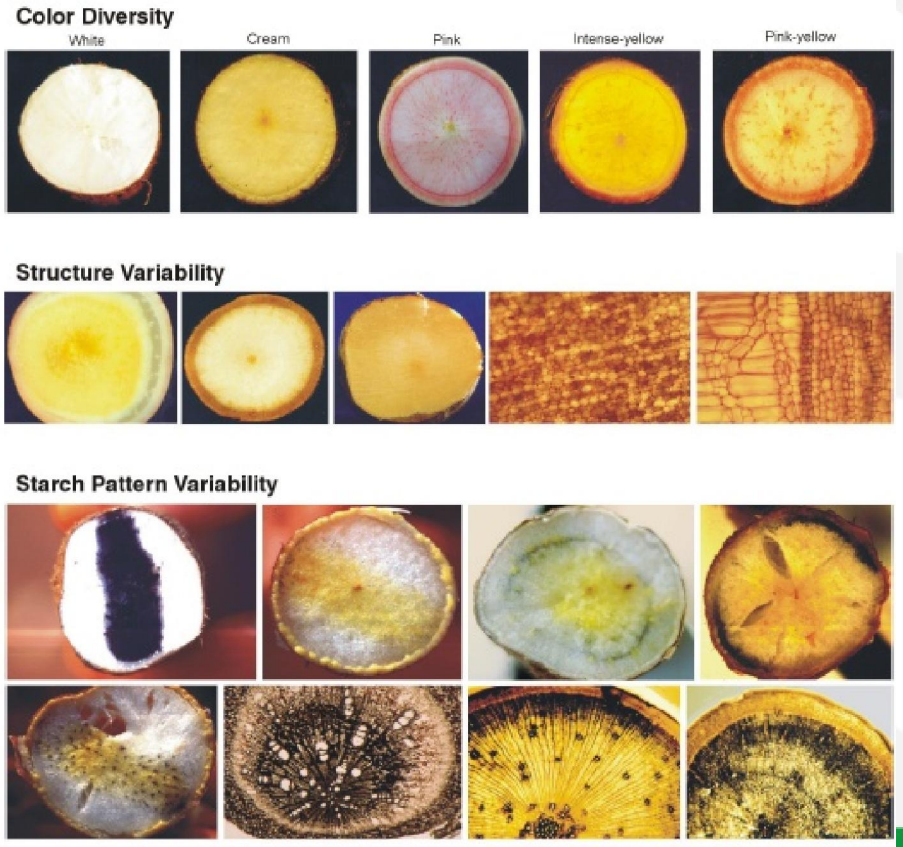
Science, Technology and Innovation for the Amazon

Agrobiodiversity

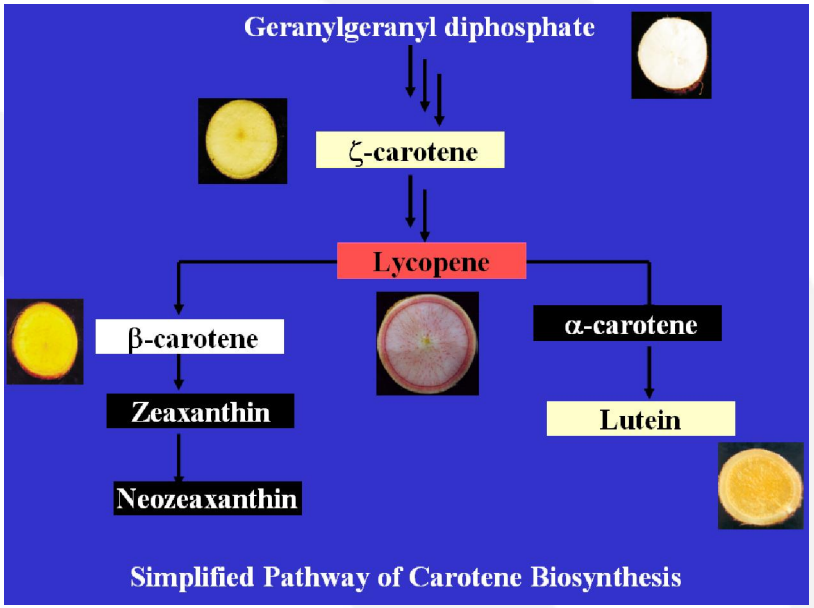
Source: Embrapa Genetic Resources and Biotechnology

Science, Technology and Innovation for the Amazon

New Biological Resources



Cassava Root Mutants
Starch & Pigments



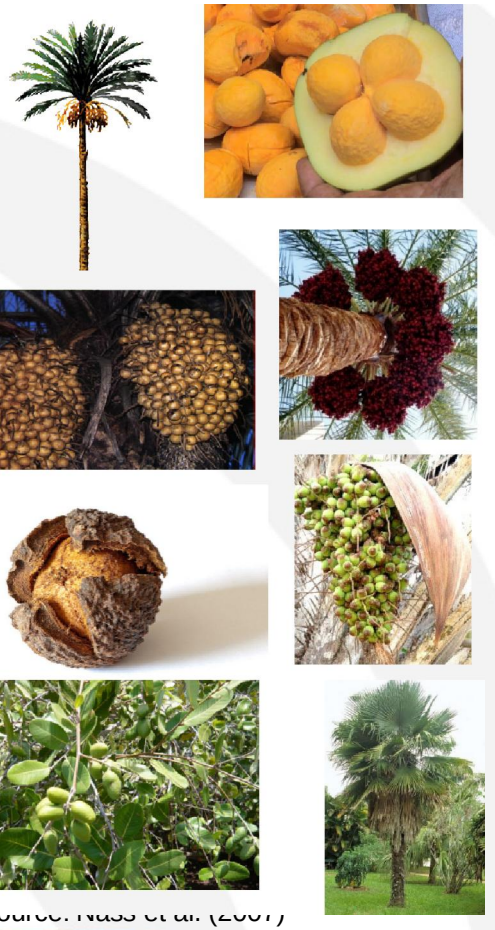
Source: Embrapa Genetic Resources and Biotechnology

Science, Technology and Innovation for the Amazon

Sustainable Energy Sources

Brazil has around 100 oil plants in the Savannah 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)

“The Amazon is a global, regional and, especially, a national issue. As such, the challenge of promoting its development is a State matter, to be discussed by the Government with the Brazilian society.

From Science, Technology and Innovation are expected crucial contributions in confronting this challenge.”

Brazilian Society for the Progress of Science, SBPC.

Mauricio Antonio Lopes, PhD
Embrapa Labex Korea
Rural Development Administration – RDA
Suwon - Republic of Korea
http://www.embrapa.br
http://labexkorea.wordpress.com/
labex.korea@ymail.com