Productive Capacity of the Land and Ecosystems

Embrapa Environment

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### Brazilian Soils

<table>
<thead>
<tr>
<th>Soils</th>
<th>Area</th>
<th>Relative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alissolos</td>
<td>371,874.48 km²</td>
<td>4.36%</td>
</tr>
<tr>
<td>Argissolos</td>
<td>1,713,853.49 km²</td>
<td>19.98%</td>
</tr>
<tr>
<td>Cambissolos</td>
<td>232,139.19 km²</td>
<td>2.73%</td>
</tr>
<tr>
<td>Chernissolos</td>
<td>42,363.93 km²</td>
<td>0.53%</td>
</tr>
<tr>
<td>Espodissolos</td>
<td>133,204.88 km²</td>
<td>1.58%</td>
</tr>
<tr>
<td>Gleissolos</td>
<td>311,445.26 km²</td>
<td>3.66%</td>
</tr>
<tr>
<td>Latossolos</td>
<td>3,317,590.34 km²</td>
<td>38.73%</td>
</tr>
<tr>
<td>Luvissolos</td>
<td>225,594.90 km²</td>
<td>2.65%</td>
</tr>
<tr>
<td>Neossolos</td>
<td>1,246,898.89 km²</td>
<td>14.57%</td>
</tr>
<tr>
<td>Nitossolos</td>
<td>119,731.33 km²</td>
<td>1.41%</td>
</tr>
<tr>
<td>Planossolos</td>
<td>155,152.13 km²</td>
<td>1.84%</td>
</tr>
<tr>
<td>Plintossolos</td>
<td>508,539.37 km²</td>
<td>5.95%</td>
</tr>
<tr>
<td>Vertissolos</td>
<td>169,015.27 km²</td>
<td>2.01%</td>
</tr>
<tr>
<td>Água</td>
<td>160,532.30 km²</td>
<td>1.88%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8,547,403.50 km²</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

59% of the total area is Luvissolos.
Good practices in Agriculture

Erosão Hídrica e Aptidão das Terras

Variação da carga de sedimentos em função da adoção do SPD no RS - 86% redução

Providing Environmental Services:
Water Producer
Carbon Sequestration SPD - 350-480 kgC / ha / year
Brazilian Agriculture: Land Use

BR - Usos da terra

- Area = 851 milhões ha.
- Arable land = 555 millions hectares - 65% of total
- Land use in 2006 = 329,9 millions hectares - 38.7% of total

Fonte: Manzatto et al., 2009
Brazilian Agriculture: Land Use Change

- **Area farm**, **Crops**, **Pasture**, **Forest**

Source: IBGE – Censos Agropecuários 1920-2006
Brazilian Agriculture: Land Use Change

% in relation to total area of farms


Year

Crops
Pasture
Forest

Brazilian Agriculture: Land Use Change

Year

1900 1950 2000 2050

Cattle

1970 – 79 millions
2006 – 171 millions

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PAÍS RICO E PAÍS SEM POBREZA
Brazilian Agriculture

[Graph showing average annual growth % for Production, Area, and Yield from 1961-70 to 1991-95.]

Fonte: Contini, 1996

[Graph showing Relative Index (%) from 1979 to 2000 for Area, Production, and Income Gross.]

Fonte: França, 2001
Evolution of the cultivated area, production and yield, between 1975 and 2010

- Expansion of agricultural frontier
- Mechanization of activities
- Breeding
- Intensive techniques of production
- Chemical inputs
- Government programs

Source: Contini, 2010
Brazilian Agriculture


Source: Silva, 2010
Environment Changes and Agroenergy

✓ Reduction of emissions and Carbon sequestrations;
✓ Regulatory frameworks on the environmental benefits associated with renewable energy;
✓ Sustainability of production and non-tariff barriers;
✓ Expansion of bioenergy production and risk to food production or to food safety;
✓ Expansion of the agricultural frontier: LUC, GEE and Ecosystem Service.
Agriculture and Ecosystem Services: Towards a Green Economy

Provisioning services: Food, water, fibers, food, biofuels

Regulation Services: Air, climate, disease, pest etc

Categorização: Millenium Ecosystem assessment (2005)

Cultural service: Recreations, ecotourism, religious, aesthetic values
DOES BRAZIL HAVE THE CONDITIONS TO EXPAND BIOENERGY PRODUCTION WITH SUSTAINABILITY?
Sustainable Bioenergy Expansion

Three fronts can be explored:

1 - Innovations in technology to achieve even second and third generation of biofuels; or
Diversification of production, so that "integration" and "complementarity" are achieved by improving:

2 - The land use and efficient use of resources' (the ecological component of sustainability);

as well as

3 - 'Adding value to products' (the economic component), with 'feedstocks' of dual purpose, favoring the empowerment of farmers (the social component of sustainability equation).
Soil x Climate x Crop Interactions and Ecosystem
Sugar Cane Agro-ecological Zonning: Methodology

- Areas without Environmental restrictions
  - Soil Maps
    - Criteria for land evaluation
      - Land suitability
        - Criteria for Climate evaluation
          - Climate Potential
            - Climate Data
              - Evaluation of Current Agricultural Use
                - Sugar cane climate/soil potential
                  - Additional Constrains: Environment
                    - Validation by State

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Culture Requirements

Soil Mapping
Climate Risk

Tools:
• EMDS - Ecosystem Management Decision Support
• Netweaver
• ArcGis

Agricultural suitability for crops

Knowledge

Agricultural suitability for crops

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Soil Mapping
Climate Risk

Tools:
• EMDS - Ecosystem Management Decision Support
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Agricultural suitability for crops

Knowledge
## Environmental Restrictions

<table>
<thead>
<tr>
<th>BIOME</th>
<th>Area Mapped PROBIO (M ha)</th>
<th>Areas with Forest/Water Cover (M ha)</th>
<th>%</th>
<th>Biome/ Park / Indian Res/ Alt Parag Basin (M ha)</th>
<th>%</th>
<th>Zoning Areas Considered (M ha)</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMAZONIA</td>
<td>423,50</td>
<td>382,86</td>
<td>90,51</td>
<td>423,05</td>
<td>100,00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>CAATINGA</td>
<td>82,58</td>
<td>52,61</td>
<td>63,72</td>
<td>5,05</td>
<td>5,98</td>
<td>29,96</td>
<td>36,28</td>
</tr>
<tr>
<td>CERRADO</td>
<td>204,72</td>
<td>124,92</td>
<td>61,02</td>
<td>57,46</td>
<td>28,07</td>
<td>43,65</td>
<td>21,31</td>
</tr>
<tr>
<td>MATA ATLÂNTICA</td>
<td>105,90</td>
<td>30,77</td>
<td>29,05</td>
<td>7,07</td>
<td>6,32</td>
<td>75,14</td>
<td>70,95</td>
</tr>
<tr>
<td>PAMPA</td>
<td>17,82</td>
<td>9,15</td>
<td>51,30</td>
<td>0,06</td>
<td>3,51</td>
<td>8,68</td>
<td>48,67</td>
</tr>
<tr>
<td>PANTANAL</td>
<td>15,12</td>
<td>13,38</td>
<td>88,46</td>
<td>15,12</td>
<td>100,00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>849,18 *</td>
<td>613,68</td>
<td>72,27</td>
<td>508,36</td>
<td>59,86</td>
<td>157,40</td>
<td>18,54**</td>
</tr>
</tbody>
</table>

SOURCE: Adapted from PROBIO, 2006. (*) Area considered in the study. (**) Relative to the area of the country

**Areas considered in the zoning: 18,5%**
Agriculture and Sustainability:
Zoning and Planning

BR - Zoneamento Agroecológico da Cana de Açúcar

Legenda

- Bioma Amazônia
- Bioma Pantanal
- Bacia do Alto Paraguai
- Limite Estadual
- Aptidão ALTA, atualmente com pastagem
- Aptidão MÉDIA, atualmente com pastagem
- Aptidão BAIXA, atualmente com pastagem
- Aptidão ALTA, atualmente com agropecuária
- Aptidão MÉDIA, atualmente com agropecuária
- Aptidão BAIXA, atualmente com agropecuária
- Aptidão ALTA, atualmente com agricultura
- Aptidão MÉDIA, atualmente com agricultura
- Aptidão BAIXA, atualmente com agricultura
- Áreas inaptas

A área de uso Agropecuária representa as áreas cobertas com culturas agrícolas ou pastagens cultivadas. São casos reais que não foram possíveis a distinção na interpretação das imagens do Satellite Landsat.
Agriculture and Environmental Sustainability: Low Carbon Agriculture – ABC Plain

✓ Agricultural expansion scenario of 2030 to 16.8 million additional ha;
✓ Low Carbon Scenario with recovery of the liabilities of LRs - additional 70 million ha;
✓ The pasture areas can accommodate the expansion of other activities as long as policies are implemented to: promote recovery of degraded pasture, (ii) encourage the adoption of production systems involving cattle in feedlots for fattening and (iii) encourage the adoption of crop-livestock-forests systems.
✓ Cost of $ 157 billion for land use, land use change and forestry.

(i) Source: World Bank, 2010
Thank you!

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