Brazilian agriculture: Knowledge, technologies, and innovation

Geraldo B. Martha Jr.
Coordinator,
Embrapa, Labex-USA

The Brazil Initiative Presents

Harvesting Innovation
A Symposium on Brazilian Agriculture in the 21st Century

In Partnership with ABRAPA and EMBRAPA

Wednesday, February 21st from 2-6pm
City View Room-Elliott School of International Affairs
The George Washington University
1957 E Street, NW-7th Floor
Washington, D.C.
The evolution of a science-based agriculture in Brazil
Brazilian agriculture in the 1960’s and early 1970’s

- Low ag. production and low yields;
- Production concentrated in South/Southeast;
- Repeatedly food supply crisis;
- Rural poverty + migration to cities;
- Lack of specific knowledge on “tropical agriculture”;
- Institutional void (ag. research, education, markets, etc.).

The task: to move from a traditional agriculture to one based on science & technology!
The sustainability of Brazilian agriculture

Index of productivity growth in Brazilian agriculture (1950=100)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>100</td>
<td>106</td>
<td>118</td>
<td>195</td>
<td>288</td>
<td>445</td>
<td>2.25%</td>
<td>4.01%</td>
</tr>
<tr>
<td>Soybean</td>
<td>100</td>
<td>206</td>
<td>236</td>
<td>311</td>
<td>347</td>
<td>452</td>
<td>2.28%</td>
<td>1.80%</td>
</tr>
<tr>
<td>Wheat</td>
<td>100</td>
<td>96</td>
<td>215</td>
<td>241</td>
<td>246</td>
<td>314</td>
<td>1.72%</td>
<td>1.27%</td>
</tr>
<tr>
<td>Rice</td>
<td>100</td>
<td>104</td>
<td>135</td>
<td>211</td>
<td>305</td>
<td>477</td>
<td>2.36%</td>
<td>3.97%</td>
</tr>
<tr>
<td>Beans</td>
<td>100</td>
<td>78</td>
<td>72</td>
<td>97</td>
<td>137</td>
<td>204</td>
<td>1.07%</td>
<td>3.61%</td>
</tr>
<tr>
<td>Cotton</td>
<td>100</td>
<td>244</td>
<td>282</td>
<td>353</td>
<td>791</td>
<td>1095</td>
<td>3.64%</td>
<td>5.54%</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>100</td>
<td>160</td>
<td>225</td>
<td>231</td>
<td>256</td>
<td>276</td>
<td>1.52%</td>
<td>0.84%</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>100</td>
<td>107</td>
<td>123</td>
<td>227</td>
<td>431</td>
<td>622</td>
<td>2.76%</td>
<td>4.93%</td>
</tr>
</tbody>
</table>

The sustainability of Brazilian agriculture

Land-use in Brazil (2017 estimate)

- Native vegetation in conservation units: 13.1%
- Native vegetation in Indian land: 13.8%
- Native vegetation in not used and registered land: 18.9%
- Cities, infrastructure and others: 3.5%
- Improved pastures: 13.2%
- Crops and cultivated forestry: 9.0%
- Native pastures: 8.0%
- Destinated area for native vegetation inside farms: 20.5%
- Others: 3.5%

Destination area for protection and preservation of native vegetation

Source: SFB; SICAR; EMBRAPA; IBGE; MMA; FUNAI; DNIT; ANA; MPOG.

*Data obtained by GITE/Embrapa, may 2017.
The huge growth in Brazilian agricultural production resulted in reduced prices to consumer. This alleviated inflationary pressures and generated an “income-effect” that benefited mostly the poor.
Market imperfection: a major barrier to widespread technology adoption in Brazilian agriculture

Incentives to Brazilian agriculture

The incentives to Brazilian agriculture have been low compared to other major players. The PSE to Brazilian farmers averaged 1.6% of the total farm receipts from 1995-2014. The corresponding values to the US’ and Europe’s farmers were 13.5% and 28.3%, respectively.

Thus, farmers will strongly respond to market signals and will adopt technologies based on individual benefit-cost analysis!
Brazilian science-based agriculture in the context of modern agricultural value-chains

Data from USP/ESALQ/Cepea (2016).
Brazilian science-based agriculture in the context of modern agricultural value-chains

Total: R$ 1,267,241 million

Infrastructure and logistics

- Input supply: R$ 151,131 million
- Ag. production: R$ 377,672 million
- Ag. industry: R$ 348,149 million

R$ 390,289 million

Data from USP/ESALQ/Cepea (2016).

A sustainable and competitive science-based agriculture ...

... can provide transformation industries with a continuous flow of quality raw materials at declining real prices, potentially increasing its own competitiveness over time.

Brazilian science-based agriculture in the context of modern agricultural value-chains

Total: R$ 1,267,241 million

- Infra-structure and logistics: R$ 390,289 million
  - Input supply: R$ 151,131 million
  - Ag. production: R$ 377,672 million
  - Ag. industry: R$ 348,149 million

Data from USP/ESALQ/Cepea (2016).

… demands modern inputs with high technological content, creating sizable markets for industrial and services sectors if they can deliver quality products at competitive prices.

... can provide transformation industries with a continuous flow of quality raw materials at declining real prices, potentially increasing its own competitiveness over time.

A sustainable and competitive science-based agriculture ...

A few future prospects
Two-cents of thoughts – key future prospects:

• A future intensive in knowledge and relationships;

• A future of increasing complexity demanding timely responses;

• A future with complex trans-boundary challenges (climate change, biological security, ...);

• Agriculture will be pressed in the direction of multifunctionality (food, feed, fiber, energy, nutrition and health, environmental services, biomass, biomaterials, green chemistry, ...);

“Of course there will be challenges but the future will also be plenty of grand opportunities to agricultural value chains”!
Two-cents of thoughts – key future prospects (strategy):

- Advanced biology (gene editing and synthetic biology);
- Preventive breeding;
- Digital agriculture (big data approaches, bio-informatics, precision agriculture, ...);
- Advanced modeling and sustainable systems;
- Adding-value approaches in agricultural value chains.
Ex.: Digital transformation of Brazilian agriculture: research, on-farm production, and consumers

- Data mining;
- High-performance computing;
- Modeling and simulation;
- Remote sensing / GIS;
- Land-use (& crop development) monitoring;
- Decision support tools; ...
Ex.: Value-added through product differentiation: the example of white & red biotech
Ex.: “Development of a Platform of Sustainable Practices”
– Integrated crop-livestock (+forests) systems

Area with some form of iCL+F systems (2016) =
~ 11.5 million hectares
Ex.: Integrated crop-livestock-forest systems in Brazilian Agriculture

- **ABC Plan target**: 4 million ha 2010-2020;
- **Cattle farmers**: to reduce the environmental impact; to recover degraded pastures; to implement rotation; to increase returns;
- **Growers**: to increase returns; to reduce risk; to implement rotation.

### Evolution of iCL-F systems area

- **Area with iCL-F systems (million hectares)**
- **Years**: 2005, 2010, 2015
- **Years**: 2005: 1.8; 2010: 5.5; 2015: 11.5
- **20.4%/yr.**

### iCL-F Systems area by State

- **States**: MS, MT, RS, MG, SC, Others
- **Million hectares**:
  - MS: 2
  - MT: 1.5
  - RS: 1.4
  - MG: 1
  - SC: 0.68
  - Others: 4.92

Source: Kleffmann study commissioned by Embrapa (2016). Elaboration: G. Martha, Embrapa Labex-USA.
Ex.: Integrated crop-livestock-forest systems in Brazilian Agriculture

- **Estimated C-sequestration**
  - ABC Plan target: 18-22 million tons CO2-eq.;
  - 21.8 million tons of CO2-eq. already mitigated!
  - Based on interviews: 7,909 in total – 3,105 cattle farmers, 2,958 soybean growers, 1,846 corn growers.

- **Profile**: majority of farmers between 31-50 yrs. old; 60% with schooling level of at least middle / high-school; 25% w/ college degree in agricultural sciences.

Source: Kleffmann study commissioned by Embrapa (2016). Elaboration: G.Martha, Embrapa Labex-USA.
Concluding remarks
Concluding remarks – communicating science:

• Given the unique regional and sectoral opportunities and challenges of agricultural value chains there is no such a thing as one size fits all. Solutions must be contextualized;

• The role of science should be to provide information to decision makers and to ensure that uncertainties around that information are made clear, rather than simply advocating a course of action;

• There is an urgent need for simple and consistent communication of the knowns and unknowns about key issues to fuel the policy-making process;

• It must be realized that based on the same evidence it is possible to pursue quite different options and that policy-making process includes other inputs – social, practical, economic, legal, electoral, ethical, cultural – in addition to scientific evidence.

Boyd, 2013; Lele et al., 2013; Gluckman, 2014
Concluding remarks – from lab to farm:

• Successful scaling-up depends upon multi-stakeholder approaches. Knowledge exchange, capacity development, technology transfer and well-functioning input and market chains are key-components to foster the adoption of sustainable technologies.

• Increasing production with more efficient use of resources will necessary encompass expanded investments in human capital. Furthermore, it is necessary to recognize that no Organization or even country has all the solutions needed to fully and adequately responds to the challenges and opportunities ahead. Thus, Brazilian agricultural R&D Organizations must strengthen partnerships and alliances within and beyond the country's borders.
The solely form of forecasting the future is to build it!

(Antonio Delfim Netto, May 2012)

Thank You!

geraldo.martha@embrapa.br
labex.usa@embrapa.br