BRAZIL'S BACKSTOP
The Modernization of Brazilian Agriculture and its Contributions to National Development

Mark S. Langevin, Ph.D.
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Brazil’s Backstop:
The Modernization of Brazilian Agriculture and its Contributions to National Development

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Brazilian agriculture is a fundamental pillar of national economic development in the 21st century. Baer reminds that agriculture has been the “engine of economic growth” since the colonial era (2014:281) and Barros reports that “Agriculture was the foundation upon which Brazil’s economic system functioned up to the beginning of the twentieth century (2009:83).” Agriculture was eclipsed by manufacturing and services during the twentieth century, but the onset and deepening of Brazil’s import substitution industrialization (ISI) model and the rapid pace of urbanization required significant income redistribution from agriculture and mining to finance mounting fiscal demands placed upon the state. Today, Brazilian economic and fiscal stability continues to be anchored to agriculture and agricultural commodity exports. Agriculture is Brazil’s backstop.¹

¹ The term “backstop” is used in finance and refers to “the act of providing last-resort support or security in a securities offering for the unsubscribed portion of shares. A company will try to raise capital through an issuance and to guarantee the amount received through the issue, the company will get a back stop from an underwriter or major shareholder to buy any of the unsubscribed shares.” Investopedia. Accessed at: http://www.investopedia.com/terms/b/backstop.asp.
If Brazilian agriculture was rooted to a colonial past of coffee and sugarcane plantations, then its modernization spread from “neglect and even outright discrimination against” this sector by policymakers representing the budding cities and the industrial elite of the post World War II era. The agricultural sector was responsible for keeping pace with the growing urban demand for foodstuffs and the foreign exchange needed for the more capital intensive ISI activities. From 1945 to 1980 the Gross Domestic Product (GDP) grew at an approximate annual rate of 7 percent while the agricultural sector, with fewer government supports and less protection, lagged behind at 4.5% annual growth (Baer 2014:282). Agriculture’s contribution to the Gross Domestic Product (GDP) slipped from from 27 to 11 percent by 1980. This sector’s modest supporting role during this high growth period made modern economic and urban development possible, but both civilian and military governments did little to mitigate this sector’s underinvestment, low productivity, and increasing conflicts over land tenure (Bacha and Carvalho 2014, Helfand 1999, Santana and Nascimento 2012).

During the depths of the “lost decade” of the 1980s the rural sector overcame decades of neglect and conflict to reinvent agriculture through migration to the Center-West “Cerrado” region (Bacha and Carvalho 2014, Santana and Nascimento 2012:75-85). The migration to the Cerrado by commercial agricultural producers and family farmers was encouraged by the innovation of tropical cultivation systems developed by the Brazilian Agricultural Research Corporation known as EMBRAPA or the Empresa Brasileira de Pesquisa Agropecuária (Bacha and Carvalho 2014:6-9). During subsequent decades the application of increasing levels of technology intensive production methods, greater scales of economy through the concentration of productive units in the Cerrado, and the vertical coupling of modern agriculture to industry to form what is now known as agribusiness served to launch a promising cycle of rural modernization. Together, Brazilian agribusiness and agriculture now comprise a third of the national economy, employ more than a third of the workforce, and feature many of the world’s most productive farmers. In addition, agribusiness represents one of Brazil’s most internationally competitive economic activities and source of exports.

In so many ways the agricultural sector plays the role of backstop to the country’s economic development by providing a reliable and widening stream of private investment, globally competitive economic activities, and government revenues. The current recession shines a limelight on agriculture’s role as a backstop for economic development and stability amidst an historic contraction of economic activity, deindustrialization, and falling government revenues. Indeed the brightest spot for the current Brazilian economy is agriculture and its exports. Despite the economy’s contraction by 3.8 percent in 2015, the agricultural sector grew from 21.4 percent of GDP in 2014 to 23 percent in 2015. From February 2015 to February 2016, agricultural exports rose by 36.9 percent in U.S. dollar value (USD) and 113.26 percent by volume.

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In February of 2015 the monthly value of agricultural exports reached $3.7 billion USD, but twelve months later the value grew to $5.76 billion USD, the highest monthly return since the data series was established in 1997.\footnote{Ibid.}

During the first five months of 2017 (January to May), the top ten agricultural exports were valued at 31.9 billion USD, 39 percent of all Brazilian exports during the period and 87 percent of all agricultural exports. Soybeans led the way, representing 34 percent of agricultural exports and 15 percent of all Brazilian exports (Confederação de Agricultura e Pecuária do Brasil 2017b: 4). Today, agricultural exports are responsible for generating billions of U.S. dollars in foreign exchange, preserving Brazil’s positive trade balance despite the national recession, and adding more than its fair share to government revenues. Without Brazilian agribusiness and its exports, the country’s current economic slump would be catastrophic.

This Brazil Initiative working paper explores the modernization of Brazilian agriculture and its contributions to national economic modernization through four sections. The first surveys Brazil’s measureable gains in agricultural development during the past two decades. The second section evaluates the contributions of this sector to national economic and social development in the twenty first century. The third section provides a focus on the critical case of cotton production in Brazil to illustrate Brazilian agricultural modernization and its contributions to development and trade policy. The last section explores the twin challenges of social inclusion and environmental sustainability as the primary obstacles to deepening Brazilian agricultural development in the 21st century.

**Brazilian Agricultural Modernization**

Brazilian agricultural development follows two distinct and rarely intersecting paths. The first reflects rapid modernization of production methods and the verticalization of agricultural and manufacturing activities, generally referred to as “agribusiness.” The second path is followed by a majority of Brazil’s 20 million small farmers and rural workers who cope with low productivity, restricted access to markets, and dependence upon government assistance programs (Garcia and Vieira Filho 2014:10). Both of these paths have increased food security in Brazil during the past decades, but modern Brazilian agriculture is responsible for several key contributions to Brazilian economic and social development due in large measure to the pace of productivity increases, technology assimilation, land concentration and the consequent scales of economy gained by large productive units, and the push for increased competitiveness and market access in the context of growing global trade liberalization. Yet, the challenge of incorporating the rural population into agribusiness value chains or efficient small scale agriculture still stands in the way of Brazil’s potential to become the dominant global producer of food, fiber and biofuels.
Brazil’s agricultural modernization during the past two decades is marked by rapid increases in productivity rather than exclusive dependence upon expanding land use. This trend emerged during the 1970s, but accelerated under the conditions of economic stability and growing domestic and international demand for Brazilian agricultural commodities and by-products. Syed reports that the land area devoted to grain and oilseed cultivation increased by 27 per cent from 1976 to 2010, but production yields for these crops grew by 213 per cent (2012:33). During this same period meat and dairy production also climbed to similar heights through more intensive production methods. Between 1978 and 2009 annual production growth rates for beef, poultry and pork were 4.46, 8.03 and 3.74 percent respectively (Syed 2012: 34). Sugarcane and fuel ethanol production also followed this trend, with sugar increasing by 369 percent from 6.72 million tons to 31.51 million tons from 1975 to 2009 (Syed 2012:35). From 1970 to 2006 total factor productivity increased by 124 per cent, production rose by 243 per cent and the use of inputs grew 53 per cent (Syed 2012:45). These remarkable results demonstrate the intensification of production across crops and livestock.

Agriculture has also outperformed the economy during the past three decades due to the rapid pace of modernization and mounting demand for the sector’s exports. According to Buainain and Garcia,

*Brazilian agribusiness has been always a strategic sector and as such has played relevant roles in the structural configuration of Brazilian society as well as in the evolution and performance of the economy. In recent decades, it has been playing an anti-cyclical role, as a factor stimulating the economy as a whole (2015:44).”*

A comparison of sector and economy wide growth rates confirms Buainain and Garcia’s conclusion, except for 2016. Table 1 reports the annual average gross agricultural product growth rates as well as the GDP rates. During each period, 1980 to 1990, 1990 to 2000, and 2000 to 2008, the agricultural sector expanded at much higher annual rates than did the Brazilian economy generally. This pattern also continued under the high growth years of the first decade of the century. Brazil’s modern agricultural sector continues to grow at respectable annual rates even when the national economy slows, largely as a result of mounting international demand. Moreover, the Brazilian agricultural sector exerts a strong role in overall national economic growth through its labor and capital contributions (Buainain and Garcia 2015, Spolador 2012). It is important to note that the sector outperformed the economy during the first year of the recession in 2015, with an annual growth rate of 3.61 percent versus an overall economic contraction of 3.77 percent of GDP. However, falling world prices, increased sector debt, and a dramatic reduction in public and private sources of financing led to a notable contraction of the sector in 2016, decreasing by 6.6 percent while the national economy shrank by 3.6 percent (Centro De Estudos Avançados Em Economia Aplicada - Esalq/Usp 2017). This disappointing outcome revealed the critical importance of finance for the sector’s continued modernization.5

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5 Brazil’s fiscal adjustment in 2015 and 2016 rapidly reduced public sector based agricultural financing and private sector financing decreased in the face of the recession and producer debts. See “Falta dinheiro!”
Table 1: Comparison of Average Annual Growth Rates from Agricultural Production and Gross Domestic Production (GDP)

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural Production</td>
<td>3.2%</td>
<td>3.1%</td>
<td>4.3%</td>
</tr>
<tr>
<td>Gross Domestic Production (GDP)</td>
<td>-0.22%</td>
<td>1.44%</td>
<td>1.60%</td>
</tr>
</tbody>
</table>

Source: Garcia and Vieira Filho (2014:9)

Agricultural modernization unfolded through the diversification and increases in production of crops for export. From 1999 to 2008 agricultural exports grew from approximately $20 billion USD to just over $70 billion USD with imports oscillating between $5 to 10 billion USD (Conceição and Conceição 2014:16). According to Conceição and Conceição, this export growth featured soybean products, animal protein products, and the sugar and ethanol complex among an increasing list of exports while coffee export growth lagged behind (2014:17).

Brazil’s increased access to world-markets, including China, promoted greater investments to drive higher yields and consequently lowering domestic prices for food (Barros 2009:86) while ramping up agricultural exports. Between 1996 and 2006 Brazil ranked as the fourth largest agricultural product exporter (behind the European Union, the United States, and Canada) and enjoyed annual average increases of 9.4 percent, the highest rate of all major exporters (Nassar et al. 2009: 64, Figure 3-3:). From 1989 to 2009 agricultural exports created positive trade balances and composed 42.53 percent of all Brazilian exports during the period (Conceição and Conceição 2014:16). By 2012, major agricultural exports included soy, sugar, chicken, cereals, beef, coffee, orange juice concentrate, corn, celulose, tobacco, and cotton. Export opportunities further encouraged agribusiness enterprises and rural producers to seek greater efficiency and productivity gains as the cost of land rose and environmental and land use laws were increasingly enforced. Brazil’s remarkable rise as an agricultural producer and exporter led the Foreign Agricultural Service (FAS) of the United States Department of Agriculture (USDA) to highlight the nation’s rapid progress and prospects for further growth,

“Along with expected record-level exports in 2011, global market share should also reach a record high. Brazil’s share of world agricultural exports in 2010 is estimated at 9 percent, up from 5 percent a decade earlier. This expanded share has come at the expense of traditional, developed exporting nations such as the United States, Canada, the European Union and Australia, which have all seen their market share fall over the past 10 years (USDA 2012).”

Brazil’s agricultural modernization is based on a fundamental shift from increasing land under cultivation to employing science based productivity improvements to cultivation techniques, a process that accelerated as international markets opened for Brazilian exports. This shift did not include all cultivation systems, crops and producers. Traditional domestic market crops, such as beans and manioc, fall far short of the productivity increases responsible for the rising production of export crops such as soy, cotton, chicken and beef. Brazil’s modern agricultural sector and its vertical integration with agribusiness industries has led to greater use of technology and intensive cultivation methods to raise the total factor productivity of this sector. Both the modern and traditional producer communities have modestly increased land-use, but it is the use of technology and extension programs that explain both the increasing productivity rates among commodity crop, livestock, and dairy production as well as the widening gap in performance between Brazilian agribusiness and traditional agricultural producers.

According to Pereira et al. (2012), Brazilian agricultural modernization was propelled by national policies that extended subsidized financial credit, rural extension programs, and tropical agricultural research carried out by EMBRAPA. Taken together, these policies allowed many producers to intensify production and raise productivity with the acquisition of technologically intensive machinery and inputs, and expand this science based production systems into the Cerrado region (Viera Filho 2016). Researchers point to the combination of science and the opening up the Cerrado as critical steps toward agricultural modernization in Brazil. Accordingly, Pereira et al. recount that

“In this process, a large share of the country’s geographic area, the Cerrado, which was once thought to be of limited value for agricultural production, proved to be a productive region when scientific knowledge and sound policies were used by entrepreneur farmers. The experience of the agricultural transformation in Brazil is proof that it is possible to have an efficient and competitive agriculture in the tropics (2012:11).”

Pereira et al. also point to scientific driven productivity gains through improvement of soil fertility, varietal and hybrid breeding to heighten crop yields, the expanded use of no-tillage systems, and the growing integration of crop and livestock production systems as factors driving productivity gains (2012: 7-8). Baer points to increasing soil fertility and accounts for the productivity increases in Brazil’s modern agriculture sector by the measurable increases in the use of fertilizers, growing from 27.8 kilograms per hectare in 1970 to 51 kilograms by 1985 (2014:293). For the Cerrado region, the soil deficiency in nitrogen and phosphorous made fertilizer applications essential to moving the agricultural fronteir to this region of Brazil.

Crop and livestock yields continued to climb into the new century, with the most impressive growth concentrated in the Cerrado region. More tractors and equipment, better seeds, the increased use of fertilizers for longer term soil management, and the targeted use of agro-chemicals or “defensives” to mitigate the threats of a tropical buzz of insects, fungi, and harmful weeds pushed productivity and yields upwards. Table 2 reveals how agricultural modernization impacted crop yields and beef production from 1960 to 2006. Comparing most of Brazil’s major crops, cotton led yield gains during the
period with an annual average growth rate of 6.6%, followed by corn (3.3%) and rice (3.1%). Other crops and beef production per hectare grew at notable levels, but well behind cotton and the other leading crops. These results demonstrate the rapid pace of agricultural modernization and highlight the special case of cotton cultivation in Brazil.

Table 2: Crop Yields by Kilogram per Hectare (kg/ha) and Annual Growth, 1960-2006

<table>
<thead>
<tr>
<th>Crop</th>
<th>1960 (kg/ha)</th>
<th>2006 (kg/ha)</th>
<th>Annual Growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cotton</td>
<td>438</td>
<td>3,900</td>
<td>6.6</td>
</tr>
<tr>
<td>Corn</td>
<td>1,075</td>
<td>3,570</td>
<td>3.3</td>
</tr>
<tr>
<td>Rice</td>
<td>1,275</td>
<td>4,007</td>
<td>3.1</td>
</tr>
<tr>
<td>Beef (heads per hectare)</td>
<td>0.5</td>
<td>1.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Sugarcane</td>
<td>34</td>
<td>72</td>
<td>2.1</td>
</tr>
<tr>
<td>Beans</td>
<td>398</td>
<td>733</td>
<td>1.8</td>
</tr>
<tr>
<td>Coffee</td>
<td>1,010</td>
<td>1,190</td>
<td>1.2</td>
</tr>
</tbody>
</table>


The Productivity Gap

Rada and Buccola (2012) identify specific factors responsible for Brazilian agriculture’s yield increases during the past three decades and conclude that crop specific agricultural research and extension services explain the existing productivity gap between best-practice and average producers while public infrastructure and subsidized, government administered credit programs can narrow the gap. Specifically, they point to the establishment and work of EMBRAPA as the primary vehicle through which “tropical” agricultural technology was developed and then extended to a growing number of modern producers seeking productivity gains. Examining the period from 1986 to 2006, Rada and Buccola find that technical improvements led to annual average productivity increases in livestock production of 7.5 percent and 2.9 for the crop sector, with a weighted sector annual average of 4.54 percent for the period under study (2012:361). They also report total factor productivity annual growth of 2.62 percent for the period. However, these productivity advances were not achieved throughout Brazilian agriculture.

In fact, Rada and Buccola find that the mean average Brazilian farmer is falling further behind the “technical frontier” or best-practice outcomes at an annual average rate of 1.92 percent (2012:361). Consequently, notable developments in agricultural research and extension do not benefit all farmers equally. For each 1.0 percent rise in national commodity research efforts, modern cultivation and production technologies pushed the best-practice farmer 0.21 percent ahead of the mean average producer in Brazil (Rada and Buccola 2012:362). These researchers also find that infrastructure investments, especially improvements in public education in Brazil’s poorer regions of the North and Northeast, along with subsidized agricultural credit programs can narrow the productivity gap within Brazilian agriculture.
The productivity gap found between Brazil’s 5.2 million farms is most pronounced among small family farmers who constitute 84 percent of all farmers, producing on 24 percent of the farmed land and responsible for 38 percent of the total value of agricultural production (Helfand, Moreira and Bresnyan, Jr. 2015:vi). Most of these small family farmers have not benefited from government policies and programs, especially the work of EMBRAPA, to the degree of the modernized production units integrated into agribusiness (Baer 2014:302, Castro, Resende and Pires 2014). Indeed, Helfand, Moreira and Bresnyan, Jr. conclude that

“family farms have a high rate of poverty in Brazil because many of them have insufficient land and because they produce with extremely low levels of productivity (2015:xv).”

The productivity gap was partially addressed in 1995 through the establishment of the National Family Agriculture Program (PRONAF) with the purpose of supporting land reform efforts and strengthening the family farm sector by providing small producers with the credit they need to produce and supply local or regional markets. PRONAF has undergone reforms and modifications to reduce interest rates on loans and increase lines of credit for planting and capital asset acquisition for both individual family farmers and their cooperatives, including those associated with Brazil’s land reform under the administration of the National Institute for Colonization and Land Reform (INCRA). Castro, et al. (2014) carry out an evaluation of PRONAF’s impact on local, microregional and macroregional per capita gross domestic product and municipal agriculture growth between 2000 and 2010. They find that PRONAF’s aggregate national performance has been positive in relation to growth of agricultural domestic product and per capita GDP in those areas with concentrations of beneficiaries, but that the results are uneven and disproportionately favor the more developed South and Southeast regions. The poorer Northeast also benefited from the program, but not to the degree of the Southern regions. Also, Helfand, Moreira and Bresnyan, Jr. (2015) found that in 2007 the highest income-earning beneficiaries captured 60 percent of PRONAF’s total resources (2015:12). Most researchers, including Helfand, Moreira and Bresnyan, Jr. (2015) and Castro et al. (2014) agree that more needs to be done to raise the incomes and productivity of Brazil’s poorest and smallest farmers.

The challenge for producers and policymakers is to understand the relationships between precision crop and livestock production systems, efficiency and productivity related technology, organizational innovation among small producers and their cooperatives, and effective programs to support rural development, including PRONAF and stronger public educational opportunities for rural youth. Helfand, Moreira and Bresnyan, Jr. argue that

“Among the highest priorities for public policy in Brazil should be to improve the quantity and quality of education for young people who live in rural areas. This is perhaps the only policy that contributes positively to all pathways out of poverty. Education is associated with higher agricultural income as a result of its relationship with productive efficiency, technological adoption, and the ability to participate in input and output markets (2015:70).”
Raising productivity among all Brazilian farmers requires greater social inclusion, especially public education and technical extension opportunities. Fereirra, et al. (2012) find existing opportunities to advance environmental research to overcome current challenges, but that further engagement between scientists, producers and policymakers is needed. Also, cotton producers have signed onto the Better Cotton Initiative (BCI) through their membership association, the Associação Brasileira dos Produtores de Algodão (ABRAPA), to incorporate sustainable, socially responsible, and financially prudent practices throughout the cotton value chain. These examples are representative of Brazilian agriculture in the 21st century and reflect a growing consensus among both producers and policymakers that Brazilian agriculture can continue to raise productivity and compete globally while also achieving greater social inclusion and environmentally responsible rural development.

Contributions to National Development

Brazilian agriculture’s contributions to recent national development are as vital as they have been overlooked. First and foremost, Brazil’s efforts to preserve stability while expanding the economy depend upon both agricultural production and exports. This effect takes on greater importance as a counter-cyclical support during economic downturns. Second, the modernization of agriculture has also promoted higher value added production chains that are vertically integrated, increasingly export oriented, and compose a substantial portion of the GDP and exports. Third, agricultural modernization has achieved high levels of food security in the context of rapid urbanization and a national consensus around fighting inflation, especially for wage goods. Lastly, agricultural modernization has contributed to broader, national efforts to diminish rural poverty, but more can be done to lessen the gap between best practice and average rural producers.

Brazilian agriculture’s contributions to economic growth and development are substantial, both in terms of direct impact on growth and indirect impacts upon the trade balance and fiscal stability. These effects are often hidden behind the overall decline of agriculture’s share of GDP since the transition from a rural to urban society. As Baer notes, the conventional measurement of the agricultural sector as a share of GDP declined from 24.28 percent in 1950 to 9.04 percent by 2004 with a concurrent decrease in the agricultural labor force, from 65.9 percent in 1939 to 20 percent in 2003 (Baer 2014:306). These figures can lead to an underestimation of this sector’s overall contribution to economic and social development in Brazil because they do not capture the associated development of a strong agricultural input industry (fertilizers, agro-chemicals, implements and capital goods) or the vertical integration with processing industries and national and international marketing activities associated with agribusiness. Today, Brazilian agribusiness represents approximately 25 percent of the national economy (Buainain and Garcia 2015:45-Table 2.1). Agricultural modernization and this sector’s industrial integration have heightened global competitiveness, increased export capacity,

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expanded high value added employment, and lifted sector growth rates well above the national economy’s expansion in past decades.

Table 2 reports the relative shares of Brazil’s agricultural exports and imports and the overall contribution to the nation’s trade balance from 2000 to 2012. Throughout the first decade or so of the century, Brazilian agricultural exports far surpassed the value of agricultural imports by considerable margins to produce positive trade balances that ranged from nearly $15 billion USD in 2000 to nearly $80 billion by 2012. During the recessionary year of 2009 Brazilian agricultural exports actually increased by over six percent as a portion of total exports and earned nearly $60 billion USD. These outcomes are also impressive on a global scale. According to Santos, Avelar, Shikida and Carvalho, Brazil rapidly increased agricultural exports from 3.23 percent of all world agricultural imports in 1999 to 5.66 percent by 2009 (2016:67). In recent years, Brazilian agricultural exports have continued to perform well although low world market prices for cotton, soy, and sugar among other commodities curbs the potential rate of export growth.

Table 3: Contributions of Brazilian Agricultural Exports to Trade Balance

<table>
<thead>
<tr>
<th>Year</th>
<th>Agricultural Contribution to Total Exports as a Percent</th>
<th>National Trade Balance in Billions USD</th>
<th>Agriculture Balance in Billions USD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>37.38</td>
<td>-0.732</td>
<td>14.845</td>
</tr>
<tr>
<td>2001</td>
<td>40.95</td>
<td>2.685</td>
<td>19.061</td>
</tr>
<tr>
<td>2002</td>
<td>41.11</td>
<td>13.196</td>
<td>20.394</td>
</tr>
<tr>
<td>2003</td>
<td>41.87</td>
<td>24.878</td>
<td>25.903</td>
</tr>
<tr>
<td>2004</td>
<td>40.38</td>
<td>33.842</td>
<td>34.200</td>
</tr>
<tr>
<td>2005</td>
<td>36.80</td>
<td>44.929</td>
<td>38.511</td>
</tr>
<tr>
<td>2006</td>
<td>35.90</td>
<td>46.457</td>
<td>42.772</td>
</tr>
<tr>
<td>2007</td>
<td>36.37</td>
<td>40.032</td>
<td>49.699</td>
</tr>
<tr>
<td>2008</td>
<td>36.29</td>
<td>24.958</td>
<td>59.957</td>
</tr>
<tr>
<td>2009</td>
<td>42.24</td>
<td>25.272</td>
<td>54.885</td>
</tr>
<tr>
<td>2010</td>
<td>37.86</td>
<td>20.147</td>
<td>63.043</td>
</tr>
<tr>
<td>2011</td>
<td>37.09</td>
<td>29.793</td>
<td>77.460</td>
</tr>
<tr>
<td>2012</td>
<td>39.50</td>
<td>19.395</td>
<td>79.405</td>
</tr>
<tr>
<td>2013</td>
<td>41.30</td>
<td>2.286</td>
<td>82.907</td>
</tr>
<tr>
<td>2014</td>
<td>42.98</td>
<td>-4.054</td>
<td>80.134</td>
</tr>
<tr>
<td>2015</td>
<td>46.16</td>
<td>19.685</td>
<td>75.151</td>
</tr>
</tbody>
</table>


Aside from the sector’s contributions to economic growth and favorable trade balance, agricultural productivity rates have substantially reduced national food prices. Pereira, Martha, Santana and Alves report that between

“December 1977 and January 2007, the domestic price for food in Brazil, in real terms, dropped at a monthly average rate of 2%. In fact, the price of a representative food
basket in November 2011 represented, in real terms, around 50% of the price paid by consumers in January 1975 (2012:4).”

While Brazilian agricultural exports attract the most international attention, it may be this sector’s growing capacity to guarantee national food security to over 200 million Brazilians, promote monetary stability, and set a strong foundation for economic and social development that deserves national recognition. Between 2004 and 2009, the percent of Brazilians experiencing grave food insecurity dropped from 7 to 5 percent, leading Garcia and Vieira Filho to conclude that the

“reduction in the number of homes suffering from food insecurity can be attributed in large measure to the important expansion of food production, economic stabilization achieved during the second half of the 1990s, and the indirect impact of the cash transfer programs implemented by the Brazilian government to increase family earnings (2014:19).”

While Brazil has made observable progress in extending food security to most of its population, rural poverty and hunger remains an obstacle to development and a challenge for policymakers (Helfand, Moreira and Bresnyn, Jr. 2015). Raising rural incomes for the poorest is dependent upon the process of including greater numbers of family farmers and rural workers within modern production processes and organizational structures that create and sustain opportunities for higher valued added agricultural and agroindustrial production. Critics of Brazil’s agricultural modernization point to the vast inequality in land tenure patterns as a source of poverty and underdevelopment and advocate for the need to expand land redistribution programs (Helfand, Moreira and Bresnyn, Jr. 2015, Reynona, Fernandes, Telles 2015). Yet, land redistribution does not necessarily guarantee increased agricultural production and it cannot by itself close the growing gap between best practice farming methods and those employed by the average and poorest Brazilian farmers. Helfand, Moreira and Bresnyn, Jr. conclude that,

“Land reform programs must either be located in regions where off-farm labor opportunities can complement farm income, or they must target an adequate farm size combined with high enough levels of productivity to avoid the reproduction of poverty (2015:69).”

The major challenge is improving the productivity of the median agricultural production unit as well as the majority of poor, small landholding family farmers in Brazil’s poorest regions.

Brazil’s agricultural modernization and contributions to national economic and social development are measurable, but the transition to sustainable, low-carbon development is still emergent and the future very much uncertain. While the expansion of modern Brazilian agriculture is largely due to more intensive, productive technologies and methods, such progress has not come without significant loss of biodiversity, environmental destruction and deforestation in the three principal forest biomes: the Atlantic Forest, the Cerrado, and the Amazon basin. Modernization has led to land consolidation and agricultural intensification around such commodity crops as soy, corn,
and sugarcane, and is dependent upon significant use of petrochemical fertilizers, insecticides and herbicides. According to Martinelli, Naylor, Vitousek and Moutinho,

“... it is paramount that there be a change in strategy for Brazilian agricultural development from continuing expansion into natural ecosystems to productivity growth on existing agricultural land without further environmental degradation (2010:437).”

To make this change Brazilian agriculture must intensify production and preserve the environment through science based agriculture and livestock production. According to Pereira et al.,

“There are clear opportunities to advance in this path of sustainability while at the same time expanding the production of food, biofuel, and fiber. Intensifying pastoral systems will be of central importance in such a policy (2012:38).”

Toward this end, farmers are experimenting with zero-tillage cropping to cut down on carbon emissions and intensive meat-production systems to limit deforestation and carbon and methane emissions. Agropalma, Brazil largest producer of palm oil, is raising yields (in part through a contract system with family farmers) to preserve forests in the state of Pará while expanding its plantation of organically cultivated African palm in accord with standards required by the Roundtable on Sustainable Palm Oil (Langevin 2011:230-231). Such efforts require both fiscal incentives and greater enforcement of Brazilian laws regulating natural resource exploitation to effectively encourage, even compensate rural producers for the upfront transition costs involved with experimentation and adoption of sustainable production methods. The case of cotton production in Brazil demonstrates the significant impacts of the modernization of this cultivation and the many contributions that cotton production has made to national development in the past two decades, but it also reveals the challenges posed by the global political economy and the need to adopt sustainable practices that preserve the environment and cut costs.

The Case of Cotton

Cotton production provides a representative, if not emblematic case study of agricultural modernization in Brazil. According to Kiawu, Valdez and McDonald

“From the 19th century until the 1990s, Brazil was a net exporter of cotton and often a major source of world cotton supplies. Brazil maintained this position despite decades of import-substitution policies aimed at nurturing industrial development at the expense of agriculture. However, economic reforms and trade liberalization in the late 1980s and early 1990s drove cotton production downward and increased imports at first, but also led Brazilian cotton farmers to look for new producing areas and new management techniques that led to a resurgence in production (2011:3).”
Correa and Schmidt further explain that

“Until the mid-1980s, the Brazilian cotton crop, concentrated in the South and South-East regions, was characterized by low productivity. At that time, the emerging boll weevil plague hit the sector hard. Moreover, beginning in 1990, trade liberalization significantly increased import competition. These two events combined with devastating effects: cotton production dropped from nearly 1 million tons in 1981 to 420,000 tons in 1992, while cultivated areas diminished from 4.1 million ha [hectares] in 1981 to 1.3 million ha in 1995 (2014:4).”

More to the point, the modernization of Brazilian cotton cultivation was pushed ahead by both import competition and growers’ own determination to employ productivity enhancing innovations to survive the cotton crisis.

**Modernizing Cotton Production**

Brazilian cotton growers responded to the “crisis of cotton” in the 1990s by moving production to the center-west region’s Cerrado (with over half of production now concentrated in the state Mato Grosso) in order to mechanize and concentrate production to take advantage of the new tropical agricultural technologies developed by EMBRAPA for the Cerrado. By 2006 the Cerrado accounted for 98.1 percent of all cotton production in Brazil (Pereira, et al. 2012:29). According to Barbosa and Ramos,

“Present modern high-input cotton production systems of the cerrado brought many benefits to the Brazilian cotton industry. They have taken away the hardship of hand weeding, other cultural practices and hand harvesting and have liberalized hand labor to other more specialized farming activities. On the other hand, it has made cotton production a more stable activity, less dependent on weather uncertainties and hand labor availability. Production concentration over a more limited area also facilitated processing and marketing. Cotton became a component of a much wider system, including grain production, cattle grazing and other alternate and complementary activities rotated with cotton (2014:5).”

The move to the Cerrado, the concentration of production, and intense application of productive technologies boosted yields beyond any other crop experience in Brazil. Viera Filho finds that the territorial restructuring of cotton production in Brazil, namely the shift of some 66 percent of cultivation to the Center-West region, was accompanied by the introduction of genetically modified seeds in 2004 (2016:15)

As Table Two above shows, the annual increases in yield of 6.6 percent for cotton between 1960 and 2006 were double the rate achieved by the second highest yielding crop (corn) at 3.3 percent. Planted cotton area decreased from just over 4 million hectares during the 1976/77 planting season to only 894,300 hectares in 2012/13, but seed productivity increased from 430 to 3,724 kilograms per hectare (kg/ha) and lint yields grew from 143 to 1,465 kg/ha during this same period (Barbosa and Ramos 2014:4). During the 2014/2015 harvest-year average Brazilian yield rates achieved 1,601 kg/ha.
(Associação Brasileira dos Produtores de Algodão 2016:49) while the world average managed only 771 kg/ha (International Cotton Advisory Council 2015). Brazilian rain fed cotton productivity ranks third in the world just behind Australia and Israel—both dependent on irrigation (Associação Brasileira dos Produtores de Algodão 2016:49).

Alvaro Salles, Executive Director of the Mato Grosso Cotton Institute (IMA) summed up the modernization of cotton cultivation by reporting that

“Brazil’s abundance of sun, heat and rain were coupled with technological adaptations for the Cerrado, especially in the areas of fertilizers and soil correctives, that together unlocked the potential for high yield rates and a second cropping of corn and soy during the same harvest year.”

Yield increases are dependent upon the technological inputs used in soil preparation and cultivation, including agrochemicals (known as “defensives” in Brazil) to treat a growing list of pests and diseases, as well as fertilizers and specialized machinery among other factors of production. Most of these inputs are imported. Therefore, costs vary in tandem with the exchange rate and world prices.

Chart One: Brazilian Cotton Farm Input Costs, 2012/2013

As the chart above reports for the 2012/2013 harvest-year, nearly half of all input costs were devoted to agrochemicals at an annual value of $911.6 million USD. Fertilizers

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were the second most expensive input valued at $615.8 million, with Machinery, Fuel and Lubricants, Spare Parts, and Seeds comprising most of the additional costs. In addition, Individual Protective Equipment (IPE) accounted for 2.8 million USD in costs for the harvest year (Barbosa and Ramos 2014:5).

Brazilian cotton production is expensive and comes with a price. Cotton farmers can spend up to $2500 USD per hectare for inputs throughout the Cerrado producing region of the states of Bahia, Goiás, Mato Grosso, and Mato Grosso do Sul. The high costs associated with driving productivity has forced many smaller farms out of production and served to further concentrate cotton production within units with 10,000 hectares or more (Barbosa and Ramos 2014:4). Small or large, Brazilian cotton farmers face a twofold production challenge. To cope with low world prices and high levels of stocks, Brazilian cotton growers must push for greater yield rates, but also lower the costs of production. This effort is largely advanced by the collective action of cotton producers through their national producers association, ABRAPA.

ABRAPA, its financing arm, the Brazilian Cotton Institute (known as IBA), and the Mato Grosso Cotton Institute (IMA) play instrumental roles in organizing national production, promoting its modernization and driving its important contributions to national development. ABRAPA was formed in 1999 following the establishment of the Mato Grosso state association of cotton producers in 1997, known as AMPA. These organizations reflect the efforts of cotton growers to represent themselves in both public and private arenas to advance their mutual interests and improve policy coordination between the growers, the input industry, the textile industry, and the different government agencies, both federal and state, that regulate distinct aspects of the cultivation and commercialization of cotton in Brazil (Baptista 2016). Also, ABRAPA promotes Brazilian cotton around the world to supply foreign markets and expand exports (Baptista 2016: 119-149, Viera, Lunas and Garcia 2016:61). ABRAPA serves to increase cotton producers’ contributions to national development, both by production of a high value added crop and through the politics of international commercialization that has distinguished this producer association during the so called “cotton dispute” with the United States at the World Trade Organization (WTO). ABRAPA’s capacity to confront the U.S. in the “cotton dispute” made for an historic mark on Brazilian trade policy and the jurisprudence of the WTO Dispute Settlement Body (Black 2016, Iglécias 2007, Guan 2014).

**Contributions to National Development and Foreign Trade Policy**

The cotton dispute stands out as the hallmark contribution to Brazil’s leadership on global trade liberalization through the Doha Development Round of the World Trade Organization (WTO). This trade dispute highlighted the world price suppression caused by United States agricultural and trade policies and revealed the global economic inequalities stemming from U.S. non-compliance with the WTO’s Agreement on Agriculture (AoA) and the Agreement on Subidies and Countervailing Measures (SCM) (Barchet, Rocha and Pai 2016, Black 2016, Guan 2014, Guerreiro 2014). While Brazilian cotton growers were devoting greater resources to increase productivity, in part due to the price suppression caused by U.S. overproduction, they also contributed the financial
resources to support Brazil’s case against the U.S., playing a critical role in supporting the Brazilian government’s leadership in the early Doha round negotiations (Black 2016).

Despite U.S. overproduction, Brazilian cotton exports contribute to the country’s positive trade balance. Today, Brazil ranks as the third largest exporter of cotton behind the United States and India (Associação Brasileira dos Produtores de Algodão 2016:51). Brazilian cotton exports began to surpass imports in 2004 as world demand mounted and growers increased production through productivity increases rather than territorial expansion of cropping (Associação Brasileira dos Produtores de Algodão 2016:67 & 70). According to the United States Department of Agriculture (2012), by the 2012/2013 harvest-season Brazilian cotton exports dwarfed imports by some 92.7 percent with exports of 4.1 million bales (480 lb). In 2017 Brazilian exports represented just over 8 percent of total global cotton exports, ranking Brazil as the fourth largest exporter with 3.1 million bales (Cotton Incorporated 2017). The aggregate level and relative share of Brazil’s production and exports could continue to grow if world demand expands and current U.S. production subsidies shrink (Lau, Shropp and Sumner 2016, Nassar, Bachion and Zambianco 2014).

Brazil’s agricultural modernization, the ramping up of agricultural exports, and increasing cotton yields, encouraged the Brazilian foreign ministry (Itamaraty) to openly question and eventually dispute the legality of U.S. agricultural and trade policies that drive over production and suppress world prices. This trade conflict sharpened Brazilian foreign trade policy and leadership over global economic governance. According to Black,

“The Cotton (and related Sugar) disputes were important parts of a process for pushing the world’s biggest subsidizer, and the EU, to change the nature of their subsidies to less trade-distorting methods (2016:405).”

Hopewell goes a step further to claim that the impact of the cotton dispute, along with Brazil’s challenge to the European Union’s sugar program,

“were profound... Brazil’s victories were of broader significance beyond the specific commodities they addressed, as they revealed major inconsistencies between the US and EU agriculture policies and WTO rules (2014:303).”

Both Black and Hopewell highlight the central role that the cotton dispute and the articulation of the Brazilian cotton growers’ commercial interests played in moving Brazil to the center-stage of multilateral trade negotiations under the Doha round.

Moreover, the resolution of the cotton dispute resulted in the largest financial settlement in WTO dispute settlement history (Hufbauer 2014, The Hagstrom Report 2014). The first step toward resolution was the 2010 Brazil-United States bilateral accord that included a provision to pay the Brazilian Cotton Institute (IBA) 143.7 million USD per year until the U.S. achieved compliance (United States Trade Representative 2010). Although the U.S. administration suspended the monthly payments in September of 2013,
the two governments negotiated a mutually agreeable solution in October of 2014 that resulted in another $300 million payment to IBA to bring the running total of the financial settlement to nearly $800 million USD (United States Trade Representative 2014). This financial settlement affords ABRAPA and IBA the resources to invest in greater productivity, environmental sustainability, and social responsibility for decades to come. The settlement did not fully eliminate all of the U.S. subsidy programs (Lau, Shropp and Sumner 2016), but it provides Brazilian cotton growers with the opportunity to expand agricultural production and exports within a socially inclusive and environmentally sustainable production and policy framework.

**The Struggle for Social Inclusion and Environmental Sustainability**

Brazilian agriculture and agribusiness will continue to drive economic development and provide a reliable backstop for decades to come. The trend toward expanding world demand for Brazil’s agricultural commodities and animal protein products will mount, but the dual challenges of achieving greater social inclusion and environmental sustainability in agriculture are requisites for national development under democracy. The Economist Intelligence Unit (2010) concluded that Brazil holds the potential of gaining ever larger shares of the global agricultural commodity markets in years to come, but that it must 1) step up double cropping and livestock-crop integration; 2) internationalize national agribusiness companies; 3) expand research into new crop varieties; 4) re-evaluate agricultural mix in frontier regions to maximise potential; and 5) improve infrastructure and logistics (2010:14-15). If the recent past is an indication, Brazilian producers, agribusiness leaders, and policymakers will work toward greater levels of productivity as well as advocate for improved infrastructure and logistics. However, the greater challenge is convincing more and more Brazilians of the importance of this sector to the national welfare, a challenge that can only be overcome by deepening the sector’s capacity for social inclusion and environmental sustainability (Bruno 2012).

Social inclusion should be understood as a key variable for modernizing and raising the productivity levels of millions of marginal farmers and incorporating larger numbers of rural workers in high value added agribusiness value chains. The productivity challenge stands in contrast to the decades old debate related to land ownership and agrarian reform in Brazil (Delgado and Bergamasco 2017). Today, family farmers and rural workers are faced with a set of challenges and opportunities tied to their capacity to produce and compete for markets, both local and foreign. These challenges and opportunities arise from the growing demand for Brazilian agricultural products and can only be met through the use of modern methods that raise productivity. This strategic goal was recently advanced by the federal government’s “Brazil Without Misery” program that featured productive inclusion as a major pillar of a broader rural development strategy wherein family farmers’ productivity plays a central role in the formation of support programs (Stropasolas 2017:446).

The national effort to expand social inclusion through productivity includes the National Program for Access to Technical Education and Employment (PRONATEC)
administered by the Ministry of Education (2014) and PRONATEC CAMPO designed for the professional development of the rural sector (Ministério de Desenvolvimento Agrário 2017). PRONATEC CAMPO seeks to develop the productive capabilities of the rural population through educational programs that focus on: incorporating youth into rural economic activities, promoting producer exchanges to diversify production and disseminate sustainable agricultural production methods, achieving subsistence production in foodstuffs while increasing family income, improving the management of small producer units and cooperatives, and establishing more social organizations that increase production and access to markets. Such programs as PRONATEC CAMPO are only a first step toward more effective policies and programs that create the conditions for increasing the productivity of millions of family farmers and rural workers struggling with limited access to land, credit, professional development, technical extension, and low cost inputs.

In addition to education as a vehicle of social inclusion, the federal government launched the National Biodiesel Production and Use Policy (PNPB) in 2005 to mitigate carbon emissions, stimulate rural development, and advance social inclusion and environmental sustainability (Diniz and Favareto 2012, Langevin 2011, Pedroti 2013). The PNPB proposes to diversify the sources of biomass needed for refining biodiesel and increasing the numbers of family farmers producing for the value chain, especially in the Brazilian Northeast with its high concentration of poor family farmers and rural workers. The 2004 Executive Order 5.297 instituted the Social Seal that is awarded to biodiesel producers that purchase a portion of their biomass (usually soybeans) from family farmers (Pedroti 2013). The Social Seal triggers a price premium for producer-sellers through a special auction process administered by the National Petroleum and Biofuels Agency (known as the ANP). The PNPB is an innovative federal policy that creates a thriving national market for biomass, incorporates and integrates agribusiness and family farmer production, and decreases the emission of carbon from dependence on mineral diesel fuel.

The PNPB is not perfect. Reforms are needed to avoid the persistent concentration of small-scale biomass producers in the Southern region of Brazil where family farming is most advanced. The challenge, as Pedroti (2013) and Diniz and Favareto (2012) conclude, is to deepen the impact of the Social Seal by expanding the participation of increasing numbers of family farmers in the North and Northeast through more diverse cultivations of biomass and through efforts to increase the productivity of these farmers. Langevin (2011) shows that the critical case of Agropalma is instructive and demonstrates the potential for lessening dependence on soy as biomass, increasing the productivity of contracted family farmers, and deepening environmental sustainability.

The PNPB demonstrates that transportation fuel and environmental policymaking can intersect with social inclusion and sustainability, but more can be done to integrate sustainable approaches and techniques into modern Brazilian agricultural production. Garcia and Vieira Filho (2014) report that efforts are underway to internalize environmental costs of every step of production and marketing in order to identify and
eliminate market distortions and cut costs (2014:22). These efforts also reflect the rising demand for agricultural products that can be certified as organic, socially responsible, and environmentally sustainable. Fereira et al. (2012) also point to Brazil’s growing ecological knowledge community as a nexus for greater dissemination of environmental protection and sustainable agricultural practices. They suggest that

“Narrowing the gap between research and policy is essential if the academic community is to capitalize effectively on recent governmental investments in research and provide the necessary evidence basis for reconciling agricultural production and environmental conservation in Brazil (2014:535).”

EMBRAPA plays a key role in narrowing this gap by providing research and extension to lead a “green growth strategy.” This government research agency is responsible for developing and promoting the use of low-carbon agricultural technologies, funded in large measure by the Ministry of Agriculture’s Low Carbon Agriculture (ABC) line of credit with below market interest rates. Pereira, Martha Junior, Santana and Alves report that Brazil’s National Climate Change Policy requires the agricultural sector play a large role in greenhouse gas emission reductions, or 21.5% of Brazil’s overall carbon reduction commitment (2012:37). These reductions can be carried out through recovery of deforested and degraded lands and pastures, greater integration of crop-livestock production systems, no till planting, and the expansion of the biofuels (ethanol and biodiesel) sector.

For example, the National Association in Defense of Vegetation (ANDEF) and the Federal University of Espirito Santo (UFES) developed the educational program Agro+ in 2012 to provide technical education in sustainable practices. In the first two years Agro+ delivered educational programs to 365 production units and 1,354 farmers and rural workers (Ministério da Agricultura, Pecuária e Abastecimento 2014:17). Agro+ is just one example among hundreds of efforts underway to incorporate science, value chain assessments, and sustainable practices throughout Brazilian agriculture. Embrapa, federal and state governments, the private sector, and increasing numbers of civil society organizations are focused on this transition to a “green” growth strategy for rural development and agricultural modernization.

Brazilian agriculture modernization delivers food security, achieves remarkable increases in productivity, and integrates elements of the national economy through vertical industrialization and global commodity chains. The sector makes sustained contributions to national economic development, fiscal stability, and trade policy formation. More than any other sector, Brazilian agriculture provides a backstop to national development in good times and bad. However, if productivity served as the major challenge at the end of the twentieth century, then the twin challenges of social inclusion and environmental sustainability must be overcome in the 21st century if Brazilian agriculture is to continue to prosper and provide Brazil with the backstop it needs to achieve greater national economic and social development while also making a leading contribution to global food security.
Bibliography


Buainain, Eliseu Alves and José Maria da Silveira, and Zander Navarro (eds.)

Castro, César Nunes de, Guilherme Mendes Resende and Murilo José de Souza Pires.


Conceição, Júnia Cristina Peres R. da and Pedro Henrique Zuchi da Conceição.
“Agricultura: Evolução e Importância para a Balança Comercial Brasileira.”


Delgado, Guilherme Costa and Sonia Maria Pessoa Pereira Bergamasco (eds.).


Langevin, Mark S. “Social Inclusion, Environmental Sustainability, and Brazil’s National Biodiesel Production Policy: The Critical Case of Agropalma.”


Martha Junior, Geraldo Bueno and Joaquin Bento de Souza Ferreira Filho (eds.). Brazilian agriculture development and changes. Embrapa. 2012.


