

# Global Markets and Sustainable Agricultural Development: Lessons from Brazil<sup>1</sup>

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## 1. Introduction

Brazil has shown rapid growth in agricultural development since 1990, with particularly rapid progress in export of major agricultural commodities including soybeans, beef, chicken meat, and pork. As the second leading global supplier of soybeans, total exports reached 19.25 million metric tons (MMT) with an export value of US\$5.40 billion in 2004 compared to only 1.55 MMT with an export value of US\$0.40 billion in 1980 (FAO 2006). In addition, Brazil was the largest exporter of chicken meat (2.42 MMT at US\$2.49 billion), the second largest exporter of beef and veal (0.92 MMT at US\$1.96 billion), and the third largest for pork (0.34 MMT at US\$0.57 billion) in 2004. Brazil is now in the top ten of agricultural exporters by value with US\$27.22 billion in 2004 (FAO 2006) and is consistently running a trade surplus for the agricultural sector, which bolsters Brazil's overall net trade balance (Hirsch and Chu 2005; de Rezende Lopes et al. 2006). What policies helped Brazil achieve this growth improvement in agricultural production and success in global markets?

The keys to agricultural advancement in Brazil have been the macroeconomic policy reform along with advances in agricultural technology and agronomy particular to Brazil (Brooks and Melyukhina 2003; World Food Prize Foundation 2006). Economic stability, reduced trade restrictions, and investments in agriculture and related sectors brought out the comparative advantage of the country for major crop commodities like soybean, sugar, and meats. Some examples of these agrarian reform policies are 1) realistic exchange rate policy; 2) enhanced access to international markets; 3) heavy investment in agricultural research; and 4) a strengthened role of the private sector. These policies trigger infrastructure development, land-use planning and zoning, and advancement in crop research and biotechnology to name a few.

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Changes in the social sector and community development likewise help push Brazil's agricultural development forward.

On the other hand, as in most country development work, detrimental impacts on the environment due to these policies cannot be ignored. Dramatic land conversion has led to loss of biodiversity, high rates of soil degradation, excessive fertilizer use, and a high opportunity cost of lost environmental services (Fearnside 2001; Laurance et al. 2001; Carvalho 2006). Loss of forest in the Amazon basin has averaged over 18,500 km<sup>2</sup> per year since 1988 (OBT-INPE 2006). As a consequence, Brazil continues to face the challenges of trade-offs between economic benefits of agricultural expansion and environmental benefits of preservation and conservation.

This paper briefly describes the trade and macroeconomic reforms that boosted agricultural development in Brazil. We will focus on access to global markets, identify the policies and investments that enhance agricultural modernization, and examine the lessons that can be drawn from this rapid agricultural development and their applicability to other developing countries while trying to balance the environmental impacts of such policies.

## **2. Background**

Reforms in macroeconomic policies spurred the development of the agricultural sector in Brazil beginning in the 1990s. A more stable investment environment—with restraints on import substitution policies; elimination of export licenses, quotas, and taxes; deregulation of markets for wheat, sugarcane and coffee; and targeted investments—during the mid-1990s stimulated agricultural growth. Land devoted for major agricultural commodities expanded since the reform. The area devoted to soybean increased from 11.25 million ha in 1990-1999 to 17.14 million ha in 1999-2005 reaching production level from 23.91 MMT to 42.51 MMT, respectively (FAO 2006). Likewise, the beef and poultry industries boomed as a result of increased availability of soybean meal (Matthey, Fabiosa, and Fuller 2004).

Rapid expansion in area or number of head harvested was the primary component of the recent strong growth in export commodity production, particularly for oranges, sugarcane, soybeans, and meats (Tables 1 and 2). Yield growth has also been an important source of production growth for most export crops, except in the case of oranges where yields have held fairly steady, but this is expected since this was already a highly competitive crop. Growth in soybean yields in the past few years has fallen off due to extensive establishment of new soybean production in the so-called “expansion states” in the Cerrado, drought impacts in the southern production regions, and problems with Asian soybean rust (USDA-JAWF 2006; USDA-PECAD-FAS 2004). Though recovery from this slump in soybean yield growth is expected once the establishment period is completed in the Cerrado and the drought lessens, this could point to some important questions of sustainability in the longer term. Yield increases in livestock production have also been fairly weak, however, and could be an important focus for future improvements. Yield growth was more rapid for most importables, such as cotton, rice, and wheat, for which area grew slowly or declined (Tables 1 and 2). Increased competition from imports due to policy reform induced rapid improved efficiency on more productive farms, and exit of less productive farms (OECD 2005; Helfand 2003a; Helfand and Castro de Rezende 2001).

### **3. Trade and Macroeconomic Reform and Access to Global Markets**

Policy reforms through the late 1980s and 1990s had a powerful impact on recent agricultural growth. Economy-wide reforms in the late 1980s dramatically reduced industrial protection, making agriculture more competitive while taxes and quota restrictions on agricultural exports were reduced or eliminated (Zahniser et al. 2004; Borras 2003; Helfand and Castro de Rezende 2001; Dohlman, Osborne, and Lohmar 2001). Perhaps the biggest impact of 1990s reforms came not from changes in trade protection, but from the deregulation of domestic markets, including elimination of support prices and reduction in the role of government in settling prices, managing production, providing agricultural credit, and regulating or monopolizing marketing and trade during the mid-1990s (Borras 2003; Helfand and Castro de Rezende 2001). The reduction of government credit to agriculture put pressure on the sector to develop private sources of capital, which was done successfully. International capital flows to agriculture were

further boosted by elimination of the Financial Operations Tax, first on agriculture only, then on agriculture-related business, beginning in 1995. Liberalization of other input markets led to productivity gains and reduced costs by exposing domestic input producers to international competition. However, the impacts of these reforms were hindered by the overvaluation of the Brazilian currency through most of the 1990s (due mainly to economy-wide macroeconomic instability), which reduced the competitiveness of Brazilian agriculture. Continued appreciation following the adoption of the *Real* in mid-1994 became unsustainable and the currency was allowed to float in 1999, depreciating by 50 percent. This large devaluation following the deregulation and liberalization of domestic markets in the late 1980s and 1990s made the agricultural sector highly competitive internationally (Helfand and Castro de Rezende 2001).

#### **4. Other Policies and Investments**

Macroeconomic and trade reform would not have produced rapid agricultural growth without fundamental investments in agriculture and soil management. Brazil is a model to other developing countries in demonstrating how an infertile, unproductive land can become a productive agricultural area. The Cerrado Region, an arid brush savanna of over 120 million ha across central Brazil, has soil characterized by high acidity and aluminum levels that are toxic to most crops. A key breakthrough in the 1950s was application of lime and phosphate-rich fertilizer in the acidic soil of the Cerrado. Results showed a dramatic increase in corn, soy and cotton yields on Cerrado soil within one growing season—200 to 300 percent higher yields than unimproved soils (World Food Prize 2006). This breakthrough was combined with further agronomic and agricultural research and extension work with farmers that refined fertilizer and soil nutrient applications in the Cerrado. These include development of high-yielding crop varieties tolerant to aluminum toxicity and able to absorb micronutrients effectively and the refinement of no-till or direct planting techniques to reduce environmental degradation and maintain high levels of soil organic matter. Government investment also created policies, institutions, and infrastructure development to enhance agricultural production in the Cerrado (World Food Prize 2006). From 200,000 hectare of arable land in 1955, the Cerrado has expanded to over 40 million hectares in 2005. The Cerrado now supplies 54 percent of soybean

harvest in Brazil, 28 percent of corn and 59 percent of coffee. Aside from crops, the Cerrado provides 55 percent of the beef industry in Brazil (World Food Prize 2006).

Total agricultural research and development (R&D) investments in Brazil has also been relatively high. Pardey and Beintema (2001) showed that Brazil accounted for half of the total investments in agricultural R&D in Latin America and Caribbean and ranked third in employing agricultural research staff in the developing countries (Beintema, Flavio Dias Avila and Pardey 2001). 79 percent of agricultural R&D expenditure was supported by the Brazilian government in 1996. Although the private sector provides an increasing amount of agricultural technology, most of its private research to generate these technologies is conducted outside of Brazil. Furthermore, the funding in agricultural R&D increased dramatically from 1986 to 1996, but fell some with a decline in general economic growth in the late 1990s. Nevertheless, the intensity of investment in Brazil agricultural R&D is now comparable to many OECD countries. Brazil invested US\$1.70 for every US\$100 of agricultural output in 1996, more than double of its 1976 level and well above the investment levels of most Latin American and Asian countries (Beintema, Flavio Dias Avila and Pardey 2001).

In addition to agricultural development, infrastructure investment has been substantial. However additional investment in market and infrastructure is still needed. Brazil still has relatively high cost of transportation. The cost of transporting maize to an ocean-accessible port, for example, can consume as much as 25 percent of the value of the product. Brazilian farm commodities travel 1,200 miles or more on uneven and heavily congested roads to reach the two main ports of Santos and Paranagua. Brazil has about 100 MMT of agricultural storage capacity, about 40 MMT less than it needs to reduce loss from spoilage and to take the best advantage of price fluctuations (Hirsch and Chu 2005).

#### **4.1. Policy reform for sustainable agricultural growth**

As Brazil continues to be the major exporter of soybean and livestock products, the government is confronted by addressing the need to balance economic benefits and issues of environmental degradation. A number of studies suggest ways on how to address these concerns, some more

extreme than others. Regulating tenure regimes is a critical approach to stemming excessive forest loss (Cattaneo 2002, Simon and Garagorry 2005). Also, establishment of protected areas where local empowerment and decentralization, partnership and collaborative agreements among the local community, state and federal government for sustainable resource conservation is vital (Carvalho 2006).

Another policy with important potential is to strengthen the regulatory framework of environmental impact assessments (EIAs). Estimation of social and environmental costs (opportunity costs) and assessment of indirect impacts of infrastructure development that encourage destructive economic activities need to be considered in reforming policies for agricultural modernization. A well-designed land-use planning and zoning protocol to manage ranching, timber harvesting, forest management, charcoal manufacturing, and the potentials and application of agroforestry and silvicultural options are useful components of a comprehensive EIA that inform difficult decisions in the policy-making process (Fearnside 2001; Laurence et al. 2001).

Furthermore, policies to promote further intensification, in terms of yield gains and productivity, rather than area expansion for crop and livestock production should be taken into consideration. Even if the end result of the environmental impact of these alternatives is still ambiguous (Cattaneo 2002, Simon and Garagorry 2005, Vosti et al. 2002), the benefits to the agriculture sector and the families that depend on this production will benefit from improved yields. Crop research in biotechnology such as applicability and economic feasibility of genetically modified crops (e.g. soybean) including marketing strategies can be attained through public and private investment initiatives (Sampaio 2001).

#### **4.2. Policy reform to make growth more pro-poor**

In the most rapidly growing crops, such as soybean and maize, crop yields gains since the early 1990s have been much faster on large farms than on small farms, and the share of production of small farms dropped considerably, with significant economies of scale in new technology for these crops (Helfand 2003a; Helfand and Castro de Rezende 2001). Helfand (2003b) found an

interesting non-linear relationship of efficiency and farm size. There is a U-shaped curve of total factor productivity with farm size. Productivity initially declines and then increases with farm size, with the medium size farms (between 20 and 2000 hectares) being less efficient with factor inputs. Larger farms gain in efficiency due to their preferential access to agricultural institutions and assistance, among other things. Despite the problems in competitiveness of small and medium farms, the percentage of the rural population in poverty and the total number of poor in rural areas fell in the 1990s (Helfand 2003a) along with poverty declining in general across the country (Table 3).

Large increases in rural wages together with expansion of social security benefits and targeted income transfers such as *bolsa alimentação* helped reduce poverty. Nevertheless, broadening the benefits of rapid agricultural growth to the poor would further increase the positive impact of growth. Helfand (2003a, 2003b) finds that key determinants of per capita farm income for agricultural households are access to land and tractors; access to agricultural and other rural development institutions, including credit, technical assistance, and electricity; and improved access to markets through better infrastructure. Both an expansion of land reform and access to land through improved rental contracts would be beneficial.

Additionally, social policies incorporating health and education investments at the individual level will also foster rural development. Aside from this, other aspects of agricultural policies related to social development should be examined. One example is the tension and competition between the small-scale farmers in the southeast and the large-scale producers from the northwest. Though the government of Brazil provides subsidies to both groups, it may be wise to consider reforms to achieve social objectives and peace in these farming areas, even at some cost to productivity (Matthey, Fabiosa and Fuller 2004).

Borras (2003) studied the outcome of the market-led agrarian reform (MLAR) in Brazil, a government response to access to land by the rural poor. His study reported some highlights of what confounded the MLAR implementation process: i) buyers need to have pre-entry average income above poverty line, limiting access to the program; ii) decentralization that was captured by local government and elite; and iii) complications in land pricing and titling. Further reform

would be beneficial at the municipal level consisting of diversification of agricultural production, expansion of the labor market, and political strengthening of beneficiaries for the promotion of physical and social infrastructure (ICARRD 2006).

### **4.3. Gains from additional global trade liberalization**

As noted above, Brazilian agriculture following policy reform has benefited greatly from access to global markets. This access was achieved despite barriers to trade resulting from OECD agricultural trade policies. How much would Brazil gain from global trade liberalization under the Doha round, or from more dramatic global trade liberalization? Based on a number of studies, the impact on Brazil of the successful conclusion of the Doha round appears to be modest relative to size of the Brazilian agricultural economy. The results vary depending on models used and how the Doha reforms are implemented, but the order of magnitude is similar. Bussolo, Lay and van der Mensbrugge (2005) estimate that an optimistic “deep Doha” reform would have virtually no impact on real agricultural gross domestic product (GDP) in Brazil, with less than a one percent increase in Brazilian agricultural exports by 2015, but slightly reduces poverty due to improved urban income distribution. Full global trade liberalization (which is not on the Doha agenda) would have a much larger impact, with a 22 percent increase in agricultural exports and a three percent increase in agricultural GDP. Full trade liberalization would also have significant impacts on reducing poverty, increasing the income of the poorest groups in the economy, by boosting employment and wages in agriculture and agriculture processing (Bussolo, Lay and van der Mensbrugge 2005).

According to OECD (2005), a 50 percent cut in tariffs and export subsidies globally, together with a 50 percent reduction in domestic support to agriculture in OECD countries, would benefit the Brazilian economy—through higher incomes for consumers and producers—by some US\$1.7 billion, the equivalent of around 0.3 percent of GDP (and only about 5.7 percent of recent annual agricultural exports). Bouet, Mevel, and Orden (2006) find that a trade reform based on the current Doha Development Round of trade negotiations would benefit Brazil by US\$0.9 billion, or about 0.13 percent real income. Brazil’s gains are mainly from improved efficiency rather than improved terms of trade, because of the relatively weak assumptions on

agricultural tariff cuts under the Doha Round. Other middle income countries, such as China (0.25 percent of income, US\$6.0 billion) and India (0.3 percent of income, US\$2.8 billion) gain more than Brazil, as do Indonesia, Malaysia, Thailand, and Turkey on a proportional basis. The relative benefits across countries are a complex outcome of the structure of supply and demand, and the magnitude of tariff and market access reform on major commodities within each country.

## **5. Conclusions**

Reform of trade and macroeconomic policies and deregulation of agricultural input and output markets in the late 1980s through the late 1990s that had historically penalized Brazilian agriculture greatly improved its competitive position. This long-term policy evolution was slowed in the mid 1990s, when the competitive position of agriculture and other tradable sectors began to erode due to the appreciation in the real exchange rate in conjunction with broad economic stabilization policies. But the float of the *Real* and resultant devaluation in 1990 greatly spurred the competitiveness of Brazilian agriculture. Together with strong supporting policies in technology development, well-planned and appropriate regulatory frameworks on environmental and social impact assessments, and crop research and biotechnology development, these reforms have dramatically boosted agricultural production growth and made Brazil a major power in global agricultural markets. Rapid growth has resulted in environmental damage, however, and left some of the poor behind; policies to alleviate some of these issues include potentially reducing some production efficiency to obtain social objectives, diversification of agricultural production, expansion of the labor market, and political strengthening of beneficiaries for the promotion of physical and social infrastructure.

The Brazilian experience shows that with appropriate policies, institutions, and technologies, developing countries can gain access to global markets despite existing tariffs and trade barriers. Global agricultural trade liberalization through the Doha Round—and preferably beyond—would further enhance agricultural growth. But as the Brazilian case shows, the gains from further global trade reform may be small relative to the gains from implementing appropriate domestic policies. Future successes in agricultural development in Brazil will be driven primarily by domestic policies and processes, including public and private domestic investment,

macroeconomic stability, research-based technological change, education, and human capital development, with improved access to global markets serving as an important facilitator and spur to these processes.

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Table 1. Annual growth rates (%) for area (or livestock head), yield, and production of major agricultural commodities in Brazil, 1990-2005.

	1990-1999	2000-2005
<b><i>Crops</i></b>		
Soybean		
Area	1.29	9.02
Yield	3.20	-1.50
Production	4.53	7.38
Maize		
Area	0.19	-0.21
Yield	3.95	1.72
Production	4.14	1.50
Wheat		
Area	-7.35	14.28
Yield	5.49	5.84
Production	-2.26	20.95
<b><i>Livestock</i></b>		
Cattle (beef and buffalo)		
Slaughter	3.10	2.68
Yield	1.39	0.14
Production	4.54	2.82
Poultry (chicken, etc.)		
Slaughter	8.82	3.77
Yield	0.02	2.55
Production	8.84	6.42

Source: FAO 2006

Table 2. Indexed (1970 = 100) area/head harvested and yields for major export and import commodities in Brazil, 1970-2004.

		1970	1980	1990	2000	2004
<i>Crops</i>						
Area Harvested	Soybeans	100	648	845	1,032	1,597
	Sugarcane	100	156	245	287	327
	Oranges	100	271	462	451	410
	Maize	100	114	124	118	122
	Coffee	100	101	118	93	96
	Rice	100	124	93	74	76
	Cotton	100	84	45	18	24
	Wheat	100	159	144	73	139
Yield	Soybeans	100	134	149	215	208
	Sugarcane	100	121	135	149	160
	Oranges	100	122	127	147	140
	Maize	100	123	140	217	248
	Coffee	100	121	107	161	192
	Rice	100	101	147	218	237
	Cotton	100	97	209	530	647
	Wheat	100	98	151	193	234
<i>Livestock</i>						
Head Harvested	Beef	100	166	250	336	383
	Chicken	100	364	544	1,330	1,648
	Pork	100	121	187	313	339
Yield	Beef	100	93	94	108	109
	Chicken	100	103	124	126	145
	Pork	100	103	110	107	119

\*based on three-year averages centered on reported year

Source FAO 2006

Table 3. Selected Millennium Development Goals indicators and trends in Brazil, 1990-2005.

INDICATORS	Early 1990s	Late 1990s	Early 2000s
<b>Proportion of population below \$1 (1993 PPP) per day</b>			
Population below \$1 (PPP) per day consumption, percentage	14.2	9.97	8.2
<b>Poverty gap ratio [incidence x depth of poverty]</b>			
Poverty gap ratio	4.45	2.73	2.1
<b>Proportion of population below minimum level of dietary energy consumption</b>			
Population undernourished, percentage	12	10	8
Population undernourished, number of people (millions)	18.5	16.5	14.4
<b>Net enrolment ratio in primary education</b>			
Net enrolment ratio in primary education, both sexes	84.7	91.3	92.6
<b>Literacy rate of 15-24 year-olds</b>			
Literacy rates of 15-24 years old, both sexes, percentage	91.8		96.8
Literacy rates of 15-24 years old, women, percentage	93.1		97.9
Literacy rates of 15-24 years old, men, percentage	90.5		95.8
<b>Under-five mortality rate</b>			
Children under five mortality rate per 1,000 live births	60	48	36.5
<b>Infant mortality rate</b>			
Infant mortality rate (0-1 year) per 1,000 live births	50	41	33.5
<b>Proportion of 1 year-old children immunized against measles</b>			
Children 1 year old immunized against measles, percentage	83.4	92.8	98.6
<b>Prevalence and death rates associated with tuberculosis</b>			
Tuberculosis prevalence rate per 100,000 population	148		90
Tuberculosis death rate per 100,000 population	12.9		8.96
<b>Proportion of population with sustainable access to improved water source, urban and rural</b>			
Population with access to improved water sources, total, percentage	83		90
Population with access to improved water sources, urban, percentage	93		96
Population with access to improved water sources, rural, percentage	55		57
<b>Proportion of population with access to improved sanitation, urban and rural</b>			
Population with access to improved sanitation, total, percentage	71		75
Population with access to improved sanitation, urban, percentage	82		83
Population with access to improved sanitation, rural, percentage	37		37

Data compiled from UNSD-DIU 2006.