CHOICES
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Overview: Tilling Latin American Soils

Peter Goldsmith, Guest Editor

Latin America has emerged as a significant force within the global agri-food system. Agricultural production in the region is growing 3% per year, or 1.5 times the global rate. At the same time, modern food and energy now involve industrialized systems of production. Larger farming units, greater coordination across the food chain, and global integration operate within a context of greater social and environmental expectations. Meeting these social and environmental expectations is especially challenging in a developing country context where public and private institutions are weak.

One of the themes of this issue of *Choices* is the challenge for Latin America to balance the world's increasing demand for food and fuel and their own ambitions for development, with society's expectations as to the way food and energy are produced and natural resources are used. Such complexities create new strategic challenges not only for Latin America's agricultural industries and policy makers, but also nongovernmental organizations and outside stakeholders who have an interest in the region's practices and development.

The objective of this theme is to provide readers with examples that highlight this difficult balancing act. There are two general messages to be gotten from this set of articles. The first is how the interconnectedness of the modern agri-food system across the globe makes optimal policy development difficult. Suppliers, consumers, and stakeholders are increasingly located in different regions of the world. Each has an interest in how foreign agricultural development takes place, as well as how their domestic producers and consumers are affected. For example, in the article written by Carlos Steiger, European consumers are increasingly eating Brazilian beef and valuing the healthiness of the region's grass-based diet for cattle. But, increased demand for Brazilian beef causes land use changes from a native state to pasture in the environmentally sensitive northern and western parts of the country.

Articles in this Theme:

The second message communicated by these articles is how Latin American agricultural development is a very modern phenomenon involving industrial production systems, greater coordination along the value chain, and much larger units of production. These modern agricultural systems have different economic, social, and environmental impacts compared with the idealized notion of a traditional small family farm. Domestic policymakers struggle in an environment of weak public and private institutions to balance environmental stewardship and the needs of small and landless farmers, with expectations for economic growth and development. For example, the article by Chaddad and Jank conveys the challenge for the Brazilian government to enact policies that lead to greater agricultural competitiveness within the global economy, while simultaneously shifting resources to support landless and small farmers.

There are four articles focused on these issues. The first article, by Fabio R. Chaddad and Marcos S. Jank, is entitled: "The Evolution of Agricultural Policies and Agribusiness Development in Brazil." The authors trace the history of agricultural policy in Brazil. Farm policy evolved from initially emphasizing food security and self-sufficiency to a focus on deregulation and trade in the late 1980s and 1990s. Recently though, policy has taken a reactionary bent focused on small farms and land reform. The authors

explain the implications of the recent shift in policy direction.

The second article, by Joao Martines-Filho, Heloisa L. Burnquist, and Carlos E. F. Vian, is entitled: "Bioenergy and the Rise of Sugarcane-Based Ethanol in Brazil." This paper documents the forces and challenges for Brazil as it has risen to global leadership in bioenergy. Key issues discussed are appropriate government policy and the importance of market forces within a developing country context, strategic investments in R&D, and the competition for inputs between the food and energy sectors.

The third article, by Peter Goldsmith and Rodolfo Hirsch, is entitled, "The Brazilian Soybean Complex." This paper coveys the story of the Brazilian soybean complex as the classic rise of an industry due to natural resource abundance and strategic investments in agricultural technology. But, it is also a story about the challenges facing developing countries as they become the dominant suppliers of the world's foodstuffs.

The final article, by Carlos Steiger, is entitled: "Modern Beef Production in Brazil and Argentina." This paper tells how the dynamic demand and supply factors in the beef industry have directed attention to Brazil and Argentina as critical global suppliers. In recent years, Mercosur countries have doubled their share of world exports to over 42%. This increasing dependence on Latin America for beef has important social, environmental, and economic implications.

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The Evolution of Agricultural Policies and Agribusiness Development in Brazil

Fabio R. Chaddad and Marcos S. Jank

JEL Classification: Q18, O54, O13, Q15

In the late 1980s, Brazil started to adopt liberal and market-oriented policies, which significantly impacted the performance of its food and agricultural (henceforth agrifood) sector. The agrifood sector is now among the most dynamic in the Brazilian economy. Grain production doubled from 58 to 120 million metric tons (MT) and meat production surged from 7.5 to 20.7 million MT between 1990 and 2005. The agrifood economy generated R$534 billion (US$183 billion) in 2004, which is equivalent to 30% of the country's GDP. In addition, it represented 35% of total employment and 40% of total exports in 2004.

Agricultural production growth and agribusiness development in Brazil are largely dependent on exports, which account for 31% of agricultural production. Total agricultural exports more than doubled from US$13-32 billion in the 1990-2005 period. Brazil is now the world's third agrifood exporter – following the European Union (EU) and the United States (US) – and surpassed the US as the country with the largest surplus in agricultural trade, with US$29 billion in 2005.

The growing competitiveness of the Brazilian agrifood sector is attributed to a number of factors, including investments in tropical agricultural research and availability of agricultural credit, which caused significant productivity gains since the 1970s. The technologies that made the expansion into the *cerrado* region in the Brazilian Central-West – in soils that are distinctly inferior to those in Argentina, the US Corn Belt and Southern Brazil – resulted from public investments in agricultural research. The average annual growth rate of total factor productivity in Brazilian agriculture was estimated at 3.3% for the period 1975-2002 and at 5.7% between 1998 and 2002, which are above the 1.8% growth rate achieved by US agriculture between 1948 and 2002 (Gasques et al., 2004). Other factors also contributed to the competitiveness and growth of the agrifood sector in Brazil, such as relative macroeconomic stability after 1994 and the significant reductions in government intervention and trade barriers (Jank, Nassar, & Tachinardi, 2004).

Despite these favorable developments and the availability of labor and natural resources, agrifood growth in Brazil faces significant internal and external constraints. In the external environment, trade barriers and subsidies to domestic producers and exporters, especially in developed countries, significantly impact Brazilian agrifood exports. As a result, Brazil adopted a more aggressive position in international trade negotiations at the World Trade Organization (WTO), bringing three high-profile dispute cases against developed countries and taking leadership in the formation of a coalition of developing countries known as the G-20.

In the domestic arena, agricultural producers in Brazil face uncertainties related to exchange rate volatility, the lack of clearly defined property rights to land, the regulatory framework concerning research and marketing of genetically modified organisms (GMOs), poor infrastructure causing logistical bottlenecks, and the decline in government spending in important areas such as food safety, animal and plant health inspection, agricultural extension, irrigation, and other traditional agricultural policy instruments. The recent reemergence of foot-and-mouth disease, which led more than 50 countries to close their borders to beef exports from Brazil, is one recent example of the policy challenges to the development of the Brazilian agrifood economy. This article discusses the evolution of agricultural policies in Brazil and how they impact the competitiveness of the agrifood sector.

Table 1. The evolution of agricultural policy in Brazil.

	1965-1985	1985-1995	1995-2005	Proposed Agenda
Macroeconomic conditions and policy	- High inflation - Controlled exchange rate - High growth rate - Increased government expenditures in farm policy	- Uncontrolled inflation and low growth (stagflation) - Heterodox plans - Debt crisis - Land as real asset - Decreased government expenditures in farm policy	- Control of inflation - Volatile exchange rate - High real interest rates - Modest growth rate - Privatization	- Low inflation - Structural reforms and fiscal balance - Less volatile exchange rate - Lower interest rates - Sustained growth - Investments in infrastructure
Agricultural policy goals	- Food security	- Deregulation - Liberalization	- Land reform programs - Family farming and social inclusion	- Competitiveness - Sustainability (economic, social, and environmental)
Price support and government storage	- Massive intervention: public agencies, government purchases and storage, price controls - Commodity price support	- Decreased intervention - Agricultural commodity market deregulation	- Modest and selective intervention	- Modest and selective intervention
Rural credit	- Government supply of credit financed by Treasury (SNCR) - Negative real interest rates	- Decreased government supply of credit - Interest rates less subsidized	- Credit lines targeted to family farms (PRONAF) - Specific programs for investment credit (BNDES) - Agricultural credit crisis and debt rescheduling	- Crop insurance - Private instruments for agricultural finance - Targeted credit lines to family farms - Credit cooperative development
Agricultural trade policy	- Closed economy - High tariffs - Import Substitution model - Export taxes on primary commodities	- Unilateral openness to trade - International integration (Mercosur) - Elimination of export taxes	- Aggressive policy against agricultural trade barriers - WTO dispute panels - Leadership in G-20 - Negotiation of regional agreements (FTAA, EU-Mercosur)	- Aggressive trade policies: negotiations, litigations - Increased emphasis on NTBs: technical, sanitary, and social barriers - Conclusion of regional and bilateral trade agreements
Agricultural research and extension	- High investment in public research (Embrapa, federal and state universities) - Development of public extension service network	- Leveling-off of public investment	- Crisis of public research and extension services	- Renewed public commitment to agricultural R&D, including GMOs - Increased role of public-private partnerships - Intellectual property rights
Social policies (family farms and land reform)	- Minimal	- Initial stage (Extraordinary Ministry of Land Reform)	- Ministry of Agrarian Development (MDA) - Distributive programs: land reform, "Bolsa Família," rural retirement, PRONAF	- Policy evaluation and monitoring - Retarget programs to different types of family farms - Farm cooperative development and modernization

The Evolution of Agricultural Policies in Brazil

Agricultural policy goals and programs in Brazil have changed significantly (Table 1). The period between the mid 1960s to early 1980s was characterized by massive government intervention in agricultural commodity markets primarily by means of subsidized rural credit and price support mechanisms, including government purchases and storage of excess supply (Figure 1). At that time, the agricultural sector in Brazil was in general not competitive (except in tropical products such as coffee and sugar), and was characterized by highly skewed distributions of farm income and land ownership with large, unproductive landholdings known as "latifundios." It was in the 1960s and 1970s that the country started to urbanize as many rural poor migrated to large cities. During this period, agricultural policy had the objective of promoting food security of an increasingly urban population, while compensating the agricultural sector for the anti-export bias of the import substitution model that was common in developing countries at the time.

The debt crisis of the late 1980s forced the Brazilian government to decrease support to farmers and to review agricultural policy goals. Economy-wide structural reforms introduced in the early 1990s further decreased the distortion of agricul-

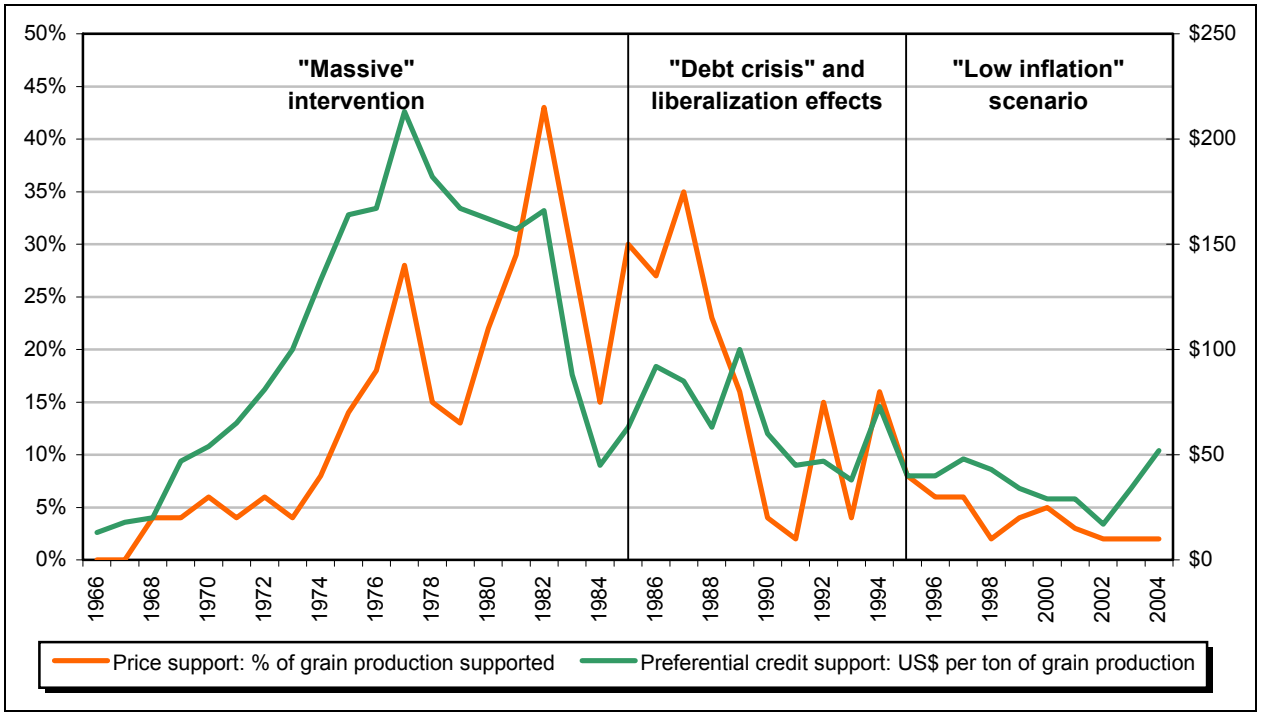

Figure 1. Commodity price and preferential credit support in Brazil.
Note: Before 1965, there was price support for coffee, sugar cane, milk, and grains. Source: Ministry of Agriculture, Livestock and Food Supply (MAPA), 2005.

tural policy in Brazil by eliminating export taxes and price controls, deregulating and liberalizing commodity markets, unilaterally reducing trade barriers (today the average applied tariff on agrifood products is 12.5%), and introducing private instruments for agricultural financing. As a result of these changes, government support currently represents 3% of farm receipts in Brazil, compared with 2% in New Zealand, 4% in Australia, 8% in China, 18% in the US, and 34% in the EU (OECD, 2005).[1]

Government expenditures on agriculture-related programs in Brazil have decreased over the last five presidential administrations (Table 2). The annual average amount spent in the Sarney administration (1985-1989), in real values, was R$20.9 billion (roughly US$9 billion), which represented 5.6% of total government expenses. The average amount spent on agricultural programs decreased to R$10.7 billion (or about US$5 billion) per year in the current administration, representing 1.8% of total government expenses in 2003-2005.

Not only have government expenditures on farm policy decreased by half in real terms since the late 1980s, they were also used in an increased number of programs by the last two administrations. According to Gasques (2004), the number of agriculture-related programs increased from 30 before the year 2000 to 100 programs in 2003, 84 under the function "agriculture," and 16 programs under the function "agrarian organization."[2] The performance of many of these programs is difficult to evaluate and, in general, expenses are quite variable or even arbitrary and do not contribute to intended goals. Additionally, some programs are stretched to the limit and cannot survive with continued budget reductions. Public services such as animal and plant health inspection, public research, and infrastructure improvements have been receiving fewer resources, despite the strong private and public

1. *These numbers refer to producer support estimates (PSE) that measure the value of supports from all forms of public policies, including domestic support and border measures relative to gross farm receipts between 2002 and 2004. The highest percentage PSE levels in Brazil are for rice (17%), cotton (13%), and wheat (6%).*

2. *Brazilian government expenditures are organized in functions and programs. A function represents the higher level of aggregation of federal government expenses, including health, education, social security, and the two agriculture-related functions (agriculture and agrarian organization). A program comprises a group of government actions towards a specific policy goal.*

Table 2. Brazilian government expenditures in farm programs by administration and function.[a]

Period	Average Annual Expenditures with Agricultural Policies			Agriculture/ Total (A/C)	Agrarian Organization/ Total (B/C)	(A+B)/Total Government Expenditures
	Agriculture (A)	Agrarian Organization (B)	Total (C)			
Sarney 1985-1989	19,549	1,330	20,879	94%	6%	5.6%
Collor-Itamar 1990-1994	17,510	1,229	18,739	93%	7%	2.8%
Cardoso 1 1995-1998	15,273	3,342	18,615	82%	18%	3.4%
Cardoso 2 1999-2002	8,712	3,290	12,002	73%	27%	2.0%
Lula 2003-2005	5,901	4,809	10,710	55%	45%	1.8%

[a] Expenditures are measured in R$ millions corrected for inflation by IGP-DI (base year is 2005). Agrarian Organization expenditures include family farm programs.
Source: Ministry of Finance (2005). Elaboration: Gasques (2004) and ICONE.

efforts that were made in the 1990s to include Brazil as one of the world's leading agrifood export countries.

Significant changes in agricultural policy goals were introduced by the first Cardoso administration in 1995, which shifted priority to land reform and family farming in an attempt to alleviate rural poverty. This shift in agricultural policy goals is reflected in government expenditures in a new focus area called the "agrarian organization" (Table 2). Agrarian organization programs are primarily related to land reform. Under the Cardoso administration, approximately 500,000 new family farms were settled in expropriated land. In addition to land reform, the government adopted a set of policies targeted to "family agriculture" in 1995 – known as PRONAF – including subsidized credit lines, capacity building, research, and extension services.

Interestingly enough, the Brazilian government created a new ministry in 2000 to run programs targeted to family farms and land reform – the Ministry of Agrarian Development (MDA). Brazil is probably the only country in the world with two ministries of agriculture. This reflects a supposed duality of farming in the country – related to the skewed distribution of rural income and land ownership – and the misleading perception that agribusiness development necessarily leads to small farmer exclusion. According to the 1995 Census of Agriculture, farms with less than 10 hectares (24.7 acres) represent 49.7% of all farms in the country and hold 2.2% of all landholdings. With more than 500 hectares (1,235 acres), the largest farms represent only 2.2% of all farms, but own 56.5% of all landholdings.

More recently, MDA officials became more vocal about the country's agricultural trade policy. In the Hong Kong Ministerial meeting of the WTO, the Minister of Agrarian Development openly defended the right of "food sovereignty" for developing countries by means of direct subsidies and additional border protections. During the same meeting, the Brazilian Minister of Agriculture, Livestock and Food Supply (MAPA) was asking for substantial improvements in market access for both developed and developing countries.

Federal government expenditures on agrarian organization programs increased from 6% in the Sarney administration to 45% of total expenditures on farm programs in the Lula administration (Table 2). Not only did total government expenditures on agricultural policy decrease both in relative and absolute terms, but traditional agricultural policy functions were also sacrificed to support agrarian organization programs. For instance, government expenditures on land reform increased from R$1.84 billion (US$836 million) in 2000 to R$2.4 billion (US$1.1 billion) in 2004, while expenditures on support of family farming (PRONAF) doubled from R$1.4 billion to R$2.8 billion. At the same time, expenditures on government purchases and storage of agricultural commodities were substantially reduced from R$1.32 billion (US$600 million) to R$0.53 billion (US$241 million). Other traditional policy programs, such as agricultural research, extension, and plant and animal health, also suffered budget cuts during the last five years.

The Modernization and Globalization of the Brazilian Agrifood Sector

Concurrent with these significant institutional and policy changes, the Brazilian agrifood system transitioned from a traditional to an increasingly global and industrial model. Fostered by rising incomes, urbanization, economic liberalization, and access to competitive raw materials, multinational food processors and retailers entered or increased their investments in the Brazilian market during the 1990s. Increased foreign direct investment (FDI) by large, private agribusinesses in Brazil displaced domestic competitors, increased industry concentration, and eliminated many medium and small companies. As a result, the market share of multinational corporations in the domestic food market increased. For instance, Brazilian affiliates of multinational agrifood companies generated 137,000 jobs, almost US$5 billion in exports, and sales of US$17 billion in 2000. Given the total value of food industry shipments in Brazil of US$58 billion, the aggregate market share of foreign companies reached 30% in 2000. Among the top ten food processors in the country, eight are multinational firms with foreign headquarters. Recent official data show that FDI inflow in the Brazilian agrifood processing industry totaled US$8.2 billion between 2001 and 2004. The top-three food retailers in the country are now controlled by two French supermarket chains (Casino and Carrefour) and one US-based company (Wal-Mart), with a combined market share of 39%.

Concomitant to these structural changes in the post-farm gate stages of the agrifood system, agricultural production also modernized and became increasingly capital intensive and integrated with upstream and downstream supply chain participants. Tightly coordinated agrifood supply chains have been developed by the private sector – in particular, large multinational food processors, fast-food restaurant chains and retailers – to cater to increasingly differentiated domestic and export markets. Farmers in Brazil are increasingly exposed to markets that are much more demanding in terms of food quality and safety, more concentrated and vertically coordinated, and more open to international competition.

According to the last census of agriculture conducted in 1995, the total number of farms reached 4.8 million (IBGE, 1995), but just a small share of the farms account for the majority of output and exports. Many of the small farms involve subsistence production and are resource poor. One of the structural changes of recent agrifood development in Brazil is the growth of commercial agriculture characterized by economies of scale and capital intensity. The spread of commercial agriculture occurs even in sectors that have traditionally been dominated by small-scale farmers such as dairy and corn. The dairy sector is illustrative, as the number of dairy producers supplying milk to the top 12 processors decreased from 175,000 in 1997 to less than 70,000 in 2004.

Taking Stock and Looking Ahead

The agrifood sector in Brazil underwent significant changes in the last decade. First, it was exposed to a dramatic "competition shock" as a result of economic liberalization, industry deregulation, and dismantling of the safety net provided by massive government expenditures in traditional agricultural policy programs. Subsequently, it experienced significant modernization and industrialization induced by private sector strategic responses to these institutional and policy changes. The development of a global agrifood model in Brazil resulted in structural changes in all stages of the agrifood value chain, significant export-led growth, and apparent small farmer exclusion.

Since the end of the military dictatorship in the late 1980s, there has been significant political and social pressure for the government to tackle the issue of the historical unjust land distribution in the country. In response to these pressures, the Sarney administration created the Extraordinary Ministry of Land Reform, but it was not until the first Cardoso administration in 1995 that the land reform program became a reality. The necessary impetus for the agricultural policy goal of land reform and the associated shift in government expenditures was the result of continued pressure from the landless workers movement (MST) in the form of land invasions, the Catholic Church, and many NGOs, combined with persistent poverty, income inequality, and small farmer exclusion from the expansion of the agricultural sector.[3]

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3. *With the technological modernization of agriculture, the end of investment in land just as a real asset to protect against high inflation, and after hundreds of thousand of new settlements in expropriated land, the number of unproductive landholdings ("latifundios") sharply declined in Brazil. This is the main reason why the new targets of MST today are the "agribusiness sector" as whole and "multinational companies," more specifically.*

Given the central role of the agrifood sector in the Brazilian economy, however, it is important that policies aimed at poorer farmers do not hold back further investments in public goods that will contribute to productivity gains and market access of all types of farms and the country's agrifood competitiveness. The recent reemergence of the foot-and-mouth disease and the logistical bottlenecks caused by underinvestment in rural infrastructure in the Central-West clearly show how lack of investment by the government in critical services can have broad impacts for an economy increasingly dependent on exports. Brazilian efforts in international trade negotiations will not contribute to agrifood growth and economic development if the country does not continue to invest in important programs such as agricultural research, public infrastructure, animal and plant health inspection, and measures to protect the environment. If Brazil continues to trade off economic development with support to small-scale farmers, it will suffer the consequences of the "visibility curse." As the country has progressed as a global economic force it has greater influence, but at the same time comes under greater scrutiny. Increased market share and activity in global agrifood trade requires that the country be increasingly vigilant as to how it comports itself. Resorting back to subsidy programs and import barriers of a bygone era in order to help small farmers survive could affect the country's ability to negotiate for freer markets and gain access to important foreign markets. A heightened presence in markets also behooves exporters to be increasingly quality sensitive as market opportunities increase and the global logistics system becomes oriented to an active South American supply network.

In retrospect, farm policies in Brazil have evolved in the last three decades from a food security and self-sufficiency emphasis before 1985, to deregulation and openness to trade between 1985 and 1995 and, since then, in a reactionary bent focused on the small family farm and land reform.[4] Looking ahead, Brazilian policy makers should develop farm policies to balance competitiveness with social and environmental sustainability goals. The policy agenda which we outline in the last column of Table 1 should comprise social inclusion goals and programs targeted to different types of family farms, but also programs and services that are essential to agrifood competitiveness. The real challenge confronting policy makers in the future is to provide agricultural producers of any scale the necessary tools to assist them in integrating with the global agrifood economy.

For More Information

Gasques, J.G. (2004). *Gasto público para o desenvolvimento agrícola e rural: O caso do Brasil*. Research report prepared for the Food and Agriculture Organization (FAO), Santiago, Chile, 75 pp.

Gasques, J.G., Bastos, E.T., Bacchi, M.P.R., & Conceição, J.C.P.R. (2004). "Condicionantes da produtividade da agropecuária Brasileira." *Revista de Política Agrícola, 13*(3), 73-90.

Hirschman, A.O. (1991). *The Rhetoric of Reaction: Perversity, Futility and Jeopardy*. Cambridge, MA: Belknap Press.

Instituto Brasileiro de Geografia e Estatística (IBGE), (The Brazilian Institute of Geography and Statistics). (1995). *Brazilian Census of Agriculture*.

Jank, M.S., Nassar, A.M., & Tachinardi, M.H. (Dezembro 2004). "Agronegócio e comércio exterior Brasileiro." *Revista USP, 64*, 14-27.

Ministry of Finance. (2005). *Relatório Resumido de Execução Orçamentária do Governo Federal*. Data available online: http://www.fazenda.org.br.

Organisation for Economic Co-operation and Development (OECD). (2005). *OECD Review of Agricultural Policies: Brazil*. ISBN 92-64-01254. 226 pp.

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4. *Albert Hirschman's masterpiece "The Rhetoric of Reaction: Perversity, Futility and Jeopardy" is a perfect conceptual text to understand the dilemma of swinging policy priorities confronting "patronal" vs. "family" agriculture in Brazil.*

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Bioenergy and the Rise of Sugarcane-Based Ethanol in Brazil

Joao Martines-Filho, Heloisa L. Burnquist, and Carlos E. F. Vian

JEL Classification: Q42, O54, 013

Introduction

> "This is something that, every time I think about it, I imagine how could human kind become dependent on something that is going to finish some day? This is stupidity. I can't understand why. How could, in less than 50 years, because it was in the first half of the 20th century, the whole human kind became dependent on something that is going to be eliminated….Each country can (now) have its own 'oil deposits.'"
> (Hon. R. Rodrigues, Minister of Agriculture, Brazil 2006.)

Brazil's rise to be the world's preeminent bioenergy producer provides three important lessons. The first lesson is about the complex task for developing countries balancing government intervention with market forces as they try to develop an industry. The second is how critical research and development (R&D) is for lowering costs to allow for market entry of an infant industry. The third is about the new challenges for bioenergy as it increasingly competes with the food industry for the same raw materials.

The Industry

Increases in petroleum prices and demand are creating pressure to develop new sources of renewable energies. Biofuel will represent 30% of the global energy used by 2020 compared with only 2% today (International Energy Agency, 2005). In 2004, the global ethanol market was US$30-40 billion, of which $4 billion involved international trade. Brazil, China, India, Malaysia and South Africa, the United States (US), and the European Union (EU) are important players in the burgeoning global market. Brazil is one of the world's most competitive biofuels producers because of its comparative advantage in producing ethanol and soybeans. The US, the 2nd leading ethanol producer in the world, has variable costs of production of corn-based ethanol of US$0.96 per gallon. Fixed costs range from US$1.05 to US$3.00 per gallon. While in Brazil the total cost of production was approximately US$1.10 per gallon during the 2005 crop year, with variable costs of US$.89 per gallon and fixed costs of US$.21 per gallon. In early 2006, the wholesale price paid to the mills for anhydrous ethanol was US$2.05 per gallon, while the retail price at the time for ethanol-gasoline blends was US$3.41 (including taxes).

Total world ethanol production (all grades) in 2005 was 12.2 billion of gallons, with 70% of this total produced by the US and Brazil (Figure 1). Other significant producers are China, the EU, and India. Production in the

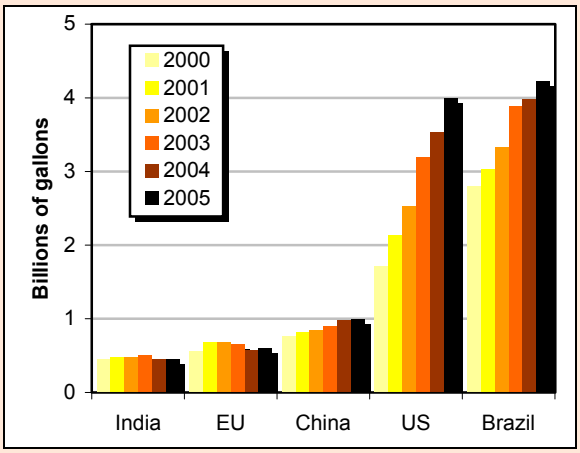

Figure 1. Leading ethanol producing nations, 2000 – 2005.

Sources: Renewable Fuels Association. Ethanol Industry Outlook 2006. Available online: http://www.ethanolrfa.org/.
F.O. LICHT. (2006). International sugar & sweetener report. Several Reports.
UNICA, União da Agroindústria Canavieira de São Paulo. (2006). Estatísticas. Available online: http://www.unica.com.br.

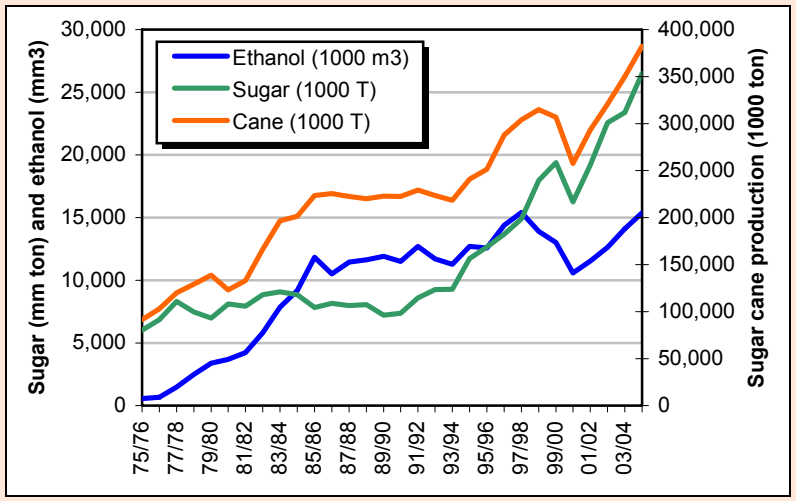

Figure 2. Sugarcane, sugar, and ethanol production in Brazil, 1975/76-2004/05.
Source: UNICA, União da Agroindústria Canavieira de São Paulo. (2006). Estatísticas. Available online: http://www.unica.com.br.

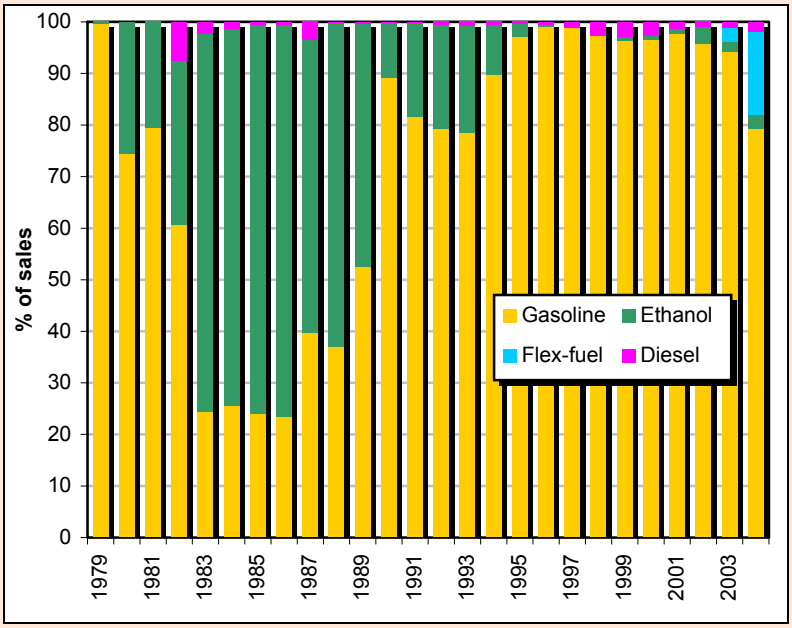

Figure 3. Fuel type of Brazilian car sales (1979-2004).
Source: ANFAVEA, Associação Nacional dos Fabricantes de Veículos Automotores. (2006). Available online: http://www.anfavea.com.br/.

US started to grow rapidly in the mid 1990s, while expansion in Brazil has been most active since 2000 (Figure 2). Between 2000 and 2005, world production has grown at a rate of 13% per year. In 2004/05, Brazil was the world's largest producer of sugarcane, sugar, and ethanol with 34%, 19%, and 37%, respectively, of world production. Today, real ethanol prices in Brazil are less than one-third of what they were in 1975.

In 2004, over 350,000 flex-fuel cars were sold in Brazil (ANFAVEA, 2006) (Figure 3). This amounted to 16.1% of the market, a 500% increase from 2003. In 2005, flex-fuel car sales jumped again to approximately 800,000, or 38% of the cars sold.

In 2005, the EU started to require a 2% blend of ethanol in their gasoline. This proportion will increase to 5.75% by 2010. Sweden, an importer of Brazilian ethanol, now offers consumers a 20% tax break to purchase flex-fuel cars, special parking privileges, and no congestion charge for urban flex-fuel drivers. New laws to be passed in Japan will require that 3% of ethanol will be added to the gasoline. This means that a new market of 0.45 billion gallons/year will be created if this Japanese law is passed. Germany intends to add 2% in its gasoline. Negotiations are also evolving with China for ethanol exports from Brazil.

This tremendous export potential has stimulated investment in infrastructure for transporting ethanol from the production areas to major ports in Brazil. A US$200 million ethanol pipeline from the interior of the State of Sao Paulo to Rio de Janeiro (1,000 miles) is currently under construction for export purposes by the Brazilian oil company, Petrobras.

There are currently around 330 operating mills producing ethanol, with another 89 planned (Unica, 2006). In Brazil during the 2005 crop year, more than half of the total sugarcane production was used for ethanol production. Use of 10% ethanol blends reduces greenhouse gas emissions by 12-19% compared with conventional gasoline and reduces tailpipe carbon monoxide emissions by as much as 30% (Wang, Saricks, & Santini, 1999). Since 2002, regular gasoline has contained 25% anhydrous ethanol, but in March, 2006 the percentage was decreased to 20% due to short supplies and strong domestic demand.

All agribusiness exports, including ethanol and sugar have grown significantly as Brazil liberalized its

trade policy. Brazil exports more than 50% of its sugar, oranges, coffee, and soybeans. Ethanol exports have increased rapidly to over 15% of production. For many nations, the size and stability of domestic consumption has been critical in the development of export markets. The rise of the ethanol industry in Brazil may be due to the reverse. Its long history as a leading sugar producer and exporter has lead to the development of a dynamic domestic cane-based ethanol industry. A new found domestic demand for ethanol complements the scale and global competitiveness of Brazil's sugar industry. This gives the sugar complex a solid domestic and international market foundation by which to grow and develop.

In March 2006, the country's fuel blenders (e.g., BR (Petrobras), Shell, Exxon, Ipiranga) had to cut the ethanol content to 20% of its blended fuel because of ethanol shortages. Sugar prices were at their highest levels in five years, as was the ratio between sugar and ethanol prices. The competition for inputs between energy and food sectors is wonderful news for processors as they now are able to sell into either of two very high demand markets, sugar and ethanol. But, the competition raises important public policy issues if energy demand limits critical food or feedstuffs.

Supply is responding, but mostly in the eastern part of the country. Poor transportation and infrastructure, longer distances to export terminals, and smaller local markets in the Center-West region make investment less appealing. The State of Sao Paulo though is in a unique situation to benefit from the country's commitment to ethanol. It has a long history of being a leader in sugarcane production, fuel processing, and automobile manufacturing. Special sugarcane varieties have been developed and perform well in Sao Paulo's climate. The topography is conducive to mechanized harvesting. Finally, Sao Paulo benefits from some of the best infrastructure in the country. Because of the tremendous interest to build mills in Sao Paulo, the value of land has risen considerably. A 1.5mmt sugar mill will need around 27,000 hectares of sugarcane no more than 40 kilometers from the mill. In the western part of the State of Sao Paulo, land in June 2002 was selling for US$1,350/hectare. By June 2005, land was selling for US$3,070/hectare.

Brazilian consumers have added to the problem of short supply as they have aggressively purchased the flex-fuel cars. Consumers only buy ethanol if the pump price is 30% below gasoline blends. For the first quarter of 2006, retail pump prices for ethanol and gasoline approached parity in Sao Paulo, forcing some consumers back to gasoline. Technology allows consumers to be very astute about their purchases and adapt consumption very quickly. The challenge is for the distribution system to match the dynamics of the market.

History

The first investment in ethanol dates back to the 1920s. The Instituto do Açúcar e do Álcool (IAA) was established in the 1930s and state intervention regulated sugarcane activity in Brazil until the 1980s. Ethanol production though was a minor activity in Brazil until the 1970s when the sharp rise in oil prices threatened the military dictatorship's ability to rule. At the time 90% of the gasoline was imported, causing fuel shortages, inflation, current account deficits, and diminished hard currency reserves. By 1975, sugar prices fell sharply in the international market. At the same time, oil importing countries suffered from significant price hikes (from US$2.91/barrel in September 1973 to US$12.45/barrel by March 1974). Brazilian imports and balance of payments accounts were strongly impacted by this oil price increase, leading the government to launch the Proalcool program at the end of 1975. The purpose of the new program was to stimulate domestic fuel ethanol supply obtained from cane biomass by means of aggressive market intervention through quotas, marketing orders, price setting, and subsidized interest rates.

The second oil shock in 1979 brought about new Proalcool activities focused on demand expansion for hydrated ethanol. A system of tax exemptions for buyers of ethanol cars and consumer pricing fixing that pegged ethanol to gasoline prices were put in place. Additional activities integrated ethanol production for the first time into its energy planning process. Brazil's National Energy Commission expanded the ethanol production target to 3.8 billion gallons as a result of growing domestic needs.

Throughout much of Latin America sweeping market-based reforms, called the Washington Consensus, occurred in the mid 1980s as a result of the deteriorating financial state and hyperinflation that had overrun the region. In Brazil, government spending controls were needed because of the high level of accumulated national debt. The need for ethanol became less compelling as oil prices declined.

In 1987 Petrobras, the state-owned oil and gasoline company, was no longer obliged to buy all the fuel

ethanol produced by the sector. In 1988, the Brazilian Constitution fundamentally changed the State's economic planning role from being normative to indicative. In 1990 the IAA, the public institution through which government intervention had been executed for about 60 years, was eliminated (MP - Medida Provisória no. 151, March 15, 1990). In 1993, the government passed a law in which all gasoline marketed in Brazil would be blended with 20% to 25% of ethanol.

Sugarcane prices, including freight to mills and distilleries, and all ethanol prices were deregulated and determined by market forces starting January 1, 1997 (Portaria no. 64, March 1996). Producers are now paid through a formula based on the sugarcane's end use, either sugar or ethanol. The Organização dos Plantadores de Cana do Estado de Sao Paulo – ORPLANA (producers) and the União da Agroindústria Canavieira de São Paulo – UNICA (mills) agreed in 1999 on a voluntary, nonprofit sugarcane payment system called CONSECANA-SP (Conselho dos Productores de Cana-de-Acucar, Acucar e Alcool do Esatdo de Sao Paulo-Consecana).

In 1997, the Cane, Sugar, and Ethanol Official Harvest Plan was published for the last time by the Brazilian government (Portaria no. 46, May 1997). The 40% tariff quotas for sugar exports were eliminated and market-based prices for anhydrous ethanol became effective May 1, 1997. By 1999, price deregulation for cane and hydrated ethanol was also in place. In 2003, the Brazilian automobile industry launched the first flex-fuel car. Consumers now could decide the mix proportion at every fill-up: pure gasoline, pure ethanol, or a blend. The tax rate at the retail level in January 2006 for pure gasoline was 52.12%. This was 58% higher than the tax on pure hydrated ethanol. The anhydrous ethanol, which is used to blend with gasoline, is untaxed. Thus, the gasoline blended with 13% or more anhydrous benefits from a lower tax level when compared to hydrated ethanol. An 80:20 blend would have an effective tax rate of 22%.

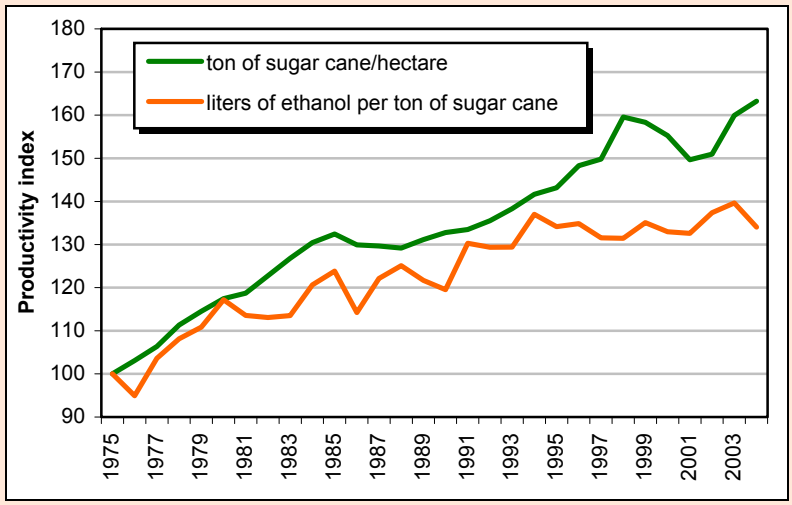

Figure 4. Sugarcane and ethanol productivity in Brazil, 1975-2004.
1975=100. Source: Centro de Tecnologia Canavieira, 2006 and authors' calculations.

R&D Investment

The sustained capacity to improve and diversify its production by investing in R&D is one of the most important factors underlying the success and growth of Brazil's sugar/ethanol complex. Sugarcane productivity has risen steadily at a 2.3% growth rate between 1975 and 2004. Yields are now over 80 tons/hectare. Industrial productivity growth is not as brisk, increasing on average 1.17% since 1975.

This growth rate is the result of new variety development, biological pest control introduction, improved management, and greater soil selectively. These efforts were initiated by the Sao Paulo state government's the Instituto Agronômico de Campinas (IAC) and Instituto Biológico. By 1970, Copersucar, a private cooperative of sugar and cane producers, created a Center for Technological Research. This research center was instrumental in the expansion of sugarcane production and the industrial development of the sector. In 1971 the federal government created the Programa Nacional de Melhoramento da Cana-de-Açúcar (Planalsucar) with a particular focus on the development of new sugarcane varieties. Planalsucar was created to reduce the technology growth rate difference between industry and production within the Brazilian cane sector (Figure 4). With industry developing faster, an agricultural production lag could eventually result in bottlenecks for sugar and ethanol producers. In the 1990s though, the Brazilian government decided to close Planalsucar, as part of its adjustment plan to reduce the size and role of government.

Copersucar (now the Center for Sugarcane Technology (Centro de Tecnologia Canavieira)) invested about 1% of its total revenue back into research related to sugarcane and its final products through the 1980s

and 1990s. The State of Sao Paulo made substantial investments in basic research and molecular genetics (ONSA - SUCEST genome project) and a US$8 million investment in a sugarcane breeding improvement project (FAPESP – Fundação de Amparo a Pesquisa do Estado de São Paulo). Work with transgenic sugarcane is also being conducted, but the legislation necessary for greater commercialization has not been evolving at the same pace as the research.

Government's Current Role

The government's current role is not only much smaller, but quite different as well. Most of the government's efforts today are to ensure that the transformation to a market-driven sector proceeds smoothly and to help improve the industry's environmental performance.

Some minor traditional interventionist policies remain. For example, cane producers in the North-Northeastern (NNE) states are still paid a subsidy (R$5.7 or 19%) to offset their higher cost of production. This transfer is maintained to equalize costs and slow migration to the Center-South (CS) states.

Government indirectly affects cane, sugar, and ethanol prices received by producers through excise taxes. The ICMS (Imposto sobre Circulação de Mercadorias e Serviços) tax is an interstate tax that varies by state and serves to generate state revenue. ICMS taxes are levied when production and utilization occur in different states. Excise tax differences cause illegal tax avoidance as sales are "booked" to a low tax state (e.g., Minas Gerais), but actually sold in a higher tax state (Sao Paulo). As a result, states have an incentive to homogenize their excise tax rates to keep sales "in-state."

The IPI (Imposto sobre Produtos Industrializados) is a federal excise tax applied to industrialized products. It is currently set at 5% of sugar prices received by producers and has not been considered a factor that causes resource reallocation between regions or states.

Two new market-oriented institutions are CIMA (Conselho Interministerial do Açúcar e do Álcool) established in August 1997 and ANP (Agência Nacional do Petróleo) established in August 1997. CIMA involves representatives from ten federal government secretaries who monitor and evaluate the deregulation process as the sector moves to a free market. ANP serves as overseer of the new oil derivatives market.

The most active area for the government has to do with regulating the industry's environmental impact and helping the industry develop energy co-products from waste material (bagasse). Activities that are controlled include: sugarcane field burning; bagasse (post-processing residual material) management; soil quality; herbicides and insecticides storage and usage; liquid waste application for fertilizer, forest preservation, surface and ground water quality, ethanol storage; water usage; sugarcane transport (weight and volume); and noise pollution.

One of the most harmful environmental effects from sugarcane production is the burning of fields to facilitate manual harvesting. Burning is conducted prior to harvesting to eliminate pests and remove weeds. This makes movement through the field safer and easier, but produces significant quantities of greenhouse gases, ash, and other airborne particulates. Absolute elimination of burning has proven difficult so a schedule was established to gradually reduce the burning over the next 20 years in Sao Paulo, the largest production region. In 2000, additional steps were taken to eliminate burning and shift practices over to mechanized harvesting (Law no. 10.547, March 5, 2000). The new law specifically established where burning was prohibited and mechanization in turn would be used; about 55% of production. It also established rules where burning would be allowed; 45% of production. Burning is still permitted where the ground is sloped 12% or more, making mechanized harvesting impossible; or where small landholders were involved and had no other means of harvesting.

Two controversial outcomes of these environmental policies are the immediate unemployment of over 100,000 of the nation's 1.2 million seasonal sugarcane workers and the creation of incentives for producers to relocate their farms to avoid regulation. The loss of jobs is important because the sugarcane workers are some of the most at-risk elements of rural Brazil. Politically it is difficult for Brazil's president, Luiz Inacio Lula da Silva, who came to office as a very strong advocate for the country's disenfranchised workers.

The sugarcane harvest area in Brazil is around 5.2 million hectares (UNICA, 2006) and employs 1.2 million workers (Parra, 2005). With the new burning law, approximately 2.9 million hectares (55% of total cane acreage) will be mechanically harvested. Each combine harvests around 1,300 hectares per year and replaces 60 seasonal workers. This means that the 2,231 combines will displace about 134,000 workers, or 11% of the sector's labor force.

Production migration too is of great concern because land is plentiful in Brazil and regulatory oversight is weak. So, environmental regulation may be having the perverse effect of

increasing pollution in the short run as production expands in new regions where environmental regulations are weak and monitoring is difficult.

The Brazilian energy sector is undergoing a restructuring process due to deregulation that has evolved since the beginning of the 1990s. One important implication for the sugarcane sector came about in September 1996, when Decree no. 2003 allowed independent producers to commercialize co-generated electric energy.

In the Brazilian sugarcane sector, the energy generated by bagasse burning is used for cane processing. However, many sugar mills, particularly in Sao Paulo, have the capacity to produce energy above their own needs that can be sold in the market. An analysis presented by the Secretaria de Energia of Sao Paulo suggests that approximately 28% of the sugarcane weight in the form of bagasse can be transformed into ethanol (Souza and Burnquist, 2000; Queiroz, and Ribeiro, 2002). The processing of one ton of sugarcane produces about 260kg of bagasse, with 13% dry fiber and 50% average moisture. About 5kg of steam is obtained from each kg of burned fiber. The current price paid for energy obtained from this source is low relative to the cost of new construction.

The current installed capacity to produce co-generated energy by the sugarcane sector in the Brazilian Southeast is estimated at 619MW with another 205MW of expansion capacity. This would be enough power to provide electricity to 700,000, or 2% of the State's residential needs. The overall energy generation by the sugarcane sector represents a total of 995MW, which corresponds to only 1.32% of the overall installed energy capacity in the country. An important advantage for the energy supplied by the sugarcane sector is that its seasonal production matches the countries' needs. During the "dry" months (June - August) sugarcane production and processing is at its peak when water reservoirs are at their lowest levels and the nation's hydro-electric system is least efficient. There is the potential using existing technology to produce 4.02GW if value added taxes (ICMS) could be reduced and electricity prices were allowed to approach market levels (Eletrobras, 2004).

Conclusion

The opening quotation by Brazil's agricultural minister, Mr. Rodrigues, captures the enthusiasm and commitment to bioenergy. Investment and expansion will continue as supply tries to catch up with demand. Brazil's leading airplane manufacturer, Embraer is reported to be exploring the use of ethanol as a substitute for jet fuel. Brazil's global strategy is focused on building basic demand in Asia and Europe. Enticing customers in Asia to switch to ethanol would give significant credibility to the fuel. It would help entice other large sugar producers, both within and outside of Brazil, to shift their mills over to ethanol processing. Also of importance are potential new opportunities for low-latitude underdeveloped countries to expand exports.

For More Information

Eletrobras, Centrais Elétricas SA. (2004). *Relatório Annual, 2004.* Available online: http://www.eletrobras.gov.br/.

International Energy Agency. *World Energy Outlook 2005*.

Parra, J.R.P. (2005). *O papel da ciência e tecnologia na evolução da cultura da cana no Brasil.* Seminário Etanol Combustível: Balanço e Perspectiva, November 16 and 17. UNICAMP, Campinas, Available online: http://www.nipeunicamp.org.br/proalcool/evento.htm.

Queiroz, E.M., & Ribeiro, D.M. (2002). *Evolução do cenário enegético Brasileiro.* SETAP, Sustainable Energy Technology Assistance Program.

Rodrigues, R. (2006). Brazil's sweet eevolution. Dateline, written by G. Stein. Available online: http://news.sbs.com.au/dateline (Accessed March 26, 2006).

Souza, Z.J., & Burnquist, H.L. (2000). A comercialização da energia elétrica co-gerada pelo setor sucroalcooleiro. Sao Paulo, SP, Editora Pleiade.

UNICA, União da Agroindústria Canavieira de São Paulo. *Estatísticas.* Available online: http://www.unica.com.br, 2006.

Wang. M., Saricks, C., & Santini, D. (January 1999). Effects of fuel ethanol se on fuel-cycle energy and greenhouse gas emissions. Argonne National Laboratory. ANL/ESD-38, pp. 39. Available online: http://www.transportation.anl.gov/pdfs/TA/58.pdf.

A complete set of references is available from the authors upon request.

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The Brazilian Soybean Complex

Peter Goldsmith and Rodolfo Hirsch

JEL Classification: Q13, O54, Q56, 013

Introduction

The rise of the Brazilian soybean complex simultaneously tells two important stories. The first story is the classic rise of an industry due to natural resource abundance (the Cerrado) and strategic investments in agricultural technology (low-latitude soybeans). Brazil is now the second leading producer of the fastest growing broad-acre crop in the world, has unparalleled arable land reserves, and has the technology to efficiently employ those reserves.

The second story is about the different challenges facing developing countries in the post-modern world. Norms and standards for land use are not the same as when the United States, Canada, and Europe were being settled. Technology and scale economies have redefined a "family farm on the frontier." Environmental and social stakeholders are now actively involved in land use and policy decisions affecting agriculture. And, the Media now plays an important institutional role in development settings communicating the activities of firms and governments to the public.

Whereas agricultural productivity and growth historically were the central objective for economic advancement, policy makers and industry leaders are increasingly cognizant of new and important environmental and social expectations. This heightened social consciousness and very effective communications environment require Brazil's agriculture to develop very differently than its forbearers in North America and Europe.

To explore these themes, this article presents the soybean complex from three perspectives: as an agro-industrial complex; as an ecosystem; and as the nexus between infrastructure, institutions, and development.

Background

The story of the Brazilian soybean industry begins within the broader context of the rise of soybeans as a key protein source for livestock and a key oil source for the food industry. Few soybeans were grown world-wide before WWII. The original genetics come from China and were adapted to the United States as a feedstuff for a fast industrializing poultry industry. For example, in 1960 world soybean production was only 12% of today's production and the United States represented 70% of that total (Figure 1). The success of soybeans in the United States, combined with the rise of the poultry sector in the Southern U.S., created research interest in Brazil for developing a soybean that could be grown at lower latitudes. Researchers quickly developed varieties adapted to the longer growing season and warmer climates by focusing on the role of the night-time photo-period in soybeans' growth and development.

These new varieties became the opening for the Brazilians. Researchers took the low-latitude technology and developed germplasm that could be deployed in the Southern three states of Brazil, Rio Grande do Sul, Santa Catarina, and Parana, a growing climate similar to the Southern U.S. (Schnepf, Dohlman, & Bolling, 2001). Brazil's soybean industry began in the South of the country in the late 1960s, supporting both soybean processing and poultry production.

By the 1980s, the federal agricultural research institute (Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA)) had advanced the photo period line of research even further. EMBRAPA successfully adapted soybeans to grow in the tropics at even lower latitudes. Developing this technology opened up the West and North regions of the country that lies between 15 degrees south latitude and 5 degrees north latitude to soybean production. Of greatest potential was the Cerrado region encompassing over 200 million hectares[1] of low brush-like forest that was easy to clear and had predictable rainfall . The development of the lowest-latitude varieties begins

the real story of the Brazilian soybean complex.

Compared to the Southern region of Brazil, Cerrado farming could take advantage of huge economies of scale. U.S. agricultural development and land privatization began before the age of mechanization. The U.S. Midwest was settled using the concept of a section, where 80 acres was sufficient to support a homesteading family. Brazil's Cerrado region has none of that social, political, or normative legacy as to what is an appropriate unit of production. The rapid expansion of soybean production in the 1980s arose because of the availability of large tracts of arable land, soybean technology that produced yields equal to the United States, mechanization that allowed operational efficiency and the lowest operating costs per hectare in the world (Figure 2). Cerrado farming also has great challenges. The infrastructure is underdeveloped, markets are distant, soils are relatively poor, and environmental concerns exist.

The Soybean Complex as an Agro-industrial Complex

Latin America has wrestled for many years with effective policies to create growth and economic prosperity. Initial attempts by Brazil in the 1970s and 1980s employed policies of import substitution and government market intervention to foment agricultural development. As a result of government incentives, there was significant investment in soybean processing. Then in the 1990s the pendulum of government policy shifted to market-based tools, aggressive

1. *This is equal to the combined land areas of the 12 Midwestern states stretching from Ohio to North Dakota.*

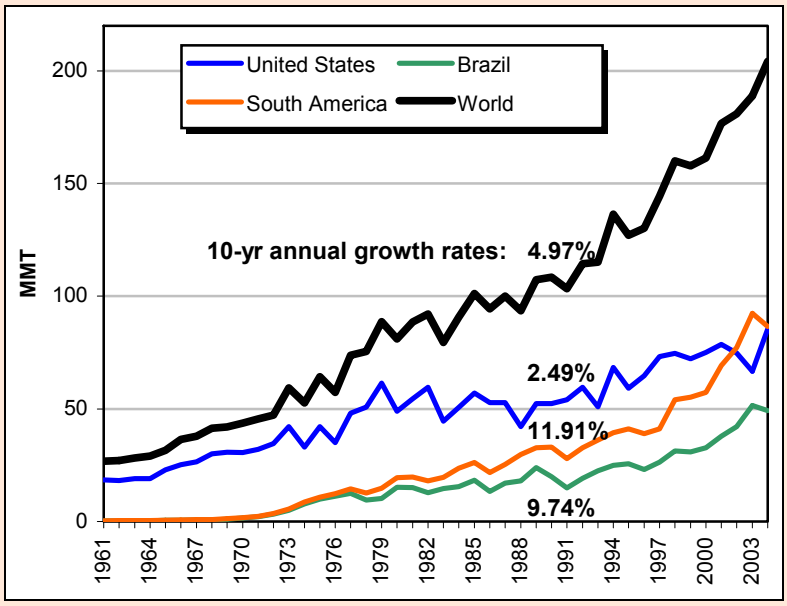

Figure 1. World soybean production.
Source: FAO and Authors' calculations.

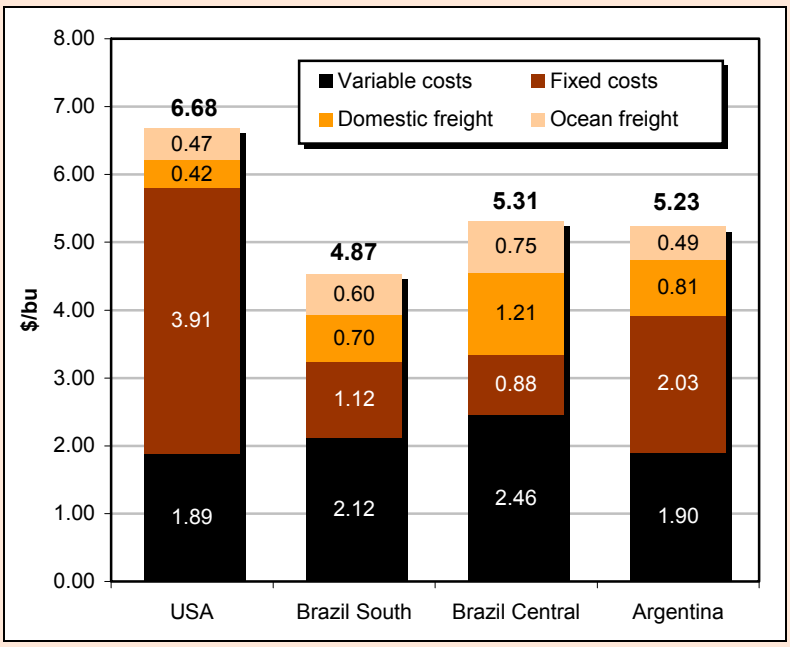

Figure 2. Average cost[a] of soybean production.

[a] Average across six studies that looked at one or more aspects of the cost of soybean production in Brazil, Argentina and the United States.

[b] OF = ocean freight; DF= domestic freight; FC= fixed costs; VC=variable costs.

Sources: Farm Business Farm Management Cost of Production for Illinois Soybean Farmers. http://fbfm.ace.uiuc.edu/. 2000.

Mcvey, M.J., and C.P. Baumol, and R.N. Weisner. "US Upgrade Unlikely to reduce Competition from Brazil." Feedstuffs. V.72, N.40, Sept.2000.

Schepf, R.D., E. Dohlman, and C. Bolling. "Agriculture in Brazil and Argentina, WRS-01-3." Economic Research Service, USDA. 2001: pp.77.

Parana. State government report of the cost of production fronm no-tillage soybeans. http://www.pr.gov.br/seab/. 2001.

Hirsch, 2002. "Costs of Soybean Production in Mato Grosso: A Survey of 11 Farmers." Undergraduate thesis. University of Sao Paulo. 2002.

Pessoa, A. and M. Jank. "Grain Markets: A South-American Perspective." Grains and Oilseed Outlook Forum. USDA. Arlington, VA. February 21-22, 2002.

inflation fighting, and export development (Schnepf, Dohlman, & Bolling, 2001). Brazil was no longer a preferred location in which to process soybeans. Soybean processing capital was now better placed in Asia and Argentina (Goldsmith et al., 2004). While Brazil has a tremendous capacity to produce some of the least expensive soybeans in the world, it still lacks the transportation infrastructure and domestic industrial cluster to make inland processors globally competitive.

Brazil is second only to the United States in producing soybeans, and Brazilian production is growing twice the global rate. Brazil is the third leading soybean processor[2] behind the United States and China, with a 7% annual growth rate from1992-2002. Though, over that same period, other major countries were increasing crush capacity at much faster rates: China 41% per year; Argentina 15%; and India 14%. Brazil's story as a leader in soybean production has been more as an exporter of soybeans, not an exporter of processed products (i.e., Argentina, or a domestic user, like the United States). Since the 1980s, there has been a steady reduction in the ratio of soybean meal: soybean exports. For example, in the last 15 years the ratio has fallen from 4:1 to 1:1.

Expansion of soybean production to the West Central and North regions pushed the grain supply far from traditional crushing and consumption regions and the well-developed transportation infrastructure of the East. Crushers were challenged to invest in the center of the continent far from livestock and export markets.

Brazil has a crush capacity of 113,000 tons per day (2002) (Goldsmith et al., 2004), second only to the United States. Fifty-five different companies own facilities and the largest five firms produce 45% of the nation's output. The biggest processors are Bunge (18%), Cargill (11%), ADM (7%), and Coinbra (a Brazilian subsidiary of Louis Dreyfus) (6%). Cooperatives own 9% of the crushing capacity and 4% of the soybean oil refining capacity, and are responsible for 29.4% of the Brazilian soybean trade.

Brazil's industry, due to the legacy of government intervention in the 1970s-1980s, is comprised of much smaller processing plants, than the United States or Argentina. Argentina has the largest plant[3] in the world and the capacity to process 12,000 tons of soybeans per day, while the largest plant in Brazil can process only 3,800 tons per day (Hinrichsen, 2000; Oleofar, 2002; Soya & Oilseed Bluebook, 2003).

Most of the national soybean crush (51.62%) is still located in the Southern region out of position as southern agriculture switches away from soybeans and the West Central and North regions rapidly expands (IBGE.a, 2003; Olefar, 2002). Mato Grosso, the largest soybean producing state in Brazil produced 13.4 mmt in 2003 but only had crushing capacity to process 38% of the crop. Alternatively, the southern state of Parana is 16% over capacity (Oleofar, 2002; IBGEa, 2003).

The strategic implication for crushers is that current crushing infrastructure is old, small, and out of position. Making inland investments close to production is difficult because the agro-industrial cluster, especially in livestock and meat production, is small and transportation infrastructure is poor. As a result, there are relatively few marketing opportunities for processors and the cost of transport to markets is high.

Soybeans are an intermediary (industrial) input and have numerous food, feed, industrial, energy, and textile uses. They are also easy to transport, store, and process. Their widespread use and favorable logistics characteristics make soybeans very conducive to trade. As a result, the geographic location and the associated economic impact of the industrial cluster into which raw soybeans flow may be distant. For example, China has shifted its policies towards raw soybean importation rather than domestic production.[4] It now imports 125% of domestic production and absorbs 38% of world exports.

This issue of the location of the industrial cluster and geography is important in the case of Brazil's soybean complex. Of importance for continued development is how to create and capture greater value through the production and exportation of higher valued goods and services rather than simply exporting raw soybeans. Most government policy interventions affecting the soybean complex over the last 30 years has targeted specific industries (Schnepf, Dohlman, & Bolling,

2. *Soybeans cannot be fed directly to livestock. They need to be processed ("crushed") in an industrial facility using heat, mechanical pressure, and chemical extraction. The output is a high protein meal for livestock and oil used in food manufacturing.*

3. *By 2005 the figure was closer to 16,000 mt/d.*

4. *Interesting because soybeans originated in China.*

2001). Differential taxes were often the tool of choice and resource extraction the result. These short-term and narrowly focused policies resulted in significant levels of uncertainty and arbitrariness. In turn, development of the agro-industrial complex in the interior part of the country was negatively affected.

The state of Mato Grosso, in the West Central of Brazil produces a similar quantity of soybeans as the U.S. state of Illinois. The Illinois soybean cluster[5] though has a value eight times the value of its soybean crop, while the Mato Grosso cluster is significantly smaller, producing .78 the value.

While such comparisons, especially within a regional context are imprecise, the inference is important. The 1995 IFPRI study on the *Future of Latin American Agriculture* stated that the most important need for Latin America to reduce poverty was for the expansion of, and improvement in, resource utilization. The tremendous growth in Brazil's soybean harvest would be consistent with such goals. But, an additional need as Latin America attempts to alleviate poverty is not simply harvesting and exporting raw agricultural goods, but developing an agro-industrial sector that produces higher-valued export goods and services, and offers better domestic employment opportunities. For example, a comparison of trade between China and Brazil reveals how Brazil is essentially a raw commodity supplier (soybeans and ore),

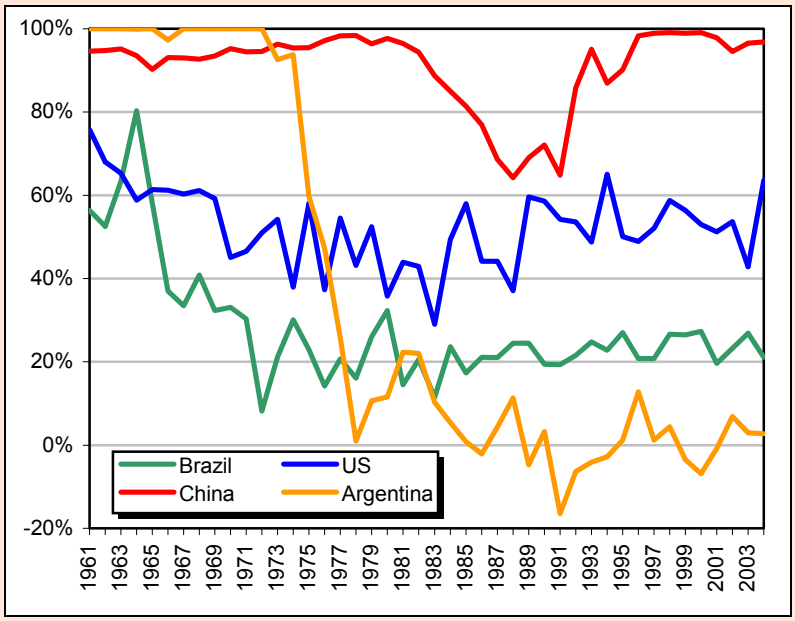

Figure 3. Soybean domestic use levels.
Source: FAO and authors' calculations.

and a higher-valued processed and manufacturer goods importer (*Economist,* 2005).

One of the best examples of distortionary policy is the case of the Kandir Law (1996) and the ICMS tax. ICMS is a state-run, value-added tax that is incurred when production and utilization occur in different states. Resource flows occur at the state, not the national, level. As a result, interstate commerce and exports of value-added goods like soybean meal are discouraged, technology adoption is slowed, and the operating size of firms is reduced. The ICMS tax is one of the most effective tools for state governments to generate revenue, and thus is difficult to reign in (Schnepf, Dohlman, & Bolling, 2001). The Kandir Law attempts to mitigate some of the distortionary effects of the ICMS tax. It focuses on the national interests of export expansion and foreign exchange inflows. The Kandir Law exempts exports of raw and semi-elaborated products, electric energy, and goods of capital assets from the ICMS tax (interstate trade tax). In effect, the law eliminated the difference in the export ICMS tax between the different products in the soybean complex. Before the law, the export ICMS taxes were 13% on soybeans, 8% on soybean oil and 11.1% on soybean meal. The differential favored domestic crushing and resulted in an over-investment in Brazilian crushing capacity (Haffers, 2003). Soybean exports represent about 40% of production after (1996) the law's enactment versus around 18% before its enactment. The Kandir Law was also responsible for increasing the idle capacity of the soybean crushing sector, as firms shifted from exporting soybean meal and oil to exporting raw soybeans.

Brazil's soybean domestic level has remained around 25% since the mid 1980s, with about half of the exports being in the form of raw soybeans (Figure 3). Argentina has an even lower domestic use rate of around 3%, but 80% of Argentina's exports are in the form of higher-valued soybean meal, rather than raw

5. *This is the ratio of direct, induced and indirect output of soy-consuming livestock production and soybean, meat, and dairy processing to the output from soybean production. The data are from 1999.*

soybeans. Argentina is a leading soybean meal exporter because most of the country's immense soybean production region lies within 300 kilometers of a deep water port. This helps make Argentina one of the lowest cost soybean meal processors in the world.

The Soybean Complex as an Ecosystem

There are 91.4 million hectares planted to soybeans in the world. Soybeans now occupy 6% of the world's arable land and are the fastest growing major agricultural crop. Land used for soybeans is increasing at a rate of 5.36% per year over the last five years, more than three times world GDP growth per capita during the same period. The demand for soybeans is essentially a derived demand for meat. Meat consumption is already very high in developed countries and is growing rapidly in developing countries, especially Asia and South America, as incomes increase. Feeders and manufacturers are switching to soybeans as their protein and oil source of choice because of its wide availability across the globe, high value:cost ratio, and its versatility as an input.

Of the 19.3k square kilometers of new soybean land every year, 75% are in two countries, Brazil and Argentina. They are expanding their soybean lands 8.4k and 6.1k square kilometers per year, respectively. Argentina's expansion mostly involves switching among crops. Land used for agricultural purposes has only increased at a rate of 790 sq kilometers per year since 1990. Brazil though has brought 14k sq kilometers a year of new agricultural land into production.

In 2003, Brazil produced soybeans on 18.4 million hectares. Soybeans are grown annually, double cropped with a grain such as corn, sorghum, or milo, or even triple cropped with a green cover crop. Estimates are imprecise, but the potential land available for future field crop expansion in Brazil is between 57 million and 170 million hectares (GEIPOT, 1999; Hirsch, 2004). There are over 160 million hectares of native and planted pasture both inside and outside the Cerrado region that services the world's largest beef herd, and which can be switched over to crop production easily (IBGE.b). As a result, soybean production in Brazil is forecasted to stabilize at almost double the 2003 levels (Hirsch, 2004). Using the most conservative estimate and current yield trends, Brazilian production should level out at 90MMT; adding 20% to the world's 2003 supply. Asian Rust, a devastating fungal disease, has slowed expansion in the low latitude regions in recent years. Resistant varieties are due on the market in 2008 (Calvo, 2005).

The rapid expansion of the soybean production region in response to the world's demand for food and energy is causing dramatic shifts in land use in Brazil as native savannahs, dryland forests, and even certain rain forest sub-regions became potential areas for soybean cultivation. The governance over the land essentially changes from public to private. Correspondingly, the goals and objectives for the land change too.

The interests and practices of agriculture may not always be consistent with broader societal goals. Tillage practices, chemical use, and the management of set-aside lands are important not only for farmer profitability, but for the numerous stakeholders actively involved in the debate over development of Brazil's interior. For example Asian Soybean Rust has meant the spraying of millions of hectares with fungicides on lands that may have never had previously known fungicides.[6]

One policy response is that the law requires that farmers preserve 80% of the land in its native vegetation, while cultivating 20% in the Legal Amazon region. The percentage allowable for cultivation increases as one moves away from the most environmentally sensitive and higher rainfall areas. While the law is fairly explicit, weakly specified property rights, limited government budgets for enforcement, and strategic private land selling practices make enforcement of such laws difficult. Local government is also conflicted because they desire greater economic growth in the region, want to help meet the world's increasing need for foodstuffs, and want to expand social programs.

The Soybean Complex: A Force for Infrastructure Development

Traditionally, the transportation issue has not been strategic to the industry, as soybean production was concentrated in Southern Brazil, near the ports and consumption regions. It was also not as a critical an environmental issue because transportation was consistent with historical population centers of the country. As a result, 74% of the soybeans still travel by road, 23% are transported by railways, and 3% by waterways. As a comparison, waterways carry 61% of U.S. soybeans, and roadways transport only 16%. The roadways though, which serve to link the new soybean production regions, are two-lane roads in very poor condition that cover great distances. This gives

6. *In 2003, 14.8 million hectares (148 thousand square kilometers) received two fungicide treatments (Yorinori, 2003).*

interior Brazil producers significantly higher domestic freight costs than either Argentina or the United States.

Recently the Ferronorte railway was constructed linking Southeast Mato Grosso state to Santos port. The Carajas railway links the interior with the Northeast port of Sao Luis and the Madeira waterway brings soybeans by barge from the western river terminal of Porto Velho (Roraima state) to the deep water port of Itacoatiara in Amazonas State. These changes have significantly improved the competitiveness of the new production regions (Schnepf, Dohlman, & Bolling, 2001; Hirsch, 2004). Inland port soybean price differentials have fallen 13% per year as transportation has improved, supply has become more regular, and transactions have formalized.

The West Central region also holds opportunities for extending the Santos rail to the North and West, and increasing barge transport utilizing the Araguaia, Tocantins, Teles Pires, and Tapajos rivers. Simulation results showed only moderate improvement in the efficiency of the soybean complex from such infrastructure improvements (Hirsch, 2004). One effect that limited significant changes in the system's overall competitiveness is the increased competition that would result among the various alternative routes.

Brazil plans future transportation corridors as part of a Brazilian Government project called *Avanca Brasil*. Transportation access in the North is strategically important to serving markets in Asia and Europe because of cost advantages due to shorter distances. As a result China has expressed significant interest in helping to finance improvements in infrastructure in the North and West (*Economist,* 2005). These projects include the paving of a major Federal south-north highway that links Mato Grosso with the city of Santarem at the mouth of the Amazon. There has been significant livestock and meat processing investment (Carrolls, Perdigao, and Sadia), as well as soybean crushing investment (Bunge, ADM, and Cargill) along the corridor because of the corridor's potential for exports.

The implementation of the Araguaia-Tocantins waterway and the BR-163 pass through remote regions of the country that are of both environmental and cultural interest. As a result, both projects have met significant opposition from governmental and non-governmental interests outside of the agriculture community. Stakeholders are concerned not only that infrastructure will accelerate resource extraction and change the sensitive ecosystems forever, but that the infrastructure development would be premature given Brazil's fragile institutional environment. The region affected is enormous, and enforcing regulations and ensuring due process would take significant resources. Thus, land degradation may be accelerated if infrastructure were improved without a commensurate ability to curtail illegal activities.

Conclusion

As one stands on the main north-south Federal highway in Mato Grosso, the most impressive feature is the constant drone of the trucks... hundreds of trucks moving up and down the route day after day. No matter the rain, the choking dust, unstable bridges, negative exchange rate moves, or soybean price weakening, the trucks keep rolling, just like they have for the last twenty years. The market forces at work that keep the trucks moving are able to surmount any of the challenges offered by contrarian government policies, new environmental awareness, or institutional reform efforts.

There are broad economic, social, and environmental implications specifically for Brazil, in particular and modern agricultural development, in general. Economic growth and development continues to be vital for improving the standard of living in developing countries. The soybean industry is a very efficient supplier of protein and oil. The growing demand for soybeans is exciting and new uses for soybeans are expanding rapidly. At the same time, a new social and political reality exists that questions how the industry should develop. Developing countries are increasingly becoming the supplier of the world's food. Many parties, including the government and industry, are trying to find ways to improve agriculture's social and environmental stewardship.

The Brazilian soybean industry in Mato Grosso takes very seriously the challenge of balancing the need to help meet the world's ever increasing demand for food with enlightened ecosystem management (Hirimoto, 2005). The challenge for Mato Grosso, in particular, but agricultural development, in general, is how to achieve the correct balance that keeps their producers and processors profitable, keeps food and feedstuffs flowing, and provides effective social and environmental stewardship.

It is also important to think beyond simply the development of Brazil. Africa's food needs are great and Brazil has developed technologies that could be applied in the savannahs of Africa. Society will struggle balancing the need to produce more food to alleviate Africa's persistent food shortages with pre-

serving important lands in a natural state.

For More Information

Calvo, E. Executive Director. (2005). TMG, Inc. (Tropical Melhoramento e Genética). Personal Communication.

Economist. (August 2005). Brazil and China falling out of love. Available online: http://www.Economist.com.

GEIPOT (Empresa Brasileira de Planejamento de Transportes.) (1999). *Areas Potenciais para Soja e Analise do Sistema Viario para Escoamento desta Producao*. Grupo Interministerial, Agricultura Transportes. Brasilia, DF.

Goldsmith, P.D., Li, B., Fruin, J., & Hirsch, R. (2004). Global shifts in agro-industrial capital and the case of soybean crushing: Implications for managers and policy makers. *International Food and Agribusiness Management Review*, *7*(2), 87-115.

Haffers, L. (2003). O Pais Quer Ser Miss Simpatia (The Country wants to be more caring). Available online: http://www.terra.com.br/dinheironaweb/site/165/entrevista/.

Hinrichsen, J.J., S.A. (2000). *Annual Yearbook on Oilseeds Markets.* Buenos Aires, Argentina.

Hirimoto, D. (November 2005). The Mato Grosso Foundation: Vision for the Future. Executive Director, The Mato Grosso Foundation. Invited speech. University of Sao Paulo, Piracicaba.

Hirsch, R. (2004). Regional competitiveness analysis of the soybean industry and transportation infrastructure in Brazil. Masters Thesis. Department of Agricultural and Consumer Economics, University of Illinois.

Instituto Brasileiro de Geografia e Estatistica (IBGE.a). (2003). *Producao Agricola Municipal*. Available online: http://www.sidra.ibge.gov.br/.

Instituto Brasileiro de Geografia e Estatistica (IBGE.b). (2003). *Senso Demografico 1996*. Available online: http://www.sidra.ibge.gov.br/.

Oleofar, A. (2002). *Brazilian Crushers Plants' Location – Situation 2001.* map. Sao Paulo.

Schnepf, R.D., Dohlman, E., & Bolling, C. (2001). Agriculture in Brazil and Argentina, WRS-01-3. Washington, DC: Economic Research Service, USDA, p. 77.

Soya & Oilseed Bluebook. (2003). Available online: http://www.soyatech.com/bluebook/index.ldml.

Yonori, J. T. Brazil gearing up for a potentially record-breaking soybean season. Foreign Agricultural Service. November13, 2003.

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Modern Beef Production in Brazil and Argentina

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Perspectives in the demand for meat products look promising because of increasing incomes around the world and changes in consumer preferences favoring meat and dairy products. Within that context, Mercosur countries seem to be in a good position to take advantage of this favorable scenario.

Brazil is a leading player in the beef, poultry, and pork world markets. Focused attention has now been placed on dairy production as well, in order to improve productivity to attain self-sufficiency, or even become a net exporter.

Argentina too has been a leading player in the world beef market, but has been losing ground because of domestic policies that favored domestic consumption, and avoiding inflation, over exports. Argentina has historically been a very minor poultry producer and a net importer, but recently has been able to use favorable exchange rates to become a net exporter. Dairy continues to be an active industry with strong exports. The pork sector is neither efficient nor large, and remains a minor activity.

The goal of this paper is to present an analysis of two of South America's leading livestock economies, Brazil and Argentina. The analysis will focus on recent trends and future scenarios related to factor endowments, economic policies, and the behavior of the micro economy.

Trends

Meat consumers have benefited from the increasingly liberal trade environment and the globalization of meat markets (Figure 1). Within a more free trade environment, the most important variables that will shape the global meat complex in near term will be positive macroeconomic growth and market disruptions form disease outbreaks (USDA, 2005a,b,c). Macro growth will spur new investments that expand and modernize production, while consumer demand will provide new and growing markets for a variety of meat and dairy products. At the same time, red meat and poultry meat prices for major exporters will continued to be influenced by disease-related trade disruptions.

Livestock diseases such as Avian Influenza (AI) (Asia and Europe), foot and mouth disease (FMD) in Brazil and Argentina, and bovine spongiform encephalopathy (BSE) (Europe, North America, and Japan) continue to impact global trade and are cause for great concern. Nevertheless global meat consumption continues to climb spurring increased production and growth in exports (Figure 2).

Brazil and Argentina only accounted for 16% of the global beef trade in 2001, but are forecast to account for over 35% of that beef trade in 2006. Beef exports from 2001 to 2005 have increased 25% or 1,280,000 metric tons (Table 1). Brazil's exports have grown over 1 mmt, as a result of the fall in United States (US) exports due to the BSE problem.

In relative terms, Mercosur countries (Brazil, Argentina, Uruguay, and Paraguay) have also shown a noticeable increase in market share. In year 2001 these countries represented 19% of world exports, while in year 2005 the share reached 42% of the market.

Brazil

Brazil has expanded its national herd 24% since 1994, with consumption per capita rising 13% over the same period. The dramatic story though has been the expansion of exports, up over 450% in volume and 385% in value. Brazil is now the world's leading exporter. This dramatic change has occurred because of the continued availability of natural resources, a favorable exchange rate, and subsidized credit. The credit program is designed to promote

investment in genetics, pasture, machinery, and cold storage capacity.

Major factors that explain the improvement of the productivity of the cattle industry in Brazil were:

- Improvement in animal genetics mostly through the use of cross breeding programs in the Center-West region. The adoption rate by beef producers of artificial insemination is about 50% greater than the adoption rate by dairy farmers in Brazil. Cattlemen are using imported bull semen, such as Red Angus, Angus, Simmental, and Limousin, to cross with the domestic Nelore breed.
- Higher enrollment in the program MODERAGRO, which replaced the program PROPASTO. MODERAGRO includes funds for soil erosion and conservation of lands and is expected to reach approximately US$390 million at a subsidized interest rate of 8.5% per year. (Commercial rates are more than 14%.) Each producer may borrow up to US$50,000.
- The Agriculture and Livestock Plan expects to allocate US$19.2 billion of rural credit, of which US$5.1 billion is designated for the beef sector.
- The program MODERINFRA allows producers to build or rebuild silos and warehouses on their farms and can also be used to modernize irrigation. This fund is limited to US$43,000 per livestock producer.
- MODERFROTA is a program aimed at the modernization of farm machinery. US$2.4billion has been allocated to this program.

Also significant has been the aggressive marketing efforts of ABIEC (Brazilian Beef Processors and Exporters Association), an association of the largest beef processors, packers, and exporters. Since 2001, ABIEC initiated an aggressive promotion program approved by the National Export Promotion Agency (APEX) to promote the brand: Brazilian Beef. They emphasize the product as natural (grass-fed beef as opposed to grain-fed beef), environmental, and healthy. ABEIC has an agreement with APEX valued at US$1.6million for market promotion, 50% of which are APEX funds.

ABIEC targets markets worldwide, but their primary focus is the

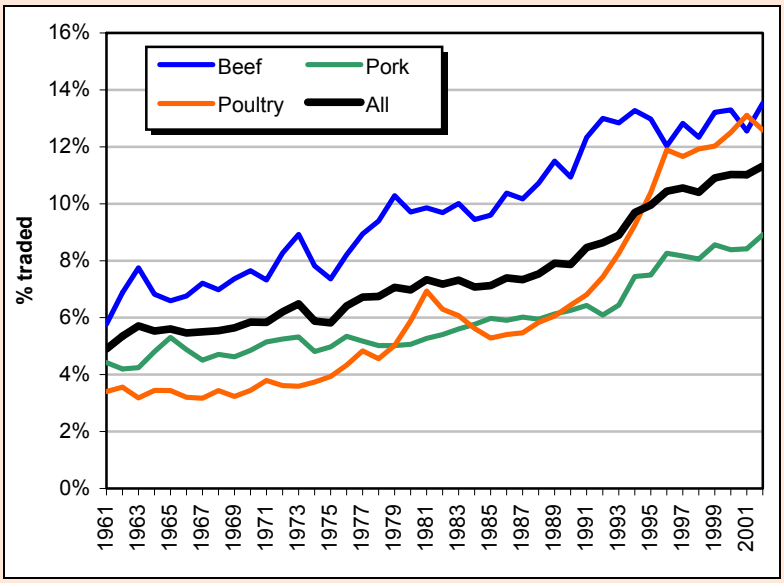

Figure 1. Evolution of global trade of key meat commodities.
Source: Goldsmith, P.D., and Cordier, J. (2006). Managing non-linear risk: Is distance an advantage or a liability? Presented at the workshop Multi-functionality: Implication for Market, Trade, and Environment. University of Illinois at Urbana-Champaign, March 1-3.

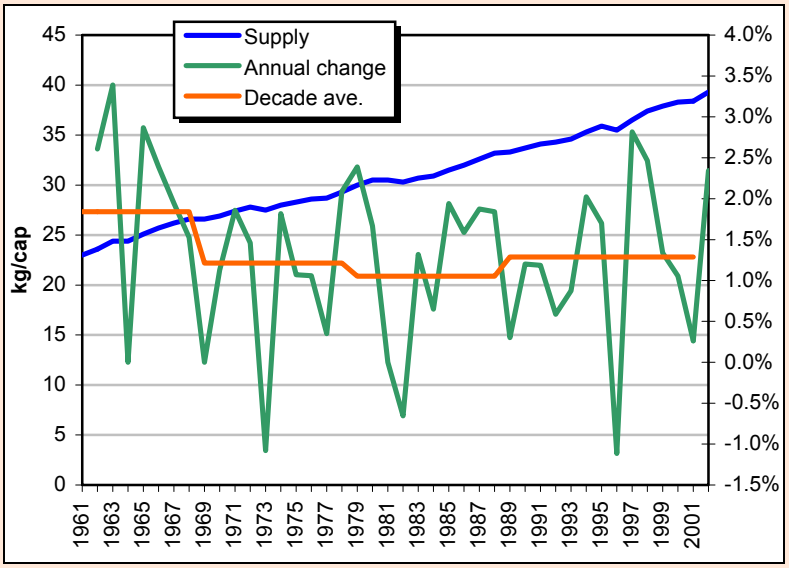

Figure 2. Global meat supply.
Source : FAS/USDA Livestock and Poultry: World Markets and Trade.

Table 1. Beef exports of selected countries.

	2001	2002	2003	2004	2005(p)	2006(f)
Brazil	748	881	1,175	1,628	1,800	1,800
Argentina	169	348	386	623	680	720
Australia	1,399	1,366	1,264	1,394	1,470	1,480
India	370	417	439	499	620	675
Canada	575	610	384	559	615	640
New Zealand	496	486	558	606	575	615
Uruguay	145	262	325	410	460	470
European Union	502	485	388	358	250	220
China	60	44	43	61	75	90
Ukraine	98	181	202	108	85	90
United States	1,029	1,110	1,142	209	285	290
Other	81	85	34	43	37	48
Total	5,672	6,275	6,340	6,498	6,952	7,138

Source : FAS/USDA Livestock and Poultry: World Markets and Trade (2001-2004), Annual Issues.

European Union (60% of Brazilian exports.) Other markets include the Middle East, Russia, Asia, Chile, and the United States.

For the last two decades, the cattle industry has moved towards the Center-West region. It is now home to over one-third of Brazil's herd. But recently, cattle production has begun to move North because of the expansion of soybean production, which has raised land prices in the Center-West. Raising cattle in the North is 10% more profitable than in other regions in Brazil because of lower land prices. Once timber is harvested, there is competition from other land uses such as crop production.

In 2006, production is forecast to reach 8.85 million metric tons (mmt) and surpasses the current record production of 8.7 million metric tons. The increase in production is pulled from the demand side due to continued expansion of the export market because of BSE outbreaks in North America; aggressive marketing efforts by Brazilian packers; competitive export prices due to favorable exchange rates; and an increase in domestic demand as incomes rise. The average slaughter age has fallen from 54 months to 38 months of age as a short-term response to brisk demand. If the herd is unable to expand, either due to competition with other crops such as sugar and soybeans and the associated higher land prices, there will be pressure on domestic inflation because of the inelasticity of beef demand.

There is still room for production and export growth. For example, the majority of Brazilian cattle are traditional breeds, with a fraction being improved cross-breeds. Despite improved genetics, Brazil produces predominantly lower-value, slower-growing, and less well-muscled grass-fed beef.

Brazil recognizes the need to not just increase quantity, but also quality of its beef products, especially in specialty and niche markets. While Brazil is the world leader in beef exports by quantity, Australia is the world's leader in beef exports by value. Australia is able to sell into some of the premium markets.

While Brazil has capitalized on the perceived minimize risk on BSE by leveraging its grass-fed production model, it is still vulnerable to supply shocks. The industry is still challenged by periodic outbreaks of foot and mouth disease. The most recent event occurred in October 2005 in the Paraguayan border State of Mato Grosso do Sul. Only with Brazil achieving FMD free status without vaccination will it be possible for exporters to access higher-value markets such as the United States.

Argentina

Argentinean beef production has showed a stable but sometimes erratic production pattern. There has been export volatility during the 1990s, the financial crisis of 2001, and an outbreak of FMD in 2003 and 2006. Exports in 2006 are expected to be up 325% over 2001 levels because of a competitive rate of exchange after the devaluation of the peso, the change in sanitary status after the World Organization for Animal Health identified Argentina as a country with an FMD zone without vaccination, and the increased demand in world markets. The early 2006 outbreak of FMD in the prov-

ince of Corrientes will dampen the demand somewhat.

There is no accurate stock number in Argentina, and most sources estimate the national herd to be between 50-55 million head. Recently, crop production was very profitable as a result of the devaluation, high world grain and oilseed prices, and the efficiency of producing and processing Roundup Ready® soybeans. Soybean production is up over 400% since 1996, while agricultural land has increased less than 1%. Though farmers shifted much pastureland to crop production, they did not reduce the size of their herds. Cattle production methods had to adjust. Feeder cattle production became more intensive by utilizing higher energy rations. However, cow-calf production became less intensive as brood cows were placed on lower quality pastures.

The slaughter in 2006 is projected to be somewhat lower than the previous year due to poorer herd efficiency. However, the average carcass weight is expected to increase as a result of a recent measure implemented by the Argentine Government prohibiting the slaughter of cattle weighing less than 300 kilos.

Beef consumption in Argentina is the highest in the world, though there has been a steady decrease from the record levels of the early 1990s (80 kg/cap) to current levels of 60 kg/cap. Much of the decrease has simply been due to the lack of buying power following the 2001 financial crisis.

Argentine beef exports in 2006 were forecast to reach 720,000 tons, one of the highest levels in history. An improved sanitary status, the opening of new markets, and strong foreign demand for beef are creating more opportunities for the local industry, which is very optimistic about the future.

Argentina will also take advantage of the decreases in production in the European Union (EU), which became a net importer of beef in 2003. EU beef consumption has rebounded from the BSE-induced decline. Total beef production in the EU though will continue to trend downward in 2006 to 7.8 mmt. Increases in the beef herd of New Member States (NMS) have not offset EU total decreases.

The decoupling of payments under the reform to the CAP (Common Agricultural Policy) reduced cow numbers (and, hence, beef production) and caused an increase in prices. Though the NMS are net beef exporters, dairy quotas under the accession agreement have forced the culling of dairy cattle and, as a result, raised the supply beef. However, any increase in beef production in the NMS will be short-lived as EU policies are likely to increase grain prices and, hence, production costs in the NMS.

The European Union is the largest market in terms of value for Argentine beef exports. Europeans are importing large volumes of out-of-quota beef and paying the very high duties on the high-value chilled cuts. The Russian Federation is the largest market in terms of volume. Their declining domestic supply, plus the European Union's lack of export surpluses has forced the Russians to look to South America for its beef. High world oil prices will generate income for the Russian Federation which will allow it to continue importing large volumes of beef.

All the factors together (competitive exchange rate, improved sanitary status, new markets open, growing world demand, and FMD outbreak in Brazil) mean a positive shift in export demand for Argentina. The question is how judiciously are farmers able to expand supply to take advantage of the current environment? Although Argentine exporters are close to full capacity, there is still room for further export expansion in the future. Investment in the sector, especially adding capacity, has not been significant over the last decade, even though there was an important flow of foreign investment in the Argentine food sector. However, exporters can still tap some unused capacity and shift some production from the local market to exports. Some companies have been buying idle processing plants and refitting them to serve export customers.

An important change in Argentina's cattle sector in the past couple of years has been the utilization of corn as feed. Before, alfalfa pastures were the most common source of feed. Many owners are now able to increase their herd sizes as cattle are placed on more marginal land and in smaller lots are being fed inexpensive and highly productive corn. Domestic corn prices were also below world prices because of export taxes that translated into lower prices at the farm level. As a result, the feed lot industry expanded significantly. Cattle feeders copied the vibrant domestic dairy industry and incorporated the use of corn silage and corn grain into cattle rations. This production technique was especially profitable to farmers and ranchers located far from the ports where freight costs per kilo were reduced and added value could be added to corn.

A second recent event in Argentina has been the use by the government of consumers' inelastic demand for beef as a means to control domestic inflation and maintain political stability. The Argentine government has stated that its goal is to provide

beef at reasonable prices. In 2005, the government implemented measures to discourage beef exports in order to increase domestic supply. In November 2005, the government suspended export tax rebates on 200 mostly food products.[1] Export rebates were designed to return to exporters 2.7% for beef cuts and 5% for thermo-processed products. The government raised export taxes on beef cuts from 5% to 15% (a 200% increase). This has dimmed the once favorable outlook for beef exports.

The Future

United States beef exports are going to recover from the BSE incidents and will add another important player to the global beef scene. Even though the US exports are oriented to Japan and Korea, and not direct competitors with Mercosur, the added supply will negatively impact prices. This is less of a concern to Argentina and Brazil beef producers because they have some of the lowest costs of production in the world. The real challenge will not come from greater price competition, but market access. Brazil and Argentina need to improve their quality control and traceability to comply with Europe's increasingly rigid standards. This will require relatively greater investment in the processing sector than for the farming sector. Delivering a fully traceable product though will be a challenge for all.

Up until now, Brazil has shown dramatic increases in production that have allowed the country to keep per capita consumption constant, while still increasing exports. Now the question is whether in the future it will be possible for Brazil to keep the same growth rates. While there is still plenty of room to increase the industry's productivity and quality, the industry is extremely heterogeneous, uncoordinated, and strategically not well defined (Zylbersztajn & Pinehro Machado). The future portends greater segmentation of meat demand towards more sophisticated quality attributes. Therefore, all players in the Brazilian beef chain will have to adapt and improve coordination in order to meet the changing needs of final demand.

There is a good opportunity at present, while prices are high, for organizational change in Brazil's beef and meat system. There is an opportunity to add value to the beef the country produces by moving from a low cost/low value-only industry to a more modern industry that competes at multiple levels. The industry needs to be able to exploit niche and high-value opportunities, while still being a reliable low cost commodity supplier.

An immediate challenge is the overvaluation of the Brazilian Real. Unfavorable exchange rates have directly reduced the competitiveness of Brazil's low value commodity exporters. Another important issue is the need to improve the coordination of private firms and government agencies regarding sanitary problems such as FMD. Foot and Mouth disease not only cuts off key markets, but causes deleterious fluctuations for those in the chain with fixed asset investments. Also, national and proprietary export promotion programs are challenged to counter the effects of FMD, while marketing the healthful aspects of Brazilian grass-fed beef. The implications with respect to FMD are the same for both Brazil and Argentina.

Longer term, the Brazilian beef industry faces serious challenges as well as it attempts to develop in the Center-West region. The agrarian reform movement calls for very different land use priorities in the Cerrado and drier regions of the Amazon compared to those of commercial agriculture. Top priorities include environmental preservation, land for the landless, and preservation of lands held by indigenous peoples. The impacts are greater competition for land, higher land prices, and increases in costs of production. The prevalence of large landowners in the Center-West and the high cost of land in the traditional eastern agricultural regions could generate conditions potentially conducive to social unrest (Matthey, Fabiosa, & Fuller). International organizations continue to apply pressure on the Brazilian government and corporations to limit deforestation in Brazil.

So, in Brazil there is a potential conflict that would prevent the continued expansion of larger, more commercial, operations. Brazil's subsidization of small farms may increase rather than decrease in the coming years. Such policies give priority to social objectives rather than efficiency objectives, and as a result could limit the rate of growth of the beef industry.

In Argentina, the future of the beef and meat sector will heavily depend on government policies. Policymakers are torn between serving domestic consumers that have the highest per capita meat consumption in the world and helping the industry to service growing world-wide demand.

In 2006, for example, the government banned beef exports, reducing forecasts for the year by 200,000 metric tons. This measure caused a decline of about 20% in the price of

1. *The measure was relaxed in May 2006 releasing large quantities of meat into the marketplace from cold storage.*

live cattle. Surprisingly, the drop in producer prices was not fully transferred to retail prices, thus limiting the government's efforts to fight inflation. The impact on the industry was immediate and very negative. More than 8,000 workers in the export processing plants were fired. Argentina's credibility as a reliable supplier was damaged as export contracts had to be broken. These events were taking place at the same time the Institute for Argentine Beef Promotion was attending fairs around the world promoting the Argentine brand.

The future direction of Argentina's role as a major beef exporter is uncertain because of Argentina's history of government intervention in the industry to serve policy objectives. In the short run, Argentina will not increase its global share of exports because the government's priority is to control inflation. Even though the government has allowed the industry to partially resume exports after the decline in live cattle prices, the Argentine image as a reliable supplier has been hurt.

The expansion of Mercosur beef exports would benefit from trade liberalization and elimination of farm domestic support policies around the globe. Support programs are creating artificially high beef production in regions like the EU. This causes the accumulation of meat stocks at target prices that are well above world prices and subsequent dumping, which drives prices down. This has been historically problematic in low purchasing power countries like Russia, which is both a customer for the EU's excess production as well as Mercosur beef.

The Common Agricultural policy in Europe and agricultural policies in Japan are designed in part to slow or prevent the continued decline in the number of farms in these countries. By retaining small family-owned farms, rural economies are strengthened and certain environmental goals are achieved in Europe. However, these policies have the indirect effect of hindering the expansion of the large-scale, low-cost farms typically found in Mercosur countries.

The next meeting of the Doha Round of the World Trade Organization is going to discuss those issues regarding the decrease of tariffs and other protectionist measures. But experience has shown that little progress has been achieved so far. So there is not much optimism in Mercosur countries regarding trade liberalization in world beef markets.

For More Information

Zylbersztajn, D., & Pinheiro Machado, C. (July 2001). *Competitiveness of meat agrifood chain in Brazil.* Invited paper, Conference on Globalization, Production, and Competitiveness of Livestock Products, Braunsweig, Germany, 19 pages.

Matthey, H., Fabiosa, J., & Fuller, F. (2004). *Brazil: The future of modern agriculture?* MATRIC (Midwest Agribusiness Trade Research and Information Center) Briefing paper, Ames, Iowa. 25 pages.

United States Department of Agriculture (USDA). (November 2005a). *Argentine government takes measures to discourage beef exports.* GAIN (Global Agriculture Information Network) Report, AR 5035, Washington, D.C.

United States Department of Agriculture (USDA). (August 2005b). *Argentina livestock and products.* GAIN (Global Agriculture Information Network) Report, AR 5027, Washington, D.C.

United States Department of Agriculture (USDA). (August 2005c). *Brazil livestock and products.* GAIN (Global Agriculture Information Network) Report, BR 5622, Washington, D.C.

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