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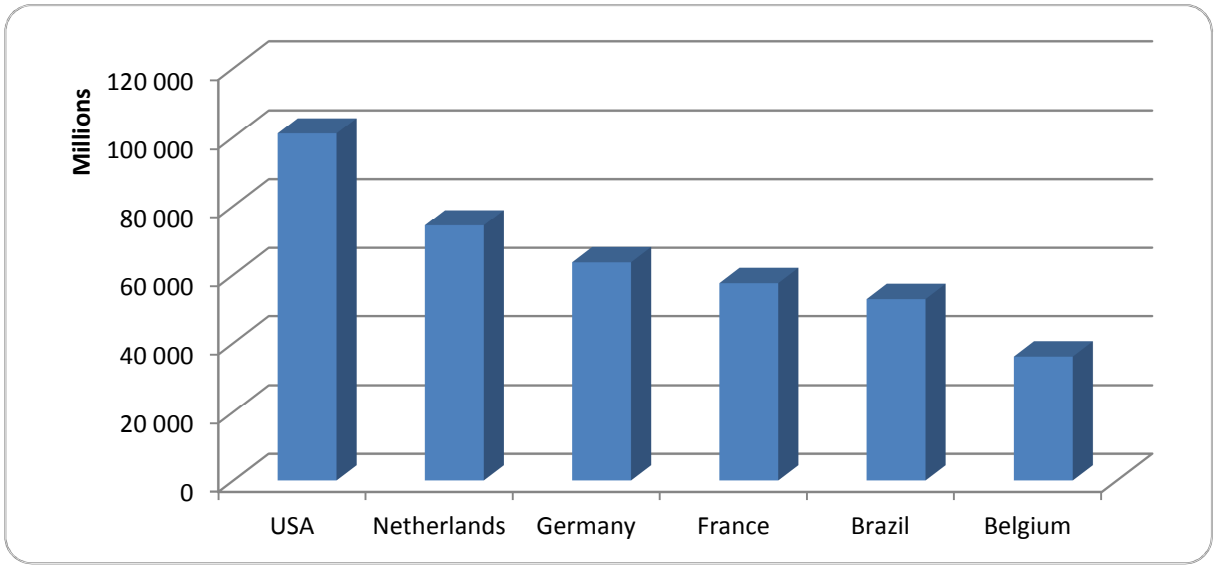
The rise and rise of Brazilian agriculture: what does it mean for South Africa?

by Ron Sandrey and Nick Vink

A feature of global agricultural trade in recent years has been the export performance of Brazil, and the objectives for this paper are to analyse Brazilian agriculture. In particular, we will examine the policies that have driven Brazil's agricultural performance, how this performance may impact upon South Africa in the future, and what lessons South Africa may learn from Brazil.

The most visible aspect of Brazilian agriculture in recent years has been its performance as an exporter, that ultimate test of international competitiveness (and especially so when this takes place in a non-subsidised environment, as we will show later). Figure 1 shows the top six global exporters during 2009, the most recent comparable data from the Food and Agricultural Organisation (FAO) database[1]. The top position is held by the United States (US), with Brazil in fifth place, and with the three European Union (EU) countries of the Netherlands, Germany and France in second, third and fourth place – although note that the EU data includes intra-EU exports.

Figure 1: Top global agricultural exporters, 2009, $ million



Source: FAO database

[1] The data uses the FAO definitions of agriculture that refers to food and agriculture products, excluding fishery and forestry products that includes only the food and agriculture products. This definition differs from the WTO definition that we use elsewhere in this paper.

To put this trade in perspective we display the FAO export value indexed at base prices[2]. Values on the left-hand side of Table 1 represent the indexed values of the exports over the 2009, 2000, 1990 and 1980 periods. The values on the right-hand side of the table show the changes in these values, with the first set showing the changes in 2009 over 1980, 1990 and 2000, while the second set on the right-hand side shows the changes in 2000 over firstly 1980 and then 1990. This gives a perspective on the relative changes, both over the entire period and between selected times. The top fifteen exporters for 2009 plus South Africa are shown. Of importance are the ratio values showing changes over the different periods, as only Indonesia has higher or equal ratios in every period. Performances from both Spain and China have been stellar, while, conversely, performance from the US, France, Canada, Italy, and Australia and, at the bottom of the table, South Africa, have all been modest.

Table 1: Indexed global agricultural exports, $ million and ratios between periods

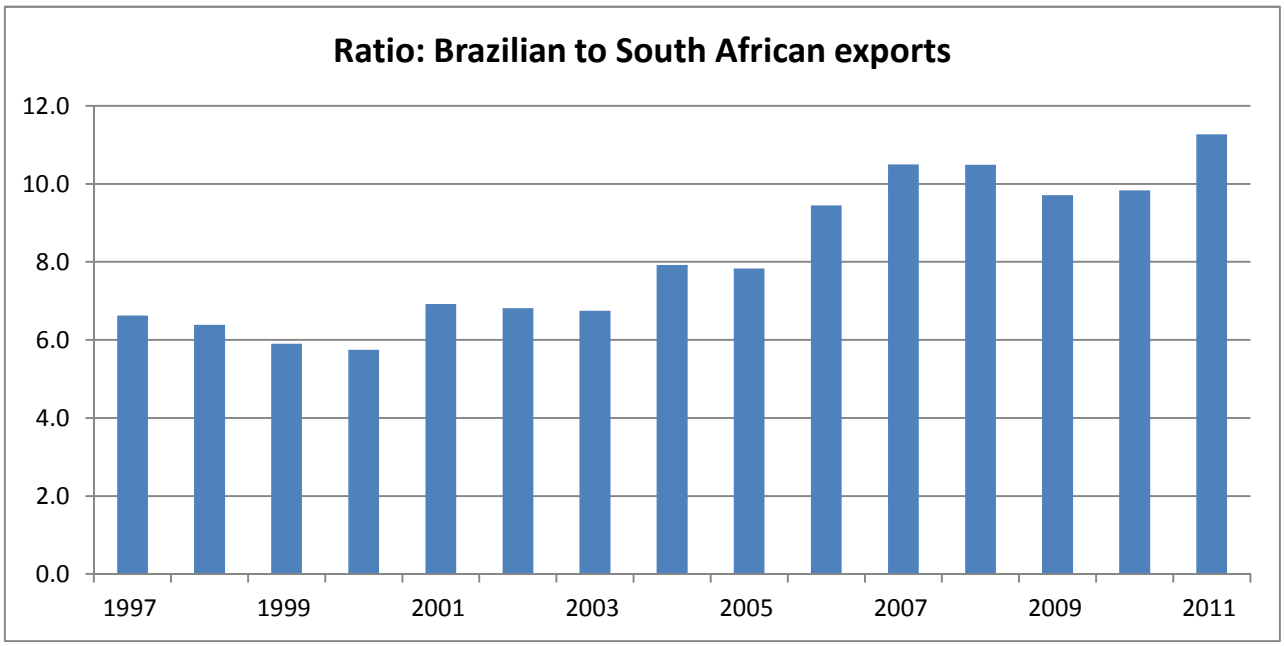
	Value $m	Value $m	Value $m	Value $m	Change in 2009 over (ratio)			Change, 2000 over	
Country	2009	2000	1990	1980	1980	1990	2000	1980	1990
US	62,144	56,880	49,272	57,835	1.1	1.3	1.1	1.0	1.2
Netherlands	46,114	27,606	27,641	16,585	2.8	1.7	1.7	1.7	1.0
Germany	42,798	36,300	20,282	12,524	3.4	2.1	1.2	2.9	1.8
France	39,829	42,892	36,304	23,706	1.7	1.1	0.9	1.8	1.2
Brazil	**37,207**	**14,227**	**8,089**	**6,232**	**6.0**	**4.6**	**2.6**	**2.3**	**1.8**
Spain	24,631	18,694	10,390	5,769	4.3	2.4	1.3	3.2	1.8
Belgium	24,475	21,525	0	0			1.1		
Canada	23,584	18,870	14,548	12,963	1.8	1.6	1.2	1.5	1.3
Italy	22,618	21,803	14,750	11,831	1.9	1.5	1.0	1.8	1.5
Australia	17,437	20,706	12,959	14,365	1.2	1.3	0.8	1.4	1.6
Indonesia	15,668	6,102	3,384	1,969	8.0	4.6	2.6	3.1	1.8
Argentina	15,130	13,518	7,019	4,707	3.2	2.2	1.1	2.9	1.9
China	14,829	15,377	9,516	3,451	4.3	1.6	1.0	4.5	1.6
Thailand	13,658	9,503	9,299	6,099	2.2	1.5	1.4	1.6	1.0
Denmark	13,067	11,292	12,610	6,397	2.0	1.0	1.2	1.8	0.9
South Africa	4,124	2,711	2,692	3,627	1.1	1.5	1.5	0.7	1.0

Source: FAO

[2] The FAO Unit Value indices for the aggregate agricultural and aggregate food products represent the changes in the quantity-weighted unit values of products traded between countries. The weights are the quantity averages of 1989-1991. The formulas used are of the Laspeyres type. Indices for food products include commodities that are considered edible and contain nutrients, except for animal feed products and alcoholic beverages. Coffee and tea are also excluded because, although edible, they have practically no nutritive value; given that coffee is a major export from Brazil this will impact upon the Brazilian values.

Figure 2 shows the real growth of the Brazilian exports relative to those of South Africa from 1997 to 2011 inclusive, with the data sourced from the Global Trade Atlas (GTA) and expressed as a ratio of Brazilian agricultural exports over South African agricultural exports. From 1997 through to 2003 the ratios tracked relatively closely, varying between South Africa's best performances of the ratio of Brazil's 5.8 to South Africa's to the worst of a 6.9 to one ratio in 2001. From 2004, Brazil outstripped South Africa, with the ratio rising to a final 11.3 in 2011.

Figure 2: Ratio of Brazilian agricultural exports to those of South Africa



Source: Global Trade Atlas, World Trade Organisation definition of agriculture

Table 2 shows the destination of these Brazilian exports, as ranked on 2011 trade data. Key points are: 1) the EU has consistently been the number one destination; 2) the rapidly growing market of China is now number two; and 3) the share of these top ten markets declined from 74% in 1997 through to around 65% in the two most recent years, thus indicating a broader export diversification.

Table 2: Brazilian agricultural exports by destination

Brazilian exports of agricultural products, as classified under WTO							
Partner Country	US dollars (millions)						
	1997	2000	2003	2006	2009	2010	2011
World	16,659	12,899	21,247	36,516	54,609	63,486	81,469
EU -27	7,461	5,498	7,857	10,569	13,981	13,912	16,560
China	651	438	1,698	2,799	7,420	9,326	14,602
United States	1,429	1,098	1,443	3,042	2,539	2,926	4,456
Russia	686	405	1,421	3,125	2,769	4,039	4,016
Japan	914	641	800	1,156	1,590	2,095	3,201
Saudi Arabia	251	265	500	817	1,479	1,926	2,391
Spain	606	490	717	862	1,385	1,546	2,211
Venezuela	39	81	78	517	1,442	1,999	2,177
Iran	157	247	745	1,374	1,091	2,061	2,120
Egypt	157	107	231	794	734	1,303	1,879
Top ten as % total	**74.1%**	**71.9%**	**72.9%**	**68.6%**	**63.0%**	**64.8%**	**65.8%**

Source: Global Trade Analysis data

The Brazilian export commodities

Table 3 shows the top twenty commodity exports from Brazil in 2011, along with the earlier 1997, 2000, 2003, 2009 and 2010 values and again the ratio of exports expressed as the 2011/2010 exports over the 1997/1998 exports on the right-hand column. These top twenty exports represented 92.9% of the total agricultural exports in 2011 as calculated in the bottom line, a figure that has been inching up over the period indicating slightly more concentration. Indeed, although not shown, the top five exports represented 64.1% of all exports in 2011. Soybeans and sugar dominate the commodities,[3] with large increases from several others in recent years. This latter group includes beef, corn and cotton in the top half of the table and almost all the commodities in the lower half of the table. This indicates that although soybeans, sugar, coffee and poultry dominate there are several alternative commodities that, on these projections, are likely to continue to contribute to Brazilian exports. The juggernaut is showing no sign of slowing down.

[3] This is even more apparent when soybean oilcake and soybean oil are added to soybeans, as the combined soybeans then add to just about 30% of the total exports.

Table 3: Brazil's global agricultural exports at HS 4 level

Brazilian exports of total agriculture, all commodities								
Commodity	Description	US dollars (millions)						Change
		1997	2000	2003	2006	2009	2010	2011	97-8/10-1
	Total agriculture	16,659	12,899	21,247	36,516	54,609	63,486	81,469	4.52
1201	Soybeans	2,452	2,188	4,290	5,663	11,424	11,043	16,327	5.9
1701	Sugar	1,774	1,199	2,140	6,167	8,378	12,762	14,942	7.5
0901	Coffee	2,749	1,563	1,316	2,953	3,791	5,204	8,026	2.6
0207	Poultry	918	879	1,862	3,039	4,945	5,952	7,243	7.8
2304	Soybean oilcake	2,681	1,651	2,602	2,419	4,593	4,719	5,698	2.4
0202	Beef, frozen	148	333	727	2,468	2,655	3,376	3,518	18.8
2401	Tobacco	1,091	813	1,052	1,694	2,992	2,707	2,879	2.8
1005	Corn (maize)	52	9	375	482	1,302	2,216	2,716	77.1
2009	Fruit juice	1,058	1,090	1,250	1,570	1,752	1,925	2,566	1.9
1507	Soybean oil	597	359	1,233	1,229	1,234	1,352	2,129	2.4
5201	Cotton	0	32	189	338	685	822	1,590	large
2207	Ethyl alcohol	54	35	158	1,605	1,338	1,014	1,492	27.8
1602	Prepared meat	253	288	434	1,097	1,438	1,269	1,488	4.8
0203	Pork	142	163	527	990	1,112	1,227	1,286	8.7
2101	Extracts coffee	385	222	231	411	490	563	710	1.9
1001	Wheat	0	0	7	64	63	227	699	large
0210	Prepared meat, etc.	3	5	8	21	531	564	659	large
0201	Beef, fresh	49	170	428	667	367	485	652	10.7
1006	Rice	2	7	5	60	268	163	613	large
0102	Live cattle	0	0	1	73	444	659	445	large
Top twenty		14,408	11,006	18,835	33,010	49,802	58,249	75,678	4.9
Top twenty as % of all		**86.8%**	**85.3%**	**88.8%**	**90.4%**	**91.4%**	**91.7%**	**92.9%**	

Source: Global Trade Analysis data, tralac calculations

Examining the data we find that China is the number one destination for soybeans, taking over half of the total in recent years, while sugar exports are more diversified, with China at number two behind Russia for 2011. For coffee, the main destination was the US, while nine of the top eleven destinations were in the EU. For soybean cake, the top three were European countries followed by Thailand and Korea, while for chickens, the rankings were Japan, Hong Kong and China and then the two Middle East countries of Saudi Arabia and the United Arab Emirates (UAE) (with South Africa in seventh place). For beef, the main destination was Russia, while for refined cane sugar, the main destination was the UAE, with six of the top ten destinations being African countries.

Brazilian agricultural trade: the 2012 update

Trade data for Brazil for the 2012 year became available as this paper went to print. Overall, merchandise exports were down by 5%, with those to Argentina down 21%. Global imports were virtually unchanged with a 1% decline and no major source changes. There are, however, significant changes in the all-important agricultural exports, as these were down by 33% overall. This included declines of 78% to China, 37% to Africa in total, and 23% to South Africa by destination and a massive decline in sugar and soybeans global exports as they went from the two top commodities in 2011 to virtually nothing in 2012. The main changes in Brazilian agricultural exports to South Africa were declines by 22% in chicken cuts and edible offal (perhaps in the face of threatened action from South African authorities against these imports, action which has now been dropped) and significant increases in the export of both sugar and turkey meats. The relatively insignificant import of agricultural products from South Africa did increase by 50%, but this was from $12 million in 2011 to $18 million in 2012.

The declines of 78% in Brazilian agricultural exports to China are significant, and they are confirmed by Chinese 2012 agricultural import data from Brazil where imports declined by 374% in 2012 over 2011 data. Brazilian data shows declines of 98.6% and 99.7% for soybeans and sugar respectively in 2012 over their 2011 values (where as the top two exports they contributed 83% of Brazilian agricultural exports to China). China import data is consistent and shows zero imports for the same two commodities. Furthermore, there is no evidence of a HS 6 line classification change – these two large trade items into China ceased, and this seems consistent with Brazil's world exports, thus pointing to supply problems during 2012 in Brazil.

Brazilian agricultural production

Table 4 puts the growth of Brazilian agriculture over the period from 1985 to 2010 in perspective by comparing the indexed growth of Brazil with selected other countries of particular interest to South Africa. The left-hand side of the table shows that Brazilian production in 2010 was 120.75 when assessed against the base of 1000 for the 2004-2006 period. This is a commendable performance but still marginally below that of India. Conversely, the right-hand side of the table shows that while Brazil rose from a 1985 level of 47.89, the performance of China was even more spectacular over this earlier period. South Africa's performance has been just above the world average since 2004-2006 but below the average before then.

Table 4: Global agricultural production index

Net Production Index, 2004-06 = 1000						
	2010	2009	2004-06	1995	1990	1985
Argentina	115.61	96.68	100	73.81	65.11	61.52
Australia	99.96	101.84	100	88.12	80.31	72.34
Brazil	**120.75**	**116.85**	**100**	**64.72**	**51.8**	**47.89**
China	118.51	115.52	100	66.63	49.67	38.86
India	123.66	114.1	100	80.88	69.96	59.21
Russia	100.21	113.21	100	93.16		
South Africa	115.99	113.7	100	71.92	81.22	72.54
US	107.91	107.19	100	83.94	77.89	77.62
World	112.61	110.7	100	77.31	70.96	63.58

Source: FAO database

From the FAO database we were able to extract the values of the top ten Brazilian agricultural products. These are shown in Table 5, where the values are ranked by 2010 and expressed in US dollars (millions). The right-hand section of the table shows the values for the same products for earlier years, while the right-hand column shows 'change' as defined by the ratio of the 2010 output to that of 1990, representing the take-off point for the sector. Beef, sugar and soybeans have consistently been the top three products, but the rankings have changed in other products. Chickens have moved to number four as a result of the growth over the period, while maize at number ten has also displayed dramatic growth. Not shown is that bananas and cassava were in the top ten during 1980, and that these products had been replaced by coffee and maize (although coffee was number

11 in 1980). Beans have also been 'there or thereabout' in most periods as well. Note that four of the top six products are the three meat products of beef, chicken and pigmeat, and cow's milk. The FAO ranks Brazil as being the number one producer of sugar cane, oranges and coffee; number two in beef and soybeans; number three in chicken meat and maize; number four in cow's milk; number five in pigmeat; and number nine in rice. Note also that, as discussed below, while sugar is, of course, an agricultural product, a significant percentage of the output in Brazil is used for ethanol fuel production.

Table 5: Brazilian agricultural production, $ million

	2010	2009	2008	2005	2000	1995	1990	1985	1980	Change
Beef	25,193	25,691	24,590	23,276	17,738	15,202	11,071	9,392	7,677	2.3
Sugar	23,362	22,513	20,993	13,823	10,597	9,808	8,350	7,914	4,609	2.8
Soybeans	16,800	15,358	16,027	13,669	8,665	6,780	5,074	4,829	3,964	3.3
Chicken	15,288	14,206	14,596	11,239	8,533	5,772	3,356	2,122	1,952	4.6
Milk	9,489	8,986	8,786	7,842	6,296	5,247	4,614	3,847	3,694	2.1
Pigmeat	4,733	4,811	4,635	5,431	3,997	2,429	1,614	1,199	1,506	2.9
Oranges	3,498	3,405	3,583	3,450	4,122	3,834	3,386	2,747	2,105	1.0
Coffee	3,122	2,622	3,005	2,299	2,045	999	1,574	2,053	1,140	2.0
Rice	3,072	3,467	3,300	3,613	3,024	3,059	1,978	2,396	2,595	1.6
Maize	2,962	2,380	2,353	927	621	1,213	572	747	586	5.2

Source: FAO database

Agricultural policy in Brazil

Our focus will now shift to the examination of what lies behind the rise and rise of Brazilian agriculture in recent years. Two seminal pieces of research in this area have been undertaken; one by the World Bank by Anderson and Valdes (2008) and the other by the Organisation for Economic and Cooperation Development (OECD). This research provides the foundation for the Brazilian agricultural policy analysis. Anderson and Valdes examined the history of distortions to agricultural incentives caused by price and trade policies in Latin America, and they emphasise the two distinctive periods of Brazilian agricultural policies in recent years. The first period from the 1960s to around the late 1980s--early 1990s was characterised by policy interventions to promote industrialisation in Brazil through an import substitution regime that resulted in both direct and indirect taxation of the agricultural sector. This led to a chronically overvalued exchange rate that

was accentuated by direct export taxes. Agriculture remained effectively closed to trade thanks to the set of trade policy instruments that skewed prices on import-competing crops by direct intervention and measures ranging through to outright bans on exports. Overall, the economy in general and the rural sector in particular stagnated, and the legendary inflation of the time created problems for the rural sector that have not yet been fully alleviated.

The second period, from around the very late 1980s, has seen macroeconomic stability (and, most importantly, a stable exchange rate) coupled with trade liberalisation and generally much less intervention in agricultural markets. The first direct changes were from 1989 to 1992 when unilateral trade liberalisation was adopted with policies that included the elimination of controls and taxes over exports and reduce tariffs on imports. Shortly after this, the economy-wide stabilisation programmes started focusing on the exchange rate and government expenditure, albeit with the side effect of increasing real[4] exchange rates of the *real*. Anderson and Valdes (2008) report that these policy reforms and their implications were again themselves effectively split into two periods. The first was a transition period from 1990 to 1999 when the newly-freed imports that were accentuated by an appreciating exchange rate depressed local prices in an environment whereby farmers were provided little support. The second was post-2000 when a devaluing local currency and higher international prices allowed the larger commercial farmers with their technological enhancements to significantly increase production and consequently exports. Brazil increasingly became a major international agricultural exporter with much of this result credited to enhanced productivity flowing from fresh investment in agricultural research and currency stability in a more neutral policy environment.

Associated with these changes was the related issue of agricultural debt as the rising inflation of the 1980s and the policy attempts alleviate the situation resulting in a chasm between interest rates on loans and farm revenues. General insolvency and restricted credit availability resulted, and by the mid-1990s, as the debt worsened, the Brazilian Government instigated a rescheduling programme. The repayment period for the overdue debt was extended by 20 or 24 years, and the interest rate was set at below-market rates. In the early 2000s further rescheduling measures extended repayments for small farmers and land reform beneficiaries at reduced interest rates, as well as for partial write-offs and some rebates. The OECD (2011) reports strong intervention in the credit sector

[4] Care must be taken not to confuse the Brazilian currency, the *real* exchange rates in nominal terms, with the common economic measure of the real exchange rate or the inflation-adjusted rate of the *real*. Key to Brazilian reforms has been the very successful *Real Plan*, the currency stabilisation plan.

via interest rate subsidies and the requirement that banks allocate at least 29% of their demand deposits to agricultural lending. This is of little consequence for larger farmers who can borrow on international markets but it imposes a burden on medium-sized farmers and other industries obliged to borrow domestically at market rates.

The main objective of the World Bank project was to estimate the assistance (be it positive for supports or negative for taxation) provided directly or indirectly to the agricultural sector. Their measure is the nominal rate of assistance (NRA), a measure that includes an adjustment for inputs such as fertiliser price distortions and credit supports. Estimates are given in Table 6 for both exportables such as beef and sugar and importables such as maize and rice. For exportables, the patterns are similar for all products except sugar, with negative estimates in the earlier periods which reflect a high taxation effect and these estimates generally changing to modest supports following the reforms just outlined. For importables, there is a longer time frame given and there is much more variability between products and time periods. Wheat was heavily supported in the early years before settling into a pattern similar to that of the exportables, following radical deregulation in 1990; maize was really neutral early on, taxed in the middle periods and generously (by recent Brazilian standards) supported in recent years. Rice was taxed early on but again generously supported in more recent times due to its function as a staple crop where governments strove to keep the prices low for consumers. In aggregate, exportables were heavily taxed through to the reforms and lightly supported since, while importables were almost neutral in the early periods, heavily taxed in the middle, and more generously supported in the latter periods.

The OECD data[5] is provided on the right-hand side of Table 6 (albeit with a minor difference in the OECD time periods), and this represents the supports as measured by the producer support estimate (PSE) expressing the assistance as a percentage of the gross value of production. It is a similar but different measure from the World Bank estimates and therefore not directly comparable.[6] These OECD estimates are generally very low, and much lower than the more comprehensive World Bank estimates. Note, however, the taxation of the sugar sector in the late 1990s, where the signs are consistent with the World Bank but the estimate of the taxation is greater.

[5] More information on the OECD estimates of support is given in the next section.
[6] Details of the definitions are provided in the annex.

Table 6: Assistance to Brazilian agriculture, World Bank and OECD estimates

	World Bank					OECD*	
	1996-9	1975-9	1985-9	1995-9	2000-05	1995-9	2000-05
Exportables	**-8.4**	**-30.0**	**-29.5**	**0.4**	**1.3**		
Beef			2.7	4.4	3.1	**0.0**	**0.0**
Coffee			-25.0	6.8	6.3	0.1	0.1
Poultry			-13.7	1.0	2.3	0.0	0.0
Soybeans	0.0	-15.6	-20.8	-1.2	-2.5	0.1	0.0
Sugar		-52.4	-55.3	-10.3	1.7	-25.6	0.0
Importables	**1.4**	**-1.9**	**-22.5**	**8.3**	**12.0**		
Maize	-9.0	-26.0	-33.9	4.0	na	5.1	5.8
Rice		-11.1	3.8	17.2	16.6	8.4	3.1
Wheat	41.4	65.8	-5.8	8.2	0.3	3.1	1.4

Source: Anderson and Valdes for World Bank, OECD (2005)

The OECD

Another authoritative review of Brazilian agricultural policy in recent years has been the OECD (2005) report which aimed 'to strengthen the policy dialogue with OECD members on the basis of consistent measurement and analysis, and to provide an objective assessment of the opportunities, constraints and trade-offs that confront Brazil's policy makers'. The highlights from this report reinforce the low levels of government support to the sector in recent years and the radical transformation of the economy in general in recent years leading up to 2005 that included *inter alia* currency stabilisation and infrastructural developments, the impacts of these changes upon firstly production and consequently new export opportunities, and a recognition that high tariffs, tariff escalation and non-tariff measures in the richer OECD markets are inhibiting future developments in Brazil. We have, however, seen from the analysis above that since 2005 the sector has continued its general growth patterns, and as the OECD noted back then this growth has been fuelled by non-traditional Brazilian products into newer (and especially Asian) growth markets.

The analysis of policy supports to agriculture is continued and updated through the OECD support measures as shown in Table 7, where perhaps the most relevant measure is the Producer Support Estimate (PSE)[7] that was used in the OECD comparisons with the World Bank estimates used above.

[7] See annex for definitions.

The PSE values are low, and, importantly, they have moved from negative values in the early periods shown (indicating that farmers have effectively been taxed rather than supported) to modest positive values from 2000 onwards. To put these PSE values in perspective internationally, Brazil belongs to a group of countries that provide minimal support to agriculture as indicated by a PSE at around 5.0 in recent years. These countries are New Zealand, the lowest at 1%, and Australia, Chile and South Africa. Conversely, the highly protected EU averages around 22%. The salient point is that Brazilian agricultural expansion has not been driven by direct supports.

Table 7: Supports to Brazilian agriculture

Indicator/yr	1995	1997	1999	2000	2002	2004	2006	2008	2009	2010
Value gate BRL million	50 576	60 104	74 222	84 661	126 597	185 126	175 401	252 278	260 819	275 161
Percentage PSE	**-6.8**	**-1.5**	**1.3**	**6.4**	**4.9**	**4.5**	**6.1**	**4.1**	**6.5**	**4.5**
Producer NPC	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Producer NAC	0.9	1.0	1.0	1.1	1.1	1.0	1.1	1.0	1.1	1.0
Percentage CSE	4.9	5.3	3.8	-3.0	-0.9	-1.6	-2.8	-1.3	-5.5	-3.1
Consumer NPC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0
Consumer NAC	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.0
% TSE (as % GDP)	-0.2	0.3	0.3	0.6	0.6	0.7	0.7	0.5	0.7	0.5

Source: OECD database

If direct supports have not driven Brazilian agriculture, what has? The OECD agrees with the World Bank in that the general economy-wide transformation of the Brazilian economy over the last 20 or so years have certainly been a major factor in its expansion. The Real Plan brought about the budgetary restraints needed to bring the notorious Brazilian inflation under control and provided (initially) a relatively undervalued exchange rate that contributed to exports, structural reforms such as a privatisation programme and the deregulation of domestic markets, and policy changes that included deep tariff cuts and a large reduction in non-tariff barriers. The OECD also agrees with the World Bank that current policy challenges concentrate upon improvements in infrastructure and the

Brazilian credit and taxation systems, the challenge of improved access to global markets, and the issue of rural poverty in the poorer subsistent sector.

There continues to be extreme disparities in the agricultural sector between the export-oriented large-scale commercial sector and the very poor and numerically strong subsistence sector.

Productivity

Examining Brazilian agricultural policy and productivity by using Brazilian census data, Rada and Buccola (2012) assess that technical progress has been significantly greater in the livestock sector than in the crop sector. They acknowledge the contribution of economic reform to the sector's recent growth, but confirm that public research and infrastructural policies have made a major contribution by enhancing on-farm technical efficiency. Using the same census data foundation, these researchers concur and assess that Brazil could substantially boost its shares in global production and trade still further by raising its low 2006 average-farm efficiency by matching a level closer to what the most efficient producers are achieving: the average farm produced 93% relative to the most efficient farms in 1985, but only 64% in 2006. Therefore, despite remarkable gains, it seems that Brazil has ample capacity for further productivity improvements**.**

This importance of Research and Development (R&D) in these technological gains is backed by **Pereira** et al. (2012) and Martha and Filho (2012) who consider that three of the main policies that played a central role in the process of agricultural modernisation in Brazil were 1) the availability of subsidised financial credit, 2) the rural extension, and 3) the provision of support for agricultural research (the National Agricultural Research System – Embrapa). The development of the Brazilian savannah (Cerrado) into agricultural land required a portfolio of technologies that have made the region one of the top grain- and beef-producing regions in the world. These technologies concentrate upon 1) biological nitrogen fixation for soybeans on poor acid soils of the Cerrado; 2) new plant varieties and hybrids and the use of no-tillage systems; and 3) the integrated crop-livestock systems and the adoption of double-cropping where possible.

Consequently, the total factor productivity (TFP) for Brazilian agriculture increased steadily from 1970 to at least 2006. Compared with 1970, TFP increased by 124%, production rose by 243%, and inputs grew by 53%. Gains in productivity represented 65% of agricultural output in the period 1970 to 2006, and inputs accounted for 35%. These productivity gains made a massive contribution not

only to Brazilian output but also, in effect, to conserving forestation in Brazil. **Pereira** et al. furthermore reported that during the period 1950 to 2006, productivity gains accounted for 79% of the growth in beef production in Brazil and supported a land-saving effect equivalent to 525 million hectares. This is equivalent to an additional pasture area 25% larger than the Amazon biome in Brazil that would have been needed to meet 2006 levels of Brazilian beef production. In addition, during this same period, production of Brazilian grain, oilseeds, and sugarcane provided an additional land-saving effect of 78 million hectares. Janks (2012) provides comparative global data for increases in agricultural productivity over the 45-year period from 1960 through to 2005, and here Brazil heads the list with an average of 2.0%, followed by China's 1.8% and India and Argentina's 1.5%. Martha and Filho (2012) confirm that this Brazilian rate is continuing, as they report that by using census data the average annual growth for agricultural total factor productivity in Brazil between 1995 and 2006 was 2.13%. Until Brazilian agricultural researchers and partners developed new crops and forage varieties allied with agricultural practices tailored for tropical agriculture it was thought that only temperate regions could feed the world, but research and entrepreneurial efforts combined in Brazil to develop and cultivate soybean varieties that are producing yields comparable or even higher than those of temperate regions. This perception has therefore changed (Martha and Filho 2012). Indeed, in discussing Brazilian agriculture growth, it was stated in The Economist ('Brazilian agriculture' 2010): 'If you want the primary reason in three words, they are Embrapa, Embrapa, Embrapa[8]'.

Martha and Filho (2012) also emphasise that often forgotten is the role played by agriculture in improving income levels and distribution. Inflation control ensures the currency's average buying power and income transfer makes purchasing power available to the target population. If the beneficiaries of inflation control and income transfer programmes largely depend on the supply of goods of agricultural origin, it is important, for the distribution to be effective, to make sure that relative prices in this sector will not increase as transfers take place. Furthermore, if production increases as a result of productivity growth, greater distribution is created by a drop in relative prices. This is the case in the recent experience in Brazil. Previously, the Real Plan measures to redistribute income and reduce poverty lost their effectiveness due to high inflation rates. After the Real Plan redistributive measures were intensified, the currency inflation corrosion reduced and an increasing availability of goods and services for the majority of the population contributed to the

[8] The National Agricultural Research System.

effectiveness of these measures. Brazilian society relies on a competitive agricultural and agro-industrial system that is extremely relevant in the international scenario today. The country will play an even more strategic role in the future because it is home to a substantial percentage of the world's remaining stocks of natural resources, and learning how to use this stock wisely is the biggest challenge ahead.

The sugar sector

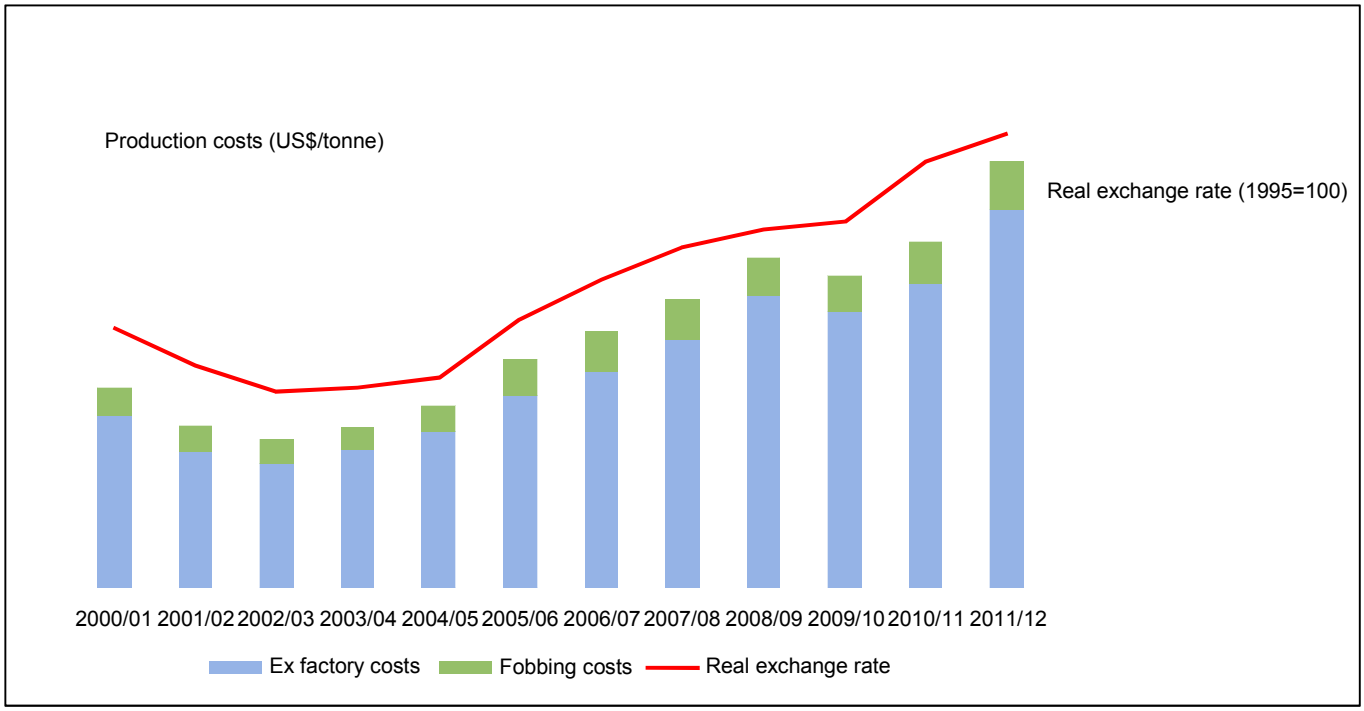
Of special interest to South Africa is the Brazilian sugar sector, and Brandao (2007) provides a very good background to the sugar/ethanol interactions in Brazil and discusses how future growth of the sector depends on both sugar exports and domestic sales of ethanol. Expansion in the sector was driven by exports of sugar and the domestic market for fuel ethanol following the first oil shock in 1973. The share of ethanol in sugar cane production increased sharply from the beginning of the gasohol programme (Proálcool) in 1975 until 1985, when 70% of sugar cane was devoted to ethanol. This slowly declined to 2001 when the sugar/ethanol ratios converged to be almost exactly equal right up to 2006. Early government intervention was a trademark of the ethanol industry for many years, with this based on production quotas, price controls and the gasohol programme that granted special tax treatment for ethanol-fuelled cars, determined the volume of anhydrous ethanol to be added to gasoline, and guaranteed purchases of the ethanol production. Intervention was phased out after 1990 and the government was left with two instruments: the ethanol gasoline mix and auctions where Petrobras purchases ethanol.

Brazil remains the lowest-cost sugar producer in the world, but the cost competitiveness of Brazilian sugar has been affected by the valuation of the Brazilian real during the 2000s. In 2004/05, all low-cost cane producers (mostly Centre/South Brazil) had costs 29% lower than the weighted average of major sugar exporter competitors Australia, Colombia, Guatemala, South Africa and Thailand. By 2009/10, this advantage had fallen to 11% (Rada and Valdes 2012). Czarnikow[9], the London-based global sugar merchant, reported that, while production costs varied, with the weaker Brazilian real the range for a good Brazilian mill was about 19 to 21 cents a pound. Weisser (2012), CEO of commodity trader Bunge, went as far as to say, 'I think most people don't realise that today sugar is cheaper to be grown and produced in Europe. It worries me. Brazil is becoming very, very expensive'. There seems to be a classic 'Dutch disease' effect in play, as the success of Brazil and an agricultural

[9] See http://www.czarnikow.com/.

behemoth in recent times contributed to its own currency appreciation erosion. This is confirmed by data from the Least Developed Country (LDC) International Survey in Figure 3 that shows how the real exchange rate in Brazil is eroding its competitive edge in world markets.

Figure 3: Centre/South Brazil sugar costs



Source: LMC International

Land issues in Brazil

Central to Brazilian sugar expansion is the issue of land clearance; the perception that this expansion is detrimental to the rainforest is refuted by Brandao (2007). He considers that Brazil has land available to support such an expansion without causing damage to the Amazon forest, as Brazil still has vast amounts of land available for agricultural expansion. The seven million hectares planted with sugar cane in 2007 were a relatively small percentage of total crop area of 61 million hectares and much lower than the soybean and corn acreages of 22 and 13 million hectares respectively. He outlines that there are around 178 million hectares of pasture land in Brazil, of which around 78 million hectares were natural pastures that were currently very low carrying capacity that is generally suitable for agriculture; and, indeed, the expansion of the sugar ethanol complex was mostly on this pasture land. It seems that the majority of deforestation in the Amazon is for subsistence agriculture or for larger landowners to expand their cattle-ranching operations, as cattle operations are moving northward. These daunting figures are supported by reports from the

American Soybean and Corn Advisory[10] and by Janks (2012) who asserts that there are some 330 million hectares of potentially arable land in Brazil from a total land area of 851 million hectares (with some 496 million hectares protected).

Is the expansion of Brazilian soybean and sugar production contributing to Amazon land clearing? The answer seems to be an unequivocal 'yes' and 'no': 'no' because the crop area seems to be taking over previous pastoral land that was being use for cattle production; 'yes' because this in turn is pushing the cattle ranching further north and at times into newly cleared land at or contiguous to the Amazon forests. Mahr (2011) used satellite data to map cropland expansion and multi-crop intensification in the crucial Mato Grosso area from 2000 to 2010. The study found a 25,095 square kilometre expansion of cropland over this period, while the percentage of this total area classified as multi-cropping increased from 37.6% to 64.4%. The Mato Grosso rapidly climbed to the second most important cropland state in Brazil and the leading soybean producer from 1990 through to 2004, with improved infrastructure, crop technology, a deregulation of the agricultural sector and increased world demand driving the increase. In particular, this study found that the change correlated most closely with the Brazilian real to the exchange rates of the main markets, the EU and China, and the significant appreciation of the real since 2009 would suggest a slowing of the expansion.

At a Financial Times conference on sustainable agriculture in Brazil held in London at the end of March 2012,[11] John Clarke, European Commission international affairs director for agriculture, expressed his concerns about the social and environmental impact of Brazilian farming. He realised that problems still existed and logging continued to destroy the rainforests as soybeans and sugarcane were pushing displaced ranchers into the Amazon basin. Farmers and officials in Brazil objected to being lectured at by Europeans whose ancestors had long since chopped down almost all their primeval forests, and they argued that most of Brazilian agriculture took place hundreds of kilometres from the Amazon forest.

How much land is there in Brazil?

Table 8 shows the FAO data that is relevant to the Brazilian agricultural land question. In the first section the quantity of agricultural land is shown, where agricultural land refers to the share of land

[10] See http://www.soybeansandcorn.com.
[11] Papers available at http://www.ftconferences.com/sustainableagri/.

area that is arable, under permanent crops, and under permanent pastures. The countries are ranked by their available agricultural land. Here it can be seen that Brazil is ranked number four with 5.42% of the global total. It is behind China, Australia and the US but ahead of Russia. South Africa is included for comparative purposes. In the middle section arable land is shown, where this includes land defined by the FAO as land under temporary crops, temporary meadows for mowing or for pasture, land under market or kitchen gardens, land temporarily fallow, and land under permanent crops such as cocoa, coffee, rubber, flowering shrubs, fruit trees, nut trees, and vines. Notable here is that Brazil has a 4.43% share of the total global agricultural land, indicating that its share of arable land is about 80% of the global average (5.42% of total land and 4.43% of arable land). The two extremes in this section are Saudi Arabia with a very small percentage of arable land and India at the other extreme with a very high percentage. In the bottom row the data suggests that around half of South Africa's agricultural land is arable. Finally, the right-hand column shows the percentage share of the world land area held by each country shown. This has some insights into the relative average land quality of each country. Not shown is that Brazil has around 1.44% of the world's land 'equipped for irrigation' (while India and China have 21.40% and 20.70% respectively) according to the FAO.

Table 8: Brazilian agricultural land in perspective, 1000 ha and % share

1000 ha	Agricultural land		Arable land		Total area
World	4,882,713	% world	1,381,204	% world	% world
China	524,321	10.74%	109,999	7.96%	7.13%
Australia	409,029	8.38%	47,161	3.41%	5.75%
United States	403,451	8.26%	162,751	11.78%	7.30%
Brazil	264,500	**5.42%**	61,200	**4.43%**	**6.33%**
Russia	215,561	4.41%	121,750	8.81%	12.70%
Kazakhstan	208,480	4.27%	23,400	1.69%	2.02%
India	179,963	3.69%	157,923	11.43%	2.44%
Saudi Arabia	173,435	3.55%	3,200	0.23%	1.60%
Argentina	140,500	2.88%	31,000	2.24%	2.07%
Sudan	136,731	2.80%	20,160	1.46%	1.86%
South Africa	99,228	2.03%	14,350	1.04%	0.91%

Source FAO database

The Economist (2010) concurs that Brazil has more 'spare' farmland than any other country, as Brazilian official figures put the available land at 300m hectares. Using FAO data, they contend that Brazil has as much 'spare farmland' as the next two countries of Russia and America together, and while Brazil is accused of destroying rainforest to create farms, almost all of this new land is Cerrado. Furthermore, Brazil has more available renewable fresh water than any other country (more than the entire Asian continent) and critically this is well spread: the country has about the same quantity of farmland with at least 975 mm of rain each year as does the whole of Africa. Martha and Filho (2012) reinforce this and go further by considering that as well as providing vital environmental services to the world in the form of the Amazon Basin, Brazil contains 13.5% of the world's equivalent potential arable land and 15.2% of the world's renewable water.

Implications for Africa

Sandrey et al. (2012) examined the agricultural export performance of the BRICs (Brazil, Russia, India and China) into the African market to assess this performance against that of South Africa and to examine where the BRICs may be a threat to South Africa. That analysis showed that South Africa has been losing market share vis-à-vis the original BRIC members in virtually all African markets except Zimbabwe in recent years, and in all products except fats and oils. While Brazil is the biggest overall threat to South Africa, China and India are competing strongly in different markets and products. Crucially, when the BRIC competition in the important processed-food products is examined Brazil, China and India are all becoming increasing competitive in most of these value-added products. Overall, there are few bright spots in South Africa's recent agricultural export performance on the African continent.

There are potential lessons for Africa in the Brazilian example of Embrapa's organisation and funding. Beintema et al. (2010) reinforce that many developing countries are experiencing stagnant and even declining investment in public agricultural research. Brazil ranks third in the developing world in terms of public agricultural R&D investments after China and India – total public agricultural R&D spending has increased substantially in recent years due to renewed commitment to agricultural R&D on the part of the Brazilian government. Embrapa has also undergone restructuring to ensure that the country's agricultural sector remains competitive, with modifications that include enhancing human and institutional capacities, improving institutional structures, and strengthening the performance and evaluation system It is also increasing its international collaborations, and

South Africa needs to seriously look at closer cooperation with Embrapa in addition to studying the Embrapa model of concentrating agricultural research into a central agency. Hazell (2012) stresses that African agriculture is 'reaping the harvest of previous neglect' and reinforces the need for Africa to invest more heavily in meaningful research and technology to capitalise on the continent's abundant resources. Similarly, Sandrey and Edinger (2009) point to the example of China for African agricultural development, as China's dramatic economic growth over the last 30 years has had a strong pillar of rural sector prosperity from the 'twin paths' of technology and an augmentation of these technologies by an extension service of over one million staff members.

Anderson and Valdes (2008) discuss how the income profiles of agriculture changed during the reform period. Based on the agricultural census data of 1995/96, they cite Lopes (2004) who found that of a total 4.8 million farms in Brazil, 3.3 million (68%) fell within the legal definition of family farming in the National Family Farming Programme. These farms generated 24% of the total gross income in agriculture, while commercial farms of all sizes (32% of all farms) generated 76% of agricultural income. Of the 3.3 million family farms, around 2 million may be considered subsistence farms run by extremely poor families, and here poverty was a problem, as the 2000 demographic census data shows that 61% of households in agriculture were living below the poverty line (in contrast to the 25% in the urban sector). By contrast, the 257,000 mid-sized commercial farms (5.1% of all farms) produced 20% of the total agricultural output and the 375,000 large commercial farms produced 52% of the production. Brandao (2012) provides a partial update on this data by citing Alves et al. (2012) who found that based on the agricultural census data, 86% of the value of agricultural production came from 11% of farms, and that net farm income was negative in 56% of farms.

Meanwhile, Brazil's ability to raise more than 40 million people into middle-class income categories and the lowering of abject poverty levels from 23% to 8% in less than two decades should serve as a source of inspiration for South Africa.

The future

Despite differences in the availability of new farmland, most observers agree that Brazil still has a significant area for development without encroaching on the crucial Amazon Basin. Clearly, productivity has driven the sector in recent years, and these impressive productivity increases are showing no signs of slowing. Examining trade opportunities and notwithstanding the, at best, current

impasse of the World Trade Organisation (WTO) Doha Round, Brazil is likely to be a major beneficiary of an outcome. Brazil has sufficient overhang between current and bound rates to ensure that few, if any, tariff adjustments domestically and few trade-distorting subsidies would need to be revised as part of the Doha Agreement. In theory, liberalisation in the major markets for products such as sugar should provide a major benefit to Brazilian exports. In practice, this liberalisation will be muted by special safeguard (SSG) mechanisms and the abilities of enhanced tariff quota rates (TRQ) to continue allowing importing countries to capture rents. And the very success of the agricultural sector is helping to sow the seeds for its future slow-down as the export growth is a contributor to the Dutch disease phenomenon of an appreciating currency.

Martha and Filho (2012) stress that in the final analysis there is a direct linkage between the national system of innovation and the capacity of the farmers to absorb the knowledge that is generated. The institutional system provides knowledge for a productive sector gain, but it is up to the farmers to invest in their training and absorb this public knowledge. This is a medium to long-term process, and the creation of Embrapa in the 1970s set the first part of this process in motion. The authors consider that more needs to be done in Brazil to transfer this applied knowledge in the agricultural sector, and Brazil must lift the absorptive capacity of producers by improving education and at the same time reduce dependence on imported technological inputs.

Overall, looking to the next 40 years, The Economist ('Brazilian agriculture' 2012) succinctly considered that

> if you were asked to describe the sort of food producer that will matter most in the next 40 years, you would probably say something like this: one that has boosted output a lot and looks capable of continuing to do so; one with land and water in reserve; one able to sustain a large cattle herd (it does not necessarily have to be efficient, but capable of improvement); one that is productive without massive state subsidies; and maybe one with lots of savannah, since the biggest single agricultural failure in the world during past decades has been tropical Africa, and anything that might help Africans grow more food would be especially valuable. In other words, you would describe Brazil.

The Economist also considers that although Brazil is not the cheapest place in the world to grow soybeans (this place is held by Argentina, followed by the American Midwest), it is the cheapest place to plant the next acre! And in a final discussion pertaining to Africa, this venerable magazine

considers that much of the Brazilian experience may be applicable to Africa – but Africa needs to develop the will to make it happen.

Based upon the evidence from the Brazilian experience, we would end with a misquote from John Paul Jones, as when during the American War of Independence he was asked to surrender by the British he replied 'Brazil has not yet began to farm'!

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