Chapter 2
Recent Development Patterns and Challenges of Brazilian Agriculture

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2.1 Introduction

In the past decade the determinants of Brazilian agribusiness[1] development have changed considerably. On the domestic scene, the government has undergone broad institutional restructuring and in terms of reorientation strategies and policies for economic development, and this has had significant impacts on agribusiness and consequently on the agriculture sector. Between 1999 and 2009, the share of Brazilian agriculture exports on the international market had increased: chicken meat, from 12 to 30%; maize, from 0.01 to 7.8%; and soybeans, from 22 to 35% (FAOSTAT 2011).

The performance of Brazilian agribusiness has denied well-established beliefs amongst policy makers that for decades have sustained the need to protect domestic markets and cut down foreign trade incentives on the grounds of ensuring food security. In fact, during the same time span, in the wake of monetary stabilisation, income redistribution and economic growth, domestic food markets have expanded at a sustained high pace without any supply disruptions and price surges well known in the past.

In this context, we will argue that the presence and competitiveness of Brazilian agribusiness on the international market and overall positive economic performance is mostly the result of broad long-term domestic structural transformations, both at the macroeconomic level and within the sector, in which innovation has played a central role. In addition, we will show that recent developments have not been

[1] Agribusiness is composed of four sectors: raw materials, agriculture, industry and distribution.

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free of contradictions. Although productivity gains have operated as a powerful growth driver, new land at frontier zones was brought into cultivation, deforestation has continued, etc. Environmental and social relations have become sensitive issues whose consequences upon both the agricultural pattern of growth and sector governance cannot be ignored. Finally, the Brazilian policy experience is quite rich, particularly on land policy (agrarian reform) and in supporting the family farm segment. It will not be easy to deal with these issues in the frame of the paper, but it might be of interest to foreign colleagues to have some hints on these issues.

2.2 Agrarian Structure, Role and Performance of Brazilian Agribusiness

One of the marks of the Brazilian agrarian structure is its exacerbated concentration of land property. According to Hoffmann and Ney (2010), in 2006, the Gini Index of land property was 0.856.

The 2006 Agricultural Census registered 5.17 million holdings occupying an area of 330 million ha. Of the total, 2.5 million holdings had an area of 10 ha and below and a share of only 2.4% of the total area; and only 47,000 holdings held 147 million ha (Table 2.1). It is important to notice that in the past 15 years, the official programmes for agrarian reform redistributed 58.5–80.6 million ha and settled 1 million families (NEAD/MDA 2008), however, without impacting the overall pattern of land distribution.

It is not easy to produce hard evidence associating property rights to land use (Buainain 2008), but it is legitimate to raise the issue of weak property rights with poverty and deforestation. Around 1.23 million producers are tenants, sharecroppers, occupants and producers with no area declaration (IBGE 2006) (Table 2.1), most of them are *minifundistas* or very small poor producers, whose economic viability is increasingly contested (see Alves and Rocha 2010). Deforestation in the frontier zones is still used as proof of previous occupation of the land, which is still a strong argument for acquiring property rights over unclaimed land or in cases of conflicts over land ownership.

The heterogeneity has been evidenced in different Brazilian regions. In the Northeast, the poorest region, vastly dominated by semi-arid territory, 60% of the holdings had less than 10 ha in 2006. The majority was of poor producers without prospects for a viable market-oriented activity. In the Centre-West holdings with 10 ha and below represented only 16% of the total, while 43% were larger than 1000 ha and covered 72.3 million ha (IBGE 2006). Even though 10 ha might allow sustainable exploitation in the Centre-West *Cerrados*, viability is hindered by poor infrastructure, which requires larger-scale operations.

The levels of development and use of technology are highly differentiated amongst farmers and regions. Around 70% of holdings are served by electricity supply, but only 830,000 used electric power in agricultural activity. 2.8 million holdings use some kind of traction force, where 44% used animal traction, 34% mechanical traction and the remaining used both (Table 2.2). 47% of the holdings

Table 2.1 Number of holdings and area for condition of the producer by groups of total area: 2006. (Source: Prepared by the authors based on *Censo Agropecuário 2006*/IBGE 2006)

Condition of the producer	Total		0 < 10 ha		10 < 1000 ha		> 1000 ha	
	Holding	Area (ha)	Holding	Area (ha)	Holding	Area (ha)	Holding	Area (ha)
Total	*5,175,489*	*329,941,393*	*2,477,071*	*7,798,608*	*2,396,483*	*175,589,570*	*46,911*	*146,553,218*
Owner	3,946,276	306,847,605	1,787,949	6,284,733	2,113,167	159,683,709	45,160	140,879,163
Settlers without ownership title	189,191	5,750,283	67,367	242,377	121,547	4,713,318	277	794,589
Tenant	230,110	9,005,203	156,836	360,539	72,208	5,701,504	1066	2,943,162
Partner	142,531	1,985,085	124,512	252,041	17,866	1,154,868	153	578,180
Occupier	412,357	6,353,218	340,407	658,918	71,695	4,336,173	255	1,358,125
Producer with no declaration of area	255,024	0	0	0	0	0	0	0

Table 2.2 Share of family farming that use components for the modernisation of agriculture in Brazil: 2006. (Source: Authors modified data from Di Sabatto et al. 2011, p 16)

Technologies	%
Technical assistance	20.88
Associated with cooperative	4.18
Use electricity	74.10
Use animal force	38.75
Use mechanical force	30.21
Use manual force	31.04
Use irrigation	6.23
Use fertilisers and correctives	37.79

with an area below 100 ha used only animal force and 34 % used mechanical force. Notwithstanding, the primary use of human force and hand-held working instruments is still dominant amongst the vast majority of poor small peasant producers. In fact, 55 % of smallholdings use no other source of traction than human force. However, it is important to highlight that technological heterogeneity is also a feature amongst large holdings: about 132,000 holdings with more than 100 ha also do not use any kind of traction force (IBGE 2006).

Only 61 % of large holdings use some kind of agronomic practices, thus confirming deep differences in the production process even amongst larger holdings. To reinforce the rudimentary characteristic of the productive process, around 57 % of the Brazilian holdings did not carry out any type of soil preparation and only 10 % use direct tilling techniques. Amongst smallholdings below 100 ha, holdings that did not carry out any kind of soil preparation were 55 % and amongst larger holdings it was 58 %. Overall, 65 % of the holdings did not use any kind of green manure. The most surprising result is that around 90 % of the holdings do not use any kind of methods to control pests (IBGE 2006).

Brazilian agribusiness has been always a strategic sector and as such has played relevant roles in the structural configuration of Brazilian society as well as in the evolution and performance of the economy. In recent decades, it has been playing an anti-cyclical role, as a factor stimulating the economy as a whole. While up to the mid-90s the surge in agricultural prices have fed inflation and were subject to various types of price control policies (which proved always ineffective), since the launch of the Real Plan in 1994 the behaviour of real agricultural prices has been one of the anchors of the successful stabilisation plan. In addition, agribusiness exports have been the main source of foreign currency, whose availability has played a fundamental role in the transition from unsustainable foreign indebtedness status to the current creditor position and high credibility achieved by the Brazilian economy (Fig. 2.1).

Between 1980 and 1990 the real Agricultural GDP (Gross Domestic Product) grew 3.3 % per year; between 1990 and 2000 it grew 3.1 % and between 2000 and 2010 it grew 3.9 %, whereas Brazilian GDP grew 3 % in the first period, in the second one 1.65 % and the last one 3.7 % (Ipeadata 2011). In 2010, Agricultural GDP was

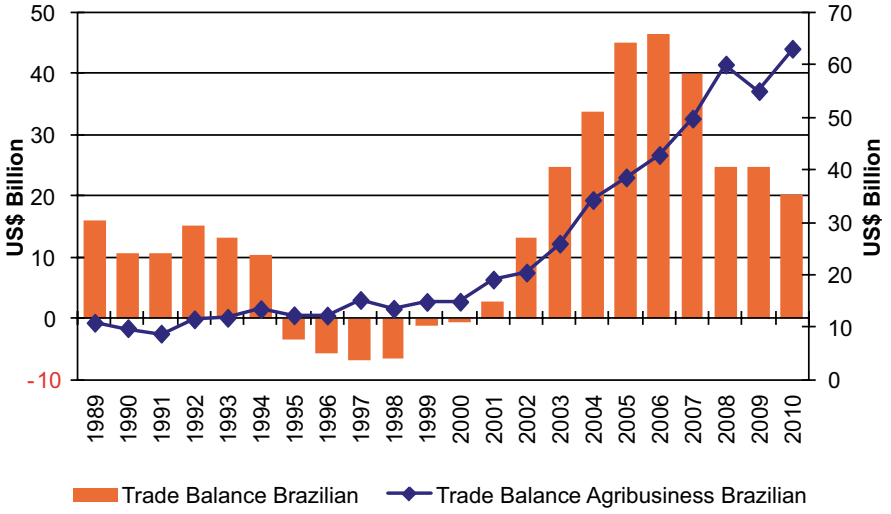

Fig. 2.1 Trade balance—total and Brazilian agribusiness: 1989–2010. (Source: Prepared by authors based on AgroStat 2011)

R$ 171 billion (US$ 97 billion), or 5.3 % of Brazilian GDP, and Agribusiness GDP reached R$ 821 billion (US$ 467 billion). The agriculture sector represented 26.5 % of Agribusiness GDP (Cepea-USP/CNA 2011) (Fig. 2.2). According to the National Agriculture Confederation—CNA (2008), agribusiness was responsible for the employment and occupation of 37 % of the employed Brazilian labour force.

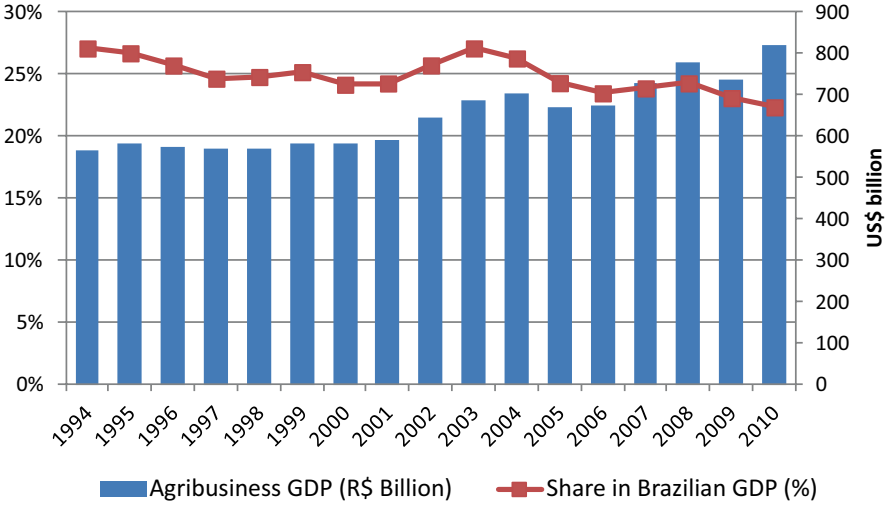

Fig. 2.2 Share in Brazilian GDP (%) and value (R$) of Brazilian agribusiness GDP: 1994–2010. (Source: Prepared by authors based on CEPEA/USP/CNA 2011)

Agribusiness has contributed most to the favourable performance of Brazilian foreign trade in recent years. Though international price increases have actually assisted in such performance, the expansion of physical exports accounts for 124% of the gains in 2000–2009 (Cepea-USP/CNA 2011)[2]. Agribusiness exports expanded at an average annual rate of 9% between 1989 and 2010—jumping from US$ 14 billion to US$ 76.4 billion—and its share of Brazilian exports has remained stable around 40%, whereas agriculture's share of imports fell to approximately 7% in 2010 (Fig. 2.3).

The recognition of the importance of agribusiness to the national economy as well as the expansion of agribusiness exports has contributed to the creation of a favourable context for investments and production; it has certainly exerted positive roles regarding policy support and fostering public and private investments as well as attracting new investors. However, at different periods, agriculture's positive performance has slid to excessive euphoria, which has probably led to overconfidence and disguised structural debilities in Brazilian agriculture.

Moreover, the expansion was not merely horizontal, sustained by the incorporation of new land and the growth of traditional tropical commodities, such as sugar and coffee, which characterise the traditional extensive pattern of growth. Both domestic institutional changes and innovation in production had a positive impact on the competitiveness and productivity of Brazilian agriculture, and allowed diversification to a broader variety of products, including fruit that, until then, had rarely been exported; it also opened up market opportunities and access to new markets

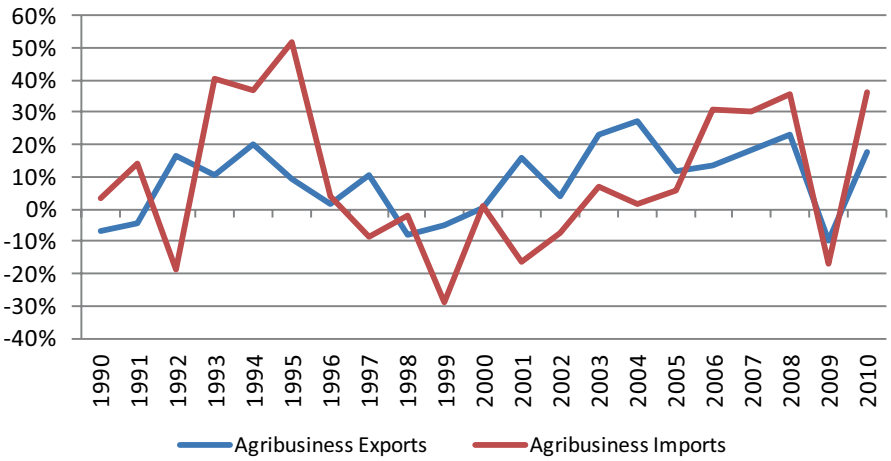

Fig. 2.3 Brazilian annual growth rate of agricultural exports and imports: 1990–2010. (Source: Prepared by authors based on AgroStat 2011)

[2] This performance is the result of the re-negotiation of farmers' debts, elimination of taxes on exports of non-manufactured products (Kandir Act), the 1999 devaluation of the Brazilian currency, high international prices of the commodities, and the emergence of animal health problems, such as mad cow disease.

(Russia, China, Middle Eastern countries, Chile, and Indonesia). The considerable increase of Brazilian share in world trade of several products, from soybeans to beef, pork and poultry, timber, sugar, bio-ethanol, paper and cellulose pulp, to quote the most important, can be taken as direct evidence of the revealed competitiveness of Brazilian producers (Silveira et al. 2005) (Fig. 2.4).

In recent decades, in the wake of institutional reforms, Brazilian agriculture and agribusiness have undergone broad economic restructuring, which is at the base of productivity gains and their competitiveness. As far as agriculture is concerned, at least four main interrelated dimensions should be mentioned: (i) innovation and technological changes; (ii) land use shifts; (iii) diversification of production; and (iv) the role of public policy.

The annual Brazilian production of grains[3] increased from 54 million t in 1990 to more than 140 million t in 2010. The new cycle of growth of agricultural production began in 1999 and gained strength recently, responding specifically to stimuli resulting from increased demand for grain in the world market, led by China. It is worth mentioning the performance of some agricultural products, which showed significant growth between 1980 and 2007: soybeans (284%), sugar cane (254%), maize (153%) and oranges (67%) (PAM/IBGE 2010) (Table 2.3).

This dynamism is related to trade liberalisation as well as to the shift in domestic agricultural policies, particularly the removal of ad hoc interventions on food price levels and on food supply flows. These included the elimination of export taxes for *in natura* products, and quotas and other imposed ad hoc restrictions due to domestic market conditions. In addition, the adoption of restrictive rules binding State

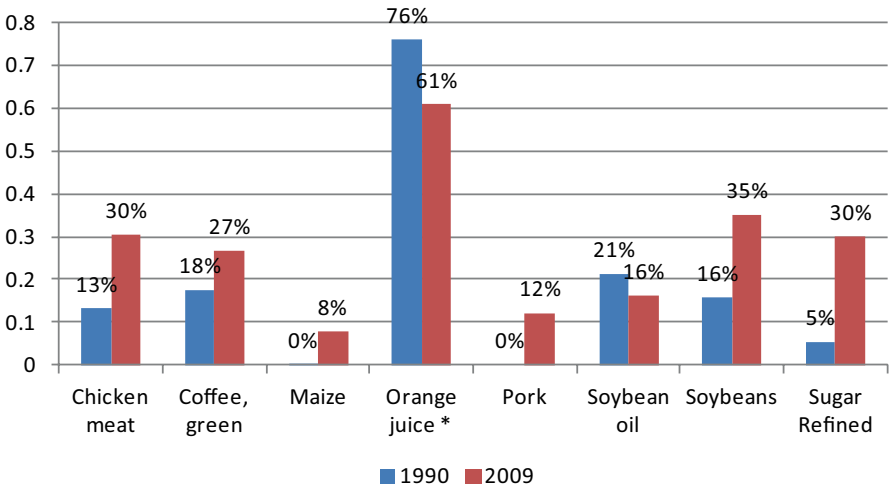

Fig. 2.4 Brazilian share in world trade by select products: 1990–2009 (Note: * concentrated). (Source: Prepared by the authors based on FAOSTAT 2011)

[3] Includes production of rice, oats, rye, barley, peas, broad beans, beans, sunflower, maize, soybeans, sorghum, wheat, and triticale.

Table 2.3 Evolution of production index of the quantity produced, productivity and harvested area by selected crops in Brazil: 1990–2010. (Source: Prepared by authors based on PAM/IBGE 2010)

Crops	Quantity produced			Harvest area (hectare)			Productivity		
	1990	2000	2010	1990	2000	2010	1990	2000	2010
Pineapple	100	182	200	100	182	176	100	100	113
Cotton (in seed)	100	113	165	100	58	60	100	195	277
Rice (paddy)	100	150	151	100	93	69	100	162	219
Sugar cane	100	124	273	100	112	212	100	110	129
Bean (grain)	100	137	141	100	93	73	100	148	193
Manioc	100	95	101	100	88	92	100	107	109
Watermelon	100	156	1409	100	118	140	100	131	1009
Melon	100	294	806	100	145	241	100	202	335
Maize (grain)	100	151	259	100	104	111	100	145	233
Soybean (grain)	100	165	346	100	119	203	100	139	170
Tomato	100	133	182	100	93	112	100	143	163
Wheat (grain)	100	56	199	100	42	81	100	131	245

interventions in agricultural markets has reduced negative market interventions and the so-called institutional risk.

Though the positive performance of Brazilian agriculture has indeed played the relevant role of securing sustainable food supply at stable and even decreasing real prices, the improvement in the food security situation is the result of a combination of several factors, among which we highlight the following: (i) price stabilisation and low rates of inflation; (ii) minimum wage real valorisation policy; and (iii) implementation and scale-up of universal pension benefits established by the 1988 Constitution. Nevertheless, these 'favourable' roles and performance cannot mask the structural changes in Brazilian agribusiness that made it possible to profit dynamically from the opportunities that arose.

2.2.1 Agriculture, Price Stabilisation, Income Redistribution and Food Security

Agriculture's positive performance is not confined to production expansion, growth of exports and trade balance surplus, but has contributed to monetary stabilisation, to improved food security, and the redistribution of income.

Brazilian food prices have shown remarkable stability since the Real Plan, and many have decreased in real terms (Fig. 2.5). In fact, the behaviour of agricultural prices—the green anchor—has been one of the successes of the Real Plan in bringing down inflation. The positive effects of food prices stability (Real Plan) and of the decrease in basic foodstuff real prices on food consumption, particularly for low-income groups, cannot be neglected. In fact, there is enough evidence to sustain the view that low-income groups have increased their consumption of poultry meat, dairy products, pasta and other industrialised food items, such as soups, canned

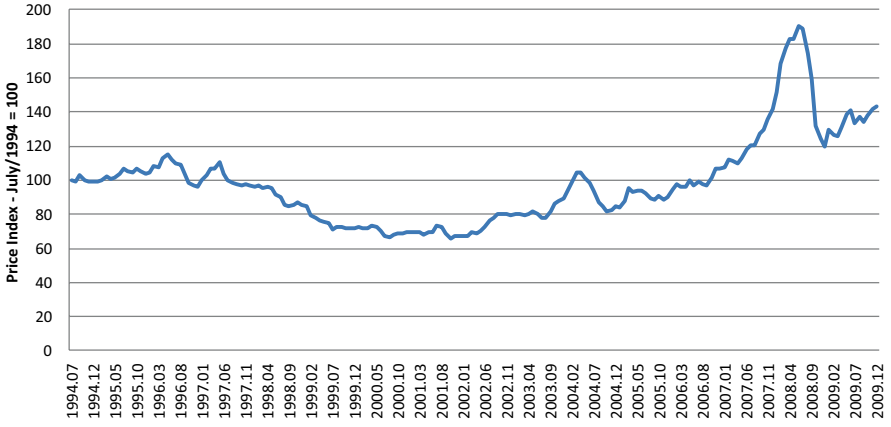

Fig. 2.5 Evolution of the price index of commodities (grains, oleaginous and fruits): 1994–2009 (July 1994 = 100). (Source: Prepared by authors based on IPEADATA 2011)

tomatoes and soft drinks. Data showing the rise in poultry meat consumption have been used for official propaganda to symbolise the positive social effects of the Real Plan.

While the behaviour of agricultural prices frustrated producers and added to the negative heritage of the inflationary period, it has certainly mitigated food security and the nutritional problems of the poor population. In fact, price stabilisation has played a significant positive role in improving the condition of the poor population.

In previous stabilisation experiences, as inflation rates fell abruptly, food demand and food prices increased. The food price increases contributed to jeopardising the heterodoxy stabilisation attempts. Short-term rigidity of agricultural supply in the context of a closed economy explains the behaviour of food prices before 1994.

After the Real Plan, this context changed and agricultural prices have indeed played a positive role in the stabilisation process. Food price trends were the result of various factors. On the one hand, trade liberalisation and import tariff cuts set an upper limit on agricultural prices and flattened seasonal fluctuations caused either by seasonal shortages or by market speculation. On the other hand, as agricultural products are mostly tradable, prices fell because of foreign exchange valorisation following the Real.

Beyond its positive macro effects, decrease in real food prices has certainly played a significant role in improving the food security status of the poor population. Food consumption increased and poverty decreased after the Real Plan. As the food needs of higher income groups are mostly satisfied, it can be assumed that lower-income groups were the main beneficiaries of cheaper food prices.

As Barros (2008) puts it, "in the 1990s, minimum wage increases took place at a time of decreasing real food prices, thus leading to higher real wages; poor families were able to spend more, not only on food but on other consumer goods as well. The redistribution of income through several sequential government programs, which culminated with the so-called *Bolsa Família*, which transferred cash to more than 11 million poor families" (p. 9).

In 2004, the *Instituto Brasileiro de Geografia e Estatística*—Brazilian Institute of Geography and Statistics (IBGE)—held the first national survey on food security; the same survey was replicated in 2009 (Table 2.4). The comparison between 2004 and 2009 allows an accurate view of the recent evolution as well as the current food security status in Brazil.

In 2004, 35% of Brazilian households were living in some degree of food insecurity and in 2009, this percentage fell to 30.2%, representing 65.6 million people. In 2009 there were nearly 40.1 million people in a low food insecurity situation; 14.3 million people in a moderate food insecurity situation and over 11 million people suffering from severe food insecurity. Interestingly, the percentage of households in situations of low food insecurity remained stable between 2004 and 2009 (18% of the total), while moderate and severe food insecurity status declined from 10 and 7% to 6.5 and 5%, respectively (Table 2.5).

This reduction in the percentage of households with moderate and severe food insecurity cannot be attributed solely, or primarily, to the expansion of food production and the stability and/or reduction in real prices of food; nor can it be attributed

Table 2.4 Description and scale of food security situation at household level. (Source: IBGE 2010)

Food security situation	Description
Food security	Regular and permanent access to quality food in sufficient quantity without compromising access to other essential needs
Low food insecurity	Concern or uncertainty about access to food in the future; inadequate quality of food resulting from strategies that aim not to compromise the amount of food
Moderate food insecurity	Quantitative reduction of food among adults and/or disruption in eating patterns resulting from lack of food among adults
Severe food insecurity	Quantitative reduction of food among children and/or disruption in eating patterns resulting from lack of food among children; hunger, when someone goes the whole day without eating due to lack of income to buy food

Table 2.5 Brazilian householders by food security situation: 2004/2009. (Source: Prepared by the authors based on IBGE 2010)

Food security situation	Total		Urban		Rural	
	Number	%	Number	%	Number	%
2004						
Total	51.666	100.0	43.671	100.0	7.996	100.0
Food security	33.607	65.0	29.099	66.7	4.508	56.4
Food insecurity	18.035	34.9	14.55	33.3	3.485	43.6
Low	9.321	18.0	7.711	17.7	1.61	20.1
Moderate	5.123	9.9	4.012	9.2	1.111	13.9
Severe	3.592	7.0	2.827	6.5	765	9.6
2009						
Total	58.646	100.0	49.882	100.0	8.764	100.0
Food security	40.909	69.8	35.223	70.6	5.685	64.9
Food insecurity	17.738	30.2	14.659	29.4	3.079	35.1
Low	10.973	18.7	9.258	18.6	1.715	19.6
Moderate	3.834	6.5	3.082	6.2	753	8.6
Severe	2.93	5.0	2.319	4.6	611	7.0

only to the direct impact of conditional cash transfer programmes focused on the poorest and to the distribution of food baskets to vulnerable groups. We shall rewturn to this theme.

The improvement in the food security situation is the result of a combination of several factors, among which we highlight the following: (i) price stabilisation and low rates of inflation; (ii) minimum wage real valorisation policy, which has been pursued since 1995 and has led to a real increase of 105% in the real minimum wage from R$ 255 (US$ 277.1) to R$ 522 (US$ 296.6); and (iii) implementation and scale-up of universal pension benefits established by the 1988 Constitution, which extended pension benefits to all, irrespective of formal enrolment or previous contribution to the existing public or private pension institutions and funds. This has benefited the rural poor more, the majority of whom had no legal rights under the previous regime and were left unattended and entirely dependent on family and charity support. The basic pension benefit was set at one minimum wage per entitled person and not by household. It is currently common to find households with more than one retired person.

The conditional income transfer programme, *Bolsa Família* (BFP), was launched by the Brazilian Federal Government in October 2003, as a result of the unification of four income transfer federal programmes: *Bolsa Escola, Bolsa Alimentação, Auxílio Gás, and Cartão Alimentação* (Table 2.7). BFP has three main lines of action: (i) immediate relief of poverty (income transfers); (ii) strengthening basic social rights—health and education (conditionalities); and (iii) supporting the generation of opportunities for the development of families (complementary programmes or actions). The participation in BFP is restricted to poor families that have monthly per capita income up to R$ 140 (US$ 79.5) and are registered in the Unified Register for Social Programs (*Cadastro Único para Programas Sociais*) (MDS 2011) (Table 2.6).

In 2010, the *Bolsa Família* programme was attended by approximately 12.8 million families, who received a total contribution (transfer value) of R$ 14.4 billion (US$ 8.18 billion) (Table 2.7).

In summary, the BFP undoubtedly had positive effects, particularly for the poorest families and the vulnerable. The value of transfers is not sufficient to ensure food security for poor households; although small, it allows families to purchase some basic items and contributes mainly to improve general welfare and to promote

Table 2.6 Main modalities of BFP benefits. (Source: Prepared by authors based on MDS 2011)

Modalities	Target-public	Transfer value
Basic benefit—BB	Families with per capita income up R$ 70 (US$ 39.8)	R$ 68 (US$ 38.6)
Variable benefit—BV	Families with children and teenagers between 0 and 15 years old	R$ 22 (US$ 12.5) per child/teenager. Maximum benefit value is R$ 66 (US$ 37.5)
Variable benefit linked to teenager—BVJ	Families with teenagers between 16 and 17 years old	R$ 33 per teenager. Maximum benefit value is R$ 66 (US$ 37.5)

Maximum benefit value is R$ 200 (US$ 113.6) (sum of BB, BV and BVJ)

Table 2.7 Summary of Transfer realised by *Bolsa Família* Program: 2010. (Source: Prepared by the authors based on MDS 2011)

Region	Total poor families	Programa bolsa família		
		Municipalities assisted	Poor families assisted	Transfer (R$ million)
Middle West	789,026	466	725,216	721.9
Northeast	6,098,232	1794	6,454,764	7,582.5
North	1,283,119	449	1,348,329	1694.8
Southeast	3,562,195	1668	3,185,843	3276.7
South	1,262,623	1188	1,064,068	1096.8
Brazil	12,995,195	5564	12,785,154	14,372.7

Average monthly transfer is R$ 93.68 (US$ 53.2)

some social inclusion. The indication that families use the money to pay for electricity bills, transportation and educational material, rather than negative, confirms the importance of social transfers to ensure a minimum capacity for poor families to deal with their 'urgencies'.

2.2.2 Institutions and Policies: from State-Driven to State-Controlled Liberalisation

Public policies have played the most relevant role in shaping Brazilian agriculture as shown by recent performance as well as some of the main structural features of the sector. Until the 1980's, agricultural policy was highly interventionist and required substantial financial transfers, both to compensate producers for anti-agrarian biased macroeconomic policies as well as to induce farmers to adopt certain productive behaviour. Although compulsory measures have been used in some cases to regulate production and demand flows, government intervention in production and markets was mostly carried out through market instruments. The effectiveness of these interventions required financial transfers, such as subsidies to rural credit, government procurement at prices above market prices, public stockholding to sustain prices and so on.

During the 80s, successive ad hoc agricultural policy changes were introduced in response to short-term macroeconomic or sectorial concerns—price increases food, supply shortages, or strong political pressures from organised sectors. By the end of the 80s and at the beginning of the 90s, State intervention—and lack of intervention—had become rather chaotic. Instead of responding to pre-defined sectoral objectives and strategy, it was mainly characterised by *ex post* interventions in response to either political pressure from large agricultural producers or to monetary stabilisation concerns. Agricultural policy, which in the past had been functional and capable of regulating production flows and securing a reasonable performance

from the agricultural sector,[4] became incapable of dealing with the mounting agricultural problems as well as the challenges created by the new economic and institutional context.

In 1990s, the aim of macroeconomic policy shifted to ensure both macroeconomic stability and an adequate economic environment for private investments. This change in the nature of macroeconomic policy had a direct impact upon the economy as a whole and agricultural policy in particular. As a consequence, financial transfers to both agriculture and industry were reduced. As 'cheap and abundant' rural credit was at the very core of agricultural policy, previous policy arrangements and rationale were virtually dismantled by the increasing financial constraint.

In past years, agricultural policy has indeed been successful in promoting investment and the growth of Brazilian agriculture. On the one hand, financing from the National Economic and Social Development Bank (BNDES) has been crucial to sustain farmers and agro industries' investments in machinery and new plants in the frontier zones. On the other hand, the creation of the Family Farmers Support Program (Pronaf) in 1995 has channelled increasing amounts of resources to previously excluded small and family farmers. Yet Pronaf and Agrarian Reform Programs have not been successful as far as the productive strengthening of small producers is concerned—whose majority is still excluded from the benefits of agricultural policy; both policies helped to ease social tensions in rural areas. Yet agricultural policy failed to remove structural obstacles that hinder sustainable agricultural development. It is still largely made up of short-term interventions, announced every year, and lack long-term planning and institutional reforms and the definitions needed to create a sound environment for inclusive and sustainable agricultural growth.

The government seems to be aware that it is not just possible to discontinue traditional policy instruments and replace them automatically by alternative instruments. It is therefore introducing new instruments, testing alternative arrangements, and educating and stimulating farmers to make use of the new instruments. The strategy is to introduce market instruments slowly and eventually to replace traditional government-managed instruments. While capitalist agriculture would rely mostly on market mechanisms, the government would focus and channel its resources to support rural development, agrarian reform and family farmers. The cornerstone of this strategy is the Agrarian Reform and PRONAF (*Programa Nacional de Fortalecimento da Agricultura Familiar*) (Box 1).

[4] Agricultural policy was functional, in spite of its inefficiency and overall negative side effects—at least for some producers and crops.

Box 1—PRONAF

PRONAF was first presented in 1995 with the creation of Program of Small Rural Production to provide small producers with special financing conditions. In June 28, 1996, Brazilian Government through Decree No 1.946 created officially the PRONAF. In 1997/1998, over R$ 1 billion (US$ 927 million) was allocated to PRONAF. In 2010/2011, Brazilian Government will allocate around R$ 16 billion (US$ 9.1 billion) to two million family farming (MDA 2011a).

PRONAF's development objective is to enhance family farms production capacity, to generate employment and income in the rural areas, to reduce rural poverty and improve overall life quality in rural areas. Its specific objectives are: adjust public policies to the needs of family farm; provide and improve rural infrastructure required for sustainable development of family farms; strengthen support services to family farms; strengthen family farmers' managerial and technological capacity and facilitate family farmers' access to financing and support services.

2.3 Sources of Growth and Competitiveness of Brazilian Agribusiness: Empirical Evidence

Brazil has a continental territory and the occupation of the frontier has always been part of the process. In the past 30 years, agricultural activity has led, for good and bad, the settlement and incorporation of the new areas into the national economy, the creation of new poles of development, and the creation and expansion of new urban centres that are responsible for the absorption of sizeable populous groups. Although the incorporation of new areas has played an important part in the recent evolution of agricultural production in Brazil, the reallocation of land use and increased productivity were factors that are even more significant.

Gasques et al. (2004, 2007, 2011) analyse the determinants of the growth of Brazilian agriculture between 1975 and 2010, based on Total Factor Productivity (TFP) methodology.[5] The results confirm that more efficient use of the land—associated with innovations and production management—has played a major positive role in the sector's performance (Table 2.8).

Over the long run, viz., 1975–2010, agricultural production expanded at an annual rate of 3.74%; more recently (period 2001–2010) the annual rate of growth

[5] The PTF is the relationship of all products and inputs measured by rates. If the total relationship of products and inputs is growing, the relationship can be interpreted as indicating that more products can be obtained from a given amount of inputs. The growth rate of the PTF is calculated as the difference between the product's growth rate versus the overall growth rate of inputs. As is common knowledge, a higher PTF represents increases in a product in terms of more efficient use of production factors, given the use of a different technological level. Variations in the PTF over time can be the result of differences in efficiency at different moments, of variations in production scales or levels, or of technological changes (Gasques et al. 2007).

Table 2.8 Sources of Brazilian agriculture growth, 1975–2010. (Source: Gasques et al. 2011)

Year	Product	Input	PTF	Labour force	Land	Capital
Annual rate of growth (%)						
1975–2010	*3.74*	*0.12*	*3.62*	*−0.48*	*0.02*	*0.70*
1980–1989	3.38	1.09	2.27	1.23	0.47	0.49
1990–1999	3.01	0.35	2.65	3.11	2.06	3.14
2001–2010	4.75	−0.53	5.31	−1.00	−0.58	0.53

was 4.75%. There was a significant growth of the TFP, around 3.62% per year between 1975 and 2010. The capital rate increased 0.7% per year between 1975 and 2010. In any case, an analysis of the annual growth rates shows that the increase in production is set off by more efficient use of inputs and higher labour productivity, which identified a TFP of 2.65% for the 1990's (Gasques et al. 2011).

It is worth drawing attention to the increase in labour productivity, traditionally a low-qualified resource. However, this situation is still largely true; there is a clear association between the increase in labour productivity and the professional qualifications of the labour force. Balsadi (2007) identified higher educational level amongst rural workers; new technology is certainly leading to the selection of higher qualified and better-paid workers.

Another source is the acquisition of fertilisers, pesticides, machinery and agricultural appliances between 1996 and 2009, that evolved favourably in the domestic market, in spite of the difficulties of the Brazilian economy and financing restrictions faced by producers until 1999, when broad debt restructuring was enforced. The acquisition of machinery and equipment increased steadily in the period 1997–2005, and again in 2008 and 2009, as a response to a federal government's support programme for the modernisation of the country's tractor fleet. Domestic sales of fertilisers and inputs in general have also increased in the late 1990s. Pesticide use has fallen considerably since 1999, certainly in response to changes in relative prices due to the 1999 devaluation but also to improvements in production management and the introduction of reduced pesticide requirement techniques (ANDA 2010; MAPA 2010).

The introduction of new varieties and mechanisation were, undoubtedly, the leading vectors of innovation. Sales of farm vehicles registered an enormous growth in the period 1996–2009, jumping from a modest 11,926 units in 1996 to more than 50,000 units in 2009. Sales of harvesters rose from less than 1000 units in 1996 to over 5000 at the end of the period, a 500% growth (ANFAVEA 2010)[6] (Table 2.9).

The apparent consumption of agro chemicals—herbicides, fungicides and insecticides—has also shown steady growth over the period 1996–2005. Fertiliser consumption has also increased over the period, with sales rising from 13,800,000 t to over 22,800,000 t between 1997 and 2005, and in 2007 reached 24,600,000 t (ANDA 2010; MAPA 2010) (Fig. 2.6).

[6] Associação Nacional dos Fabricantes de Veículos Automotores—Brasil (Anfavea).

Table 2.9 Domestic wholesale sales (Brazilian-made and imported) distributed by groups of products. (Source: Prepared by the authors based on ANFAVEA 2010)

Year	Tillers (motorised cultivators)	Wheeled tractors	Combines (harvesters)	Total
1994	1.308	38.518	4.049	43.875
1995	1.210	17.594	1.423	20.227
1996	714	10.312	900	11.926
1997	707	16.049	1.709	18.465
2002	1.050	33.217	5.648	39.915
2003	1.585	29.476	5.440	36.501
2005	2.141	17.729	1.534	21.404
2009	2.960	44.206	3.817	50.983

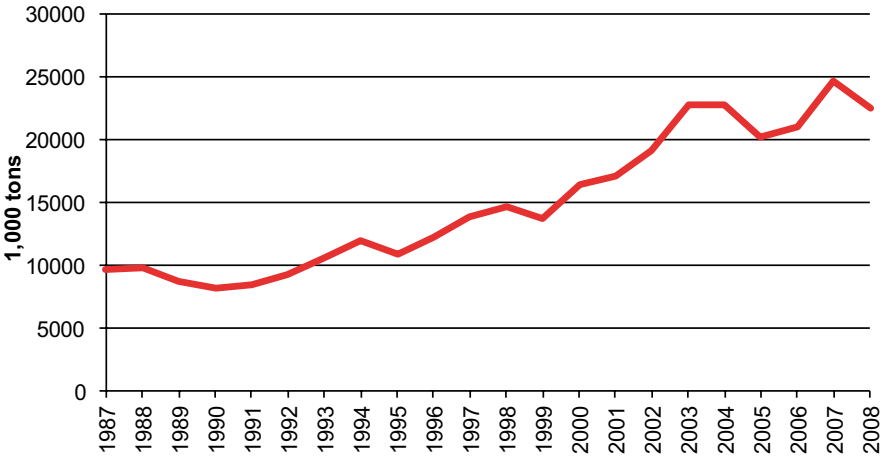

Fig. 2.6 Fertilisers delivered to final consumer between 1987 and 2008 (1000 t). (Source: Prepared by the authors based on ANDA (2010) and MAPA (2010))

The increase in fertiliser consumption is closely related to the incorporation of new arable land into production rather than to intensification of fertiliser use. Early occupation of the Central West frontier in the 1960–1980s had left behind large tracts of degraded land, improper for cultivation and even for semi-intensive cattle raising. These areas were reclaimed during the 1990s for productive exploitation through the application of soil correction techniques and the introduction of modern and sustainable farming methods.

In this regard, it should be noted that it is no longer possible to associate, without proper qualification, the use of chemical inputs with innovation and technological modernisation. On the contrary, many technological innovations, including genetically modified seeds and more efficient management methods, are specifically focused on reducing the use of such inputs. In the case of Brazilian agriculture,

the analysis of the TFP showed lower use of these inputs, and this fact, associated with higher productivity, leads to the conclusion that management of agricultural production systems has improved.

No less important, the seed-producing sector is also partially responsible for the success of Brazilian agribusiness. This sector showed increases in production and productivity in a context of intense scientific and biotechnological research. In this case, the public sector is strongly representative in both its institutional and operational modes, and in making financial resources available for research and development (R&D). Publicity regarding improved seeds and their use has contributed to the introduction of new, hybrid varieties, and this has favoured the growth of farm production in general. Seed market is highly concentrated in three crops: soybeans (56.7%), wheat (14.6%) and corn (12.2%).

Buainain et al. (2005) found a high positive correlation between the rate of use of seeds and average productivity. Analysing the evolution of productivity amongst regions, they found that productivity increased faster in those states that presented broader use of improved seeds. The obvious conclusion is that more intensive use of improved seeds is a strategic and fundamental factor for the progress of grain production in Brazil. They point out that the incorporation of improved seeds by farmers is usually accompanied by the introduction of better production practices, including plant health, pest and disease control and the intensification of technological transfer among farmers.

Finally, another source is the reduction in tariff and non-tariff barriers that led to the reduction of prices of inputs and imported equipment, thus partially offsetting the fall in prices suffered by producers between 1995 and 2003. Favourable terms of trade have played a key role in the recent boom of Brazilian agribusiness. The combination of higher international prices and the devaluation of the national currency can offset, at least partially, the systemic inefficiencies that hinder the economic growth of Brazilian agriculture.

2.3.1 Brazilian System of Innovation in Agriculture: key features and roles

The pattern and rhythm of growth are also the result of structural and particular institutional features of Brazilian society as well as of planned and fortuitous policy interventions rather than of the workings of any invisible hand. Innovation was a key factor, but financing, trade, and industrial and price policies were quite important. Land distribution, land ownership and the accompanying land policy are key institutional features of Brazilian agriculture. In fact, land policy was highly permissive and allowed, for decades, unlawful land grabbing of vast areas in the frontiers zones; legal ownership of land was granted without any financial compensation or clear social and environmental contracts regarding the appropriation and use of fiscal land. It is such permissiveness, and not the colonial heritage that explains the skewed land distribution pattern in contemporary Brazilian society, which has shaped the recent modernisation of Brazilian agriculture.

The public sector has played a central role both in the innovation of processes and in the diffusion of technology in the agricultural sector. Since the early 1970s, Brazil has been developing a solid system of innovation in agriculture, whose construction, consolidation and effectiveness are all the results of consistent long-term efforts of multiple public and private stakeholders.

In 1992 the National Agricultural Research System (SNPA) was formally created and was integrated with Embrapa (Brazilian Agricultural Research Company) (Box 2), State Agricultural Research Organisations (OEPAs), universities and research institutes at the federal and state as well as other public and private organisations engaged to varying extents in agricultural research. It also includes privatised companies, subsidiaries of international corporations and private R&D Brazilian companies that usually occupy 'market niches' (Fonseca et al. 2004). Approximately 22 state research organisations (OEPAs), operating in all five regions in Brazil, participate in the SNPA (Embrapa 2011b). According to Vieira Filho (2010), in 2006 OEPAs had more than 1800 researchers, carrying out around 2100 R&D projects in 230 laboratories and 215 experimental stations.

Box 2—EMBRAPA: A Case of Successful Institutional Innovation

Embrapa was created in 1972 and is bound to the Ministry of Agriculture. In 2010, Embrapa had 9249 employees (Embrapa 2011a). In 2009, 2010 and 2011 the Embrapa budget was almost US$ 800 million. Embrapa can be considered a case of successful institutional innovation that has many distinctive characteristics: a public corporation model of organisation; scale of operation at the national level; spatial decentralisation; specialised research units; enhanced training and remuneration of human resources; and a vision of an agriculture based on science, technology and innovation. The main aspects of the organisation's development and consolidation can be summarised in: (1) Continuous support from the Federal Government; (2) Diversified R&D portfolio; (3) Timing and social support; (4) Option for a public corporation model; (5) Scale, interactivity and decentralisation; (6) A concentrated organisation model for the research units; (7) Human resources; (8) Professional relations and coexistence with power; (9) Independent reviews and evaluations of impact; (10) Communication with society; (11) Foresight and institutional flexibility. Source: Lopes and Arcuri (2010)

Embrapa emerged as the most prominent organisation, undervaluing the contribution of several other relevant institutions, such as the Agronomic Institute of Campinas (AIC), the *Escola Superior de Agricultura "Luiz de Queiroz"* (Esalq), a faculty of the University of São Paulo (USP), the Federal University of Viçosa in Minas Gerais, and the Federal University of Santa Maria in the southern state of Rio Grande do Sul, which are all good examples of highly productive agro research centres. Figure 2.7 depicts the evolution of Brazilian agricultural research institutions.

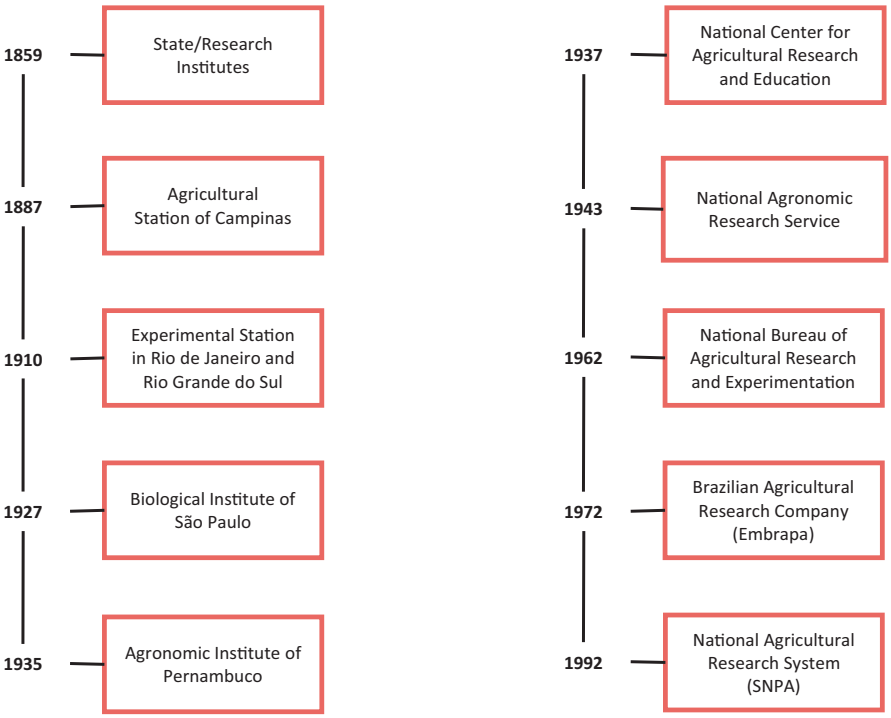

Fig. 2.7 History of Brazilian agricultural research. (Source: Prepared by the authors based on Faccion 2010)

The work carried out by Embrapa played a fundamental role in the increase in the production of grains in Brazil, especially the introduction and spread of soybeans. Soybean—a crop grown in temperate climates—was adapted to the conditions of the Brazilian climate and today Brazil is the world's second largest producer. Approximately 50% of the area cultivated with soybeans in the country uses plants developed with the participation of Embrapa and approximately 90% of the area where rice and beans are grown uses plants that it developed. The company contributed to the promotion of the technological advances in modern Brazilian farming that addressed the development of techniques for biological and integrated control of harmful biological agents. It should also be noted that, thanks to these efforts, Brazil now has one of the largest areas of direct planting in the world.

Embrapa is focusing on the development of solutions for the sustainable development of Brazilian agribusiness through the generation, adaptation, and transfer of knowledge and technologies. While committed to efficient use of public funds, the allocation of resources is based on a strategic view regarding the needs of Brazilian agribusiness but also on short-term political pressures exerted by the government, parliament, producers' organisations, NGOs and even international stakeholders. Since 2007, Embrapa has received a renewed burst from the Federal government, which invested in modernisation and construction of new installations, creation of

new centres, and hiring of 600 new young scientists. Yet Embrapa can hardly provide support to all segments and regions related to agribusiness and, unless priorities are clearly defined to guide the company's actions, the increasing number of priorities and level of dispersion may jeopardise its future.

However, there are centres of excellence in research and even cases where there is a process of competition and cooperation with Embrapa in important areas, such as the improvement of plant varieties (especially for the Rural Agency of Goiás, IAC, IAPAR), food technology, and support to programmes aimed at conservationist and environmental questions, such as that of the micro basins in São Paulo (APTA) and Paraná (IAPAR) (CONSEPA 2011).

2.4 Obstacles and Challenges for Brazilian Agriculture

The current challenges for the agricultural sector are not different from the ones the Brazilian economy as a whole is facing: how to achieve real sustainable competitiveness and simultaneously overcome mounting social inequalities, in particular rural and urban poverty and misery.

Brazil has 90–150 million ha of unused arable land (most conservative estimate) to sustain the increase in agricultural production without further deforestation. They are mostly degraded pastures and savannah land with high potential to be used for agriculture, whose exploitation under appropriate production systems would have minor environmental impact. Besides, as Brazilian agriculture is deeply heterogeneous, there are opportunities to improve the use of land and to increase the productivity of many productive systems, from sugar cane to cattle breeding and even traditionally extractive crops.

This improvement, based on a greener technology than the current ones, depends fundamentally on investments in R&D and financing for innovation at the farm level. It also depends on new institutional arrangements to remunerate producers for valuing nature, an evident problem for countries facing serious social problems that in the end are a priority over environmental concerns.

In addition to favourable weather and abundant lands, Brazil has well-informed elite of rural producers that may lead sector growth, grasp current opportunities and create others. They are aware of technological innovations, market demands and conditions and of increasing social and environmental requirements regarding the production process.

Without neglecting external restrictions, the main obstacles faced by Brazilian agribusiness are domestic: (i) poor infrastructure; (ii) producers' high indebtedness; (iii) capacity to sustain innovation; (iv) institutional frame and property rights; (v) financing and fixed capital relative cost; and (vi) lack of risk management tools.

To sustain Brazilian agribusiness' growth it is necessary to combine and to converge several highly complex processes. The scientific and technological innovations should be fundamental.

As mentioned above, in recent years innovation made possible the occupation of the agricultural frontier in areas previously considered inappropriate for agriculture, with bearable environmental effects. However, to sustain further growth a substantial increase in the productivity of lands already cultivated will be required. Based only on the occupation of degraded land and productivity increase, it will be possible to expand without further damage to the environment. This is not an easy task, particularly when considering the lack and/or inadequacy of mechanisms to avoid negative externalities and to economically value the environment and nature. In Brazil, a standing tree is still undervalued (if it is valued at all) by landowners, while a cut tree may complement revenue and may secure the tenure of new areas for agricultural use. While this reality remains, political objectives and decisions on zero deforestation will remain nice paper plans, full of good and sincere intentions.

It should be noted that after 1990 the rate of productivity increase of several crops has suffered a slowdown. This might be associated with high heterogeneity and lack of incentives and conditions for many producers to invest in innovation, and also to technological and institutional barriers to the introduction of innovation. It is not at all absurd to raise doubts about the limits of the current technological paradigm to sustain further and significant productivity growths as registered in the past.

In fact, Vieira Junior (2006) maintains that the productivity of the main vegetable species commercially explored is quite close to their respective potential productivities. According to him, at least in the near future, technological innovations based on transgenic species resistant to pests and diseases will not contribute to increased yield productivity. The major impacts of this technology will be on cost and environment concerns. Genetic engineering's best contribution to increasing agricultural production shall be the development of species more tolerant to environmental stress that are still not available.

The challenge to meet demand's growth is not a small one. In the past, Brazilian agriculture met relatively permissive conditions to answer economic incentives and to expand agricultural production. On one side, a wide availability of relatively fertile land and of relatively easy incorporation into production allowed the fast expansion of the agricultural frontier, with relatively low economical costs—although with high environmental costs. On another side, the institutional environment was not so strict regarding the incorporation of technical progress. The growth of demand, associated with the outstanding experiences of food insecurity, created favourable conditions to mobilise public resources for R&D applied to agriculture and to apply, almost without restrictions, any technologies that could contribute to increase yield per area and total productivity factors. Conditional requirements such as environmental concerns, global warming, food safety and food security, which are now part of the equation to be solved, at that time were not even raised as matters of concern.

In the first 80 years of the past century, Brazilian agriculture expanded into new lands. The incorporation of additional new land into production is currently subject to increasing regulatory restrictions, and growth will have to be sustained by innovation, more efficient use of land and higher productivity. Although Brazil still has

between 90 and 150 million of ha that could be used for agriculture, barriers for an immediate increase of production are higher and will require more efforts than in the past. Let us get a closer look at the context and obstacles ahead.

In the past two decades, the institutional context, composed of trade rules and norms, consumers' demands, technology, macro and sectoral policies as well as the cultural aspects, have suffered deep transformations that substantially affect the productive and technological dynamics of all productive chains.

As mentioned, the Brazilian economy, relatively closed until the 1990s, was subjected to quite deep institutional changes, particularly trade liberalisation, which is more comprehensive and deep than the simple analysis of tariffs and trade flows might indicate.

In the international scene, the globalisation process enlarged in geographical terms and deepened in a remarkable way. The integration of China in the world market as well as its affiliation to WTO is the most outstanding symbols of globalisation and had a major impact in the restructuring of world markets. Also remarkable is the presence of India, Russia, South Africa and Brazil as new players in the global economy.

A set of structural factors is provoking deep transformations in food consumption trends, with direct impacts on the organisation of agribusiness chains. World population continues to grow and is getting older. The demographic changes, by themselves, have important implications on the food market, not only because of its enlargement but also mainly because of consumers' new demands.

The broadcast and the diffusion of information on a global scale contribute to instill real life into the so-called 'global village', changing consumption habits and consumers' preferences. The elevation of educational level and income of the population are also important factors.

Brazilian agriculture does not have relevant subsidies and it is competitive to expand into the world market. However, important sectors such as beef, ethanol, orange juice, and fruit face market access restrictions that hinder their growth potential.

On the other side, the Brazilian experience of using the WTO to reverse illegal trade practices—as in the case of cotton—did not produce concrete results in terms of market access. Even the effectiveness of the retaliation authorised by the WTO is questionable, as its application may be followed by unilateral counter-retaliation by the USA that may affect Brazilian exports more than the authorised retaliation will damage US exports to Brazil.

Climate change is already distorting well-known weather patterns and increasing climate risk in many traditional farming zones. In Brazil, the expected negative impact varies from 15 to 25% in the south, central and northeast areas and above 25% in Western Amazonia. Embrapa forecasts regarding the immediate effects of climate change are not optimistic. According to the study 'Global Warming and Future Brazilian Agriculture Scenarios' that evaluates the impact of temperature increase on agriculture in 2020, 2050 and 2070, 'global warming may provoke a significant change in Brazilian agriculture's map, reducing producing areas and economic damages of R$ 7.4 billion in 2020 and R$ 14 billion in 2070'

(Assad and Silveira Pinto 2008, p 13). The study evaluated the following crops: cotton, rice, bean, coffee, sugar cane, sunflower, manioc, corn and soy.

An increasing number of people understand the seriousness of the environmental problem, locally or globally. The concern with natural resources has deep impacts over the whole logic of the sector, particularly regarding the use of technologies. In the past, the technological drive was to increase production and revenue and secondarily to reduce cost, without major concern for environmental impacts. This 'philosophy' guided the Green Revolution and was responsible for the enormous progress of agriculture as well as for the removal, in these past 50 years, of the Malthusian ghost. The total productivity factor increased considerably and allowed the multiplication of food in proportions perhaps equivalent to the biblical miracle of the multiplication of fishes.

This progress was reached, at least partly, with the sacrifice of natural resources and with negative impacts on the environment in general. The current context is different. Productivity elevation and/or production cost reduction no longer may be reached at the expense of the environment. The analysis of environmental impact became, in the new context, a pre-condition for the feasibility of any technology, from the simplest to the most sophisticated one.

The new environmental rules impose, in a brand new way, the convergence between micro and macro interests, between the producers and society interests, expressed by the international trade rules and by a set of demands, many of them still not transformed into written norms and approved for the bodies that regulate the economy and consumers in general.

In the current context, although technology may be profitable from the microeconomic point of view, it shall hardly become hegemonic and disseminated if it does not conform to established patterns, especially the ones related to food quality and safety as well as to environmental requirements.

At the same time that the market and consumers value, more and more, the product with all its attributes and qualities, a growing concern is observed—non-existent until some time ago—with the production process. It is not enough to know that the product is good; it is necessary to know how it was done. What inputs were used in the production? Is the technology friendly to the environment? Is it socially sustainable? Was child labour employed? Where was it produced, in what country? How did it get here? In this new context, more and more, it is fundamental to identify the technology used and the production processes, and to track and certify the whole production of the agribusiness.

This institutional context that is partially new and still being consolidated points out, in an unequivocal way, to future tendencies that cannot be ignored by companies, governments and producers. The world market is under restructuring. Although in many segments the availability of natural resources is a necessary condition to growth, competitiveness is more and more determined by the capacity to answer to the consumers' demands and preferences. Moreover, in the future, competitiveness will depend on the capacity to anticipate demands and transform them in sources to aggregate value to the agribusiness products through technological innovations.

Agricultural subsidies in the US and Europe continue to restrict the growth potential of world agricultural production, particularly in countries like Brazil that have great potential to grow. Before the 2008 food crisis, what was the explanation for the persistence of protectionist programmes? If there is an evident loss of welfare, what is the logic that sustains the protectionist policies? As Zylbersztajn (2008) put it, the incentives for private groups to organise in defence of protection predominate over those of groups that would benefit from the reduction of protectionist policies.

Considering the above mentioned, it can be said that institutional issues are the main obstacle to increasing food production in countries such as Brazil, because in addition to limiting production itself, they inhibit investment in R&D, which constrains the future of world agriculture.

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