



CADERNOS

# FGV PROJETOS

NOVEMBER 2011 • YEAR 6 • Nº 17 • ISSN 1984-4883

## AGRIBUSINESS IN BRAZIL

INTERVIEW

JOSÉ GRAZIANO

ARTICLES

ANTÔNIO CARLOS COSTA • CLÁUDIO RIBEIRO DE LUCINDA •  
CLEBER GUARANY • EDÍLSON P. FRAGALLE • FERNANDO MACÊDO •  
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NOVEMBER 2011 • YEAR 6 • Nº 17 • ISSN 1984-4883

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# editorial

## FGV PROJECTS

### EDITORIAL

*Cesar Cunha Campos*

DIRECTOR  
FGV PROJECTS

Dear readers,

FGV Projects, together with the Agribusiness Center of the São Paulo School of Economics of FGV Foundation (GV Agro/EESP), has been at the forefront of major advances in Brazilian and international agribusiness. At the global level, FGV Foundation has worked together with the Brazilian Ministry of Foreign Affairs and major international organizations to develop and implement economic and financial feasibility projects relating to agroenergy in several Tropical Belt countries. A number of technical cooperation agreements have been signed to facilitate work in this field, including partnerships between: (1) Brazil and the United States for the promotion and development of biomass energy in Central America and the Caribbean; (2) the Brazilian Ministry of Foreign Affairs and African countries to develop biomass projects; and (3) the European Union and Brazil for a feasibility study of biofuel and foodstuff production in Mozambique. As a result of these initiatives, 13 countries have already been the subject of feasibility studies for the development of more than 50 biomass projects related to ethanol, biodiesel, electricity, steam, and foodstuffs. In Brazil, FGV Foundation leads the discussion on major issues related to agribusiness, in close collaboration with the Brazilian Agricultural Research Corporation (Embrapa), which has published the Brazilian agribusiness magazine *Agroanalysis* for 30 years.

In this publication - specially developed for the Organisation for Economic Co-operation and Development (OECD) and FGV Foundation's seminar "Agribusiness in Brazil: Policies, Experiences and Perspectives" (Paris, November 2011) - we present an overview of the current state of Brazilian agribusiness and its contribution to the world. We begin with an interview with José Graziano, the recently elected Director General of the United Nations Food and Agriculture Organization (FAO). It is no coincidence that the new FAO president is a Brazilian. Brazil's

growing role on the world stage is also related to its proven success in reducing hunger and poverty among its own people, through programs that can be replicated in other countries via the FAO.

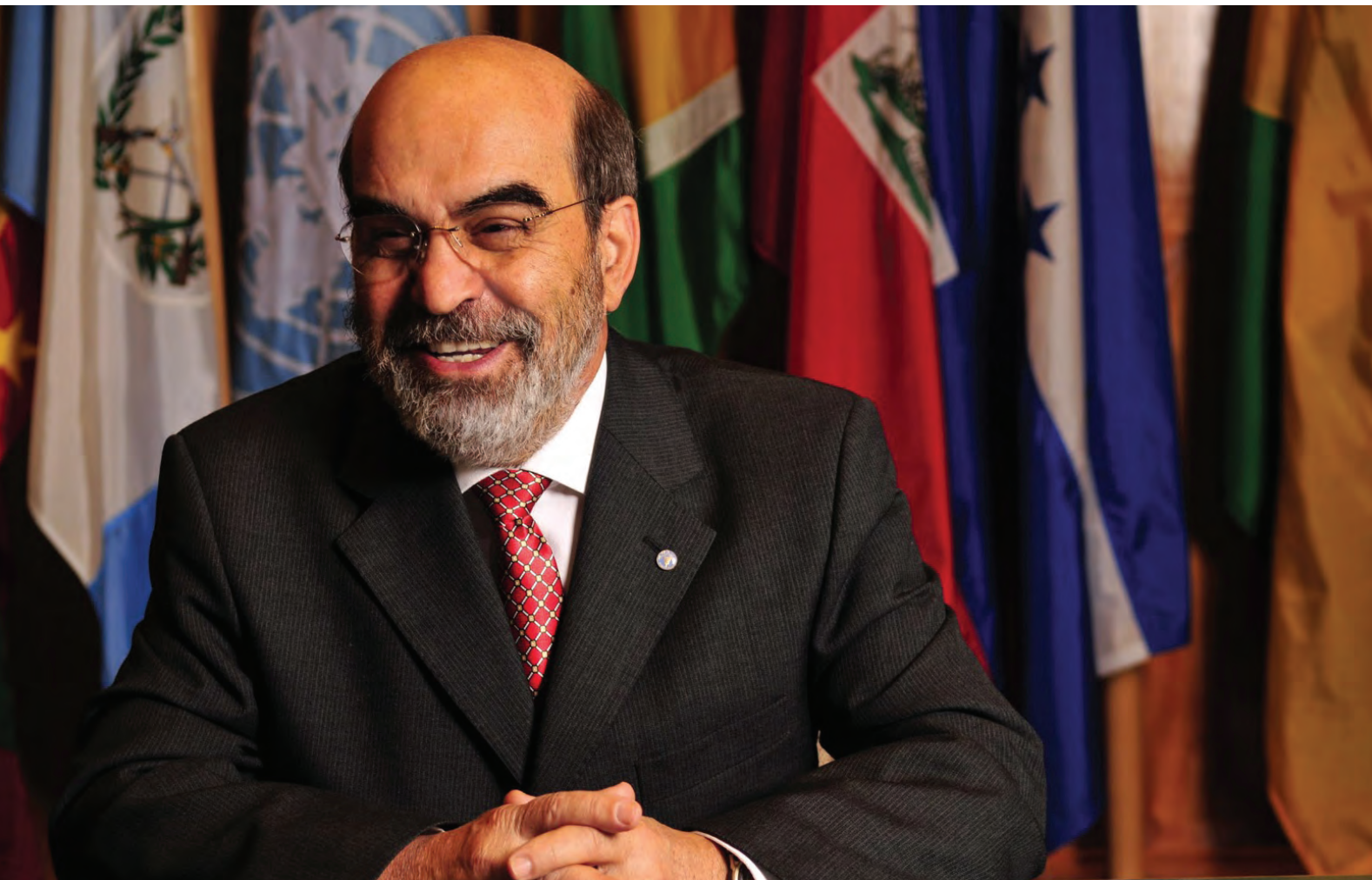
The articles collected here include pieces by renowned experts like Antonio Carlos Costa, who gives an overview of Brazilian agribusiness and highlights Brazil as the single most important food producer in the world. We also present two papers from Embrapa, a world leader in agriculture-related research, detailing Brazilian technological advances in tropical agriculture projects for Africa. Cleber Guarany, Coordinator at FGV Projects, describes important food and agroenergy projects in the Tropical Belt, and Fernando Rigatto gives insight into the potentially competitive relationship between foodstuffs and biofuels and explains the determining factors behind rising food prices. Marcelo Neri, an economist and professor at FGV Foundation, shows that poverty reduction programs in Brazil have been successful but argues that without continued investment in education, this effort to transform the poor into fully-fledged citizens may only be partially successful.

We conclude with the views of Sílvia Crestana, former president of Embrapa, on Brazil's competitiveness and sustainability with regard to science and innovation, and Roberto Rodrigues - Brazil's former Minister of Agriculture and Coordinator of GV Agro - who outlines the road map Brazil must follow to fulfill its new role as a world power in agribusiness. And lastly, FGV Foundation highlights key statistical data on Brazilian agribusiness.

We trust that this publication will fulfill its goal of contributing to the dissemination of knowledge and to guide policies and strategies that lead to the enhancement of initiatives facing the sector.

Enjoy!





*interview with*

**JOSÉ GRAZIANO**

*José Graziano*

**GENERAL DIRECTOR OF THE FOOD AND  
AGRICULTURE ORGANIZATION OF THE  
UNITED NATIONS (FAO)**

#### **JOSÉ GRAZIANO**

José Graziano da Silva received his bachelor's degree in agronomy and master's degree in rural economics and sociology from the University of São Paulo (USP) and his Ph.D. in economic sciences from the State University of Campinas (UNICAMP). In addition, he has two post-doctorate degrees in latin american studies (University College of London) and Environmental Studies (University of California, Santa Cruz). Graziano has had a distinguished professional career in the fields of food security, agriculture, and rural development. Of particular note is his seminal contribution as Brazil's Extraordinary Minister of Food Security and Fight Against Hunger, in charge of the implementation of the "Zero Hunger" Program (*Fome Zero*). Since 2006, he serves as FAO Regional Representative for Latin America and the Caribbean and Assistant General Director. In 2011 he has been elected as Brazil's General Director of FAO.

FGV PROJECTS: MR. GRAZIANO, YOU'VE DESCRIBED THE ERADICATION OF HUNGER AS AN ATTAINABLE AND REASONABLE GOAL. WHEN DO YOU THINK THIS GOAL WILL BE ACHIEVED, IN LIGHT OF THE FACT THAT FAO HAS BEEN FIGHTING FOR THIS FOR YEARS AND THE NUMBER OF PEOPLE GOING HUNGRY IS ON THE RISE? WHAT ARE YOUR IMMEDIATE PRIORITIES IN THIS AREA?

**JOSÉ GRAZIANO:** The world produces enough food to meet the basic needs of all of its seven billion inhabitants. Sixty years ago, Josué de Castro stated that hunger was a political phenomenon. Recognizing this is fundamental to be able to combat this problem, which involves so many different areas – production, access, nutrition, economy, etc.

This is what then-President Lula meant in 2003 when he said he wanted each Brazilian to have three meals a day. *Fome Zero* (Zero Hunger) has placed the fight against hunger at the center of the government's agenda, and by formulating a set of policies to attack all the forms and roots of the problem we have shown that it is possible to make progress in reducing hunger and misery in a short period of time. Ghana, whose former president John Kufuour has just received the World Food Award along with former Brazilian President Lula, is just one of many countries that have joined us in making this commitment.

I was elected on a platform made up of five pillars, which will now guide my mandate: eradicating hunger; increasing the production and sustainable consumption of food; creating a more just and effective governance system for worldwide food safety; continuing internal FAO reforms; and broadening South-South partnerships.

The core pillar is hunger eradication. The other pillars are important insofar as they contribute to this goal.

FGV PROJECTS: CAN A DEADLINE BE SET FOR HUNGER ERADICATION?

**JOSÉ GRAZIANO:** It is difficult to set a deadline for eradicating hunger as this depends on the commitment of governments and the implementation of a variety of policies and actions. Until now, ours has been the only region that has

formally committed itself to this goal, through the Latin America and the Caribbean Without Hunger Initiative 2025.

In addition to setting forth a goal for hunger eradication and not just hunger reduction, a specific deadline would help to give a greater sense of urgency to this challenge. But even without a deadline, what is important is to begin acting now, through a combination of short- and long-term actions.

FGV PROJECTS: IS IT POSSIBLE TO WIN THE BATTLE AGAINST HUNGER DURING YOUR MANDATE?

**JOSÉ GRAZIANO:** My mandate at FAO will be short: it will end in 2015, the target year for the Millennium Development Goals. Nevertheless, although many countries are struggling in the fight against hunger, I believe that between now and 2015 we can reverse recent increases in the number of malnourished people throughout the world and make progress in the direction of eradicating this evil.

I can affirm that because a number of crises have once again placed the struggle against hunger at the center of the international agenda. The fight against hunger and misery is an element that can bring together governments, private initiative and civil society, and can bring together efforts to combat the diverse crises we face at present: the climate crisis, the energy crisis and the economic-financial crisis.

At FAO, I want to fight hunger at two levels: via focused and concentrated efforts in individual countries with high food uncertainty that have made the decision to prioritize this issue, and at the global level through the implementation of a more efficient governance system.

FGV PROJECTS: WHAT ROLE COULD BRAZIL PLAY IN THIS PROCESS? AND WHAT DO YOU FORESEE FOR EMPRAPA?

**JOSÉ GRAZIANO:** Developing countries, particularly in Africa, have high expectations regarding their cooperation with Embrapa. Over the last two years, Embrapa has made significant progress in tropical agriculture – by bringing

new techniques, raw materials, and agricultural implements and tools to tropical areas, and more recently, by developing new seed varieties that can thrive in the semi-arid regions of Brazil. Since many countries in Africa share similar geographic and climatic characteristics, these technologies could yield positive results in Africa as well, and Embrapa is already working towards that.

Brazil faces a major challenge as the country transitions from being an aid recipient to becoming an international donor. To make this leap, Brazil needs to strengthen its institutions as the country's current cooperation structures remain more oriented toward receiving aid than delivering it.

Other developing countries also have valuable experiences to share. Approximately 90% of grain production in Argentina, for example, was achieved using a direct cultivation technique that helps to preserve the soil and water and can be adapted to African countries.

That is why South-South cooperation was one of the core pillars of my campaign. I am convinced that FAO can be a catalyst in encouraging new forms of cooperation.

An important issue we should keep in mind is that South-South cooperation is much more horizontal in nature than traditional cooperation. The benefits are reciprocal, with both donors and recipients learning from one other, and problems and solutions are identified jointly, by governments and communities, rather than from the outside.

FGV PROJECTS: DO YOU BELIEVE THAT COOPERATIVISM CAN BE AN EFFECTIVE INSTRUMENT TO ORGANIZE RURAL PRODUCTION AND INCREASE YIELDS IN RURAL AREAS?

**JOSÉ GRAZIANO:** Without a doubt. And in 2012, I want to bring FAO closer to the cooperatives. I have already held conversations about this with representatives of the private sector that participate in the World Food Safety Committee.

FGV PROJECTS: DO YOU BELIEVE IT WOULD BE POSSIBLE TO REPLICATE *BOLSA FAMÍLIA* (FAMILY

STIPEND) IN OTHER COUNTRIES, INCLUDING POORER COUNTRIES WITH FEWER RESOURCES?

**JOSÉ GRAZIANO:** Each country has its own characteristics and we cannot simply export a ready-made model, from Brazil or any other country. For many years, for example, there was the attempt to resolve problems in food production using technologies and varieties from developed countries that were not adapted to the specific conditions of that country or were not accessible by small producers in that country. We need to take these differences into account.

Despite this, there is no doubt that a variety of public policies from Brazil and other developing countries could be adapted by other countries. *Fome Zero* itself took its inspiration from a set of policies and actions disseminated throughout Brazil and also built on ideas stemming from the New Deal, which helped the United States and the world to overcome the Great Depression in the 1930s, and the Food Voucher program launched a few years later.

In many countries in Latin America and the Caribbean, FAO is working alongside the Brazilian government to implement programs that link family agricultural programs to school nutrition, guaranteeing healthy nutrition for school-age children and income for family agriculture, in addition to injecting resources into local markets.

Regarding income transfer programs, Brazil has developed a variety of instruments relating to *Bolsa Família* that could eventually be of use to other countries. The use of a magnetic card is only one of these. The decision to deliver resources for families to women is a simple initiative that has a significant impact on family nutrition. Additionally, there is a strong component of participation and social control in policy design, in the definition of who the beneficiaries are and in the delivery of the resources. In the case of Brazil, these are all elements that have helped to grant legitimacy to government actions.

At present, 18 countries in Latin America and the Caribbean have income transfer programs that have benefitted around 113 million people. These countries have all come to the same conclusions we had: that income transfers respond to situations of



“FAO estimates that US\$30 billion per year is needed in investments in agriculture and food safety to eradicate world hunger”.

*José Graziano*

dire need in a way that has the additional benefit of stimulating local markets.

And all of this is done at a relatively low cost. In Brazil, *Bolsa Família* costs only 0.4% of GNP and benefits 13 million families.

Wherever there is hunger, invariably there are economically depleted rural communities where vegetation cannot thrive because of insufficient water. Income transfer policies operate like rain on the dry soil, allowing the land to grow and flourish once again.

Planting, harvesting and consuming is what makes the wheels of economy turn in millions of small population centers across the planet. If implemented on a national scale, with credit for small producers, technical assistance and the acquisition of harvests, from food to mixed or criolle seeds, this is the engine that has helped Brazil overcome the crisis. This example can also serve to inspire other countries.

Because of the potential to enhance dynamism, income transfer programs and work fronts have been used as a response to emergencies -- in Somalia, for example, and in Pakistan.

FGV PROJECTS: WHAT IS YOUR OPINION OF THE AGRICULTURAL PROTECTIONISM OF WEALTHIER COUNTRIES AND THE DOHA ROUND NOW WRAPPING UP AT THE WTO (WORLD TRADE ORGANIZATION)?

**JOSÉ GRAZIANO:** Developed countries spend around US\$ 1 billion per day on subsidies. Two statistics help to put this into perspective. FAO estimates that US\$30 billion per year is needed in investments in agriculture and food safety to eradicate world hunger. And one day of subsidies correspond to two years of FAO’s budget.

I still believe that, in the current scenario of steep prices amidst an economic crisis, we can come to a satisfactory agreement in the Doha Round, with a review of agricultural subsidies in developed countries -- especially since the high prices we observe at present, which are expected to remain high in coming years according to FAO and OECD, should make it even easier for farmers in

developed countries to accept a reduction in aid given the political pressure for cuts in public spending. ➡

I also believe we should focus on negotiations to eliminate export subsidies that distort the price of commodities, making it ever more difficult for farmers in developed countries to compete in international markets.

FGV PROJECTS: DO YOU BELIEVE IT IS NECESSARY TO IMPROVE COMMUNICATIONS RELATING TO AGRICULTURE SO THAT URBAN SOCIETIES SUPPORT DEVELOPMENTAL AGRICULTURAL POLICIES? HOW CAN FAO SUPPORT THIS PROCESS?

**JOSÉ GRAZIANO:** Over the past few decades, agriculture has become less common as an activity in the rural world. This has occurred as the functions of an agricultural unit have been transferred to other spheres. For example, the use of chemical fertilizers and mechanical traction have created industries that support agricultural activity, but that are completely different from it. At the same time, the rural world as a social arena has also literally lost ground to the urban world, leading to a true “rural urbanization”.

These are trends that have been ongoing for decades and will not be reversed. On the other hand, there is growing concern in urban societies regarding food: where it comes from, how it has been produced, what it contains, and how much food production costs in economic, social and environmental terms. These point to a convergence of the rural and urban worlds around food, which is FAO’s signature issue.

It is issues such as these that pose the new challenges to which agriculture will have to respond, and that should be considered when deciding upon agricultural policies.

A central issue is that of sustainability. One way of responding is by strengthening local production and consumption circuits. This allows for several advantages: it brings the consumer closer to the producer, offers a healthy diversification of diets, with fresh and traditional foodstuffs, and greatly decreases costs relating to transportation.

Agribusiness should also respond to this concern. The Green Revolution was responsible for a great leap in agricultural production beginning in the 1960s, based on the intensive use of natural resources and agricultural raw materials. Nevertheless, the model adopted has also had a significant impact on the environment.

We need to invest in a doubly green revolution, one that will increase cattle raising and agricultural production in a sustainable way. FAO has called this new paradigm save to grow. And it is perfectly feasible. Nowadays there are a variety of technologies and agricultural practices with proven productivity gains and lower costs to the environment. This includes techniques such as direct planting and agri-forestry production systems, as well as the use of seed varieties that are more resistant to droughts, making it possible for food production to take place with less water.

It is not always easy to change this paradigm as it requires a change in the way the world looks upon resources. However, we have made strides. To mention but one example, Brazil and other countries in South America are involved in projects to recover areas degraded by extensive cattle raising, with the aim of increasing agricultural production. We can make the leap by following this trend.

We should also look towards the future: by 2050, the world population is expected to increase from seven billion to nine billion people. FAO estimates that if we maintain current consumption standards in Western developed countries, we will have to increase the production of food by 70% as we will not only have more people but these people will also eat better.

It is interesting to note that, even if we increase production, FAO estimates that we will still have millions of undernourished people who will continue to lack adequate access to food. Improving access is fundamental and depends on investing in family agriculture, strengthening social protection networks, and increasing income and employment rates.

And although we will be able to increase production to respond to this additional demand by 2050, it is also necessary to seek changes in the world's consumption patterns. If the entire world adopts the "western" diet, we will be exerting an enormous

pressure on our natural resources. This is a diet that brings other problems in its trail: at the same time that we have around one billion people in the world who suffer from hunger, another two billion suffer from being overweight or from obesity, conditions that also result from poor nutrition.

**FGV PROJECTS:** WHAT'S YOUR OPINION REGARDING FOOD PRICE INCREASES AS PART OF A STRATEGY TO ENHANCE FOOD SAFETY?

**JOSÉ GRAZIANO:** The main problem lies in the combination of price increases internationally with the greater volatility and speed with which these variations are taking place. These two factors combined lead to a situation that benefits neither producers nor consumers.

Steep prices increase the risk of food insecurity in countries with deficits in their trade balances, and reduce access to food by poorer populations that need to spend a larger amount of their incomes on food. A short-term solution is to reinforce social protection networks that protect consumers, especially people who spend the majority of their household income on nutrition.

On the other hand, the high prices of basic agricultural products may create an opportunity for family farmers to increase their production and incomes. Nonetheless, although the steep prices tend to encourage more investment, the volatility observed since 2007 has become an obstacle, especially for family farmers.

Producers who planted in 2008 by buying inputs at high prices, with the expectation of using the profits from their production to recover their investments during the harvest season, have been faced with a situation in which their revenues amount to less than what they spent on production.

Beginning in June of 2010, the price of foodstuffs increased once again, and in August of 2011, a new all-time high was attained for food prices, 130% higher than what was recorded, on average, between 2000 and 2005. This new level was also 3.1% greater than the peak reached by prices in June of 2008, in the midst of the financial and economic crisis. Without a doubt, volatility will once again lead to uncertainty.

**“In the case of Brazil, ethanol production based on sugarcane does not compete with the use of resources for the production of food, and sugarcane is a raw material whose use in the production of biofuel does not affect food safety”.**

*José Graziano*



Therefore, we should seek rules at the global level that will allow for greater stability in prices, with fewer fluctuations, increases and sudden drops. This is important: these rules would also help reduce losses if prices plummet once again, as happened between the 1960s and the year 2000.

At local levels, high prices open up the possibility of going back to the production of traditional food, such as beans, white corn and quinoa in our region, and we should make the most of this. This brings the additional benefits of diversifying diets and injecting resources into local economies.

**FGV PROJECTS:** DO YOU BELIEVE THAT AGROENERGY IS A PROJECT THAT CAN BE REPLICATED TO GUARANTEE THE SUSTAINABLE SUPPLY OF RENEWABLE ENERGY, SUCH AS COGENERATION OF POWER IN SUGARCANE PLANTS? IS THERE A CONFLICT BETWEEN THE PRODUCTION OF FOOD AND BIOFUELS? IN BRAZIL? IN THE WORLD?

**JOSÉ GRAZIANO:** Lula states that, like cholesterol, there are good and bad biofuels, which is to say that we need to avoid generalizations. The impacts, both positive and negative, of the production and the use of biofuel vary in accordance with the geographic conditions of each country and the type of raw material used.

Each country should assess the possibility of producing biofuel based on its specific conditions and considering the impact this could have on other countries as well.

In the case of Brazil, ethanol production based on sugarcane does not compete with the use of resources for the production of food, and sugarcane is a raw material whose use in the production of biofuel does not affect food safety. Brazil has shown that it is possible to increase the production of biofuel and food simultaneously, and that this can generate benefits for small producers, as has been the case for biodiesel production.

Under these conditions, the production of biofuel is a positive thing. Nevertheless, this model cannot be replicated in all countries. A joint survey of FAO and ECLAC indicates that in South America, only Argentina, Brazil, Columbia and Paraguay would be able to significantly expand their production of biofuel, mainly through the recovery of degraded land.

If we use raw materials like corn, oilseeds and similar materials in the production chain, the situation will change completely. In that case, there could be an impact on food safety, even though there is an increase in the aggregated supply of such commodities. There is an additional related issue: the production of biofuel in the United States and in Europe is only economically

viable with production subsidies. Because of this, we stand by our recommendation that these countries review their policies on subsidies for the production of biofuel.

**FGV PROJECTS:** DO YOU BELIEVE IN THE COMPLEMENTARITY OF PRODUCTION ACTIVITIES AMONG SMALL, MEDIUM AND LARGE PRODUCERS?

**JOSÉ GRAZIANO:** Yes, I do. And Brazil is one of the best examples of how they can live together, become complementary and strengthen each other mutually. At present, Brazil is one of the grain silos of the world, and one of the top producers and exporters of poultry, bovine cattle and pork. This is an important contribution to the world's food safety because it fulfills the needs of other countries.

On the other hand, a large part of the products that we consume domestically are produced by family farmers. As an example, a study by FAO and the IDB in 2007 showed that 67% of the beans, 84% of the manioc, 49% of the corn and 52% of the milk consumed in the country were produced by this sector. Therefore, they are relevant and important for our own food safety. This phenomenon has also occurred in other countries in Latin America.

**FGV PROJECTS:** YOUR ELECTION AS DIRECTOR GENERAL OF THE FAO WAS A GREAT AND

HONORABLE ACHIEVEMENT FOR BRAZIL. WHAT DO YOU ATTRIBUTE YOUR HISTORIC VICTORY TO?

**JOSÉ GRAZIANO:** I believe my victory was the victory of hope. Many countries look towards Brazil and feel inspired by the path that we are following because we have managed to reduce hunger and misery quite rapidly in a short period. To quote only one statistic, malnutrition in children decreased by 61% between 2003 and 2010.

This is the result of the commitment of former president Luiz Inácio Lula da Silva and of the current president Dilma Rousseff to the struggle against hunger and misery.

Symbolically, this was what was so successful about my campaign. Equally important was the cohesion of the countries of Latin American and the Caribbean. Practically the entire region supported my candidacy, even with formal declarations by blocks of countries such as the Union of South American Nations (Unasul), Mercosur, and the Community of Caribbean Countries (Caricom). Added to this was the decisive support of the countries in the Portuguese Language Countries Community (CPLP).

As I mentioned immediately after the election, in 2012 I will be the FAO Director General for all the countries of the world. And the challenge that lies ahead of us is to work together for the world without hunger that we believe to be a possibility.





*article*

# AGRIBUSINESS IN BRAZIL: PAST, PRESENT AND PERSPECTIVES

ANTÔNIO CARLOS COSTA AND FERNANDO MACÊDO

*Antônio Carlos Costa*

---

MANAGER OF THE AGRIBUSINESS DEPARTMENT OF  
THE SÃO PAULO FEDERATION OF INDUSTRIES (FIESP)

## ANTÔNIO CARLOS COSTA

Antônio Carlos Costa holds a graduate degree in agricultural engineering from Universidade Estadual Paulista (UNESP), and was director of the International Trading Department of the Ministry of Agriculture, Livestock and Supply, responsible for the agricultural negotiations of the bi-regional agreements such as Mercosur - European Union, and multilateral agreements such as the World Trade Organization (WTO). He is currently manager of the Agribusiness Department of the São Paulo Federation of Industries (FIESP).

*Fernando Macêdo*

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SPECIALIST IN THE AGRIBUSINESS DEPARTMENT OF  
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## FERNANDO MACÊDO

Fernando Macêdo holds a graduate degree in agricultural engineering from the University of Brasilia (UNB) and currently studying for his master's in agroenergy management from São Paulo School of Economics of FGV Foundation (EESP/FGV). He drafted various strategic studies regarding productive chains in agribusiness. He also conducted a research and produced studies and newsletters on topics linked to the food industry, focusing on the tax substitution of ICMS, on the National and State Policy on Solid Waste, on the Food Consumer Profile, on Climate Change, the Forestry Code, among others. Macêdo was technical advisor to the Ministry of Agriculture, Livestock and Supply (MAPA) and is currently a specialist in the Agribusiness Department of the São Paulo Federation of Industries (FIESP).



18 The Brazilian agribusiness sector has proven to be one of the most dynamic in the world, with significant production and productivity gains over the last two decades that have made the country one of the top food suppliers for the world. According to the World Trade Organization (WTO), Brazil’s trade surplus of US\$ 57.9 billion in 2010 is 77.7% higher than that of the world’s second biggest food producer.

Important transformations in the Brazilian economy overall, which positively impacted agribusiness in particular, occurred throughout the 1990s and beyond and help explain Brazil’s continued strong performance today. These have included macroeconomic stabilization, structural reforms and the opening of trade, the latter of which is mainly due to the creation of Mercosur, which eliminated import duties for customs union participants Argentina, Uruguay and Paraguay, with the first two playing a significant role in the international production of grain, dairy products and beef.

As a result of the reforms mentioned above, it became necessary to modify certain protectionist measures designed to support Brazilian agriculture that were no longer compatible with the elimination or reduction of duties. The liberalization process underwent a deregulation of important segments, such as coffee, wheat and sugarcane, and was completed with the elimination of export quotas.

These transformations were critical for increasing Brazilian productivity, despite a necessary period of adaptation on the part of farmers who had to quickly adjust from the government interventionism and protected markets to which they were accustomed to a new environment of increased international trade that placed them in direct competition with major international players.

In the realm of agricultural policy, there was a significant shift as private resources became more important and the relevance of public resources declined. Things became ever more geared to the market, through the funding of costs by producers, productive investments and marketing. Although reduced in terms of expenditures, the policy

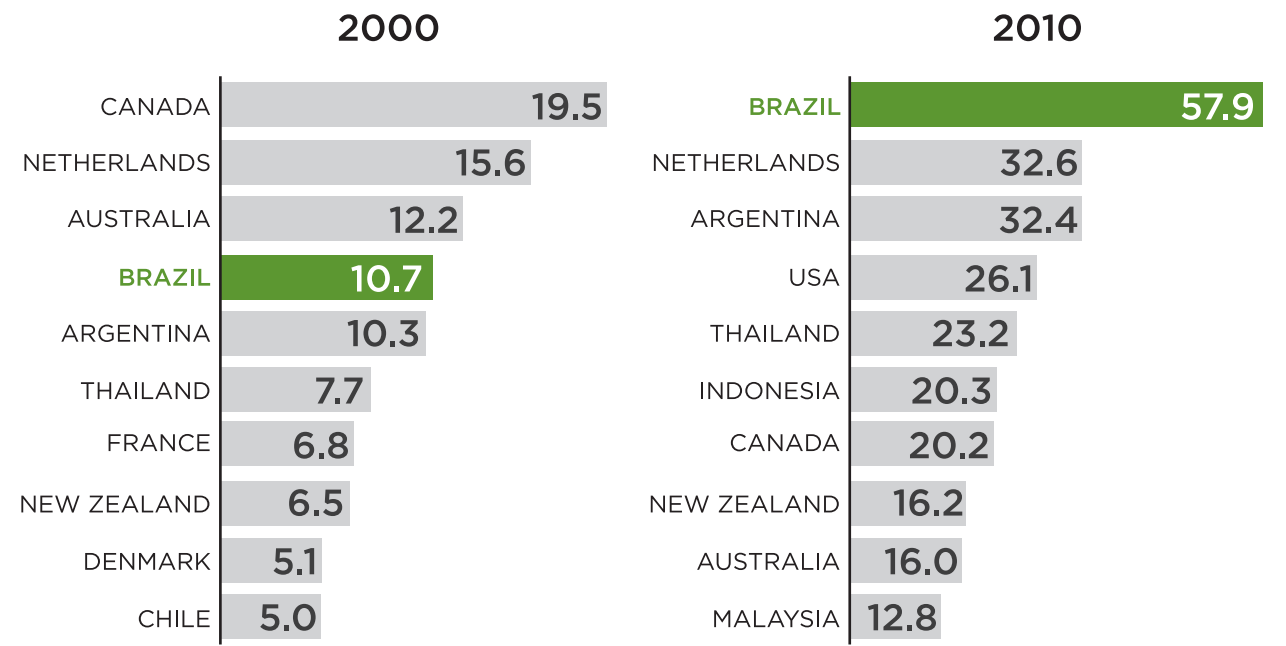
guaranteed that minimum prices would continue to exist.

Nevertheless, the resources utilized to date, according to the minimum price modality, are not sufficient to artificially increase supply and have not affected Brazil’s status as one of the countries with the lowest levels of subsidies in agriculture, according to monitoring carried out by the Organization for Economic Development and Cooperation (OECD) by means of the Producer’s Total Support Estimate (PSE) which measures the share of agricultural subsidies in various countries in relation to the Gross Production Value (GPV) of the sector. In a remarkable report presented in 2005, “Analysis of Agricultural Policies of Brazil”, the OECD calculated this figure to be only 3% for Brazil, based on its averages in 2002 and 2004, placing Brazil ahead of Australia, a country that with notoriously liberal agricultural policies that obtained a PSE of 4%. This places Brazil in a strong position compared to major competitors such as the European Union, the United States, Mexico and Canada, as illustrated by figure 3, which uses averages for the period 2008-2010.

With a more adequate macroeconomic environment, it can be observed that from the 1990s through the present, the Brazilian agribusiness sector has recorded stronger gains in efficiency for most of its products. In the case of grains, the country increased its productivity by 181% between 1990-91 and 2010-11, with gains that are five times the world average.

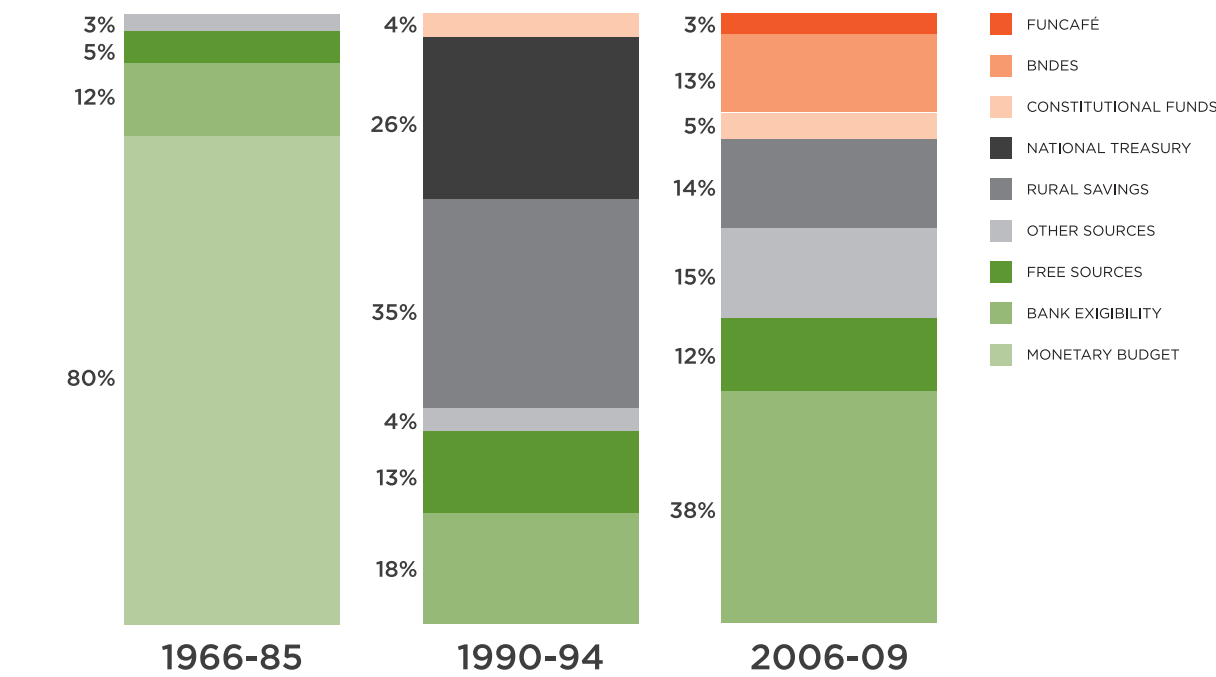
If on the one hand this result may sound impressive, it is largely due to agricultural policies more oriented towards the market, with an emphasis on actions such as the “program to modernize the agricultural tractor fleet, associated implements and harvesters (Moderfrota)”, which allocated approximately R\$ 18,4 billion in funding between 2000 and 2009 for the renewal of the Brazilian fleet; on the other hand, it shows how the country had previously been lagging behind when compared to its main competitors, such as the United States, in terms of the average productivity of its crops.

FIGURE 1  
TRADE BALANCE FOR AGRICULTURAL PRODUCTS (US\$ BILLION)



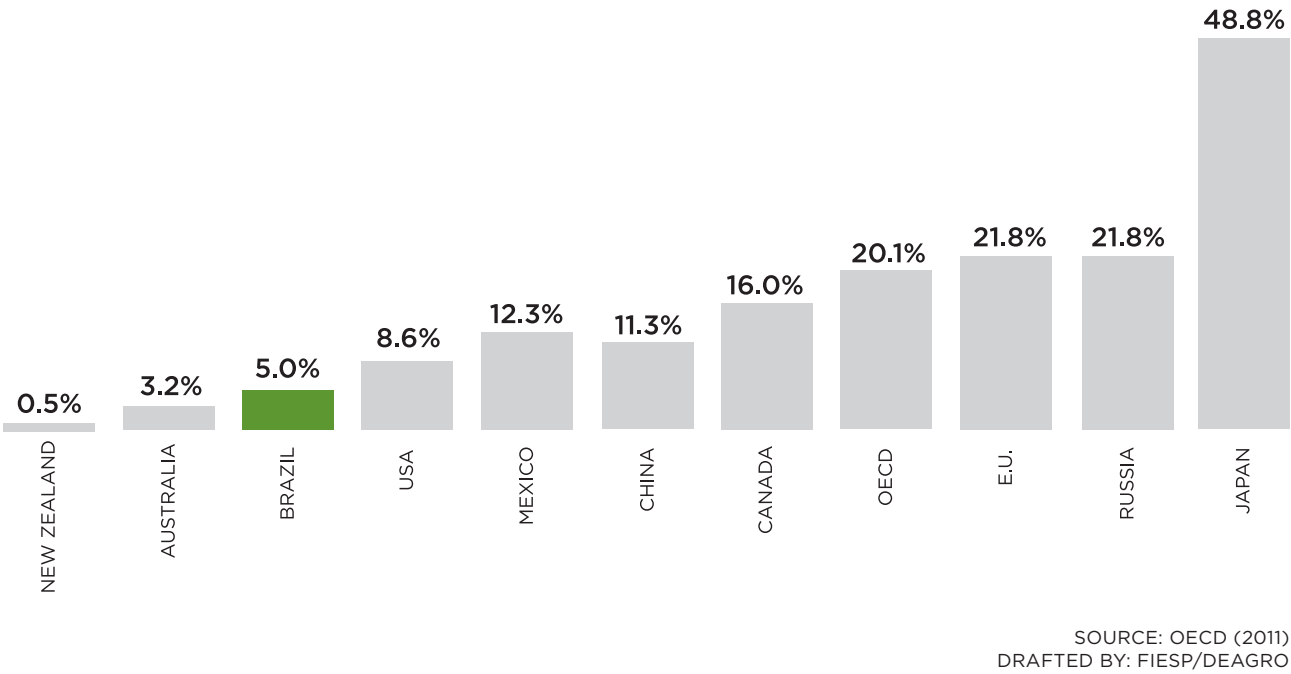
SOURCE: WTO (2011)  
DRAFTED BY: FIESP/DEAGRO

FIGURE 2  
DIVERSIFICATION OF THE SOURCES OF RURAL CREDIT IN BRAZIL OVER TIME



SOURCES: MAPA/SPA AND BCB (2010)  
DRAFTED BY: FIESP/DEAGRO

20 **FIGURE 3**  
PRODUCER’S TOTAL SUPPORT ESTIMATE (PSE) IN BRAZIL AND SELECTED COUNTRIES  
(AVERAGE FOR 2008-2010)



**FIGURE 4**  
BRAZILIAN GRAIN HARVESTS: VARIATION IN ACCUMULATION OF PLANTED AREAS,  
PRODUCTION AND PRODUCTIVITY (INDEX 100 = 1990-91 HARVEST)



Nevertheless, two decades were sufficient to achieve a “change of level” for products such as soybeans and cotton, which, in the 2010-11 harvest, with 3.0 t/ha and 1,5t/ha respectively, fell to levels that were higher than those observed for the United States, with 2.9 t/ha and 0.9 t/ha, respectively. Still, for crops such as corn, it became clear that the challenge was for the country to increase productivity -- recorded in this case at 4.1 t/ha, below the current world average of 5.1 t/ha --, a performance that explains the significant differences in regional agricultural development in the country.

Expansion of agribusiness to the Center-West of Brazil explains a large part of these positive results, as this region enjoyed an increase of 334% in grain production over the last 20 years, making it the second largest producer in Brazil for the 2010-11 harvest, with the strongest performance in the state of Mato Grosso. This, along with the significantly higher dynamism of the other states in the region, contributed to an increase of 675% in grain production for the period, making it the country’s second greatest producer, with 18.9% of the current harvest, behind only Paraná, which accounts for 19.9%.

21 The country’s impressive gains in agricultural production have been matched in the field of exports, where, in just ten years, Brazilian agribusiness has increased its exports by 271%, from US\$ 20.6 billion in 2000 to US\$ 76.4 billion in 2010. Brazil is now the world’s top exporter of orange juice, sugar, poultry, beef, and coffee, and the second-biggest exporter of soybeans.

During this same period, there was also an increase in the number of export markets, from 186 in 2000 to 215 in 2010. This diversification translates into a lower dependency on two of the greatest importers of food in the world, the United States and the European Union, which previously represented a combined 59% of the export market for Brazilian agribusiness ten years ago and now represent only 34%.

This growth is, therefore, largely due to a change in export markets during that same period, led by developing countries that increased their share of the export market from 30% to 57%, as illustrated in figure 6. China, with a 14% share, is the importer that stands out the most, second only to the European Union, which accounts for 27% of the total. Soybean exports to that market, the greatest worldwide importer of the product, represent 65% of Brazilian sales in that sector.





FIGURE 5  
BRAZIL: DYNAMISM OF THE MAIN GRAIN-PRODUCING STATES (FOR HARVESTS FROM 1990-91 THROUGH 2010-11)

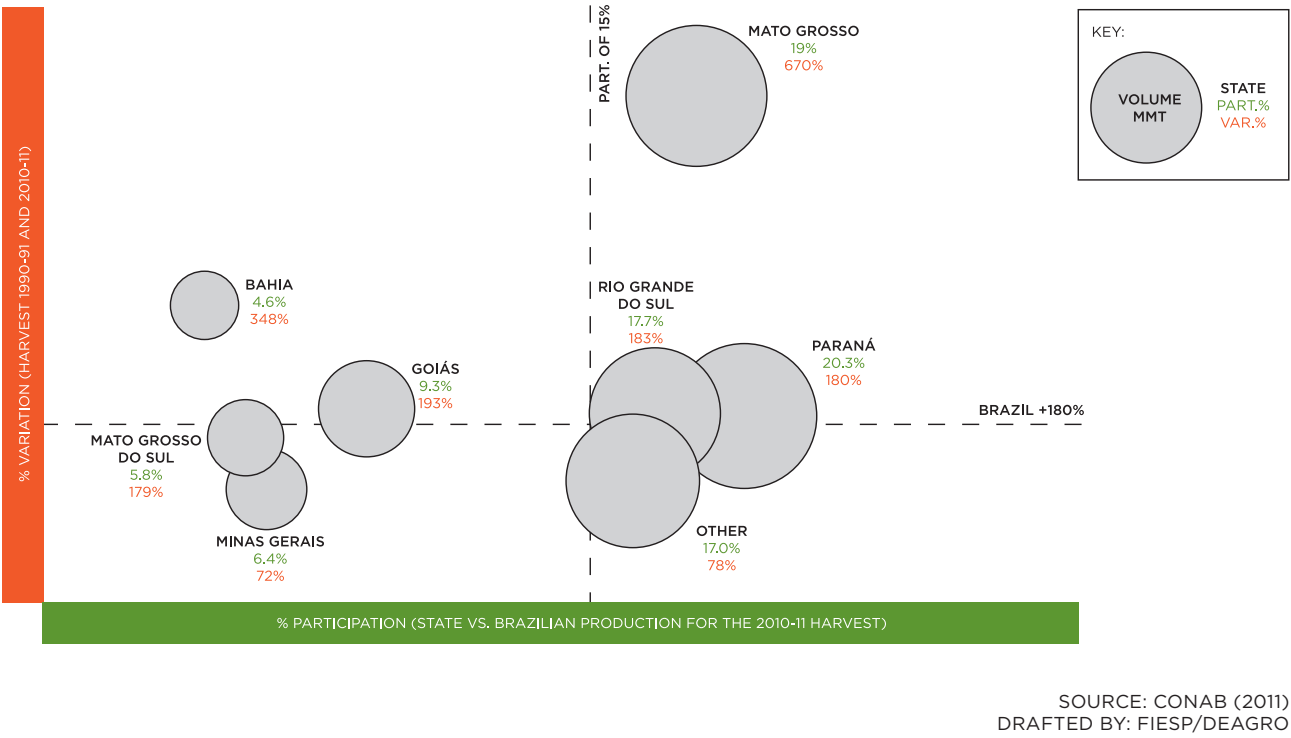
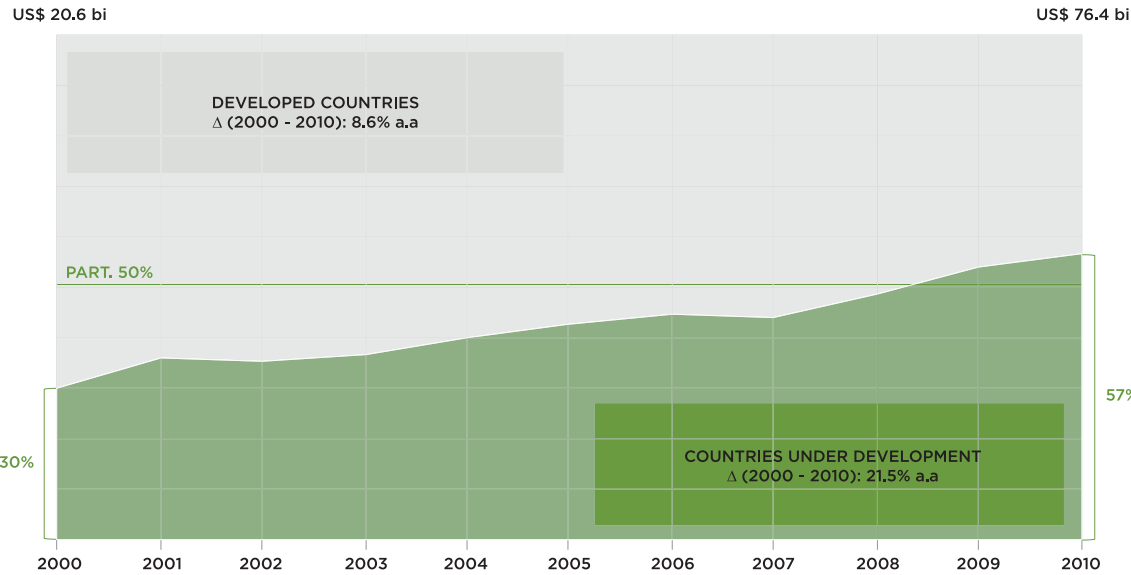


FIGURE 6  
BRAZILIAN AGRIBUSINESS EXPORTS TO A GROUP OF COUNTRIES (2000-2010)



While diversification is a positive trend, especially during these times of world economic instability, when the epicenter of the crisis is in Europe and the United States, the reduced relative share of developed countries for Brazilian exports has led to a reduction in the average price paid for some of the products. The average price paid by the European Union for in natura beef imported in 2010 was US\$ 5.335/t. Nevertheless, this market, which was formerly responsible for 67% of Brazilian exports in this sector in 2000, now represents a mere 9%.

In Russia, which was the main destination for Brazilian in natura beef exports in 2010, with 27% of the total, the average price per ton of the product that same year was US\$ 3.299/t. The graph below shows the world’s leading importers of in natura beef, and the respective share for Brazil, where it is possible to observe, mainly because of sanitary restrictions, the absence of the country in a large majority of these markets.

If the diversification in export markets over the last ten years was significant, the same cannot be said of the “product basket” exported, which basically remained the same throughout the period. The difficulty of selling goods with a higher level of industrialization results from the tariff structure of the importing countries, especially the developed ones, which prioritize the purchase of basic products because of their low import duties, to the detriment of more processed ones, which of course have higher duties. Coffee is a good example of this tariff escalation, as green coffee beans are imported without duties by the European Union, while processed coffee is subject to a tariff of 9%. For this same market, tariffs are growing for products with high sugar and dairy content - in Japan, for example. In Japan, in the same way, green coffee is imported without duties, while roasted beans are hit with a duty of 12%.

Figure 8 presents the evolution of products exported by Brazil at two different periods: 2000 and 2010.

At this time, the fundamentals for the world food sector represent an important challenge for major

producers as the very close relationship between supply and demand gives way to inflationary pressure in several countries, including Brazil, where the basket of “Food and Beverages”, as monitored by the Brazilian Institute of Geography and Statistics (IBGE), was responsible for 49% of the country’s total inflation in 2007, for 41% in 2008, and for 40% in 2010.

In China, where the total accumulated inflation for the 12 months ending in August of 2011 was 6.2%, inflation for food and beverage prices was even higher, at 13.4%. In their last two reports, the FAO and the OECD predict “a decade of high food prices” that could pose a challenge to the entire world, pointing to the need to increase food production by 20% over the next decade, with Brazil as the country that needs to achieve 40% growth, the highest relative growth rate of any country. In this scenario, even with the serious economic crisis affecting Europe, international price quotes for agricultural commodities remain substantially above historical averages, proving once again the power of market fundamentals.

Some of the factors contributing to these high prices, which exert strong pressure on demand for food, are:

- Growth of the world’s population: the U.N. has forecast that the world population will increase by 2.24 billion or 32% by the year 2050.
- Urbanization of China: the country is undergoing an accelerated process of urbanization, with millions of people migrating from rural areas and from subsistence agriculture to exert greater pressure on the food supply in urban areas.
- Growth of the Chinese GDP: in September 2011, the International Monetary Fund (IMF) estimated that country’s GDP for that year to be 9.5%, indicating that fears of a strong contraction or deceleration in China’s economy as a result of the international crisis were unfounded and that demand for food will continue unabated in coming years.

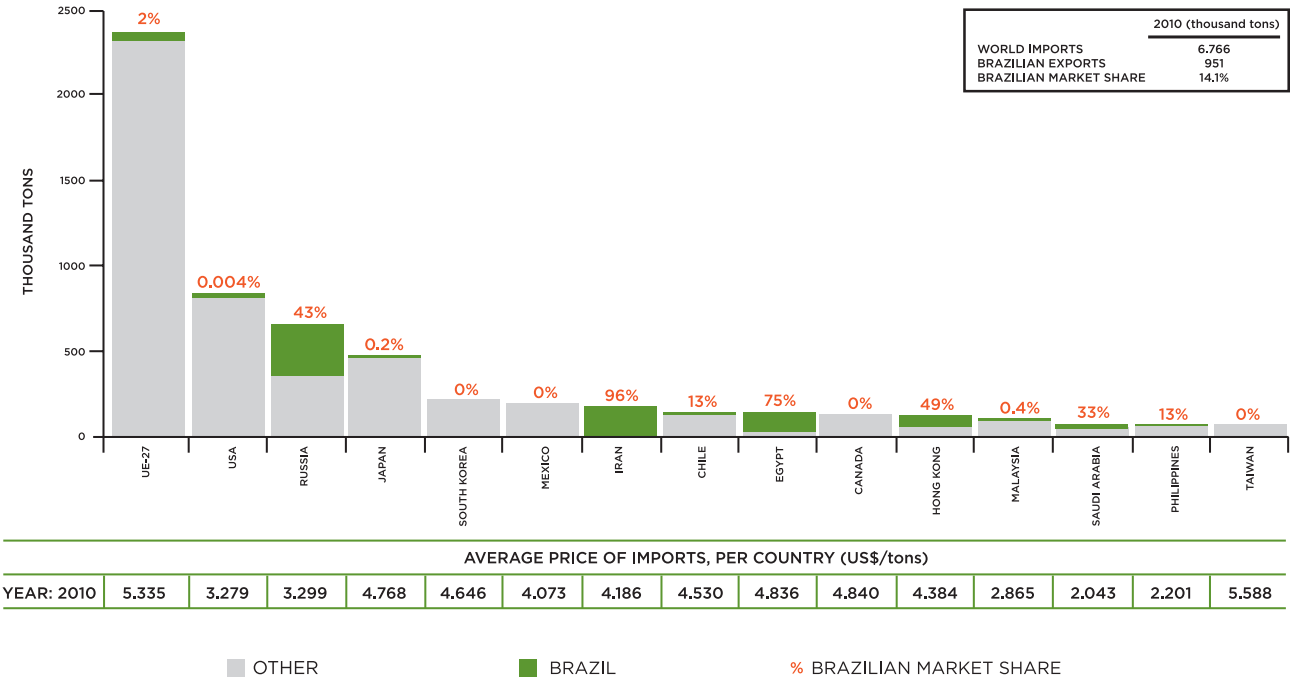


• Westernization of eating habits: the consumption of beef has increased by 340% in China over the last 20 years, reaching 4.2kg/inhab/year in 2010. This is still quite low, representing about half of the per capita consumption of the worldwide market for the product. Nonetheless, growth continues to be vigorous. To achieve an increase of 1kg in per capita consumption in the country, which is realistic for at least the short term, the world would have to respond with an 18% increase in exports. For poultry, the growth in consumption for each inhabitant in China for the period was 328%, reaching 9.0kg/inhab/year to come closer to world averages. India has also shown significant growth in certain indicators, such as an increase of 852% in poultry consumption since 1990, although its current level of 2.1kg/inhab/year shows that the country still lags significantly behind world averages. It is important to underscore that the increase in consumption of animal protein leads to an increase in demand for grains as it is generally necessary to have an average of 8kg of grains in order to produce 1 kg of beef, 4kg to produce 1kg of pork, and 2kg to produce 1kg of poultry.

- An increase in incomes in developing countries: besides China and India, the increase in purchasing power for the Brazilian population (34% over the past five years) has raised the country’s per capita consumption of beef to 38kg/inhab/year, on par with levels in the United States.
- Scarcity of productive land: from 1961 up to the present, the area used for the production of food in the world has expanded by only 11%, from 4.55 billion hectares to 5 billion hectares. During this same period, however, urban population tripled and the consumption of meat in general increased by 433%. If in the 1960s, the ratio of 4.5 hectares in production for each inhabitant in the cities held true, at present that ratio has dropped to 1.5 ha per inhabitant, increasing the pressure on the world’s food producers for continued productivity gains in the future.

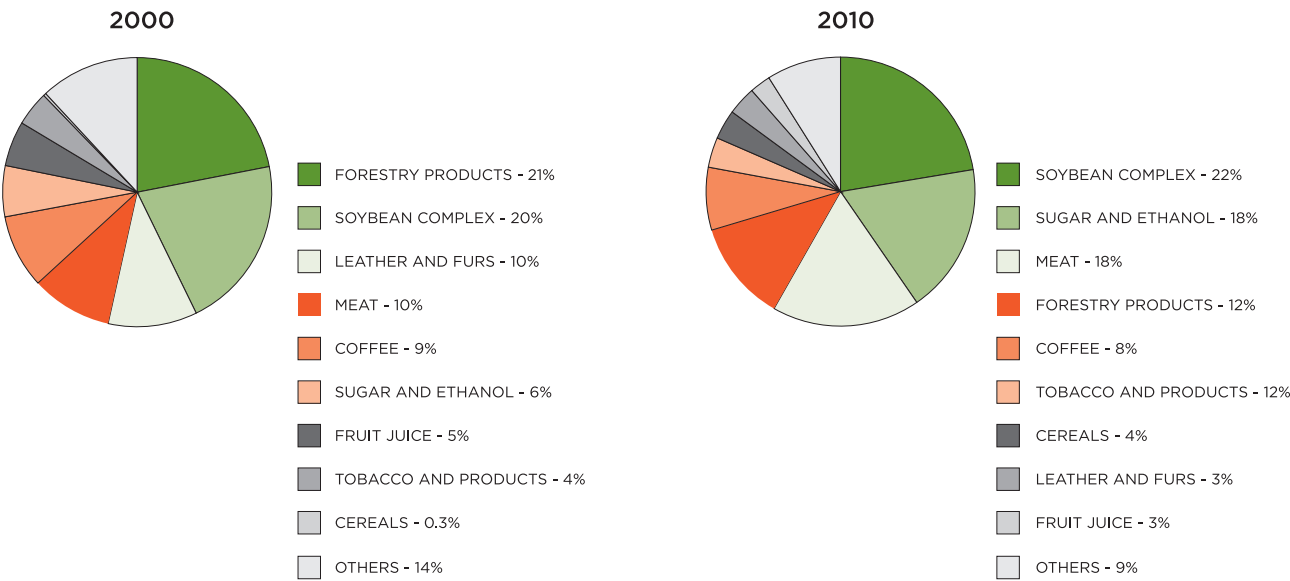
As a result of these projected trends, the pressure on demand should remain steady in coming years, with the possibility of intensifying if there are significant shortfalls or disruptions with regard to the agricultural harvests of major producers, as

FIGURE 7  
MARKET SHARE OF BRAZIL AMONG LEADING IN NATURA BEEF IMPORTERS (2010)



SOURCE: INTERNATIONAL TRADE CENTRE / TRADE MAP (2011)  
NOTE:IN NATURA BEEF (SH 0201 AND SH0202)  
DRAFTED BY: FIESP/DEAGRO

FIGURE 8  
MAIN AGRIBUSINESS PRODUCTS EXPORTED BY BRAZIL, IN VALUE



SOURCE: MAPA/AGROSTAT BRASIL (2011)  
DRAFTED BY: FIESP/DEAGRO



happened in Brazil in 2003-4 and 2004-5, which led to a combined reduction of 27.2 million tons of grain.

Brazil is, therefore, one of the only major food producers in the world with the possibility of expanding its agricultural areas - predominantly through pastures, which represent 52% of the arable land in the country.

According to the IBGE, based on data from the agricultural and cattle raising census of 2006, Brazil has 172 million hectares, which shelter 170 million heads of cattle, giving the country a ratio of 0.99 heads of cattle per hectare, an average which is very low compared to other major producers. In the following table, we see the use of land for different agricultural purposes in Brazil.

Increasing the number of heads of cattle, to the 1.5 heads per hectare found in the state of São Paulo, would free up some 60 million hectares for agriculture, which currently uses 49.9 million hectares to produce the current harvest level of 162.9 million tons of grains. For this increase to occur, however, public and private investment would be needed due to the limited margins this activity yields for producers.

TABLE 1  
TERRITORIAL DIVISION IN BRAZIL (MILLION OF HA), 2010

BRAZIL	851.0	100%
ARABLE LAND	329.9	38.8%
CULTIVATED AREA (ANNUAL AND PERENNIAL)	72.2	8.5%
SOYBEAN	21.8	2.6%
CORN	14.1	1.7%
SUGARCANE	8.4	1.0%
SUGARCANE (ETHANOL)	4.3	0.5%
COFFEE	2.1	0.3%
ORANGE	0.8	0.1%
PLANTED FOREST	6.5	0.8%
PASTURE	172.0	20.2%
AVAILABLE AREA	85.7	10.1%

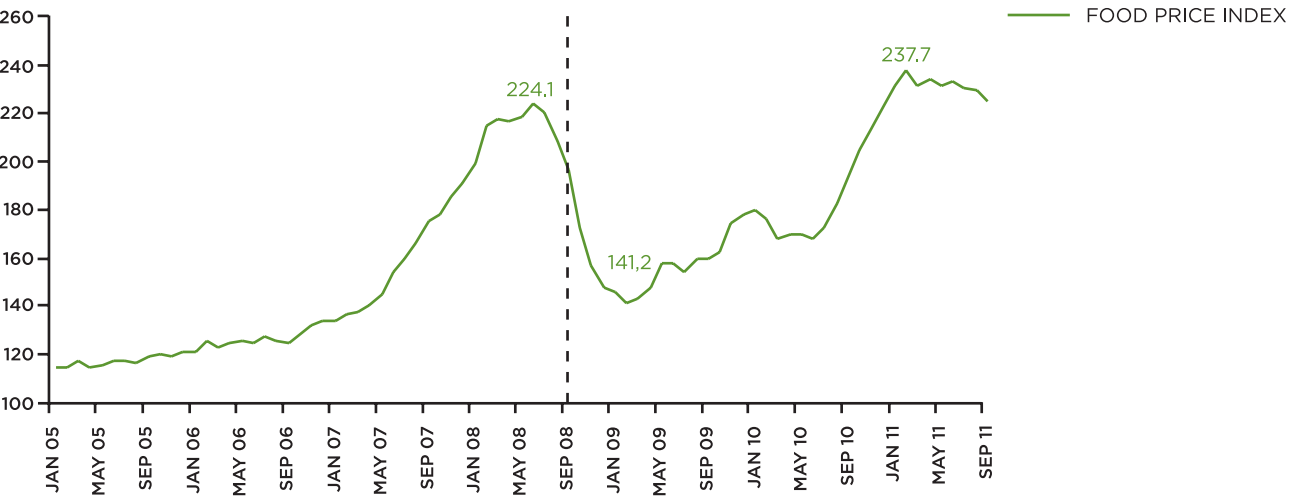
According to projections for Brazilian agribusiness by the Ministry of Agriculture, Cattle Raising and Supply (MAPA), significant increases are expected by 2020-21 in terms of agricultural and cattle production, as indicated in figure 10.

For Brazil to be able to fulfill its role in coming years, it will need to make investments in infrastructure and logistics, as well as in the development of new corridors and routes for exports. (Two ports, Santos and Paranaguá, currently account for 60% of all Brazilian agribusiness shipments.) Needed reforms include enhancing the agricultural insurance system, to stimulate competition and to wean producers from their dependency on federal subsidies, and giving priority to commercial agreements with key markets, such as Mercosur and the European Union.

This highly challenging scenario for the world presents itself as an opportunity for Brazilian agribusiness and for the country's economy. If the necessary adjustments in public policy priorities are made, such as those mentioned in the previous paragraph, it will be possible to broaden the strategic role played by Brazil as one of the most important and competitive suppliers of food for the world.

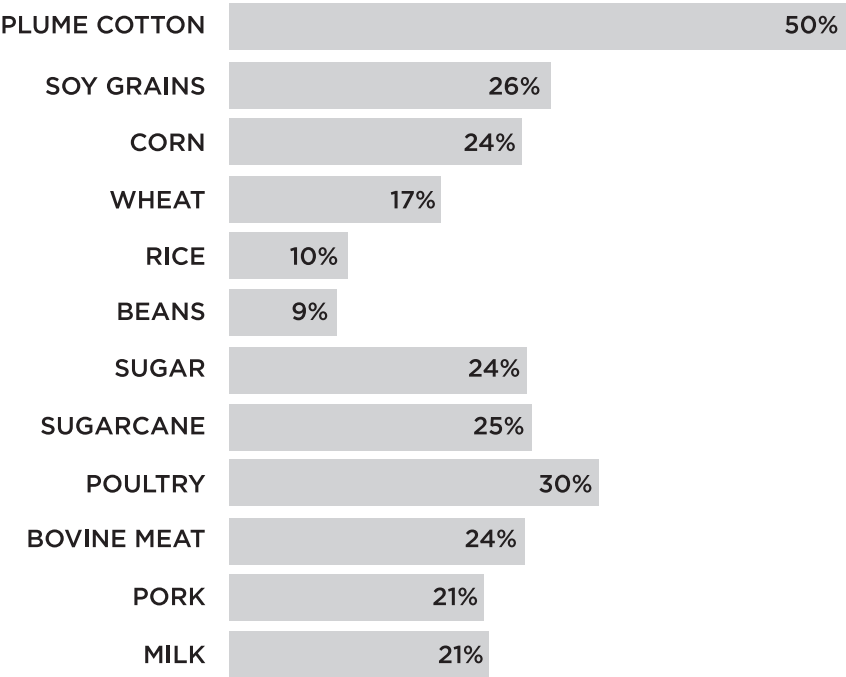
SOURCES: IBGE (CENSO AGROPECUÁRIO 2006) AND CONAB  
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FIGURE 9  
FOOD PRICE INDEX FROM FAO (BASE 100 = AVERAGE 2002-2004)



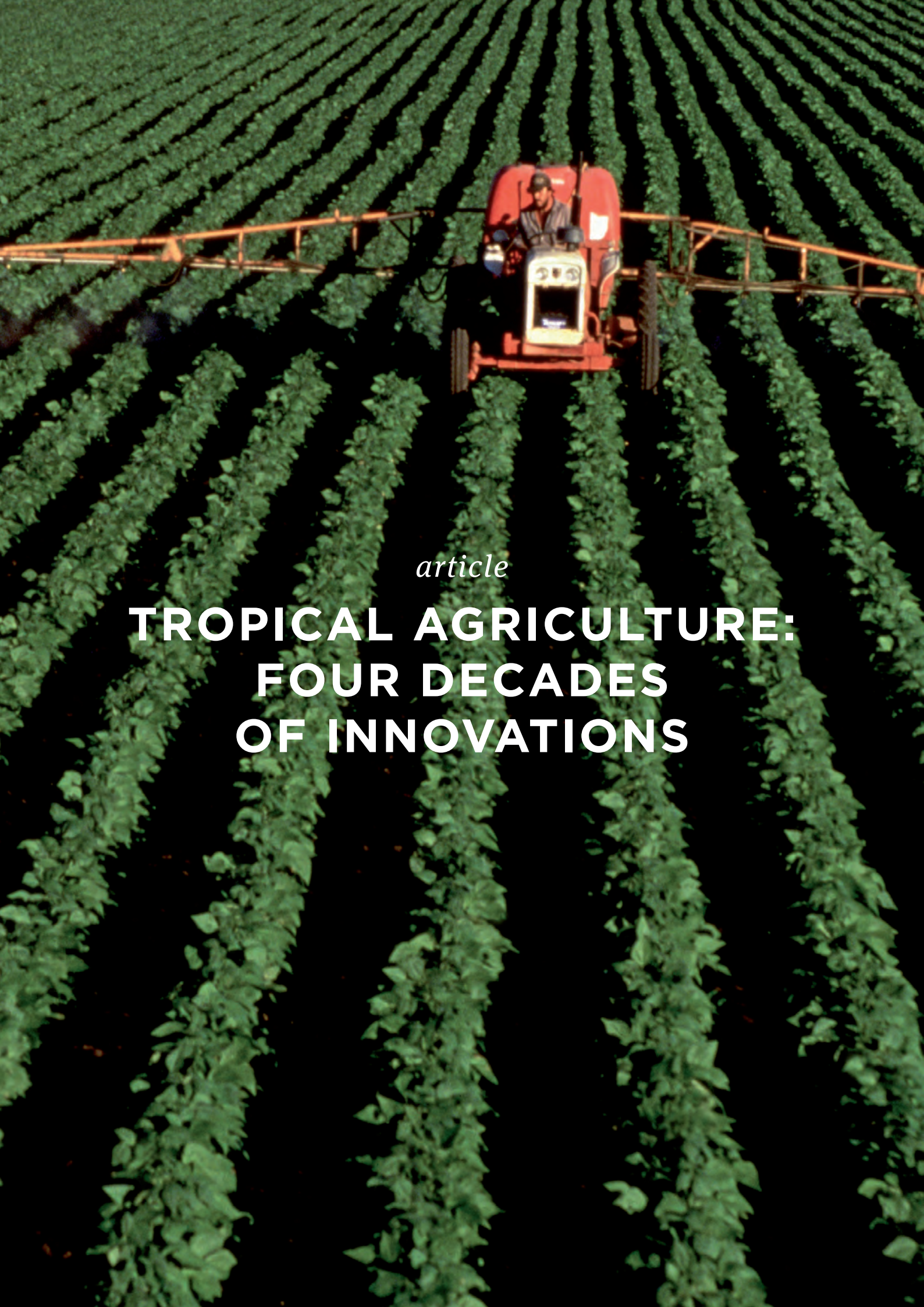
SOURCE: FAO (2011)  
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FIGURE 10  
PROJECTIONS FOR BRAZILIAN AGRIBUSINESS: PRODUCTION INCREASES BETWEEN THE HARVESTS OF 2010-11 AND 2020-21



SOURCE: MAPA (2011)  
DRAFTED BY : FIESP/DEAGRO





article

# TROPICAL AGRICULTURE: FOUR DECADES OF INNOVATIONS

*This is an adaptation of the article “Tropical Agriculture – Four Decades of Innovations Narrated in an Anthology”, published in Agroanalysis magazine of FGV Foundation, edition of September 2008.*

## INTRODUCTION

Brazil is recognized as a global leader in tropical agriculture, an area in which it has shown tremendous technological innovation. Although Brazil has advantages in this area thanks to its natural resources, its success over the past four decades did not happen by chance. Rather, it was built on:

- Rapid gains in productivity;
- Agricultural products with reduced prices and enhanced quality; and
- Value-added production.

Although this type of agriculture is restricted to specific tropical regions, it is tied to wider initiatives geared toward:

- Natural resources management within sustainable production systems;
- Multidisciplinary research carried out at different institutions;
- The dissemination of new technologies; and
- Fostering rural development.

## UNDERSTANDING THE CONTEXT OF TROPICAL AGRICULTURE

The tropical region encompasses the region of the globe between 23°27' latitude north and 23°27' latitude south, located between the Tropics of Cancer and Capricorn. The tropics span four continents – America, Africa, Asia and Oceania. There is a surplus of solar radiation up to 35° latitude North and South, while the opposite phenomenon occurs in the higher latitudes. The region's tremendous genetic diversity is what makes tropical agriculture so remarkable.

Other important variables define the tropical region, such as altitude, relief, precipitation and its distance from what are deemed to be the great water masses. Climate areas are never demarcated by straight lines, but by circuitous ones.

Temperate climate areas in Brazil are located between the 23°30' South and 33°45' South parallels, encompassing the states of Rio Grande do Sul, Santa Catarina, and regions in the center and south of Parana. In this region, the climate is temperate and humid, with rainfall during the entire year; the average temperature in the hottest month is 22°C or higher, while temperatures in the coldest months oscillate between -3 °C and 18 °C.

Tropical climate agriculture and temperate weather are easier to recognize and define in the middle of the geographic areas where they are located. It becomes harder to distinguish when we get closer to the border areas between them, which is what happens when we move towards the center-south of the country.

The study of tropical agriculture in Brazil is complex and requires the careful attention of scholars. Presently, the country is leading a process of technological innovation. Its legacy is an agriculture with its own identity, that of the tropics.

The contribution of agricultural and cattle raising research in Brazil were subordinated to the agricultural patterns of the tropics for centuries, due to historical contingencies. In the creation of tropical agriculture, Brazil was able to introduce genetic resources from a variety of regions from the tropical world, and went on to become a global producer of coffee, soy beans, oranges, black pepper, jute, palm tree oil, coconut trees, mangoes and eucalypti wood, in addition to being a significant bovine cattle and buffalo breeder. Although these products originated in other tropical regions, the New World contributed the rubber tree, cocoa, manioc, tobacco, Irish or white potatoes, tomatoes, corn, and peanuts, among others.



30 **DEBATING TROPICAL AGRICULTURE: THE FIRST CYCLE OF THE REVOLUTION**

Embrapa was born as a response to the problems arising from the use of the import substitution model, such as discrimination against agriculture, difficulties in the production of food and fibers, and the limited response of agriculture to incentives.

The new agricultural and cattle raising company has the following objectives:

- Developing Brazilian agriculture;
- Generating knowledge and technologies;
- Modernizing the agricultural sector; and
- Increasing production and the productivity of food and fibers for the population and for industries at large.

This has led to the creation of 37 research centers, with legal flexibility in terms of coordination, and with the creation of a National Research Agricultural and Cattle Raising System and a modern system for technical assistance and rural extension.

Beginning in 1973, Embrapa began to carry out and implement a series of important measures through an aggressive training program for its researchers. This meant making heavy investments in cattle raising and agricultural research.

The new institutional model was conceived with innovative ideas and investments based on creating a national research center for each product, thematic centers and eco-regional research centers, and strengthening the above-mentioned national system.

Joint efforts in agricultural and cattle-raising research at both the federal and rural levels, activities for technical assistance and rural extension, the broadening of the rural credit system, and the participation of rural producers and agribusiness entities have led to an internal phenomenon known as the “first cycle of the tropical agricultural revolution in Brazil”.

The occupation of the Cerrado was one of the main achievements of such a cycle, with relevant economic and social impacts for the country overall, such as:

- Development of the hinterlands: greater

- income, employment, education and health for the population;
- An increase in the human development index (HDI);
- Stabilization of supply and a reduction in the price of the family basket, resulting in a real increase in workers’ salaries; and
- An increase in agricultural exports, simultaneously producing large trade balances and less vulnerability to foreign events.

Brazilian research over the last 30 years has produced a considerable list of fundamental innovations, both technological and institutional. It is this list that has allowed Brazil to excel in the development of tropical agriculture.

**TECHNOLOGY, EDUCATION AND SOCIAL INCLUSION**

Market demands for quality become ever more sophisticated, and it is therefore important to disseminate science and technology for use in rural and urban activities. The existence of an educated population capable of bringing about a technical-scientific transformation is a sine qua non condition for social inclusion and for competitiveness in Brazilian cattle raising and agribusiness activities.

The development of agribusiness cannot live side by side with exclusion. Issues linked to rural poverty, education, health and agricultural activities need to be dealt with as inter-related issues. It is necessary to transform those affected by underdevelopment into development actors.

The use of science and technology in the field depend, above all, on the user’s education. The illiteracy rate is decreasing in Brazil. Between 1998 and 2010, it dropped from 13.8% to 9.6%. Still, it remains very far from the necessary “universalization” of basic education, even in terms of secondary education, that the Brazilian population needs.

Therefore, investments in education and science and technology that are currently underway will help to usher in a new future, in the sense that they will enhance Brazilian competitiveness and help Brazil to help its people.





DEBATING TROPICAL AGRICULTURE: THE SECOND CYCLE OF THE REVOLUTION

The second cycle of the Brazilian tropical agricultural revolution can be characterized by:

- Centrality of the new sciences, of bioenergy, bionanotechnology and data processing;
- Social, economic and environmental implications of agricultural and cattle raising, agriforestry and agribusiness innovations in national development; and
- Expansion of scientific contracts, through the creation of excellence centers in several continents.

Attention is geared towards basic traditional issues which have a significant impact domestically and internationally (grain production, meat, fruit and fibers), as well as to factors that are extremely attractive at present, such as agroenergy. New forms and routes of interaction have been opened. It has now become necessary to revitalize not only Embrapa but also the National Agricultural and Cattle Raising Research System (SNPA), by means of measures that are beginning to be adopted, as is the case with agroenergy.

Agroenergy is one of the countless issues that will lead us into the future, a challenge and an opportunity as well for the expansion of Brazilian agribusiness. The international energy matrix - nowadays made up mainly of oil (35%), carbon (23%) and natural gas (21%) – is currently undergoing changes. Studies point to the fact, on one hand, of a scarcity in the near future of these fossil fuels, and on the other hand, of the deleterious effects of the emission of hazardous gases from the burning of such fuels.

The quest for new sources of renewable energy, with an emphasis on energy generated from biomass, is now urgent if we are to face the problems of climate change and global warming.

Since 2006, we have seen the creation of Embrapa Agroenergy, with actions that originate from two bases: from agroenergy, with scientists from the SNPA, and from the implementation units located in each region of the Country. The expectation is that 100 million tons of oil will be produced in the next thirty years. This should take place without having to occupy areas set aside for the production of foodstuffs.

The production of biomass requires the use of new land, without having to compete with agriculture for the production of food or with tropical forests, positioning Brazil in a situation that is radically different from that of many developed countries.

Brazil, with one of the greatest land extensions that can be incorporated into the production process, has the opportunity to transform energy agriculture into a relevant component of its agribusiness.

There are four competitive routes that energy agriculture can follow:

- By-products of carbohydrate or amylaceous or starchy intensive products, such as ethanol;
- Lipid by-products, such as biodiesel;
- Wood and biomass by-products, such as briquettes or vegetable carbon; or
- The use of agricultural residues for the production of ethanol.

The country has taken on a position of leadership in the generation and implementation of tropical agriculture technology, associated to a strong agribusiness sector, in which one of the paradigms is precisely that of ethanol agribusiness, acknowledged as being one of the most efficient worldwide, in terms of process technology and management.

To intensify scientific contact with centers of excellence and contribute to the agri-industrial development of other tropical countries, Brazilian agricultural and cattle raising research counts upon the Embrapa Laboratories Abroad (Labex). The first was Labex United States, through a partnership with the American Agricultural Research Service (ARS). At the end of 2006, an extension of the Labex Europe was installed in Holland, located at Wageningen University, where advanced biology and genomic research is carried out. In 2008, an extension was created in England, at the Rothamsted Research Institute in Hertfordshire, dedicated to the fields of high-resolution microscopy, bioinformatics, biometry, pest control and climate change. There is also a new extension of Labex in Korea, in Suwon. In South America, Embrapa Americas was recently established in Panama.

If the North-South interaction came about during the first cycle of the tropical agriculture revolution, with Labex United States and Labex Europe, in France, the international South-South experience

began with a view towards transferring technologies and tapping new markets. This pioneer experience is already taking place in Africa.

An additional and important aspect of the second phase of the revolution in tropical agriculture refers to genetically modified food and products. Presently, new innovations are being developed, such as:

- Beans that are resistant to golden mosaic disease, transmitted by the white fly;
- Potatoes resistant to the leafroll virus; and
- Papaya resistant to the ring spot virus.

In the near future, there will be the creation of tomatoes resistant to the Gemini-virus, lettuce resistant to fungi, beans resistant to rot, and genetically modified soy beans that can survive in droughts, as well as cotton cultivars resistant to herbicides, insects and fungal and bacterial diseases.

The ever growing construction of traceability systems should enhance the production of safe and healthy food. The more developed systems we have seen up to the present correspond to the integrated production of fruit and vegetables and quality bovine meat production.

Also linked to those problems are the nutraceuticals and medication at large. This field is rich in innovations, such as: lettuce plant vaccine to combat diarrhea; soy bean cultivars that produce growth hormones and antibodies to combat different types of cancer; bioreactor animals that contain growth hormones in their milk; and genetically modified animals and plants that can produce Factor IX, which is fundamental for blood coagulation.

Binomial biodiversity and bioplants make up a significant part of the second phase of the tropical agriculture revolution. Brazil contains one fifth of the biodiversity of the entire planet, which means a significant range of “active principles”, most of which are unknown. To convert environmental assets into products with a diversity of uses may be strategic for Brazil as it will give it a competitive edge in business and employment.

The potential of Brazilian biodiversity combined with new technologies and the entrepreneurial vision of the bioplants also opens up the possibility of conducting research on threatened vegetable

species. In this case, biotechnology would use vegetable micro-propagation techniques that make it possible to produce plantlets on a large scale and in a short time period, and overcoming some of the shortcomings or limitations found in the conventional propagation of such species. To date, Brazil has acted rather timidly in these areas.

In the second phase, fibers and pulp continue to merit the attention of tropical agriculture in Brazil. This arises from the fact that the fiber sector for the manufacture of paper products is very promising in Latin America, making this continent the leading location for such production in the world. This results in significant forestry production in tropical and subtropical areas that host species of the Eucalyptus and Pinus types.

The paper sector should grow significantly in Latin America, especially to supply the Asian market. European and North American producers of cellulose fibers tend to close down their less productive units, giving an opening to the new producers in Latin America. The reason is the high productivity of tropical forests (high photosynthesis) which results in a decrease in per unit cost.

Reforestation with a view towards making better use of open areas, those that are unsuitable for agriculture, and promoting the recovery of areas that should not have been deforested can help to mitigate global warming and the reduction of pressure on natural forest stocks. To this we can add recent world efforts to reduce the use of wood from native forests for a diversity of purposes. The goal is to decrease use from 67% today to 50% in 2025 and 25% by 2050.

Companies have been seeking greater uniformity in cellulose, by using homogenous wood or lumber and establishing greater control over the process. The production of paper requires greater speed from the machines, greater ease in drainage and high resistance from the fiber. As a result, the fiber suffers less stress, and it becomes necessary to resort to the use of fewer chemical products, causing lower environmental impact.

The more innovative lines in the field of cellulose fibers currently depend on nanotechnology for the production of intelligent products. Also in the field of forestry biorefineries, we need to extract greater



value from wood, not only from the fibers for paper production but also from products with higher added value, through the conversion of their components into biofuels, polymers and other products used in fine chemistry.

Also worth mentioning is research in biotechnology, such as the eucalyptus genome program (*Eucalyptus* spp.), to reduce the lignin content in wood, increase the fiber volume in trees, and alter the structure of eucalyptus vessels. As a result, all of this points to an increase in productivity and in the homogeneity of the forest – 100% of the wood consumed comes from the planted forest. Additional advantages are the reduction of the use of chemical products in pulping and a reduction in power consumption and water in the process.

The production of cellulose fibers at present is basically achieved through processing related to the pulping of the wood through chemical, mechanical and mechanic-chemical methods. The fibers are primarily used in the production of paper (for writing and printing, for packaging, and for cleaning products). Some units convert the cellulose fibers into by-products, such as viscose, cotton rayon, microcrystalline cellulose, cellulose nitrate and cellulose acetate. Power markets and solid lumber products also exist, such as sawed wood. There are also energy markets and those for solid wood including sawn wood, sheets, plywood.

Another important activity arises from the domestication of new species. In several Brazilian ecosystems, there is intense activity to collect biological items that are part of the extractivism resources in the country, such as fruit and native resins. As the demand for such fruit and resins increases, both regionally and domestically, domesticated cultivation becomes imperative. This domestication process, which has already been used for rubber trees, guarana, Brazilian nuts, cupuaçu, assai, native hearts of palm or pupunha, long pepper and jambu (*spilanthus oleracea*), can also be applied to a variety of other species in Brazil.

Another important area is that of vegetable and animal sanitation (new diseases, “invigorated” diseases). Sanitation systems are designed to protect the productive system without impacting the health of the end consumer. In the case of animal production, it is understood that the full genetic potential of herds

and the productive potential of breeding systems can be realized if the limiting factors are eliminated.

Animal sanitation is very closely linked to productivity and the quality of herds and breeding. An important part of the work in these areas is geared to the natural control of parasites, the prevention of new diseases, such as bovine spongiform encephalopathy (BSE) and avian flu, caused by a variety of the influenza virus (H5N1), and the upsurge of some “invigorated” diseases, such as hoof and mouth disease.

Insofar as pest control goes, it is important to consider that the success of tropical agriculture depends on a recognition that chemical control needs to be put in place simultaneously with other measures, such as biological control and sanitation. In the case of ectoparasites, such as bovine ticks, the horn fly and bott, the disease with the greatest impact in conditions of extensive bovine cattle breeding, the strategy has proven to be the most effective is that of “integrated management”.

In animal and vegetable sanitation, there is a strong emphasis on quality. In fact, endless changes have taken place in the field of phyto-sanitation, mainly through product certifications and measures adopted by the World Trade Organization (WTO), more precisely the Agreement for Application of Sanitary and Phytosanitary Measures (SPS Agreement), of which Brazil is a signatory.

In the history of Brazilian agriculture, until recently, pests were considered a minor nuisance in ecosystems. Their upsurge has led to greater efforts to combat them, often through the use of products that are too harsh for human beings. The main emphasis has been on production and productivity, that is, exclusively on the quantitative aspects.

Nowdays, tropical agriculture is focusing, above all else, on ways to achieve the highest quality for its products. Among these are phytosanitary actions on integrated production and pest systems, free areas, monitoring and dispersion. The paradigms that are being focused on at present are related to production, productivity, sustainability (environmental as well as social) and quality.

With regard to the recovery of degraded areas, persistent attention is being given to the program for the integration of the plantation-cattle raising-

forestry. This program consists of a set of techniques that make it easier to recover degraded areas, and focuses on crop rotation and the sustainability of the direct planting system, which contributes to diminishing the deforestation of natural vegetation.

In the second phase, tropical agriculture is also committed to exploring new technological possibilities, one example of which is the aquatic environment, new food sources, bacteria, algae and new plants.

When it comes to new plants and animals that can tolerate adverse climate conditions and possess greater nutritional value, Embrapa should, by maintaining current levels of resources, get them on the market in a five-year time frame. Among the innovations are the cultivation of corn in sandy soil, the recovery of pasture for the production of energy, and the development of soy bean seeds that have a higher nutritional value and are drought-resistant.

The innovative options, as well as the more traditional ones, show that the binomial technology and innovation must continually be enhanced.

Act nº 10.973, dated December 2, 2004, more popularly known as the “Law for Technological Innovation”, defines innovation in its Article 2 as being the “introduction of novelties or enhancements in the production or social environments, which result in new products, processes or services”. This can be extended further by considering the distinction between meaningful innovation and irrelevant innovation.

A relevant innovation emerges from the interaction of social processes, in which significant knowledge is generated in the context of its practical application and the moral or ethical implications. This means to say that, for example, in addition to making sure it is efficient, we must make sure tropical agriculture is relevant. It is therefore necessary to acknowledge the complexity, diversity and dynamic within the tropical context under transformation, going beyond a mere concern with results from the survey, so as to include a commitment concerning its impacts. This is important for agricultural and cattle raising research itself, whose institutional sustainability depends more on its own external relevance than on its internal efficiency.

In management terms, the concept of relevant innovation implies high management efficiency of the means of the research, and mainly the relevance of knowledge generated and appropriated by the social, economic, political and institutional players of development. Politically, relevant innovation is of interest as it regards to the institutional sustainability of the rules, roles and the constitutive institutional agreements of the SNPA, because the complexity of tropical agriculture requires action that is independent from all of those who are part of the system.

It should not be forgotten that sustainability means cultivating the conditions and relationships that will generate and support life. Therefore, the ethical dimension of the activity should be present at all times in the process. This goes from the negotiation of problems to the definition of the relevant challenges and the conception of research projects, going through their execution, application of results and then verifying the consequences of their impacts. Ethics is a topic that cuts across everything and has an impact on the way people are, feel, think, do and speak.

Innovation for integrated production systems should not be thought of as a defined set of conceptual tools, methodological instruments and operational steps that can be summarized in a research manual. Instead, it is about changing the standards that guide attitudes and behaviors, whose implications include a qualitative transformation of the ways of interpreting and intervening.

Brazilian researchers – acting jointly with experts in public policy and institutional development, and producers and consumers – are called upon to lead the way in making these new innovations: anticipating problems, planning solutions and testing results -- boldly but with caution, with rigor and safety.

Technology is a dynamic process. New technologies should be generated and the innovations should be implemented, leading to a decrease in the regional inequalities, fostering the effective insertion of farmers in the market, and sustainability in tropical agriculture in the economic, social and environmental spheres.





article

# AFRICA PROJECT AND NANOTECHNOLOGY

*This is an adaptation of the article “Embrapa Special - Project Africa e Nanotechnology”, published in Agroanalysis magazine from FGV Foundation, edition of January 2011.* 37

## AFRICA

### EMBRAPA'S TROPICAL AGRICULTURE STRENGTHENS THE RELATIONSHIP BETWEEN BRAZIL AND AFRICA

Brazil ended the year 2010 in a strong position internationally, particularly with regard to science, research, and development relating to innovations in cattle raising. Thanks to its own successful experience in this field, the country has been requested to collaborate in agricultural initiatives in the Americas, Africa, and Asia. The presence of Brazil in forums that seek to offer knowledge and solutions to nations in development, through technical cooperation or humanitarian aid, is not uncommon. And, without a doubt, the Brazil Company for Cattle Raising Research (Embrapa) has constituted one of the pillars of Brazilian efforts in that field.

There are good reasons for the state company to become part of the list of public institutions charged with developing international relationships on behalf of the federal government. The history of Embrapa is one of them. The company, created 37 years ago, has benefitted from agreements with the best teaching and research institutions worldwide, and has sent hundreds of its researchers abroad. The aim is to have a sound staff trained in master programs, Ph.Ds and post-doctorate work.

Decades after it began playing the role of a research institution and a recipient of scientific knowledge, the company achieved international recognition as a provider of technological solutions for tropical agriculture, and is now collaborating with foreign technicians to do for other countries what it has long done for Brazil. The difference is that this time, the teams go abroad to put in practice technical cooperation, allowing for knowledge, development and innovations for nations who have not yet mastered the relevant

technology to be able to enhance the food supply and living standards of their people.

Through its work in scientific and technical cooperation, in addition to technological business, Embrapa has strengthened its South-South ties, with an emphasis on the African continent. The instruments for such projects are carried out jointly with the Brazilian Cooperation Agency, via the Foreign Ministry (ABC/MRE). Despite this, it is necessary to point out that the company's presence abroad is not restricted to Africa.

### WHY AFRICA?

There are at least two determining factors for Embrapa's involvement in Africa beyond the foreign policy of Brazil. The first is Africa's continuing food shortages as its population continues to grow; and the second relates to the continent's long list of nutritional challenges, an area where Brazil as a whole, and Embrapa in particular, have a lot to offer. Also important are the strong cultural ties and the importance of trade flows between Africa and Brazil, which exceeded US\$ 26 billion in 2008, placing African countries in fourth place among Brazil's main trade partners, according to ABC/MRE data.

The strengthening of technical cooperation and a closer relationship with African institutions came about in 2006, when the Brazilian government launched the first physical representation of the state-owned company on African territory: the Africa Embrapa project in Ghana.

Since that time, the company has kept some permanent staff in Africa – namely, two researchers headquartered in Accra, the capital of Ghana. This represented a decisive step and helped to facilitate planning. In only the first three years, according to ABC/MRE, at least 19 of Africa's 53 countries received visits aimed at meeting their needs and evaluating opportunities for cooperation in areas



38 such as forage, grains, forests, manioc, and bovine and milk cattle breeding.

With the increase of demand on the part of African governments, the project's permanent staff increased. Nowadays, in addition to the team in Ghana, there are employees in Mozambique, Mali and Senegal. Furthermore, many of these international activities have received greater attention with the passage of Provisional Measure 504, giving the activities of the state company more flexibility when operating outside Brazil.

### INITIATIVES IN MOZAMBIQUE

The challenge for the institution is to share technologies that will contribute towards social and economic development, with special attention to the balance between production and environmental conservation.

It is with this purpose in mind that in Mozambique, where the cattle raising sector represents 89% of the Gross Domestic Product (GDP) and of the production base and family agriculture, that two structural projects are being implemented by Embrapa. "This is the first time we have worked through trilateral cooperation and, even more interesting, with a Southern Axis country leading the actions", says Carlos do Prado, the cooperation coordinator of Embrapa's International Relationship Secretariat (SRI),

The technical support program for an innovative cattle raising program was launched in Mozambique in 2010. The initiative is a partnership among Embrapa, the ABC, the American Cooperation Agency (USAID) and the Mozambique Institute for Agrarian Investigation (IIAM). Over the next four years, actions will be carried out in five components: strategic planning, seed system, territorial management, communication and teaching assistance. "The objective is to strengthen IIAM. According to Pedro Arraes Pereira, the director-president of Embrapa, at least four macro-activities were initiated in 2009: training workshops, drafting and review of the ILAM strategic plan, drafting

of a proposal geared towards modernization and the acquisition of production infrastructure.

In addition to resources from ABC, which amount to US\$ 4.2 million, and Embrapa's own contribution, the American cooperation agency USAID will contribute US\$ 8.4 million in funding for four private international centers in cattle raising research in Mozambique. These resources will also be used for the maintenance of a unit for a management program geared towards cattle raising innovation in the country called UGP – made up of an ILAM representative and staff from Embrapa and international agencies funded by USAID.

The Brazilian and U.S. governments are working jointly with the Mozambique Ministry of Agriculture to develop a cattle raising innovation platform that will allow for self-sufficiency in food production. For this purpose, over the next four years, Brazil and the U.S. will develop parallel but complementary projects.

### SAVANNAS FROM MOZAMBIQUE RECEIVE INVESTMENTS

Conceived by Brazilian, Japanese and Mozambican specialists, the Pro-Savanna Japan-Brazil-Mozambique aims to enhance research capacity and technological transfers for agricultural development in the Nacala corridor – a tropical savanna area that extends all the way from the central region to the north of the country. The signing of the agreement for this US\$ 13.4 million program took place in the capital city of Maputo in November of 2010, when Pedro Arraes accompanied the committee of then President Lula to Mozambique.

The Brazilian experience in the Cerrado region has made a strong contribution to the implementation of the Pro-Savanna, which has a duration of 63 months with the possibility of renewal. According to Pedro Arraes, there are many similarities and lessons to be learned from both experiences. "The project horizon is at least 20 years. We will work to take into account the learning obtained from the Cerrado region, which has been transformed





40 into a productive area based on a very similar program to that of Pro-Savanna”, explains Arraes.

MORE COTTON AND FOOD FOR SMALL FARMERS

The West African countries of Benin, Burkina Fasso, Chad and Mali are long-time cotton producers and now seek to attain greater productivity for their crops, most of which are cultivated by small farmers. The cotton crop is the main source of income for families and the main product traded by the four countries, known in the World Trade Organization (WTO) as Cotton-4 (or C-4). However, as they use a genetic base with limited cultivar options, these cotton producers have been unable to increase production, obtain a differentiated product and, in the process, obtain better prices. They face another problem as well: thanks to the type of soil, diversifying their production is very difficult.

With the purpose of motivating the Cotton-4 members to change this, ABC and Embrapa, , developed the Support project to aid development for the cotton sector in the C-4 countries. The objective is to increase the output level and quality of cotton production, as well as to strengthen the production chains of the group members.

The base of activities is centered in the Experimental Station for the Sotuba Agricultural Research Station, in Bamako, Mali. At that site, during the 2009 agricultural season, local cultivars of cotton varieties from Emprapa were tested and purchased (Buriti, Safira, Cedro, Aroeira, BRS 293, Sucupira, BRS 286, Araçá, Jatobá and Seridó). Land with a combination of sorghum and corn was also tested and evaluated. In this case, the intention is to prepare the soil and thus introduce the direct planting system in cotton crops.

In 2010, the other three Cotton-4 countries installed demonstration units, this time with

assays of five varieties from Embrapa (those which had presented the best results in the previous crop among the ten tested) and five planted in the four countries. The first demonstration unit of direct cultivation for coverage plants was also installed, as part of the first phase of the project.

In the two years since it was launched, the Cotton-4 project has brought together different groups to evaluate the results of the demonstration units. The construction of the trichogramma laboratory and the refrigeration chamber to condition the seeds (germplasm bank) was initiated. Agricultural and laboratory equipment were consequently purchased. Additionally, the human resource component obtained excellent results, including the participation of 56 researchers of the C-4 in six courses on genetic improvement for the cotton plant, direct cultivation, and integrated pest control or management.

TECHNOLOGY FOR THE CULTIVATION OF RICE IN SENEGAL

On Africa’s Atlantic coast, south of the Sahara, researchers from the Senegalese Institute of Agricultural Research (Isra) began the year of 2010 hopeful that their crops would not suffer from the problem faced by Senegalese farmers: low productivity on rice plantations of 4.5 tons per hectare, which had led to a 16% trade balance deficit because it became necessary to import grain. In the final analysis, an average consumption of 74 kilos per year is needed to guarantee quality and to put food on the table for Senegalese citizens, who use rice as their main staple.

The technologies that can help increase rice production in Senegal have already begun to be tested. Since June of last year, the Support project has been underway, coordinated and funded by the ABC/MRE and technically executed by the Embrapa Rice and Beans (Santo Antonio de Goiás-GO) unit, decentralized from the company.

Estimated at US\$ 2.4 million through 2012, the project also follows this structure. For this reason, the basic idea is not only to test varieties but also

to work in such a way as to intensify and diversify 47 rice cultivation, enhancing production systems as a whole.

The work in Senegal is under the direction of a researcher from the Brazilian state-owned company living in that country. This professional is responsible for setting up the demonstration units for validation assays of eleven cultivars (BRS-Tropical, BRS-Alvorada, BRS-Formoso, BRS-Maravilha, BRS-Primavera, BRS-Sertaneja, BRS-Curinga, BRS-Caiapó, BRS-MG Conai, BRS-Pepita and BRS-GO Serra Dourada) from Embrapa which have been developed for high and intermediate areas that are irrigated.

TRAINING IN BRAZIL

In 2010, technical cooperation gained an important ally to complement the activities in African countries: Embrapa Studies and Training (Brasilia-FD), inaugurated in May by former President Lula. One of the newest units of the company, it fosters and coordinates the carrying out of studies in areas considered to be of strategic importance which have the capacity to contribute to institutional enhancement. National and international professionals are the target audience for this center, to systematically and continuously offer and hold courses and training on Tropical Agriculture.

In October of this year, 45 technicians and researchers from 20 countries across the continent participated in the two-module training. In the first module, they debated strategies for the training, structuring and strengthening of a research institution, all based on the Brazilian experience. In the second, called “From Theory to Practice”, topics covered included the cultivation of forage, pastures, good practices and seed production.

MARKETPLACE LEADS TO INNOVATIVE INTERACTION BETWEEN BRAZIL AND AFRICA

Researchers from Brazil and Africa are developing closer relationships and are ever more motivated





to enhance agricultural innovation and development in the African continent.

The link for this coming together is the Africa-Brazil Platform Agricultural and Cattle Raising Innovation (Africa-Brazil Agricultural Innovation Marketplace), an initiative that is bold in its creative approach to modernization. This initiative, dedicated to South-South cooperation, brought 125 specialists from 15 African countries together in Brasilia in October 2010.

The creative approach to conceiving the format and the expeditiousness and agility of the methodology used to draft and assess projects with a view towards broadening innovative knowledge exchange are but some of the features that attracted US\$ 3 million in funding by international organizations for the first Marketplace round.

In practice, the Marketplace has opened space for researchers to work together from different locations. These researchers work together to create projects in their respective countries, with the help of a specific site. Sixty-one of these works have been presented in a variety of areas.

## NANOTECHNOLOGY

### EMBRAPA DEVELOPS TECHNOLOGIES AND FORESEES THE FUTURE

Defined as a set of activities or mechanisms that occur at an extremely small scale, with implications in the real world, nanotechnology is present in chips and in computer memories in a range of electronic equipment and has an impact on multiple areas of application such as engineering, human and veterinary medicine, education, and agriculture, among others. The economic impact of nanotechnology can be measured in billions of dollars, precisely because of its high potential for application in almost every field of industry. The investment opportunities are huge, especially in the field of research.

Embrapa has been investing in this area since the second half of the 1990s, and today coordinates

a national research network that brings together research institutes and universities, along with, since 2009, the National Nanotechnology Laboratory for Agribusiness (LNNA) in São Carlos (SP), located at Embrapa Instrumentation. A variety of research lines in areas deemed to be at the frontier of human knowledge are developed at the Embrapa Instrumentation laboratory, including:

- sensors and biosensors for quality control, certification and traceability of food;
- new uses for agricultural products, such as polymers and thin films for intelligent packaging, edible products and active surfaces;
- natural nanofibers, such as hemp, jute, and coconut, to reinforce materials;
- nanoparticles for the controlled release of nutrients and pesticides in soils and plants and for veterinary medicine; and
- characterization of materials of interest to the world of agribusiness, to obtain new information on soil and plant particles, bacteria and pathogens that are of interest to agriculture.

Actions to foster technological innovation have also resulted in vanguard technologies, some of which are available in the market, while others are in the product development stages, based on prototypes set forth in the research projects. One of these technologies is a system called Electronic Tongue, a set of nano-structured sensors that correlate information on known systems, such as juices, wines or coffee, deemed to be of good or bad quality. Faced with an unknown sample, the system is able to receive an impression that is very similar to one by the human palate, and to classify it as a function of prior information. In a normal laboratory analysis, this type of information is highly complex and depends on an immense amount of conventional analysis. However, in the Electronic Tongue, what is obtained is a classification through a single analysis, in the same way as we evaluate an unknown beverage as being either “good” or “terrible”. This tool provides support to make decisions for professional tasters, and intense work has already been carried out, in the classification of commercial fruit juices for

instance. The technology was licensed for a company that participates in one of Embrapa’s incubation programs.

This is not the only development, however. A parallel project was the Electronic Nose, once again a system of nano-structured sensors, in this case adapted for the detection of gases, that are being tested to prematurely identify gases associated with the process of fruit ripening, offering rural producers new mechanisms for decision making when it comes to their harvests.

Nanometric films that are edible and non-toxic have been developed and adapted for national conditions and can be applied to fruit and to seeds that present selective properties for the passage of gases. Once applied, this film makes it possible to extend the average shelf life of an apple, usually seven days, to 25 days, without any rotting of the fruit or alterations in the taste and quality.

Other technologies which make the most of agri-products, such as pulp by-products and vegetable residues, have been developed for a project on nanocomposites and augur a future generation of biodegradable packaging that is environmentally safe.

### TECHNOLOGY INAUGURATES INVESTMENT OPPORTUNITIES

In the current worldwide scenario, two large technological groups have been identified in the field of nanotechnology: one for self-denominated products, which the producer/marketer of technology has deemed to fall under the category of nanotechnology, and one for non-denominated products, for which there is a product property associated to a nano-strategy although there is no association with the term nano in its dissemination or advertising. This latter situation means that there is an intrinsic nano property, however, normally identified only after specific characterizations. Some well-established products, such as industrial catalyzers and hardware technologies, fall under this category. Nevertheless, the so-called self-denominated products correspond to a greater

effort to consolidate nano-technologies due to the fact they present an innovative possibility with regard to new markets.

One source of reference is the Emerging Nanotechnologies Project, maintained by the Woodrow Wilson Center, which consists of a voluntary inventory of companies which, in 2009, added up to 1,015 product registries. At the foundation, the division of products into categories shows a great concentration in the health and personal care areas. This characteristic shows the market trend of seeking high value-added products that do not compete directly in structural areas. Other sources diverge regarding the distribution of technologies. A survey by Cientifica Ltda. regarding the distribution of sectors with products in the market indicates that the chemical sector now accounts for 53% of the world market in nanotechnology, followed by these sectors: semiconductors (34%), electronics (7%), defense and aeronautics (3%), medication and health (2%) and automotive (1%). In fact, developments in fine chemistry and semiconductors (geared mainly to microelectronics) can largely be classified as nano-technological, even if they are frequently defined as such. All of these sectors added up to a US\$ 135 billion market in 2007.

This scenario is well illustrated in Brazil by the chemical sector, which accounts for a large part of the total production of basic raw materials. According to the chemical industry’s Annual Report for 2008, the billing of the Brazilian chemical industry reached US\$ 122 billion. In one of the sector’s areas lies the production of nanoparticles, such as nanometric silica, currently produced in Brazil by many companies. Its applications extend to several sectors, with the use as a nanoload in rubber for tires as a key example.

Nanomaterials have been losing their status as high value-added material and have quickly taken on the behavior of commodities, indicating that there are no longer large windows of opportunities for small entrepreneurs. Therefore, the opportunities for new entrants continually tend towards market niches that are little explored, like specialties. In this aspect, sectors



44 associated with agriculture and cattle raising should also be seen as promising. It is necessary to keep in mind that the agriculture and cattle raising sectors have traditionally been thought of as low density technological sectors, but this is a mistake: the development of cattle raising and agricultural research is acknowledged as a differential for Brazil, presenting productivities above world averages, thanks to which the country is presently considered an expert in tropical agriculture. Under this scenario, there are still few developments listed for the nanotechnology sector, although, in its V Master Plan, Embrapa states that it considers nanotechnology as one of the most promising trends for agriculture and cattle raising research over the next decade. The sector's professionalization also makes it easier to include new technologies and foster new developments.

Nevertheless, despite these motivating scenarios, there is scanty information, even at the international level, on applied products. The analysis of the products that have undergone an inventory by the Emerging Nanotechnologies Project indicate that fewer than 10% of the products listed correspond to applications in agriculture and food, including technologies for packaging. There is an expectation of an increase of products, mainly for the food industry, especially in the field of additives for texture, aromas and flavor. This area, nonetheless, is undergoing a normative difficulty, leading to the announcement of products that are never launched. Very generally, products that are part of the inventory follow the value-added standard in that those products are concentrated in food supplements, nutraceutic additives, and additives with flavors typically associated with health, such as nano-salt, a product designed to reduce the salt content in food without a loss of flavor, or texturing additives to reduce the fat content in processed food.

Despite the impact of products on food, in this field the developments in packaging are significant and more important. Three sectors have been identified in the markets, corresponding to new packaging with less permeability to vapors,

sanitized packaging, and packaging with traceability systems or visual identification.

The data that makes it possible to identify those products that are potentially impactful in the food sector are nanometric silver, colloidal silica and nanometric titania (the latter have already been released, in bulk forms, as food additives) in addition to the possible food additives already used, such as soluble ions, like nano-selenium, nano-calcium, nano-magnesium and nano-iron. In Brazil, some companies that are specially marketing polymeric materials such as nanometric silver, for external sanitizing and increased shelf life (due to the reduction of contamination), have already been identified.

In the cattle raising sector, more generally, technologies are identified, mainly in the sector for agricultural pesticides, with technologies in fertilizers. The products marketed in pesticides are restricted to nanocapsules for the controlled or delayed release of the active principle (the pesticide per se). In this category, we mainly find herbicides, in which the alleged advantage would lie in the release of the active principle and its protection against weather conditions. In the case of cattle raising, no significant technologies have been identified. Nevertheless, there are great expectations for the entry of nano-encapsulated veterinary medication in the market, which could definitely have a strong impact.







*article*

# ECONOMIC AND SOCIAL IMPACTS OF IMPLEMENTATING PROJECTS IN FOOD PRODUCTION AND AGROENERGY

CLEBER GUARANY

*Cleber Guarany*

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COORDINATOR AT FGV PROJECTS

## CLEBER GUARANY

Cleber Guarany holds a degree in metallurgical engineering from São Paulo University (USP). He was a multinational CEO in the primary sector for four years, developing the South American market and expansion projects in Brazil. With 25 years experience in the private sector in national and multinational corporations, he structured the implementation of palm oil and biomass production for family farming businesses and associations. Over the past six years he has coordinated, prepared and implemented agroindustrial projects at FGV Projects. Guarany has coordinated works in the biofuel and food areas in more than 13 African and Latin American countries in partnership with local governments, professional bodies, multilateral banks, research institutes, and development and environmental agencies.



48 Capitalist economies have always faced the challenge of producing energy and food in sufficient amounts to support their development processes. The fact that, in many nations, several different stages of development coexist at the same time makes this challenge even more complex.

While some countries struggle to address the scarcities suffered by their populations, others pursue strategies designed to help them meet the energy and food demands of the emerging middle class, to maintain levels of economic growth.

Regardless of the nature of this challenge, the fact is that the stable supply of energy and food are fundamental variables for the development of modern societies. Insecurity in the supply of these necessities may lead to economic and even political instability, as was seen in the conflicts that arose in 2008.

The large majority of the almost 100 countries located in the so-called tropical belt face a peculiar paradox: despite the fact that this region has excellent soil and climate conditions for the production of food and agroenergy, many countries in this region are unable to meet their own demand.

If we consider the case of energy, data shows that Africa and Latin America, where most of the territories in the tropical belt are located, are the regions with the lowest energy consumption. Most remarkable is the disparity between energy consumption in those regions and energy consumption in North America, Europe and Asia (Figure 1).

Regarding food consumption, Table 1 shows the significant expenditures on imports in some of the more relevant commodities for food which could easily be produced in the tropical belt region.

In addition to the impact on trade balance deficits, issues that refer to “food safety” fully justify policies to reduce external dependency. Furthermore, the excellent climate and soil conditions found in this region allow these countries to support their own development with the production of food and agroenergy.

BRAZIL: AN EXAMPLE OF DEVELOPMENT THROUGH AGRICULTURE

Brazilian development has always relied heavily on agriculture. Several value chains in Brazil were developed based on the production of basic agricultural crops, such as soy beans, sugar cane, corn, coffee, manioc, and citric fruit. These chains were strengthened as the country became increasingly competitive in agricultural production with the development of new cultivars and new cultivation, management and harvesting techniques.

By challenging the view that industrialization would be the sole path to development, Brazil’s experience proved that agricultural activity can not only convey its externalities to other cattle-raising activities but can also add dynamism to other sectors of the economy, such as industry and services.

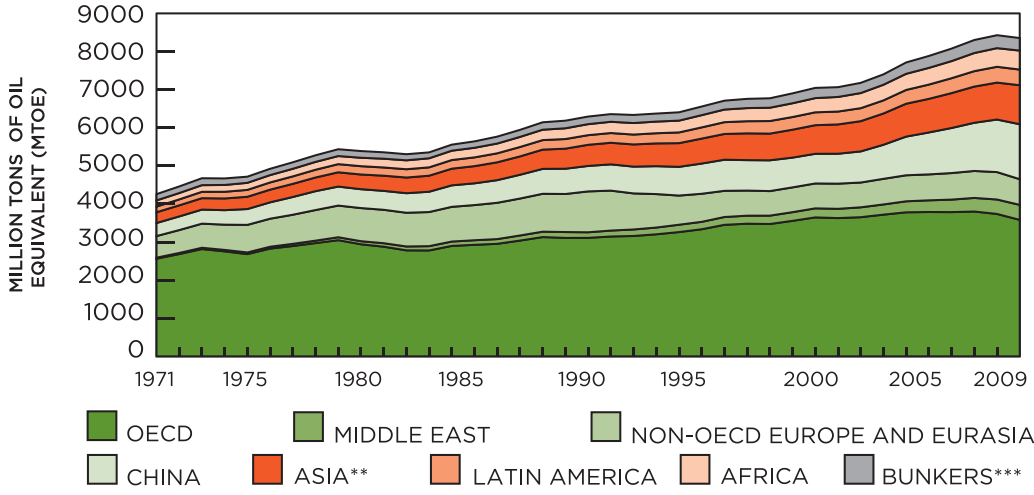
An interesting case is that of the soybean chain, which has had a marked impact on the development of the center-southern region over the last 30 years. Animal protein production has gained force as soybean plantations began to develop while the increase in the supply of soybean bran for animal rations significantly reduced the costs of cattle-raising production.

In a similar fashion, the production of soybean oil, formerly a product with limited demand, was found to contribute to the production of biodiesel, making it possible to develop an entirely new industry. This process is illustrated in Figure 2.

Another example relates to sugarcane production. This chain gained momentum with the Pro-Alcohol Program (Proálcool), which in 1975 set up a regulatory framework for the introduction of ethanol into the Brazilian energy matrix. Thanks to this, incentives were created so that, in addition to ranking among the main worldwide producers of this fuel, the country could position itself as the world’s leading sugar producer.

In addition, there was yet another increase in power generation, due to the cogeneration process that used sugarcane bagasse. Today, this chain seems

FIGURE 1  
WORLD CONSUMPTION\* FROM 1971 TO 2009 BY REGION



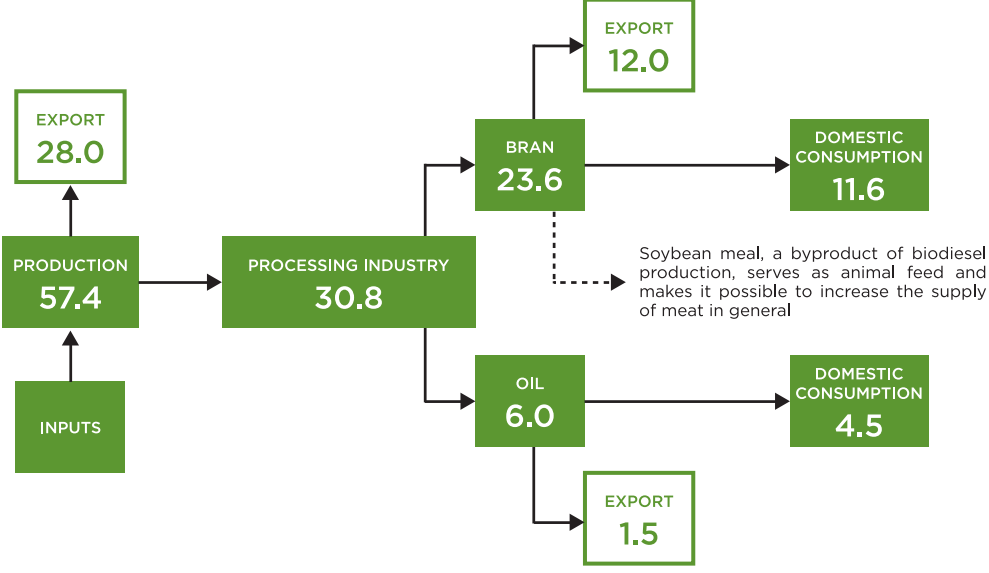
SOURCE: IEA  
\*DATA PRIOR TO 1994 FOR BIOFUELS AND WASTE FINAL CONSUMPTION HAVE BEEN ESTIMATED.  
\*\*ASIA EXCLUDES CHINA  
\*\*\*INCLUDES INTERNATIONAL AVIATION AND INTERNATIONAL MARINE BUNKERS

TABLE 1  
FOOD IMPORTS, PER REGION, IN 2009 (US\$ THOUSAND)

	PALM OIL	CORN	RICE	SUGAR
AFRICA	3,680,451	2,750,058	2,465,875	1,839,159
CENTRAL AMERICAN AND CARIBBEAN	386,179	2,475,227	731,758	589,658
SOUTH AMERICAS	233,722	1,746,743	346,346	430,171
ASIA	14,062,792	9,766,844	7,600,916	3,790,468
EUROPE	7,982,965	18,191,414	-	10,671,306

SOURCE: FAO

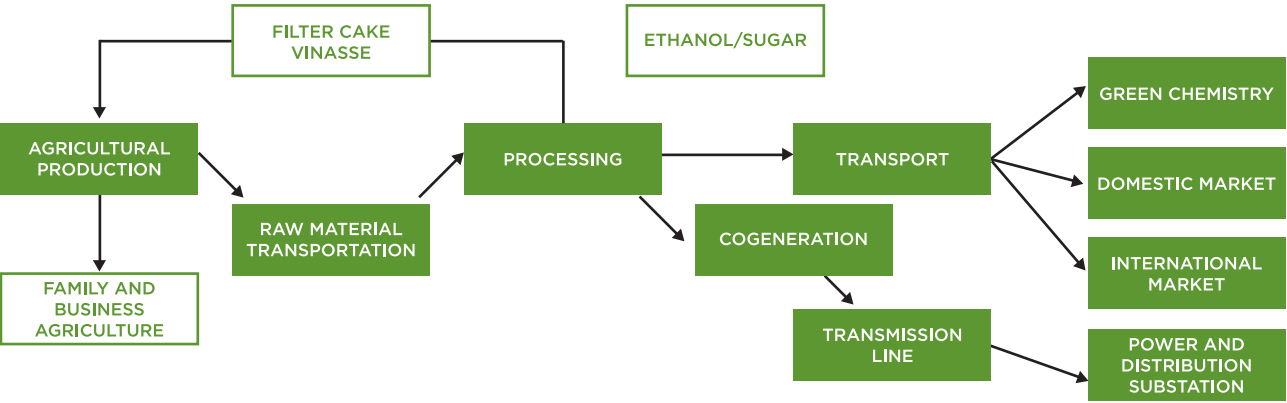
FIGURE 2  
SOYBEAN CHAIN 2009/2010 (MILLION TONS)



SOURCE: FGV PROJECTS



50 **FIGURE 3**  
SUGARCANE CHAIN



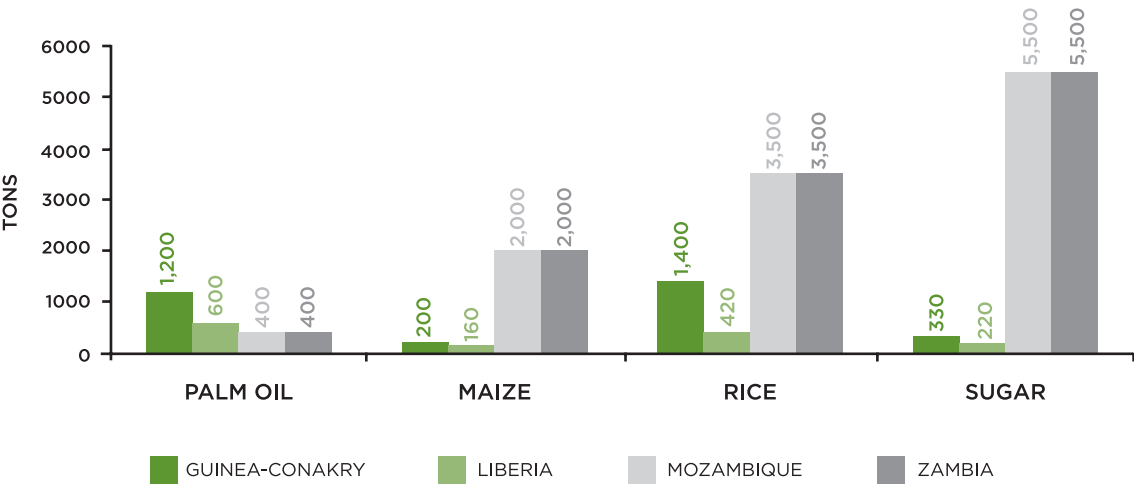
SOURCE: FGV PROJECTS

**TABLE 2**  
POTENTIAL AREA FOR PLANTING (HECTARE)

	PALM OIL	CORN	RICE	SUGARCANE	TOTAL	% COUNTRY AREA
GUINEA-CONAKRY	200,000	50,000	200,000	30,000	480,000	2.0%
LIBERIA	100,000	40,000	60,000	20,000	220,000	2.0%
MOZAMBIQUE	100,000	500,000	500,000	500,000	1,600,000	2.0%
ZAMBIA	100,000	500,000	500,000	500,000	1,600,000	2.0%
TOTAL	500,000	1,090,000	1,260,000	1,050,000	3,900,000	-

SOURCE: FGV PROJECTS  
NOTE: AREAS INCLUDED FOR ABANDONED OR DEGRADED REGIONS

**FIGURE 4**  
PRODUCTION POTENTIAL OF THE COUNTRIES STUDIED



SOURCE: FGV PROJECTS  
NOTE: AREAS INCLUDED FOR ABANDONED OR DEGRADED REGIONS

poised to establish Brazil as a leading world player in products derived from green chemistry, such as bioplastics (Figure 3).

All of these activities have generated a demand for industrial goods while allowing for the development of other sectors, such as machines and equipment. The production of tractors, agricultural implements, silos and even agri-industrial complexes to process the agricultural production was originally supported by local demand and is now able to compete worldwide.

In the same way, the fertilizer and pesticide industries have benefitted from the growth of Brazilian agriculture and, as with other sectors in agribusiness, have begun to foster and support growth in a variety of regions in Brazil.

The research and development sector (R&D) was also fundamental in this process. Under the leadership of EMBRAPA, which has played a fundamental role in the introduction of new varieties and advanced management techniques, private companies have set up laboratories for the development of new and more productive cultivars that can adapt to the tropical climate.

REPLICATING THE BRAZILIAN EXPERIENCE

Although we are aware that other nations may face different limitations than those found in Brazil, the cases described above clearly point to the enormous potential that agro-industry has for promoting the development of countries located in the tropical belt.

With the aim of identifying these limitations and specificities, FGV Projects has already studied and analyzed the agricultural production capacity of 13 countries in Africa and Central America. Significant potential was identified in the production of food and agroenergy in degraded or abandoned areas.

Table 2 contrasts four African nations with different social and economic characteristics, identifying areas suitable for the production of some of the most consumed food products in the world, such as palm oil, corn, rice and sugarcane. A maximum limit corresponding to 2% of country’s territory was established to evaluate the potential for agricultural production.

It has been verified that there exists not only the production potential to supply local markets,





52 but to capacity to generate surpluses that could be exported to other nations, in both Africa and elsewhere (Figure 4).

Considering only current levels of imports for the African continent, the surplus volumes in production in the countries surveyed would be enough to meet the entire demand for rice and sugar, as well as corn and palm oil, for Africa, as shown in Table 3 and Figure 5.

It is worth remembering that the social and economic impact generated by such activities in the economies of the producing countries would also be very positive, helping to improve the prevailing conditions in education, health and infrastructure.

The African continent also counts upon other countries with similar potential and with the capacity to produce, in addition to the abovementioned crops, such high-demand crops as soybeans, sunflowers, and peanuts, among others.

For the production of energy, it is interesting to note that the countries surveyed are importers of fossil fuels, mainly diesel and gasoline. In this context, agroenergy could also contribute to reducing this dependency and could help increase the energy security of these nations.

Liberia, Guinea, Mozambique and Zambia could develop a vigorous agroenergy park by using a mere 0.5% of their territory. The production of the resulting biodiesel would meet the domestic needs of almost all of the countries evaluated, with the exception of Mozambique. In the case of the latter, biofuel would meet 50% of the country's demand, a still significant amount, as shown in Table 4 and Figure 6.

With regard to ethanol, all of the countries evaluated would have the capacity to replace 100% of the volume consumed and to export significant surpluses to other countries of the region, which at present face similar problems, with a high level of dependency on fossil fuels (See Table 5 and Figure 7).

Considering the growing demand for power across the African continent, the potential for production

of electrical energy generated from the planted biomass and that is generated by sugarcane bagasse obtained from the production of ethanol, was also evaluated.

As seen in Table 6, the cost of production for biomass power is US\$ 200/MWh, much cheaper than for power produced in a diesel thermoelectric plant.

Energy generated through thermoelectric plants operated by diesel is one of the most commonly utilized forms of energy in Africa, and the reduction in costs made possible by substituting renewable energy could be significant. In Table 6, we see a potential savings of approximately 2 billion dollars per year as a result of the production of energy with biomass.

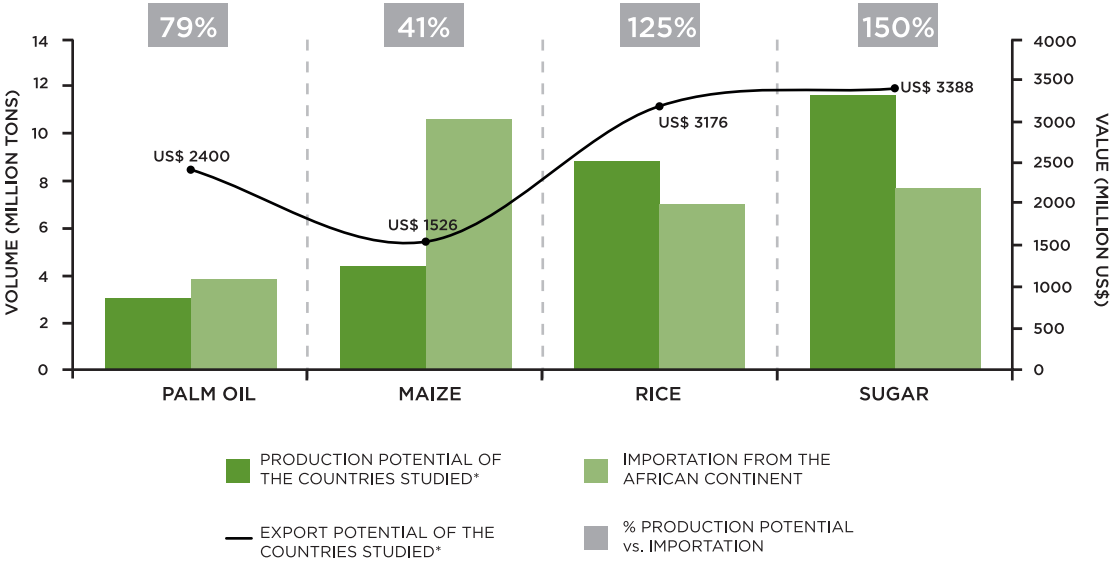
Food production and agroenergy projects have the capacity to generate employment and distribute income as they prioritize import substitution for the production of strategic local inputs for the countries. Once these countries become aware of their huge agricultural potential, they must find a way to attract private investment.

With this in mind, by developing projects for the production of food and agroenergy, FGV Projects has become involved in the creation of efficient mechanisms to attract capital, to enable it to focus on projects with a high financial return and low perceived risk.

The intention of this paper is not to suggest that the Brazilian example can be fully reproduced or replicated in other regions of the world. As mentioned, the great social and economic diversity found in different nations demands a customized development plan for each that takes into account local specificities and how best to use the resources and potential available.

With this in mind, FGV Projects has actively worked to identify this latent potential, and, by doing so, to contribute to the social and economic development of Brazil and the world, in accordance with its role as one of the leading think tanks in Latin America.

FIGURE 5  
PRODUCTION AND IMPORTATION POTENTIAL OF THE COUNTRIES STUDIED\* VS.  
IMPORTATION FROM THE AFRICAN CONTINENT



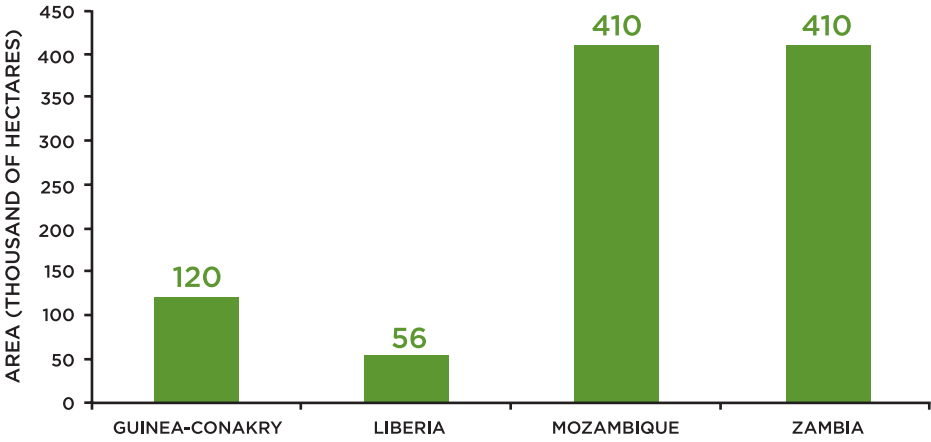
SOURCE: FGV PROJECTS  
\* COUNTRIES: GUINEA-CONAKRY, LIBERIA, MOZAMBIQUE AND ZAMBIA

TABLE 3  
EXPORT POTENTIAL OF THE COUNTRIES STUDIED\* (TONS)

PRODUCTION	PALM OIL	CORN	RICE	SUGARCANE
PRODUCTION POTENTIAL OF THE COUNTRIES STUDIED	3,000,000	4,360,000	8,820,000	11,550,000
IMPORTATION FROM THE COUNTRIES STUDIED	166,494	176,442	680,192	170,427
IMPORTATION FROM THE AFRICAN CONTINENT **	3,642,509	10,445,599	6,352,305	7,529,242
EXPORT POTENTIAL OF THE COUNTRIES STUDIED (THOUSANDS US\$)	2,400,000	1,526,000	3,176,153	3,388,159

SOURCE: FGV PROJECTS  
\*COUNTRIES: GUINEA-CONAKRY, LIBERIA, MOZAMBIQUE AND ZAMBIA/\*\*AFTER DISCOUNTING THE VOLUMES FROM THE COUNTRIES STUDIED

FIGURE 6  
POTENTIAL AREA FOR PLANTING



SOURCE: FGV PROJECTS  
CROPS: PALM OIL, SUGARCANE AND BIOMASS (ELEPHANT GRASS) /  
PREMISE: USE OF 0.5% OF THE TERRITORIAL EXTENSION OF THE COUNTRIES  
NOTE: AREAS INCLUDED FOR ABANDONED OR DEGRADED REGIONS

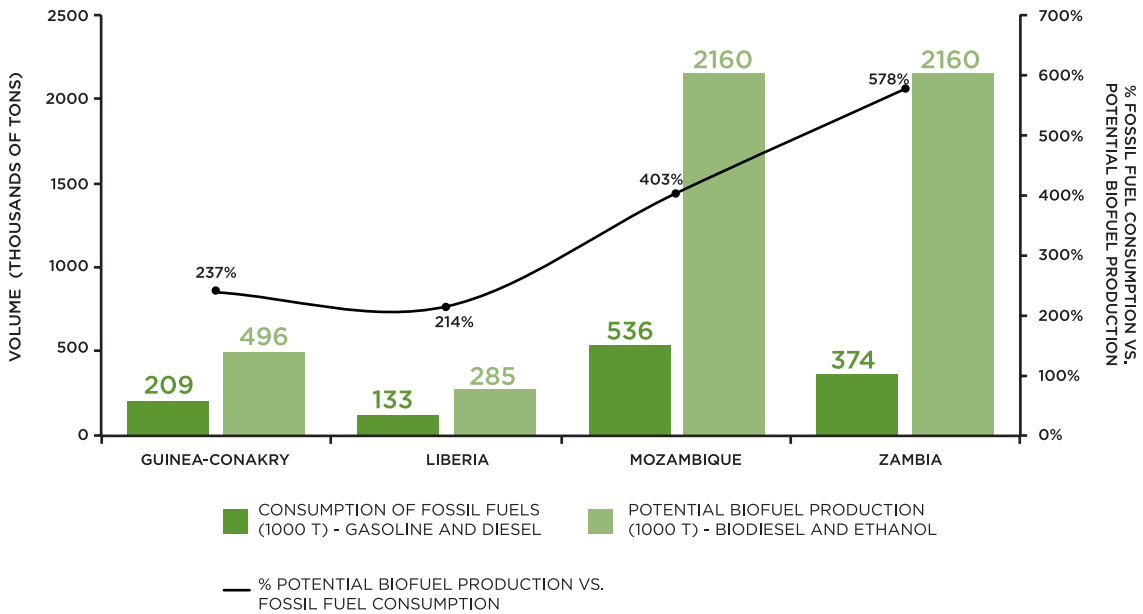


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TABLE 4  
POTENTIAL AREA FOR PLANTING (HECTARES)

COUNTRY	PALM OIL	SUGARCANE	BIOMASS	TOTAL	% COUNTRY AREA
GUINEA-CONAKRY	40,000	40,000	40,000	120,000	0.5%
LIBERIA	24,000	22,000	10,000	56,000	0.5%
MOZAMBIQUE	60,000	300,000	50,000	410,000	0.5%
ZAMBIA	60,000	300,000	50,000	410,000	0.5%
TOTAL	500,000	1,050,000	1,260,000	3,900,000	-

SOURCE: FGV PROJECTS  
NOTE: AREAS INCLUDED FOR ABANDONED OR DEGRADED REGIONS/BIOMASS: ELEPHANT GRASS

FIGURE 7  
CONSUMPTION OF FOSSIL FUELS VERSUS POTENTIAL BIOFUEL PRODUCTION



SOURCE: FGV PROJECTS

TABLE 5  
POTENTIAL BIOFUEL PRODUCTION VS. FOSSIL FUEL CONSUMPTION (THOUSANDS OF TONS)

	CONSUMPTION OF FOSSIL FUELS		POTENTIAL PRODUCTION OF BIOFUELS	
	DIESEL	GASOLINE	BIODIESEL	ETHANOL
GUINEA-CONAKRY	96	113	240	256
LIBERIA	81	52	144	141
MOZAMBIQUE	438	98	240	1,920
ZAMBIA	246	128	240	1,920
TOTAL	861	391	864	4,237

SOURCE: FGV PROJECTS  
NOTE: BIODIESEL AND ETHANOL - CONSIDERING THE PRODUCTION AREAS OF TABLE 4

TABLE 6  
SAVINGS AFFORDED BY THE PRODUCTION OF ELECTRICAL POWER USING BIOMASS  
(COMPARATIVE BASIS: DIESEL-POWERED THERMOELECTRIC POWER)

	BIOMASS POWER (MWH)	BAGASSE POWER (MWH)	TOTAL POWER (MW YEAR)	DIESEL COST (US\$)
GUINEA-CONAKRY	160	80	1,612,800	322,560,000
LIBERIA	40	44	506,880	101,376,000
MOZAMBIQUE	200	600	4,176,000	835,200,000
ZAMBIA	200	600	4,176,000	835,200,000
TOTAL	600	1,324	10,471,680	2,094,336,000

SOURCE: FGV PROJECTS  
NOTE: DIESEL-POWERED THERMOELECTRIC COST: US\$ 300/MWH; BIOMASS-POWERED ELECTRIC POWER COST: US\$ 100/MWH;  
SAVINGS AFFORDED BY THE USE OF BIOMASS-POWERED THERMOELECTRIC POWER: US\$200/MWH





*article*

# DETERMINING FACTORS IN FOOD PRICES: THE IMPACT OF BIOFUELS

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58 At the end of 2008, FGV Projects sponsored a survey analyzing factors that determine food prices. One of the main conclusions of that survey was that the expansion of the production of biofuels, more precisely of ethanol made from sugar-cane, was not a relevant factor for the increase in food prices observed throughout the year 2008. According to this study, two factors that did in fact contribute decisively to the food price increases were speculation in the futures market and an increase in grain demand at a time when supply was lower than usual.

Over the last few years, there has been increasing debate among multilateral institutions regarding the reasons for the recent increase in food prices in the world's leading markets. In its flagship report for the year 2011, "The State of Food Insecurity in the World", the United Nations Food and Agriculture Organization (FAO) suggested that possible causes included the increase in demand for grains in countries with rapid development processes, population growth, and growth in the production of biofuels.

Nevertheless, despite the institutional relevance of the agency sponsoring this report, there does not exist a complete consensus regarding the relative importance of each of these factors. In other words, although many of those factors are relevant, it is necessary to first qualify the context in which biofuels are produced and marketed. For example, ethanol production based on sugarcane is quite different from corn-based ethanol or from that of other cereals, as the production of biodiesel based on palm oil differs from the production of biodiesel based on soybeans.

In this sense, the report on which this summary is based -- "Determinant Factors in Food Prices -- The Role of Biofuels" -- aims to detail the eventual impact of biofuels on the prices of the main grains used for human nutrition -- corn, soy beans, wheat and rice. Additionally, the report presents a case study regarding the evolution of palm oil, which is increasingly used for the production of biofuels.

Overall, this study has updated the data from

the previous study, and qualitatively and quantitatively evaluates the impact of the production of biofuels on the recent behavior of food prices based on stylized facts and appropriate statistical models that are consistent with the way markets operate.

Food prices have undergone strong fluctuations in the period subsequent to the conclusion of the abovementioned study, dropping drastically after the breakout of the financial crisis in 2008 before rebounding to pre-crisis levels in mid-2010 and remaining at those levels in 2011. The graph below illustrates food price movements in general and for grains in particular (measured through the FAO price index) during the first decade of the new millennium.

In this context of fluctuating food prices, the present study updates the results of previous studies, highlighting the role of market fundamentals in food pricing and the mechanisms for price transmissions between the futures markets and spot markets for agricultural commodities.

It is important to note that, according to most of the work conducted in this area, there is not one single factor that could explain recent food price increases on its own; rather, it is about a set of factors. One of the most comprehensive studies, carried out by FAO, shows potential causes but warns that it is difficult to measure the isolated contribution of each cause when it comes to price increases. Among the factors analyzed, the following should be emphasized:

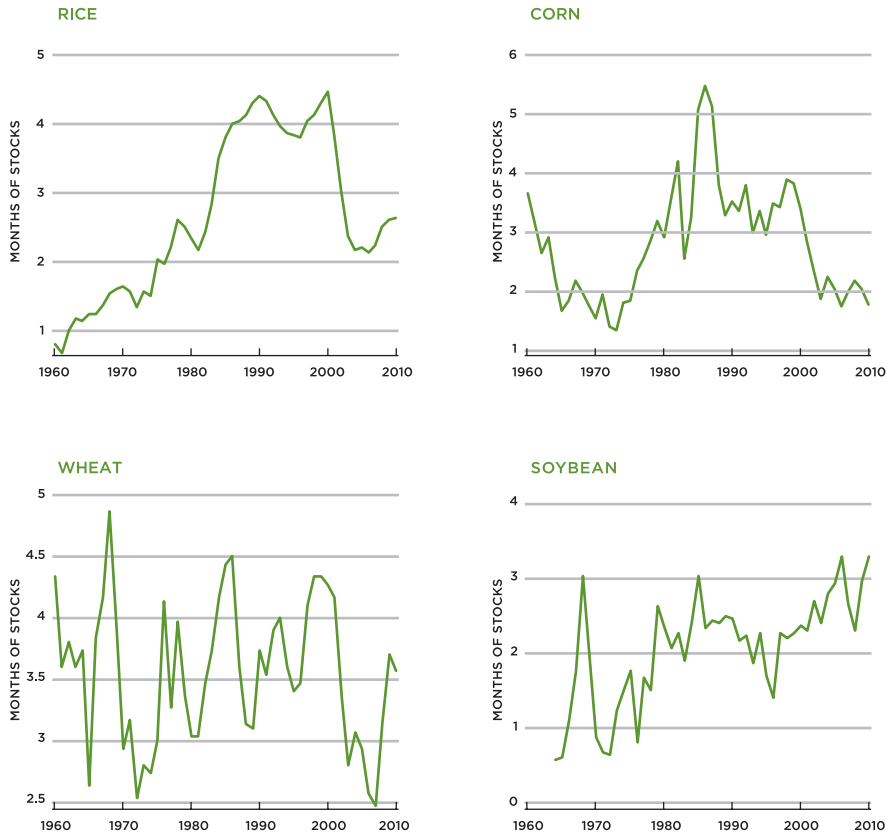
- Growth in the demand for food and a change in the consumption structure -- more proteins and less carbohydrates -- thanks to the income growth of the population and the urbanization of less developed countries;
  - Use of cereals and other agricultural products in the manufacture of fuels;
  - Operations in financial markets;
  - Harvest shortfalls caused by the climate; and
  - Low levels of cereal stocks resulting from changes in public policies or harvest shortfalls.
- These elements can be consolidated into two

FIGURE 1  
EVOLUTION OF FAO PRICE INDEX\* (FOOD AND CEREALS)



SOURCE: FAO  
NOTE: \*THE FOOD PRICE INDEX: IS A MEASUREMENT OF THE PRICE INDICES FROM THE FIVE GROUPS OF COMMODITIES FOLLOWED BY FAO (MEATS, MORNING PRODUCTS, CEREALS, OILS AND FATS AND SUGAR) CONSIDERING THE AVERAGE SHARES OF EXPORTS IN EACH GROUP DURING 2002-2004. GRAIN PRICE INDEX: COMPILED BY THE GRAIN AND RICE PRICE INDICES TAKING INTO ACCOUNT THEIR SHARES OF COMMERCE DURING 2002-2004.

FIGURE 2  
WORLD STOCKS FOR THE MAIN AGRICULTURAL COMMODITIES  
(IN MONTHS OF CONSUMPTION)



SOURCE: USDA



different groups: those associated with market fundamentals - the supply and demand of agricultural commodities - and financial elements, such as the relationship between the futures market and spot markets.

According to critics of biofuels, the greatest demand for agricultural products for energy purposes may have given rise to the toughest competition ever for cultivation areas. Additionally, the expansion of biofuels could have diverted part of the production destined for food consumption to fuel refineries.

Figure 1 and 2 show that there has been a reduction in the stocks of the main grains, but this does not necessarily result from the production of biofuels. In fact, the increase in demand for grains can also result from the other causes mentioned previously, particularly increases in consumption and dietary changes in developing countries, with the supply also being influenced by other factors such as production conditions and the climate.

Of the commodities shown below, corn and soybeans are the ones that have most frequently been blamed for price increases over the past few

years because of their conversion into biofuels. Based on a simple visual inspection of the graphs, it can be observed that the corn inventories, in fact, point to a drop in the last decade, but the soy bean stocks do not show any decreasing trend in the long term.

As shown in the studies drafted by FGV Projects, stocks, along with the increase in demand, represent the most significant variable, at least statistically, that would explain the recent increase in grain prices.

Nonetheless, we must be attentive to a phenomenon that is not usually addressed in studies examining this issue : the relationship between biofuels and food prices must be understood as a two-way relationship. If the production of biofuels can divert food production, the contrary relationship can also occur, whereby food production can also derail biofuels production. This second possibility is particularly important in case the production of biofuels proves to be an alternative to fossil fuels.

In fact, the energy issue (or, better said, oil prices) has always been associated with agricultural

production though a one-way channel of costs, supplying inputs for the production of fertilizers and for the production and outflow of agricultural production. When a variety of agricultural commodities also begin to be used as an alternative energy source, as a response to the quest for renewable alternatives to oil, food production and energy production begin to be linked through an arbitrage mechanism bridging these two possible uses of land. Great ruptures or breaks, in any direction in this relationship, can produce adverse price shocks, as was seen in the impact on energy prices during the oil crisis of the 1970s.

This is a relatively well-known phenomenon in Brazil, a country that, early on, adopted an energy production program based on biomass, as is the case of ethanol produced from sugarcane.

Therefore, in the Brazilian case, when the price of ethanol is attractive, the production of sugarcane plants is geared to producing more of this product, to the detriment of the production of sugar. On the other hand, when the price of sugar becomes relatively more attractive, production is displaced to this particular product, decreasing the

production of ethanol. Once regulatory issues are complied with, regarding the minimum mixture of ethanol in gasoline, what follows is that when the price of ethanol fuel increases, part of the demand for the product is replaced by gasoline due to the high share of biofuels vehicles in the national fleet. According to the results of this study, this is the only reason why the ethanol supply strongly corresponds to the share of flex fuel cars in the national fleet.

In summary, since ethanol based on sugarcane became established as a viable alternative for fuel, we can see the two-way relationship that is being set forth here more clearly. Unfortunately, ethanol is not a good substitute for diesel oil. If it were, the relationship would be even clearer, considering that diesel is both a direct input for agricultural production as well as a by-product of it in the case of biodiesel. This is the case for palm oil, briefly analyzed in the update of the FGV Projects study.

Figure 3 illustrates the argument presented above, showing that the share of flexfuel automobiles reached more than 80% of the fleet at the end of the first decade of the new millennium. In other





words, at least in the Brazilian case, agricultural production and the production of energy are already closely linked. What we are attempting to show throughout the work is that this may happen without detrimental impacts on food production.

In this sense, the production of ethanol by means of sugarcane, besides not contributing to the increase of food prices, represents an important energy reserve for the country that may be able to at least partially mitigate the effects of occasional shortages of fossil fuels.

A pioneering study carried out in this area by the World Bank (Mitchell, 2008) concluded that the impact of the production of biofuels was one of the main factors responsible for the steep increases in food prices from mid-2007 through 2008. According to this study, 75% of the increase in food prices can be attributed to the expansion of bioenergy. Another study carried out by the IMF (Lipsky, 2008) concluded, along the same lines, that the increase in demand for biofuels was responsible for 70% of the price increases which occurred in corn prices and for 40% of the increase in soybean prices.

On the other hand, the United States Department of Agriculture (USDA) came to rather different conclusions: while admitting there was an impact from the production of biofuels in food prices, it found this impact to be minor. More precisely, according to the USDA, only 3% of the 40% increase in food prices could be attributed to the impact of the production of biofuels. In the same vein, a 2008 study from the European Commission argued that it was not possible that there had been a great impact from biofuels production on food prices as only 1% of the European production of cereals had been used for the production of ethanol -“a drop in the ocean”, in the words of the study.

It should be mentioned that in 2010 the World Bank produced a new study (Baffes & Haniotis, 2010) that contradicted the conclusions of the 2008 study, granting greater importance to financial speculation in futures markets as a factor

that could explain the crisis in food prices:

*“The effect of biofuels on food prices has not been as large as originally thought, [but] the use of commodities by financial investors (the so-called “financialization of commodities”) may have been partly responsible for the 2007-08 spike.” (Baffes & Haniotis, 2010).*

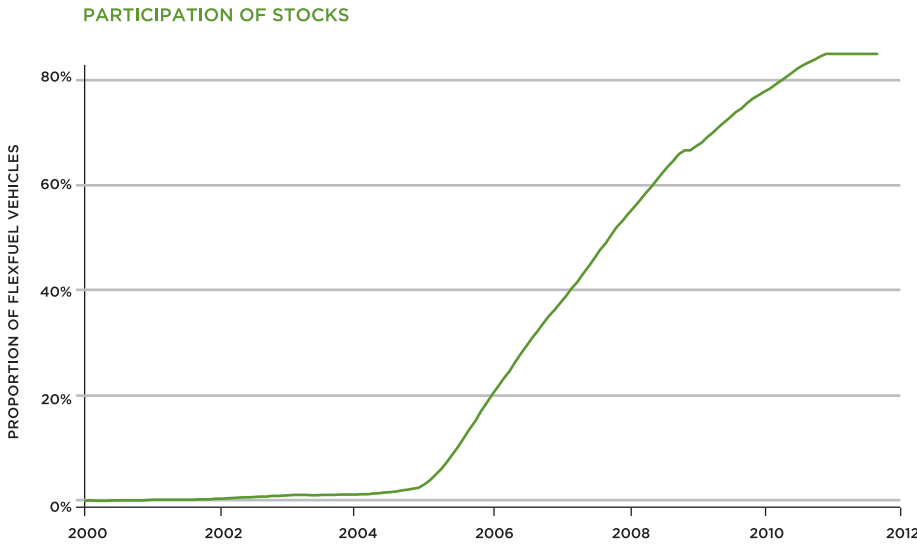
Even so, the World Bank argued that there is a significant link between the price of energy commodities and the price of non-energy commodities, and that this will be the determinant factor in the food market dynamic in the near future. In its explanations regarding the food price crisis in 2008, the World Bank study emphasized there was a combination of adverse climate conditions which significantly reduced supply at the same time as the conversion of land for biofuel production. Their main concern, however, was related to corn in the U.S. and edible oils in Europe:

*“In the case of agricultural commodities, prices were affected by the combination of adverse weather conditions and the diversion of some food commodities to the production of biofuels (notably corn in the US and edible oils in Europe). That led to global stock to use ratios of several agricultural commodities down to levels not seen since the early 1970s, further accelerating the price increases.”*

The possibility of causing a significant impact on the price of commodities in futures markets relative to the fundamentals (underlying supply and demand) - that is, regarding the spot market prices in which there is the effective delivery of the good being negotiated -, is a controversial issue in economic literature. Nevertheless, there have been some recent and important strides not only in the formulation of models but in the empirical evaluation of the hypothesis of a long-lasting distancing of future prices and spot prices, based on speculative activities.

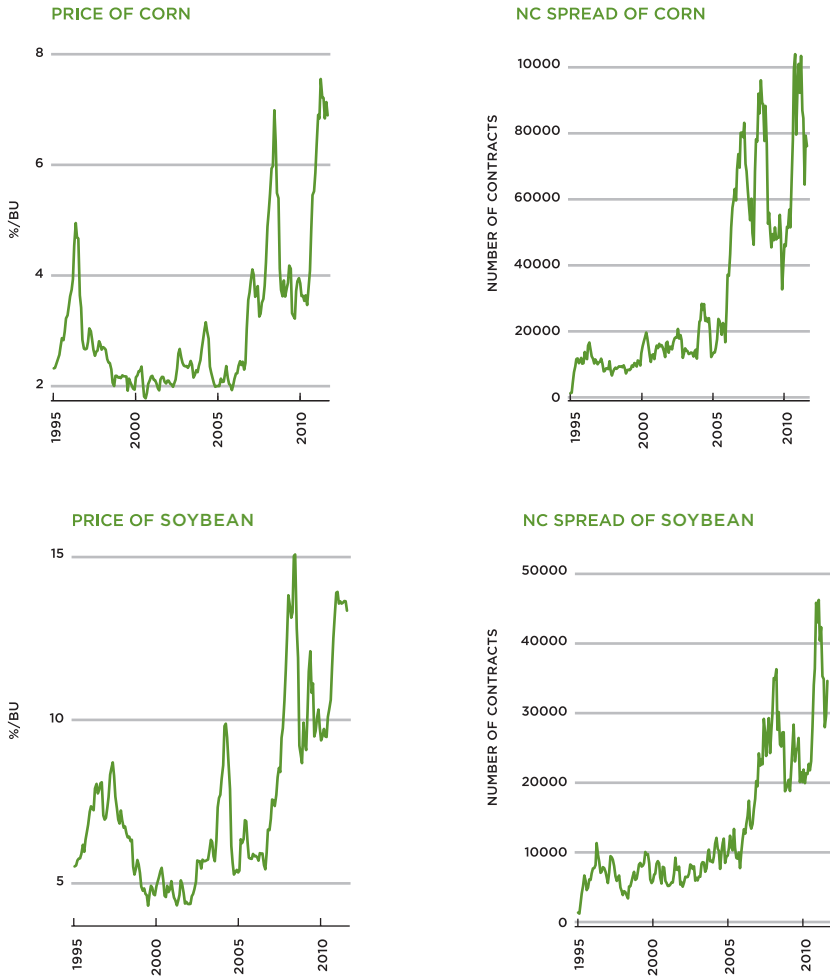
An example is the study by Lagi et al (2011) that argues that the sudden movements that led to spikes in prices during the 2008 crisis, and once

FIGURE 3  
SHARE OF FLEX FUEL VEHICLES IN THE BRAZIL



SOURCE: ANFAVEA

FIGURE 4  
SPOT PRICES AND NON-COMMERCIAL SPREADS CONTRACTS



SOURCE: CBOT



again in 2010-2011, were consistent with the typical dynamics of speculative bubbles and that the confirmation that speculation would be at the center of these crises requires a quantitative model so that the price dynamics can directly incorporate the role of speculators. Lagi et al (2011) therefore built a dynamic model for supply and demand which also takes into account the participation of speculators. The model describes trend-following behavior and can explicitly generate dynamics of the bubble-crash type.

In this model, if well-informed investors believe that supply and demand are mismatched or out of sync, there is a force that operates to counterbalance this effect, in the sense of obtaining a balanced price. When the prices are above the balance line, investors sell and when it is below, they buy. The alternating between dynamics of the trend-following type and restoring the balance of fundamentals can generate different types of results, depending on the relative importance of each situation.

For a sufficiently large volume of participation by speculators in the market (as a counter-position to, or to the detriment of, those who operate merely seeking protection, i.e. hedge) the trend-following behavior can lead to a great discrepancy among the prices in effect and can impact the balance between supply and demand. Even so, as this discrepancy increases, the forces that restore balance come into play and are immediately accompanied by trend-following behavior in the opposite direction -- that is, by a return to the fundamentals (and can even go beyond that point of balance). A large participation in the market by speculators is confirmed by the strong presence of non-commercial operators in long positions in the Chicago merchandise stock exchange.

Table 1 illustrates that fact. As can be observed, the number of future contracts celebrated by non-commercial agents, normally a good measure of the operators involved in a speculative activity, increased considerably in the second half of the first decade of the new millennium when compared to average figures from the mid-1980s.

In the case of corn, this number grew more than three-fold in percentage terms. Figure 4 also show that the increase in numbers of contracts of a more speculative nature has a close correlation with the spot market prices of commodities.

The quantitative analysis performed by Lagi et al (2011) shows results that in large measure contradict the belief that biofuels were the great villains in the food price crisis. Furthermore, they reveal that the production of biofuels that has some impact on food prices is the one that refers to ethanol produced from corn:

*“Here we provide a quantitative model of price dynamics demonstrating that only two factors are central: speculators and corn ethanol” (Lagi et al, 2011 p. 2).*

Such results are consistent with the results obtained in the original FGV Projects study, which was recently updated. In the Granger causality tests, we can actually see that the future market prices precede the spot market prices for all of the commodities researched. Figure 4 show the prices in the spot market and the number of contracts in long positions for corn and soy beans, two important commodities that have undergone conversion into biofuels – ethanol and biodiesel, respectively.

In sum, the long-term trend for food prices is determined by the market fundamentals, notably the low stocks of the main commodities, while speculative activity explains the dynamic of the strong oscillations in periods of crisis.

Furthermore, although the results regarding the conversion of corn into ethanol have not been statistically significant, this and other studies indicate that this conversion has a minor impact, albeit a positive one, on the prices of this product. The same is not observed in relation to ethanol made from sugarcane, in which the area cultivated with sugarcane does not significantly impact the price of grains. This suggests that a recent increase in the production of ethanol is due, above all, to productivity gains and not to the simple expansion

of cultivated areas and the conversion of land for the production of grains.

A similar phenomenon takes place with another crop investigated in the present work: cultivation of palm oil. The main product of this crop, palm oil, has been used successfully in the production of biodiesel, although critics have argued that the increase in cultivation could lead to the degradation of forest areas in the Amazon region.

Nevertheless, the use of palm oil for the production of biodiesel remains negligible. In addition, the crop expansion occurs in devastated areas where there is still a great deal of room for growth, occupying only the degraded areas without moving into the native forest. Finally, if Brazilian productivity for palm crops attains the standards of Southeast Asia, it will become possible to increase the production of palm oil by 50% without occupying a single additional hectare of land.

It should be emphasized that these conclusions

are not different from those of other studies cited above. As mentioned, even the World Bank, when updating a 2008 study, acknowledges that the production of ethanol has not had such an impact on food prices as predicted earlier, although it recognizes that the prices of energy and non-energy commodities should remain linked in the future, as noted in the case of ethanol from sugar cane.

Even the FAO studies indicate inventory levels (increase in demand) and speculative activities, as potential factors for explaining the rise in prices. However, such studies should be considered as prospective studies on the phenomenon, as they do not provide sufficient input to distinguish between the impacts of different crops used for biofuel production, for example, between sugar cane and corn, or between Brazilian and Southeast Asian palm oil.

TABLE 1  
FUTURE NON-COMMERCIAL CONTRACTS AND THEIR % OF THE TOTAL

		1986 - AVERAGE JAN-APR	2005 - AVERAGE JAN-APR	2008 - AVERAGE JAN-APR	2011 - AVERAGE JAN-APR
CORN	NO. CONTRACTS	10,011	133,416	614,574	781,254
	% OF THE TOTAL	14.3%	25.0%	48.1%	53.6%
SOY BEANS	NO. CONTRACTS	12,514	65,116	243,864	313,093
	% OF THE TOTAL	32.5%	29.7%	49.2%	54.0%
WHEAT	NO. CONTRACTS	5,630	60,684	170,382	189,691
	% OF THE TOTAL	34.5%	33.3%	44.8%	41.2%

SOURCE: CBOT



*article*

# POVERTY AND THE NEW RURAL MIDDLE CLASS

MARCELO NERI

*Marcelo Neri*

ECONOMIST - HEAD OF THE FGV SOCIAL POLICIES CENTER (CPS) AND PROFESSOR AT RIO DE JANEIRO SCHOOL OF ECONOMICS OF FGV FOUNDATION (EPGE/FGV)

## MARCELO NERI

Marcelo Neri holds a bachelor's degree and a master's degree in economics from Rio de Janeiro's Catholic University (PUC-RJ), and a doctorate from Princeton University in the United States. He is head of the Social Policies Center (CS/FGV) and a professor of the Rio de Janeiro School of Economics of FGV Foundation (EPGE/FGV). He is acknowledged for his work charting innovations in the areas of social welfare, poverty, education, and income distribution. Neri is active in addressing, assessing and discussing public policy, has contributed to the creation of the state minimum wage system, and has been involved in the implementation of income transfer programs throughout Brazil. He is a specialist in micro-econometrics and social program assessment, and in measuring inequality and poverty. He has published papers and articles in various national and international journals and other media.



8 INTRODUCTION

*“If China is the world’s factory, Brazil is its farm. Brazilian agriculture is flourishing and bears fruits.”*

If China is the world’s powerhouse, Brazil is its farm. Brazilian agriculture is flourishing and bearing fruit. Brazil’s contributions to agriculture range from Josué de Castro’s book “The Geography of Hunger” in the 1940s to the recent election of José Graziano as Director General for the Food and Agriculture Organization (FAO), an agency linked to the United Nations.

Luis Inácio Lula da Silva, in his victory speech in 2002, spoke of the importance of pursuing Zero Hunger (*Fome Zero*) as opposed to Zero Tolerance (Tolerância Zero), the latter a reference to policing policy in New York City. In 2007, during a rise in food prices that would have benefitted Brazil macroeconomically but hurt poor people everywhere, Brazil readjusted its Family Stipend (*Bolsa Família*), to help offset losses in purchasing power at the base of distribution.

Dilma Rousseff has continued this approach by selecting the eradication of misery as her main priority. (In this case, the miserable are defined as those who cannot meet their basic caloric needs). The government’s motto is: “A wealthy country is a country without poverty” and Brazil Without Misery is her platform (Brasil Sem Miséria). Therefore, from the viewpoint of food production, and in terms of social goals, poverty now occupies a core position in the agenda of Brazilian public policies. In this paper, I will discuss the trajectory between the old poverty and the new rural middle class, its advances, drawbacks and challenges based on a project for the Inter-American Institute for Cooperation in Agriculture (IICA), the results of which will be published in the form of a book.

POVERTY

*“The proportion of the extremely poor is 47% according to the Census but only 31% in the PNAD (National Household Survey).”*

The MDS and the IBGE (Brazilian Institute for Geography and Statistics) have just launched a study, based on the 2010 Census, indicating that approximately 8.5% of the population lives below the poverty line, with about 16 million living in dire poverty. This figure is 58% higher than indicated by the 2009 PNAD, which showed the headcount ratio to be 5.38% . As this new survey reveals, poverty dropped 16.2% between 2009 and 2010, increasing this discrepancy even further. In 2001 our “End Hunger Map” already showed that, according to the Census, the FGV poverty rate was 14% greater than in the PNAD.

This has a direct impact on the measurements, not only of the level, but also of the composition and importance of extreme rural poverty compared to urban poverty. The rural proportion of the extremely poor is 47% according to the Census but only 31% in the PNAD. In my opinion, rural poverty is overestimated in the Census. This issue -will be discussed here.

We calculated how much additional income the poor or miserable must receive to fulfill their basic needs, based on the PNAD and the FGV lines of R\$ 151 reais a month, adjusted for regional differences and cost of living. In rural settings in 2009, we calculated the total cost to eradicate misery from approximately R\$500 million per month, equivalent to R\$19.43 per person (a difference of R\$ 10 reais compared to the Brazilian average of R\$ 9.33). As 32% of the population lives below the poverty line, the cost per non-poor person is evidently greater, reaching R\$28.53 in rural areas (R\$ 11.02 for the total). On average, a poor rural dweller would receive R\$60.91 every month. This exercise should not be understood as a defense or justification of specific policies, but instead as a reference point for measuring the opportunity cost of adopting poorly targeted policies. The information is useful for targeting future actions and for arranging sources of funding. But how has poverty evolved in rural areas?

In 1992, despite the fact that it was inhabited by only 18% of the total population (at that time, 145 million), rural settings already accounted for 28% of all poor Brazilians. For every ten people living in rural areas, six found themselves living



below the poverty line. Moving forward in time, we find a completely different situation. With the urbanization process that went underway, the country has decreased the rate of rural poverty by approximately 50%.

We have used controls to compare populations with similar characteristics (such as gender and schooling) in order to isolate the role of the field/cities binomial. It is important to note that the accrued and absolute decreases in poverty followed a similar pattern in both the six-year period between 2003 and 2009 and in the 11-year period between 1992 and 2003, with a 63% lower incidence of poverty in 2009 than in 1992.

The drop in the relative risk of poverty in rural area compared to metropolitan areas was greater during the first period, 47%, which includes the period of the metropolitan crisis, than it was during the second period, when it dropped to 3%. In the period after 1992, when the Constitution was still

fairly new and its effects were just beginning to be felt, the primary benefits went to rural areas, while in the period after 2003 the benefits were more evenly distributed among poor people everywhere, in rural, urban and metropolitan areas alike.

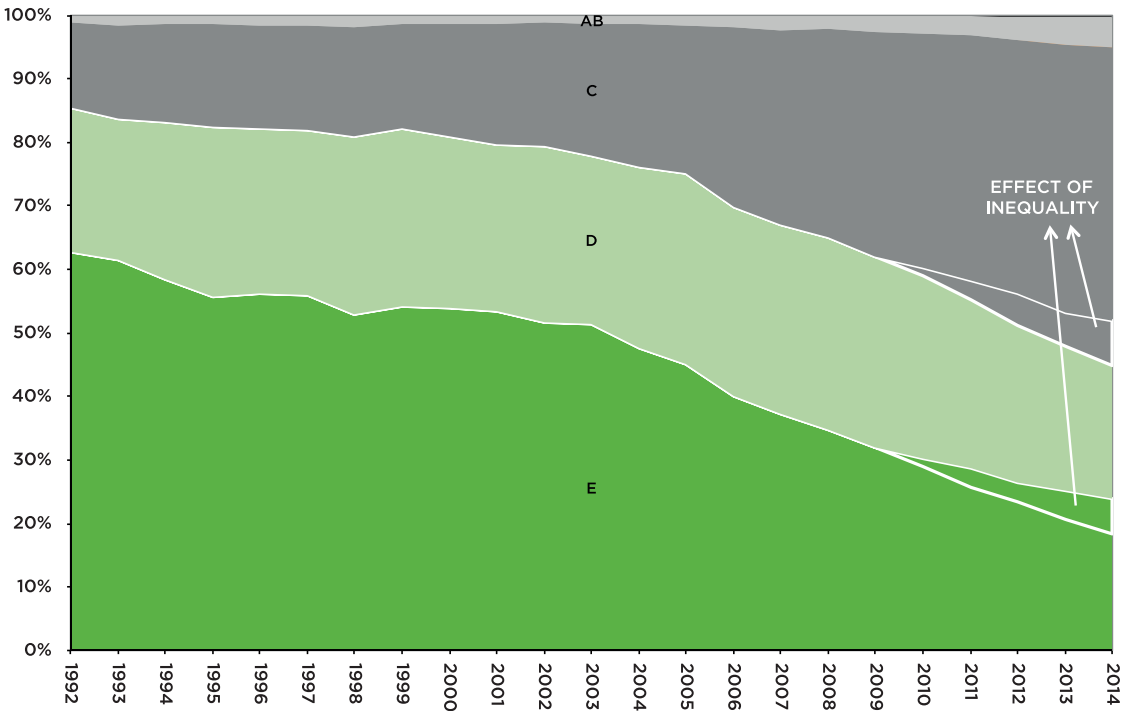
MIDFIELD

*“In its trajectory from the old poverty, the new middle class seen gains of 15 points more in rural areas.”*

Between 2003 and 2009, per capita income growth in the PNAD and GDP rose considerably. When we compare the Rural PNAD and the GDP, this difference doubles to 25.4 percentage points. When we compare the Rural PNAD and the GDP in Cattle Raising and Agriculture, the difference is even sharper, at 36 percentage points. The growth in income less associated to agribusiness plus the expansion of public transfers to the field (Rural

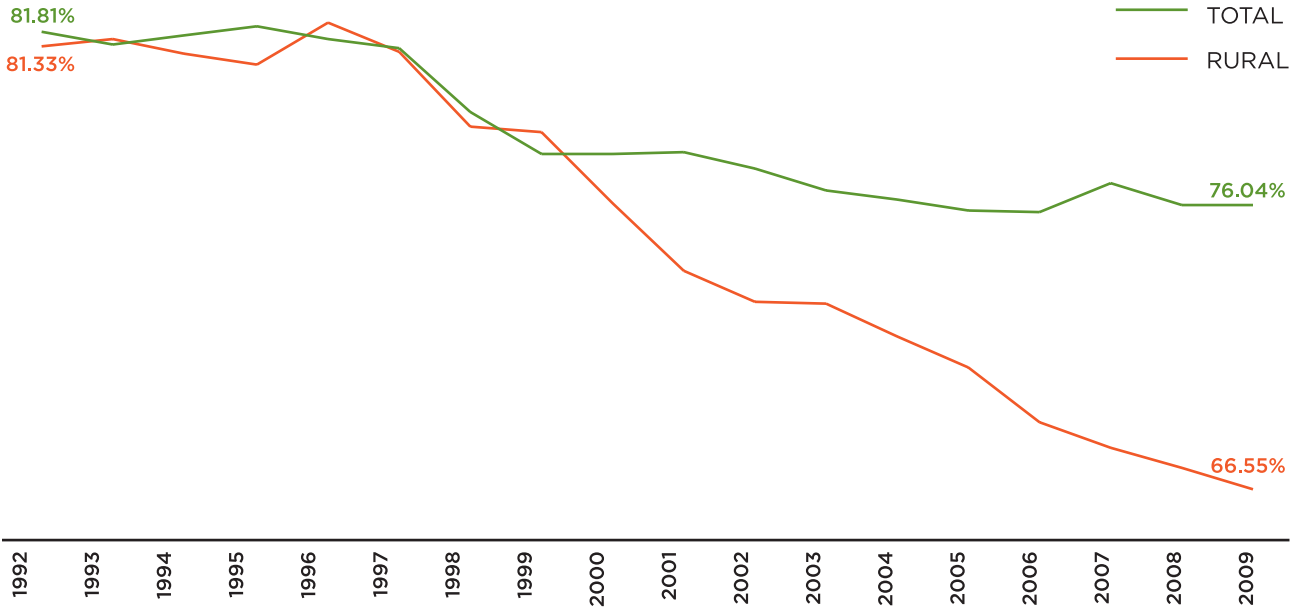


70 **FIGURE 1**  
CHANGING COMPOSITION OF ECONOMIC CLASSES FROM 1992 TO 2014 - IMPACT OF INEQUALITY\*



SOURCE: CPS/FGV BASED ON THE MICRO DATA FROM PNAD/IBGE  
NOTE: \*GROWTH OF CLASSES PROJECTED FROM 2010 TO 2014 - WITH AND WITHOUT A REDUCTION IN INEQUALITY

**FIGURE 2**  
SHARE OF WORK (% OF AVERAGE HOME INCOME PER CAPITA)



SOURCE: SOURCE: CPS/FGV BASED ON THE MICRO DATA FROM PNAD/ IBGE

Retirement Benefits, BPC, Family Stipend (Bolsa Familia), etc.

In 2009 the Gini inequality index was 0.489 in rural areas, 10.3% lower than in the rest of the country. The Gini index decreased by 8.3% in rural areas between 2003 and 2009, compared to a 6.5% decrease during the same period in the rest of the country.

When we measure accrued gains in income by tenths of the rural population between 2003 and 2009, there are losses for only the bottom 20% compared to the rest of the country, with gains in the other income segments. The greatest relative growth was observed in the means of distribution, with an accrued growth of 61.07%. Greater economic gains were seen in the middle segments.

As a consequence of this, the new middle class accounted for 20.6% of the rural population in 2003, rose to 35.4% in 2009, and, according to projections, will make up half of the population in 2014, the same ratio as for the rest of the country

The accrued growth of 71.8%, from 2003 to 2009 is equivalent to having 3.7 million Brazilians becoming part of the C bracket (9.1 million people in 2009). The proportion of people in this group in rural areas was equivalent to 55% of the one verified for the entire country in 2003, and reached 70% in 2009.

We have projected scenarios for changes to the composition of the various rural economic classes through the end of 2014. If the trajectory of the last six years is repeated - that is, if the per capita income in rural areas grows 6.14% annually over the next five years, and if the changes in distribution are repeated -, the new middle class, known as the C bracket, will correspond to approximately half of the population living in rural areas in 2014. Under this scenario, the new Brazilian middle class that we have seen in the country overall, as of 2009, would be replicated in the rural milieu by 2014.

In figure 1, we present a visual summary of the change in composition of the different economic brackets in rural areas between 1992 and 2014,

adjusted by the change in inequality referring to each state or Federal Unit (FU). These graphs are accompanied by a darker area that indicates the specific effect of maintaining inequality; that is, it is a pure growth scenario with a constant relative distribution among people. Note that the frontier between the A and B brackets and the C bracket is virtually unaffected by the trajectory foreseen for inequality. On the other hand, fewer people are expected to ascend to the D class; this would retain more people, although it would receive fewer people than the E class.

Some authors define the middle class as being made up of people who have a well-defined path for increased prosperity. Based on this definition, we used global index from the Gallup World Poll, which surveys more than 132 countries. Brazil held the world record in future happiness in 2006 compared to 2011, surpassing Denmark, the world leader in present-day happiness and 6th in the future happiness ranking.

If we look only at the rural areas in the nations surveyed, Brazil's projected happiness in 2011 was 8.6, compared to 8.53 for rural areas in Denmark, the current world leader. Rural Brazil is in the third place in the world ranking when isolated to rural areas. (Colombia occupies the top spot.) Zimbabwe has the lowest happiness rating, followed, somewhat surprisingly, by Paraguay and Ecuador. That is, the rural populations of these middle income countries in South America do not fall in the middle of the happiness rankings but rather at the extremes of happiness ordering.

INCOME SOURCES

*“The share of work in income has become less important in the rural areas, where it is now 66.5%, than in the rest of the country, where it averages 76%. This is down from 81%, in both rural areas and in Brazil overall, in 1992.”*

We now turn our focus to the changes that have made the sustainability and growth of income levels possible. Initially, we investigated the behavior of different income components for families living in rural areas. The analysis carried



72 out was not only for the rural population as a whole but has been broken down by economic class.

Between 2003 and 2009, the average per capita income for rural Brazilians grew by 6.1% per year, in real terms (i.e. discounting inflation and population growth), from R\$212.58 to R\$ 303.30. (The national average increase during this same period was 4.72%).

Entitlements from social programs were the source of income that enjoyed the greatest growth in rural areas (21.4% compared to the national average of 12.9%), led by the creation of the Programa *Bolsa Família* (Family Stipend Program) in 2003 and the expansion of similar programs. The process of aging of the population and the effects of readjustment in the minimum wage, which grew by more than 45% during this period, exerted pressure on the base value of such benefits. In rural areas, the base value of income from social security grew by 5.58%, reflecting the fact that many retired Brazilians are now included in this segment.

Work income enjoyed an annual average increase of 4.5%, below that of other income sources and below what we observe for Brazil as a whole (4.6% per year), showing that it has become more difficult to maintain living conditions beyond the official income transfers offered. Income from work became less important in rural areas than in the rest of the country, corresponding to 66.5% of the average income received by a Brazilian citizen living in rural areas (compared to 76% for the national average). Despite the high share in total income, work accounted for only 52.1% of the growth recorded during this period. For the country overall, the contribution of work now surpasses what is recorded in rural areas by approximately 24 percentage points, and has now reached the level of 76.0%.

Income from work constituted 81.3% of average per capita household income in rural areas in 1992, in line with similar levels recorded for the country as a whole. It reached its peak in 1996, after which it began a long decline that continues today. As a counterpoint, public transfers acquired greater relative importance during this period,

as a consequence of the previously mentioned programs that were created for income transfers and of the increase of social security benefits.

## RURAL LABOR

*“Employment levels have declined as the quality of the old/new rural life in Brazil increases.”*

Above and beyond what we have seen, there has also been a reduction in the share of work in rural income sources. Turning to the labor market in rural areas, we see that in 2009, 19 million people, or 74.2% of the rural population, were employed. In 2003, there were 20.1 million rural workers, corresponding to 77.4% of the rural population. This drop in employment rates is the inverse of what was happening in Brazil as a whole at this time, during which employment rates increased from 64.7% to 67.2%.

The initial explanation for the discrepancy observed lies in the differences in GDP growth in rural areas compared with other parts of Brazil. Cattle raising and agriculture grew by 40.4%, in real per capita terms between 1995 to 2010 compared to 29.1% GDP growth for the country as a whole. Between 2003 and 2009, GDP growth in rural areas totaled only 6.6%, compared to 17.3% growth for Brazil as a whole, which means that the agricultural economy grew at a slower rate during this period than the economy as a whole.

The drop in employment rates in rural areas is at odds with trends for agricultural GDP, and even less consistent with GDP trends. The mismatch has been even more pronounced during national economic booms, as was the case immediately following the implementation of the Real Plan and during the post-2004 economic recovery. There is a contra-cyclic behavior in rural employment. One possibility is that there was a drop in employment in agriculture as a result of the expansion of opportunities in other sectors with greater job security or as a result of public transfers.

The decrease in market share for rural labor (by -0.53% per annum) and employment rates among the economically active population have remained stable.

That is, there has been a significant contraction in the work supply in rural areas, while both these figures have increased for the country as a whole.

## Quality

Despite the effects of the contraction in employment mentioned above, individual income has been growing slightly more in rural areas, by 4.3% compared to 3.9% for all of Brazil, consistent with gains in the perceived quality of jobs and job security. There has also been an increase in labor productivity in rural areas, measured by hourly wages, which has been growing at a rate 3.4% a year, consistent with national rates. The working day has also gotten shorter in rural areas.

The core piece that is missing in the analysis is income from public transfers, which has been growing at a higher rate in rural areas. If we look at the population between the ages of 15 to 65, we see that income from social programs and from retirement benefits has dropped by 0.24% for the country as a whole but has increased by 0.9% annually in rural areas, which could lead to an increase in reserve salaries.

It is necessary to note that the current employment rate in rural areas continues to be higher across all age brackets, with differences from national averages becoming greater the older the population segment. Among people who are over 60 years of age, the employment rate is 67.1% in rural areas compared to 44.1% nationally. There was a greater drop in the share of the labor market of children under the age of 15 years and for people aged 60 and older. At these two extremes, working income has grown by 3.7% and 6.7% respectively, compared to 1.49% for all rural age groups.

Looking at the aggregate figures, the share of income from social programs and rural retirement benefits increased from 27.3% to 33.5% between 2003 and 2009, while it remains stable at the national level at around 23.5%. This share was approximately 18% in both rural areas and nationally in 1992.

73 Turning our attention to the changing quality of labor relations between 2003 and 2009, we observe the following improvements: the share of individual jobs lasting more than five years increased from 13.2% to 15.7%, indicating that jobs with shorter durations were those that experienced the sharpest decline. The proportion that involved public social security contributions increased from 16.8% to 25.5%. Jobs in establishments with 11 or more workers increased from 4.35% to 6.86%. The direction followed by quality of labor seems to be more like the Ford type model, with a relative formal employment increase in labor relations. The proportion of those employed increased from 9.2% to 13%.

## Employment

The rural modules in the PNAD make it possible to visualize how precarious work and entrepreneurship were between the period between 2003 to 2009. Let us begin with the latter: the proportion of those employed who lived on the same land where they worked was 48.5% in the final year, a decline from the 54.8% measured in 2003. The proportion of rural area dwellers that depended on some type of subsistence activity (cultivation, fishing or animal breeding) to feed their families decreased from 6.1% in 2003 to 5.1% in 2009.

In 2003, around 17.2% of those employed received from their employers a specific area of land for their own production; this increased to 15.33% in 2009. The percentage of employers who had some sort of partnership arrangement with their employers fell to half in 2009, 3.09% of what was observed in 2009. The unionization rate went from 21.9% to 23.8% between 2003 and 2009, down from 19.3% in 2001.

All these indicators point to the increased professionalization of rural employment. But before claiming victory for agribusiness or for family agriculture, it is important to look at the evolution of small businesses during that period.



The ratio of self-employment and employers drops from 23.3% to 19.9%, pushed down by those working autonomously. In 2009, the average area included of a rural enterprise by self-employed workers was 11.3 thousand m<sup>2</sup>. This is the lowest average area reported since 2002. The year 2003 was the better, with averages of 12.6 thousand m<sup>2</sup>. That is, those working on their own.

The proportion of individual owners goes from 64.08% to 70.79% between 2003 and 2009. Other forms of existing relations are partners, tenants, squatters and grantees. Below we quantify the proportion of autonomous workers and employers that had taken on a previous commitment to sell part of their production the previous year. The data points to an increase in this variable, consistent with recent advances in the Brazilian consumer market. In 2003, 26.19% of entrepreneurs had taken on such a commitment, a figure that increased to 32.06% in 2009. Buyers of products are represented as follows: 25.41% are companies, 10.16% are cooperatives, and 0.35% is accounted for by governments. These buyers all showed growth during the period, while all others groups saw their share of buying fall.

A considerable part of household nutrition for these entrepreneurs is obtained from production, but this part of subsistence is dropping. Among entrepreneurs, 19.45% consumed more than half of what they produced in 2002; this dropped to 15% in 2008.

To sum up, the amount of work in rural areas has decreased while the quality of that work has improved. The share held by the small subsistence entrepreneur has decreased, but there has been an increase in formal, Ford-type employment. There has been an increase in salaries and public monetary transfers. These are the main labor transformations in the old/new rural areas of Brazil.

### CONCLUSIONS: NEW AGENDA

*“It is necessary to extend the Brazil Test to rural schools, as quality education is the main route to sustainably overcome poverty.”*

The average growth of Tupiniquim in the past few years is far from remarkable. If we look at the audience: who has sat in the first row, and who has missed out on the show of growing incomes?



Unskilled workers who have enjoyed a higher increase in income than all workers in Brazil overall include those with less schooling, in sectors including domestic services, construction and agriculture.

This trend is in contrast to trends in developed countries and in the other BRIC countries, in which growing inequality is very evident. Brazil was the last country in the Western world to abolish slavery, and is now beginning to free itself from the inheritance of slavery.

The large farm house with its slave quarters (Casa Grande e Senzala) is essentially a rural vision. We outline here, based on a project for the Inter-American Institute for Cooperation in Agriculture, a portrait of the biggest recent transformations in the old/new rural life of Brazil. We have included the trajectories of rural income, side by side with those of the country as a whole. We then went on to explore the indicators set forth by the PNAD/IBGE, which make it possible to incorporate details regarding social and labor rural changes.

### *New Agenda*

It is now time to “give the market to the poor”, fulfilling what began a few years ago when, by reducing inequality, “we gave the poor to the markets (as consumers)”. Pursuing a pro market agenda for the poor is beneficial to all as it does not lead to higher fiscal costs, generating improvements in the Pareto curve, where nobody loses and the rural poor win differentiated upgrades as they were farther away from the market than the urban poor. When the markets are extremely incomplete, it is possible to move beyond the dilemma of having to choose between efficiency and equity and come out ahead, by achieving both. Benefits from social programs are particularly important in rural areas, leveraging gains in well-being compared to those contemplated for reasons of equity.

We should treat the poor as empowered actors and not just as recipients of official money transfers and credit in the form of benefits. The program citizen territories proposes to do this

from a public perspective. Possibilities for action in rural areas, through the interaction of public and private activism, need to be explored further.

Popular productive credit is fundamental to unleash low-income entrepreneurship. Banco do Nordeste, a public federal bank located in a poor area, provides examples of this through its “Agroamigo” program, modeled after a similar program, Crediamigo, which targets urban dwellers. In both programs we have seen work yields increase along with productivity (salary-efficiency) -- in the case of credit agents, we have even observed three-fold increases in salary --, depending of the portfolio’s performance. There is wealth in the midst of poverty, and the state must work together with the private sector to release and expand it. To date, not enough has been done to support workers from small rural producers by increasing access by the poor to consumer markets.

The launching of an adequate policy for highways and roads in rural areas, where 15% of the Brazilian population lives and where a large part of the agriculture production is produced, should also follow along these lines, bringing producers closer to markets. Projects to expand access to electricity in rural areas, such as Light for Everybody (Luz para Todos), should be prioritized as well.

Education functions as a passport for finding formal work. As the public sector becomes closer to the poor, it can pave the way to access to markets. Despite the costs, it is necessary to extend the evaluation of the Brazil Test (Prova Brasil) to rural schools with fewer than 30 students. In this way, the goals of IDEB education can reach rural areas with full force. Quality education is the primary route for sustainably overcoming rural poverty.



*article*

# TROPICAL AGRICULTURE IN BRAZIL: COMPETITIVENESS AND SUSTAINABILITY BASED ON SCIENCE AND INNOVATION

SILVIO CRESTANA AND EDÍLSON P. FRAGALLE

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Silvio Crestana holds a degree in physics from the University of São Paulo (USP), has a master's in physics and a doctoral degree in Science from USP. He also occupied the position of associate member at the International Center for Theoretical Physics in Trieste, Italy, and has post-doctoral qualifications in the USA from the University of California, Davis (1988 and 1989), and USDA-Agricultural Research Service, Beltsville, Maryland (1998 to 2001). He was CEO of the Brazilian Agricultural Research Corporation (Embrapa) between January 2005 and June 2009. He was head of Embrapa Agricultural Instrumentation between 1992 and 1997, coordinated the implementation of the pioneering Virtual Laboratory of Embrapa Abroad (Labex) in the period from 1998 to 2001, in the USA, and is a member of several scientific societies and editorial boards of national and international magazines.

*Edílson P. Fragalle*

JOURNALIST

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Edílson P. Fragalle holds a graduate degree in media studies from the Catholic University of Campinas (Puccamp) and a master's in communication from the Julio de Mesquita Filho State University (UNESP). He worked as assistant to the reporting desk at EPTV Central, an affiliate of Rede Globo in Sao Paulo. Between 1995 and 1998, he was communications advisor of Embrapa Instrumentação, before assuming the position of chief reporter and manager of journalism at EPTV Central. In 2003, he returned to Embrapa, to take up the position of media chief. He was also manager of the communication and business area until 2011. Fragalle is currently deputy head of Technology Transfer at the same company.



78 Science and innovation, based on education, represent essential ingredients for the consolidation of Brazil's position as a global power in the 21st century, the first decade of which saw the emergence of the country as a "player" on the international scene and its consolidation as a sovereign nation, following the resolution of basic problems of food and energy security and progress towards resolving the problems of territorial security – including environmental security – and the elimination of poverty and want.

Today Brazil is seen as an emerging economy which is developing, with a firmly established democratic system, which is used as a model for many nations. We can point to certain sectors where we are in the lead, such as tropical agriculture, the extraction of oil in deep waters, the manufacture of executive aircraft, the production of clean and renewable energy, among others.

On the other hand, when we look at it in a world context, we note the existence of both new and old problems. The former serious problem of hunger and poverty is not only still with us but is increasing on a global scale, according to the latest reports from the FAO. More recently two other problems on the same scale have been added: the absence

of world governance and the environment. Multi-lateral agreements are not respected and targets not met. Generally speaking, world forums and organisations do not reach agreement or do not manage to exercise the arbitration role expected of them. And on the rare occasions that multi-lateral agreements are reached, they are not implemented. There is no shortage of examples: Kyoto, Doha, COP- 15 and 16, the Millenium Goals (UN-FAO), the failure of the UN Security Council to settle conflicts, the enormous difficulties of the IMF and the World Bank, among others, in dealing with the recent global financial crisis. As for the environment, it is the first time in the history of our civilisation that there has been a crisis on a global scale, constituting a grave threat to the human species. The connectedness and interdependence of local and global events and the perception that natural resources are finite has become evident. More than this, the capacity of the planet (biocapacity) to respond to the growing demands of human society shows that we have already reached critical limits with regard to the conservation of biodiversity, water resources, gas emissions, erosion, among other items. Climate Change, Ecological Footprint, Ecological Intelligence, Environmental Security represent some of the terminology for the repertory

of environmental problems and concerns which afflict us on a global scale. Are there any solutions on the horizon, from the point of view of science and innovation? And what is the position of Brazil – a new global "player"? Is it part of the problem or part of the solution? From the point of view of challenges and opportunities, Brazil is already a world power in: agriculture (a leader in the production of food, fibres and energy and the development of know-how in tropical agriculture), environment (the greatest tropical biodiversity and the greatest reserves of liquid water on the planet), clean renewable energy (with almost 50% it represents the greatest source of clean renewable energy in the world) and with the "Pre-Sal" it will become a global oil producing power over the next decades (the fifth or sixth largest oil producer in the world).

In its history of development, this will be the first time that Brazil will have to face the five challenges on a global scale, at one and the same time. Thus it will not be a single challenge, but five simultaneously. And all dependent on each other. In other words, a challenge raised to the fifth power!

In the knowledge society in which we live, there are no alternatives on the path to sustainable progress and development which do not involve decisions based on knowledge, science, technology and innovation. And none of this can be achieved without education. Which brings us to the challenge of moving forward rapidly in order to transform ourselves, within the next two decades, into a global power in education and science, technology and innovation (S, T & I). Thus, meeting this challenge becomes a sine qua non for us to overcome the five challenges of global significance referred to earlier. Which in effect imposes on us, as a nation, the facing of six challenges on a global scale.

Science and technology have to mobilise, through innovation, the social energy needed for sustainable development and the sustainability of societies. So C, T & I must be used to establish policies and priorities, principally because national and international interests are not always reconcilable with public and private investment.

Brazil is noted on today's global stage for being a repository of agricultural production, having already

79 attained the rank of third largest exporter, behind only the US and the European Union. One of the most important consequences for Brazil is the generation of foreign exchange and of employment, as the sector which makes by far the biggest contribution towards the positive figure for our balance of payments.

It is also relevant to point out what is globally recognised, namely the production of the second world harvest, obtained from tropical ecosystems, which we have called the agriculture of the tropics or simply tropical agriculture.

## NEW CHALLENGES

In 2010, the Brazilian Association for Agro-Business (ABAG) and the Higher Council for Agro-Business of the Federation of Industries of the State of São Paulo (FIESP) prepared a proposed agenda for the Federal Government, during the presidential election campaign. The proposals for agriculture were founded on six pillars:

- 1) Guaranteed income for farmers;
- 2) Infrastructure and logistics;
- 3) Foreign trade;
- 4) Research, development and innovation;
- 5) Agricultural protection;
- 6) Insitutionalisation of public authority.

Investment in these areas is fundamental for Brazil to continue in its leading position and to aspire to growth on the international stage, especially after recent reports containing projections of world demand for food, issued by the Organisation for Economic Cooperation and Development (OECD), the United Nations Food and Agricultural Organisation (FAO) and the British government. They highlight Brazil as the principal country to meet this demand over the next 10 years, a demand which will grow by 20%, largely to meet the growth in population and per capita income in the emerging countries. The increase in supply will have to come from various regions. The European Union will contribute with growth of 4%, Australia with 7%, the United States and Canada with a maximum of 15%, Russia, China, India and Ukraine with something around 27%. The largest part of the contribution must come from Brazil, with 40% of the increase in production.





In recent decades, there have been many questions, mainly in the developed countries, with regard to the Green Revolution. It is possible to produce more, but under what conditions? By degrading the environment, rendering the agriculture of the future or water, soil and forest resources unviable? It is necessary to take account not only of productivity, of the amount of production per area, but also of the environment in which it occurs, giving priority also to conservation and preservation, with a view to achieving environmental security. In this territorial dimension it is fundamental to consider man himself, and therefore to add a social and cultural dimension which is characteristic of human relations.

Since the end of the 20th century various alternatives or possibilities have arisen to underline or modify concepts of intensive agriculture. The so-called advanced biological technologies, or biotechnologies, are one example. The combination of the knowledge of genetic improvement with that of biotechnology is a key element for a great leap forward in agriculture.

Precision Agriculture is another term which has appeared in order to deal with questions not only of productivity but also of environmental variables. The current revolution which agriculture needs to make, in substitution for the green revolution, involves producing, including socially, without at the same time degrading the environment – a kind of agro-social-environmental revolution. What is needed is a new green revolution, only this time greener and socially more inclusive. It should also be noted that the progress obtained in the last two centuries was based on the isolation of the different disciplines. None of the disciplines of chemistry, biology, genetics, machine engineering were integrated. The basic ingredient of the agro-social-environmental revolution is inter-disciplinary and trans-disciplinary work (figure 1).

These days what potential do S, T & I have for affecting the near future and changing paradigms, for example by reconciling productivity and environmental conservation? Or, to put it another way, by rendering viable sustainable agricultural production systems, what we have called the “agro-

social-environmental revolution” in substitution for the green revolution. The answer is to be found by understanding the concept of convergent technologies (figure 2).

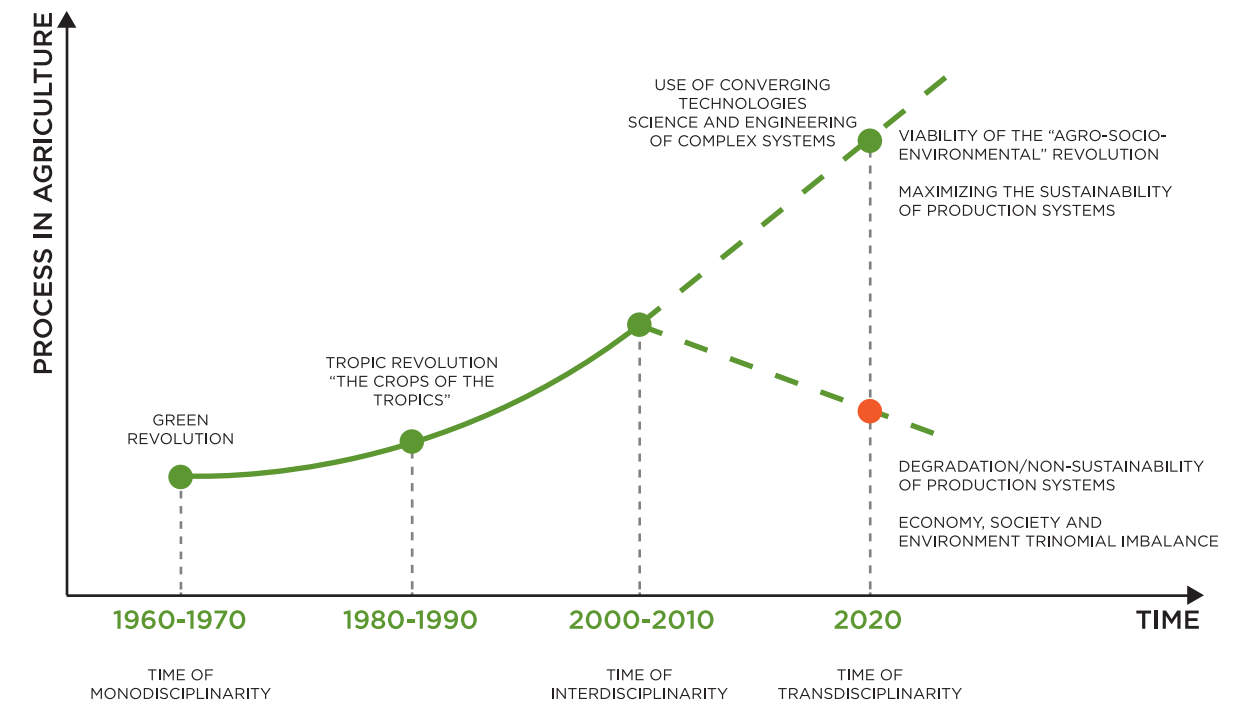
In other words bits, genes, atoms and molecules and neurons. For the first time in the history of humanity, man is able to manipulate, simultaneously, atoms, molecules, genes, bits and neurons by means of technologies stemming from information, the cognitive sciences, bio-technology and nano-technology.

In other words, to manipulate matter and life, for example, by producing new materials, plants, animals and consequently new systems of production. Strictly speaking, these sciences and technologies could interact between themselves, communicating, converging and producing synergies potentially unprecedented in the whole history of S, T & I. At their core they possess the revolutionary capacity to change paradigms which could alter the relationship of man to man and his relationship with nature. Which takes us on to the management of complex systems, in which decision-making needs the integration of systemic and not linear approaches, including, besides technological problems, questions of ethics, of law, and of individual and collective well-being (figure 3).

Boldness is necessary to face the great challenges of our age, in which the inter-connectivity of scales varies from the local to the global, from the individual to society, and vice-versa, at speeds implanted by astral communication, never before seen by human civilisation. For example, in the area of public administration, organisations are not prepared to meet the consequent demands and expectations, principally in the light of democracy and analyses of the growing emergency of crises.

In the last century, forcing governments to exercise their authority and seeking the results of policies through evaluations of performance and conformity was a great victory. Good results are based, essentially, on the foreseeability of problems, on the implementation of recurrent tasks under the vertical command of such governments. However, the current situation requires institutions

FIGURE 1  
SCHEMATIC REPRESENTATION OF TWO POSSIBLE SCENARIOS FOR THE NEXT DECADES

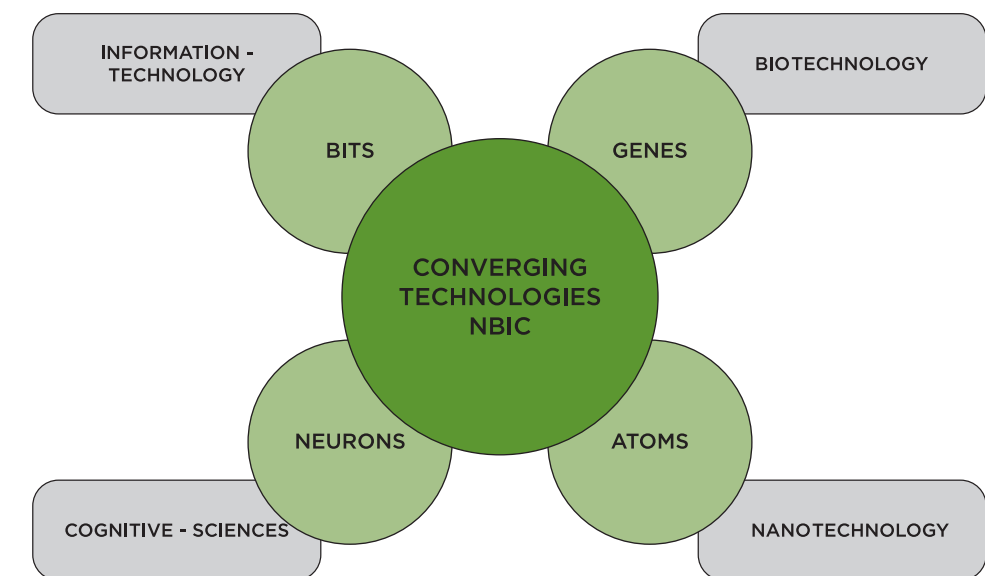


SOURCE: AUTHORS

FIGURE 2  
SCHEMATIC ILLUSTRATION OF THE FOUR BASIC ELEMENTS AND THE SCIENCES AND TECHNOLOGIES DERIVED FROM THEM

## CHANGE OF PARADIGM: TRANS AND INTERDISCIPLINARITY

SYNERGY BETWEEN SCIENTIFIC AND TECHNOLOGICAL KNOWLEDGE  
CONVERGING TECHNOLOGIES



SOURCE: ADAPTED FROM NATIONAL SCIENCE FOUNDATION NSF/DOC REPORT, 2003



FIGURE 3  
EXPECTED SOCIO-TECHNICAL ADVANCES OVER THE NEXT FEW YEARS, TO BE OBTAINED  
THROUGH THE USE OF CONVERGENT TECHNOLOGIES

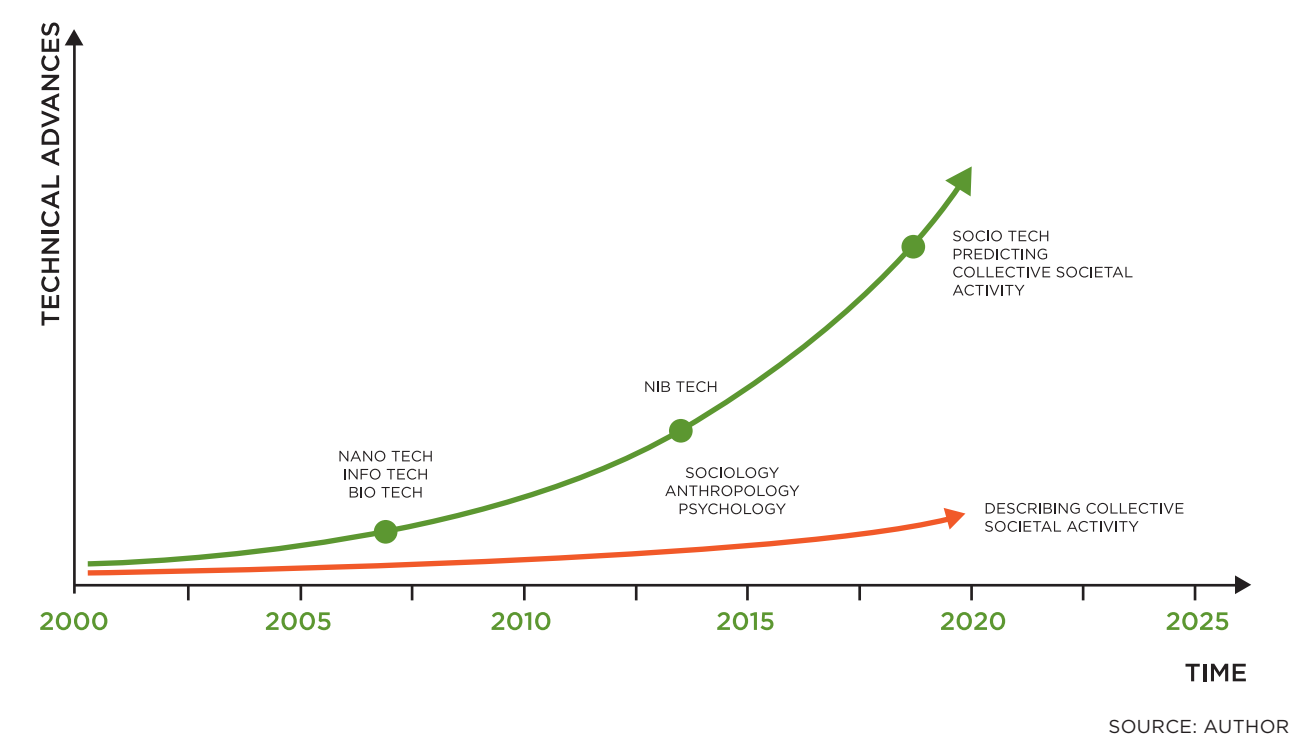
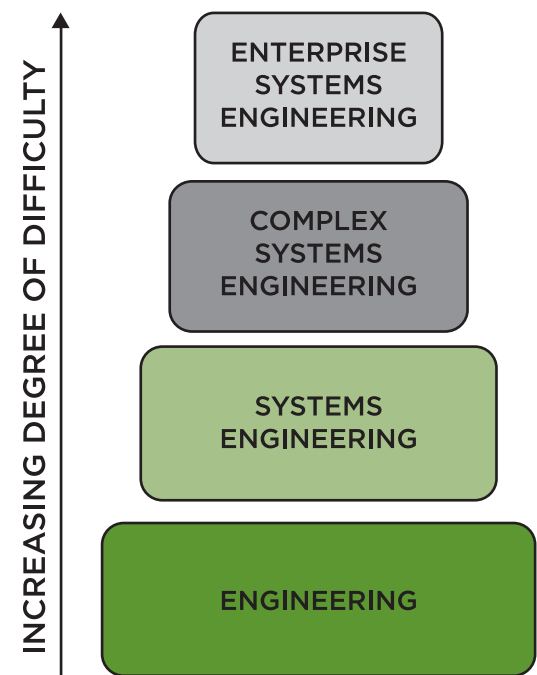


FIGURE 4  
SCHEMATIC ILLUSTRATION OF THE HIERARCHY OF ENGINEERING DISCIPLINES TAKING  
INTO ACCOUNT THE GROWING DEGREE OF DIFFICULTY AS THEY APPROACH COMPLEX  
SYSTEMS



SOURCE: AUTHORS

to prepare themselves to include in their management programs the unforeseeability of events, the complex themes, the analysis of the growing increase in crises and the participation of multiple partners. More than government, it is necessary to have governance, which considers and administers not only the vertical dimension of authority, but also the horizontal dimension of the collective intelligence and power emanating from society.

Thus, more than results from policies, it is necessary to obtain civic results. To face such new challenges it is necessary to include in the administrative and management framework the dimensions of emergency and resilience, as well as conformity and performance, thus making up the four essential quadrants. We must wait, in accordance with the perspective from this new framework, for the temporal management dynamics of a given institution or public organisation to consider and be moved in the four quadrants. In other words: explore, adapt, check and conserve, respectively, in the quadrants: performance, resilience, emergence and conformity. It must be recognised that such visions, concepts and proposals represent an innovatory frontier in public administration. For one reason or another it has become clear that that there is an opportunity to think in terms of the creation of a new area of science and engineering: that of Complex Systems (figure 4).

Based on Sarah Sheard, complex systems are systems that do not have a centralizing authority and are not designed from a known specification, but instead involve disparate stakeholders creating systems that are functional for other purposes and are only brought together in the complex system because the individual “agents” of the system see such cooperation as being beneficial for them.

The demands outlined above signal one trend with great clarity: sustainability. Research has a dominant role in this aspect with the development of methods, processes, systems, sensors and equipment with a view to the integration of production systems which can be sustainable. We already possess good examples in Brazil, such as direct planting in straw or plantation-cattle-forest

integration, which has now migrated from the field of science to public policy.

The so-called “Green Economy” or “Low Carbon Economy” constitute realities which can bring important gains from the environmental point of view, but also from the economic and social aspects. One of the hopes is that agriculture which is based on good farming practices and which contributes to environmental conservation and preservation will be seen as a supplier of environmental services and that farmers will be rewarded for this. The Ministry of Agriculture, Farming and Supply is engaged in making viable the ABC (Low Carbon Agriculture) Program, whose contribution will be decisive for Brazil to fulfil its targets in the reduction of CO2 emissions.

And while we are seeking the essence of sustainability, we cannot forget to mention one of the most important assets of humanity, which deserves the full attention not only of scientists and researchers, but of the whole of society. We refer to the economic use of water, which is abundant in Brazil, but which in the future could be the subject of international disputes, as oil still is in various parts of the world, as recent conflicts in the Middle East and North Africa show only too well. The outlines are taking shape of a new world geo-political structure of hunger and food production, where water is the great determinant. In the case of Brazil, by virtue of existing legislation, the use for agricultural production will have to be charged.

Tropical agriculture also has many other challenges, such as the implementation of good practice, including traceability, certification, accreditation, and the assessment of product life cycle, which could lead to options for more conscientious and sustainable consumption, as well as opening up opportunities in foreign trade which are today closed to Brazil, where one of the reasons is the fact that the country does not always adhere to good agricultural practice to the standards which the international market demands.





article

# BRAZILIAN AGRICULTURE: A NEW LEADING GLOBAL ROLE

ROBERTO RODRIGUES

*Roberto Rodrigues*

COORDINATOR AT FGV FOUNDATION'S AGRIBUSINESS  
CENTER (GV AGRO) AND FORMER BRAZILIAN MINISTER  
OF AGRICULTURE

## ROBERTO RODRIGUES

Roberto Rodrigues, Brazilian Minister of Agriculture from January 2003 to June 2006, coordinator of the Agribusiness Center (GV Agro) of FGV Foundation and president of the Superior Council of Agribusiness of the São Paulo Federation of Industries (FIESP), is a farmer and agricultural engineer by training, following in the footsteps of his father and grandfather. He is also a professor of Rural Economics at São Paulo State University (UNESP). Professor Rodrigues is a strong supporter of the cooperative movement and has chaired the Brazilian Cooperatives Organization, the World Committee on Agricultural Cooperatives and the International Cooperative Alliance. He has traveled the world in that capacity, visiting 80 countries while performing his duties. He is a distinguished agribusiness leader and has served as president of the prestigious Brazilian Rural Society and Brazilian Agribusiness Association and as a board member for dozens of Brazilian producer associations.



Recent studies carried out by the OECD, concerning the growth of both the world’s population and incomes in emerging countries, point to the need to increase world food production by 20% over the next ten years. They also show that, for this goal to be achieved, Brazil will need to double its outputs and increase its share of world food production to 40%. According to OECD, the three most important factors that must be addressed to make this happen are tropical technology developed in Brazil, the availability of land, and the quality of rural producers.

Regarding technology, figure 1 shows that over the last 20 years, areas cultivated with grains in Brazil increased by 32% while production increased by 181%, almost six-fold. Productivity increased so spectacularly thanks to the technological innovations developed by Brazilian research institutions under the leadership of EMBRAPA. But underlying this figure is something even more important. If today’s productivity per hectare were as low as it was 20 years ago, it would be necessary

to have another 57 million hectares planted with grains beyond the 43 million cultivated hectares responsible for current harvests.

Evidently this trend is not limited to the production of grains. The growth in meat has also been notable over the past two decades.

The same can be said of sugarcane: if productivity rates today were as low as they were during the period of Pro-alcohol (1975), we would need to cultivate an additional 6 million hectares of sugarcane to match current harvests.

This technological explosion is seen in virtually all sectors, including biotechnology, nanotechnology, precision agriculture, crop-cattle raising integration, sugarcane ethanol biodistilleries and ethanol by-products from sugarcane and an endless number of new techniques with outstanding results, not only from the viewpoint of productivity but also with regard to the social benefits for users of these ever cheaper products.



FIGURE 1  
BRAZILIAN GRAIN PRODUCTION

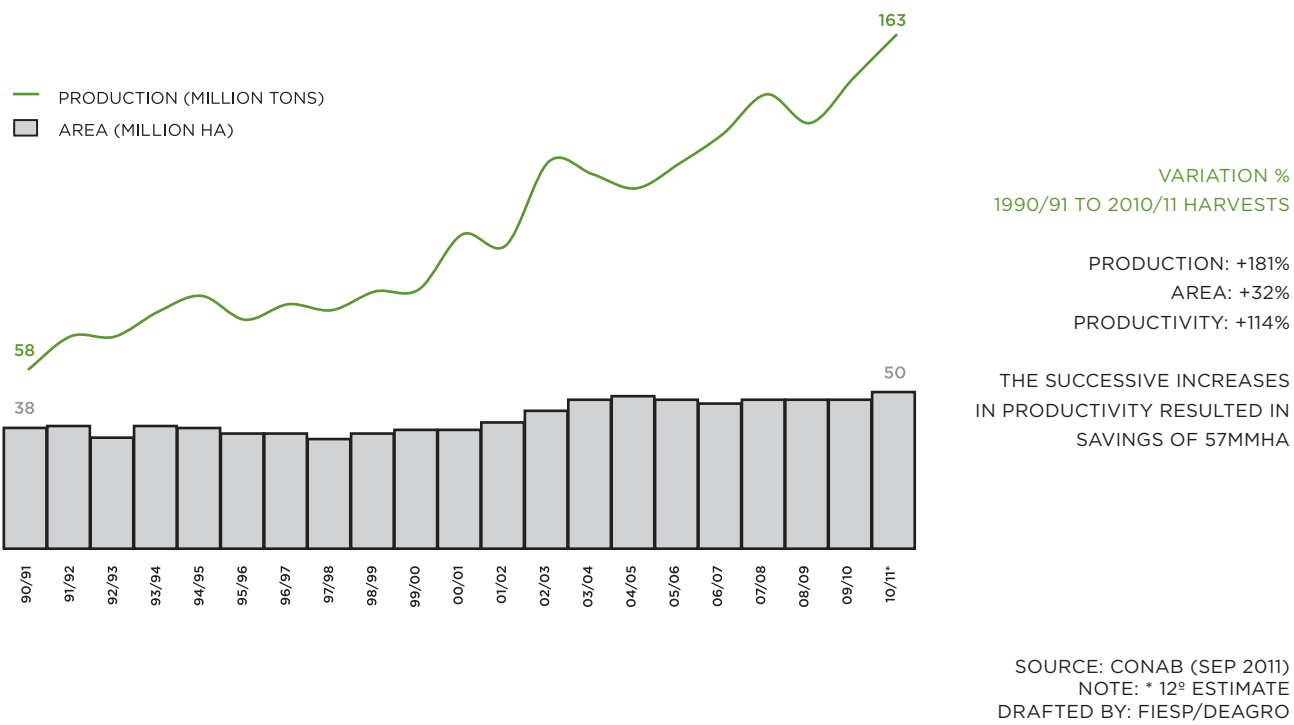


FIGURE 2  
BRAZILIAN MEAT PRODUCTION

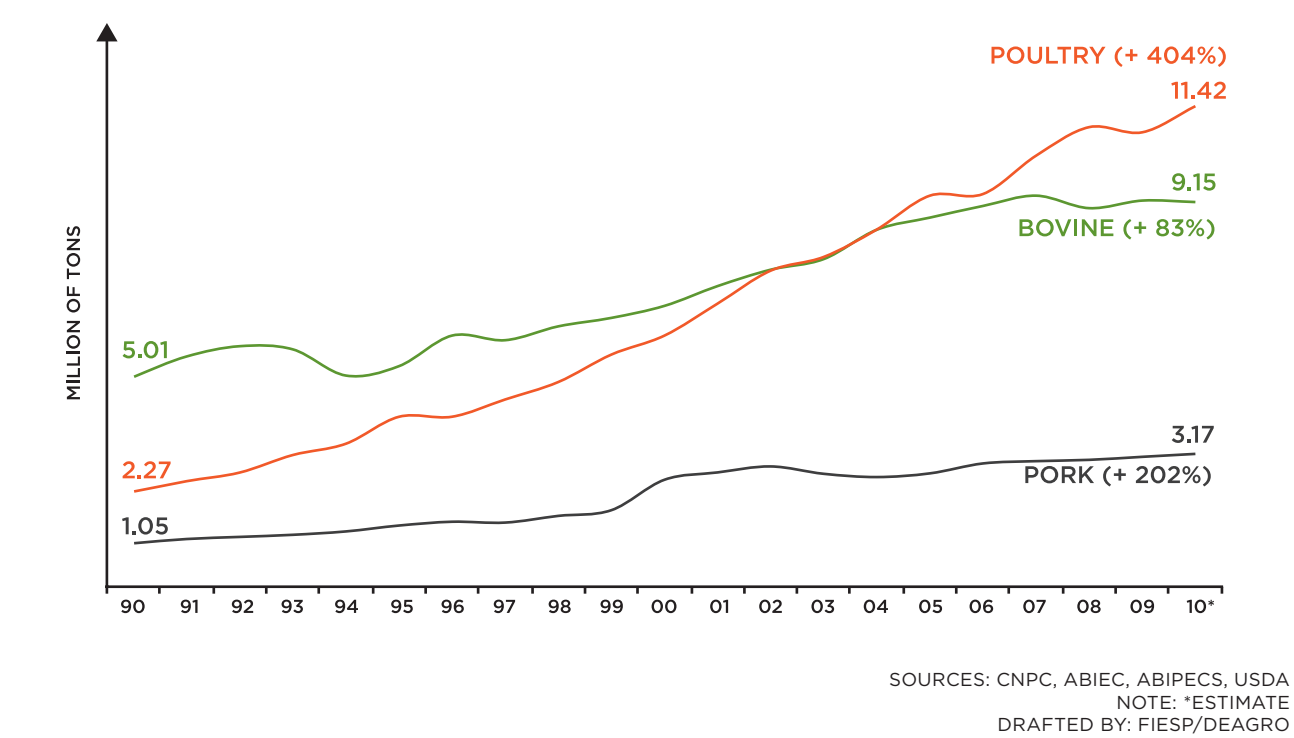




FIGURE 3  
BRAZILIAN SUGARCANE, SUGAR AND ETHANOL PRODUCTION

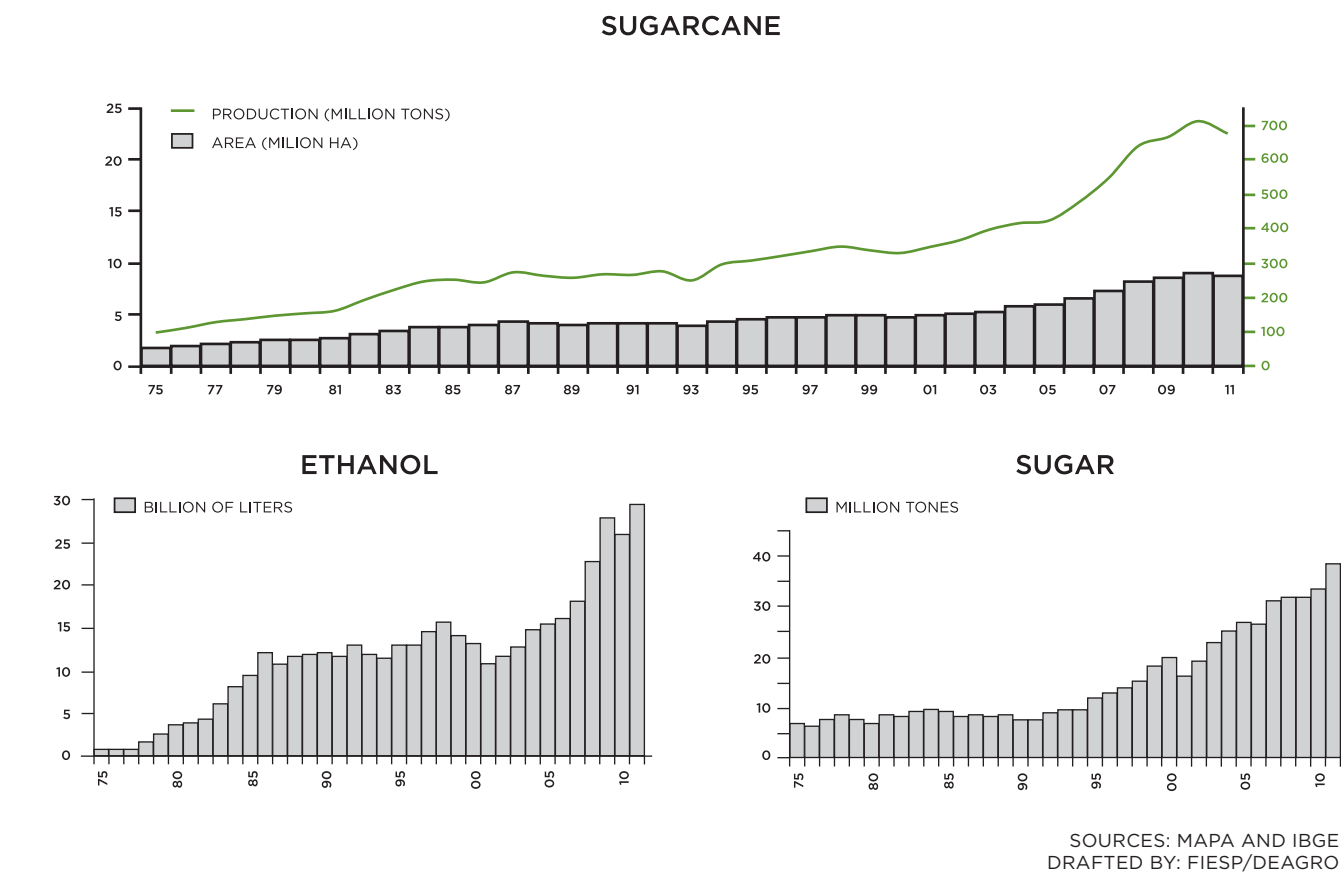
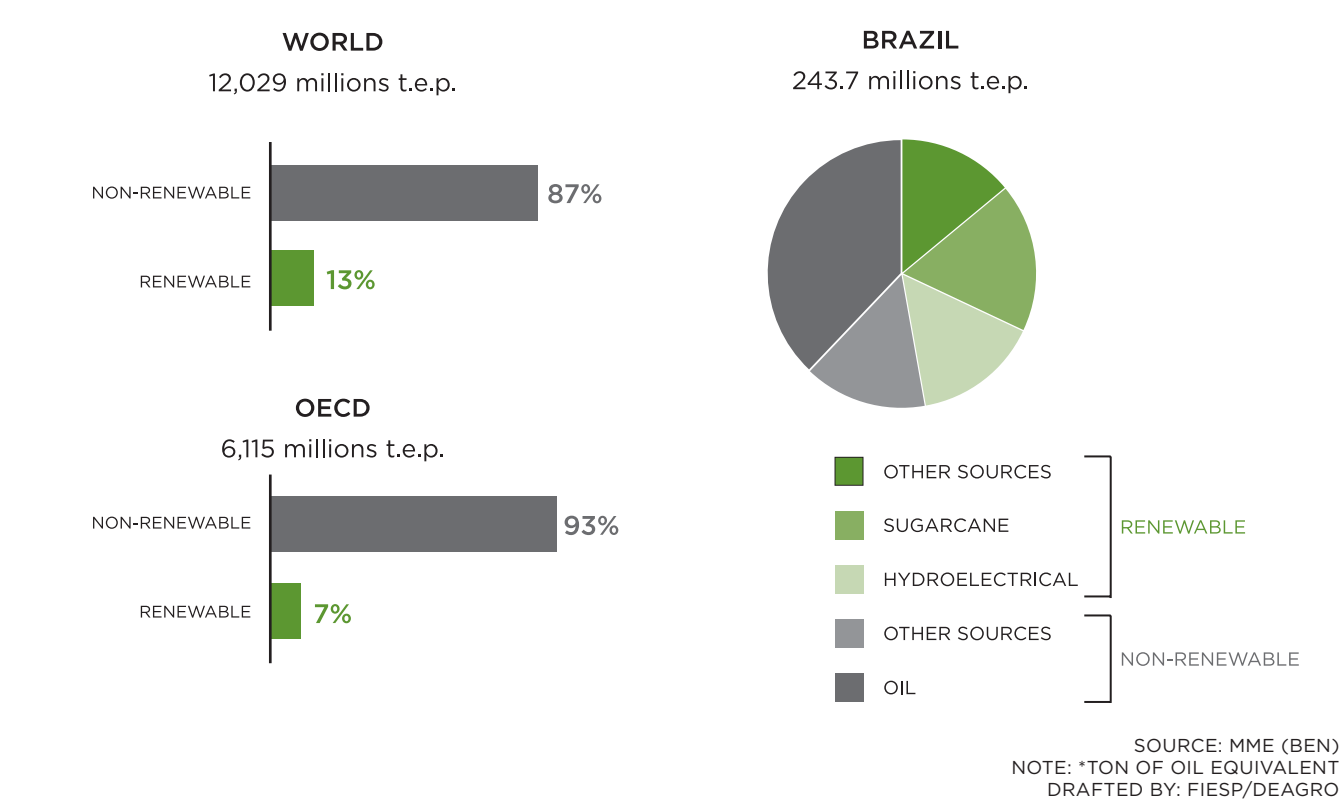


FIGURE 4  
ENERGY MATRIX



It is also apparent that there is plenty of available land. Of the 851 million hectares of national territory, only 72 million are cultivated with crops and 172 million with pasture – adding up to less than 30% of total land.

Few countries have as much available land, although there are some constraints imposed by a legal order currently being debated in the Brazilian Congress relating to the “Forestry Code and Land Purchase by Foreigners”. But the capacity to horizontally expand planted areas is evident as, thanks to new cattle raising techniques, it is possible to produce more meat per hectare, opening more space for agriculture by converting degraded pasture.

Finally, there is the quality of Brazilian producers. The successive Economic Stabilization Plans that have been implemented since the 1980s have led to a strong decrease in income in rural areas, and were succeeded by two simultaneous waves: one of exclusion in which thousands of producers were expelled from the activity because they were unable to adapt to a high competitive global economy and a stable domestic economy; and one of competitiveness, in which the remaining producers had to professionalize very rapidly, incorporating new technologies and new financial, commercial, environmental, human resource, and taxation tools. This attracted a generation of extremely well-trained and professional young producers to the rural areas of Brazil.

Although the three factors outlined above are the most important, according to OECD, there are other important factors linked to the issue of sustainability, including agroenergy. For instance, CO2 emissions from alcohol-powered cars (considering the entire sugarcane chain of production), produce only 11% of the emission levels of gasoline run cars, producing a significantly lower impact on the environment. There is also the Brazilian energy matrix to consider, in which sugarcane is already much more important than hydro-electricity.


All of this positions Brazil to take a leadership role in a project that concerns all of humanity: sustainable food production and energy safety.

In a world without individual or institutional leadership, a project of this nature is needed, with a breadth that will arouse enthusiasm among the world’s wealthy and poor alike. In the final analysis, eliminating hunger is a necessity if we wish to foster peace and democracy in the world. Brazil can, under the command of FAO, OECD, and other institutions, help to develop tropical technologies in Latin America, sub-Saharan Africa and Asia. We can also share our successful experience regarding cooperative organizations and social programs, such as the Bolsa Familia (Family Stipend), with countries in these regions. It is clear that other issues should also be considered. In the institutional arena, for example, the issue of agricultural protectionism in developed countries needs to be resolved, and the Doha Round of WTO negotiations must come to a positive conclusion.

At the national level, there are recurring themes, from logistics to infrastructure, income policies for rural areas, trade policies, and sanitation issues. However, these are all items to be included in a broader strategy that the country must take on as it assumes a leading role in world food production. We should focus at this time on the growth of our exports, which over the past ten years has grown from 20 billion dollars’ worth in the year 2000 to 76 million dollars’ worth in 2010.

In addition, we have changed our products and their destinations, based on OECD findings. Brazil has made impressive gains, but it can do even more as it strives to comply with the goal of 40% of total world food production in 10 years, which is fully achievable as long as the issues outlined here are addressed with expeditiousness, skill and determination.





# BRAZILIAN AGRIBUSINESS STATISTICS

FGV PROJECTS

TABLE 1  
BRAZILIAN POSITION AS A WORLDWIDE PRODUCER OF AGRIBUSINESS PRODUCTS  
(HARVEST 2010/11)

COMMODITY	UNIT	PRODUCTION	SHARE % OF BRAZIL	RANKING
COFFEE GREEN	1000 60 KG BAGS	54,500	39.5%	1°
ORANGE JUICE	1000 MT	1,440	62.3%	1°
ORANGES FRESH	1000 MT	20,196	37.5%	1°
SUGAR CENTRIFUGAL***	1000 MT	38,168	24.8%	1°
MEAT BEEF AND VEAL****	1000 MT CWE**	9,184	16.0%	1°
ETHANOL FUEL PRODUCTION***	MILLIONS OF GALLONS	7,290	31.3%	2°
ANIMAL NUMBERS CATTLE(*) (****)	1000 HEAD	215,220	69.0%	2°
OILSEED SOYBEAN***	1000 MT	75,324	28.6%	2°
CORN***	1000 MT	57,514	6.9%	3°
MEAT SWINE****	1000 MT CWE**	3,384	3.1%	4°
RICE MILLED	1000 MT	9,257	2.1%	4°
COTTON	1000 480 LB. BALES	9,000	7.8%	4°
OIL SOYBEAN	1000 MT	6,875	16.7%	4°

SOURCE: USDA; \*\*\*CONAB; \*\*\*\*IBGE  
NOTE: \*2010; \*\*THOUSAND TONNES AT CARCASS WEIGHT EQUIVALENT

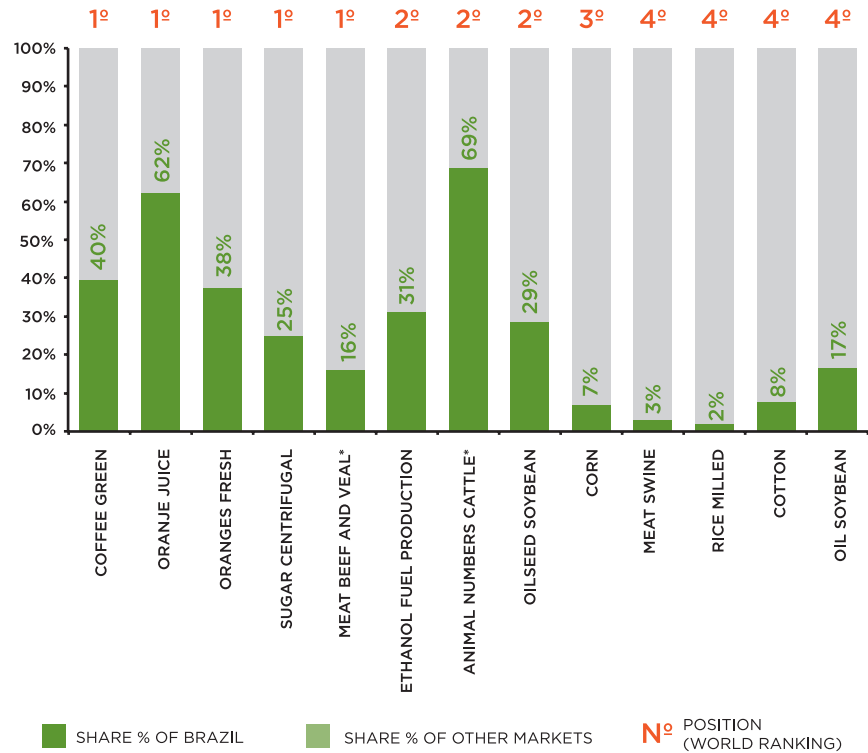
TABLE 2  
BRAZILIAN POSITION AS A WORLWIDE EXPORTER OF AGRIBUSINESS PRODUCTS  
(HARVEST 2010/11)

COMMODITY	UNIT	VOLUME EXPORTED	WORLD MARKEY SHARE	RANKING
COFFEE GREEN	1000 60 KG BAGS	34,000	33.4%	1°
ORANGE JUICE	1000 MT	1,240	79.3%	1°
SUGAR CENTRIFUGAL	1000 MT	25,650	50.1%	1°
MEAT BEEF AND VEAL	1000 MT CWE*	1,799	20.1%	1°
OILSEED SOYBEAN	1000 MT	29,951	32.7%	2°
OIL SOYBEAN	1000 MT	1,702	17.6%	2°
CORN	1000 MT	8,500	9.5%	3°
MEAT SWINE	1000 MT CWE*	573	10.2%	4°
COTTON	1000 480 LB. BALES	2,000	5.6%	5°

SOURCE: USDA  
NOTE: \*THOUSAND TONNES AT CARCASS WEIGHT EQUIVALENT

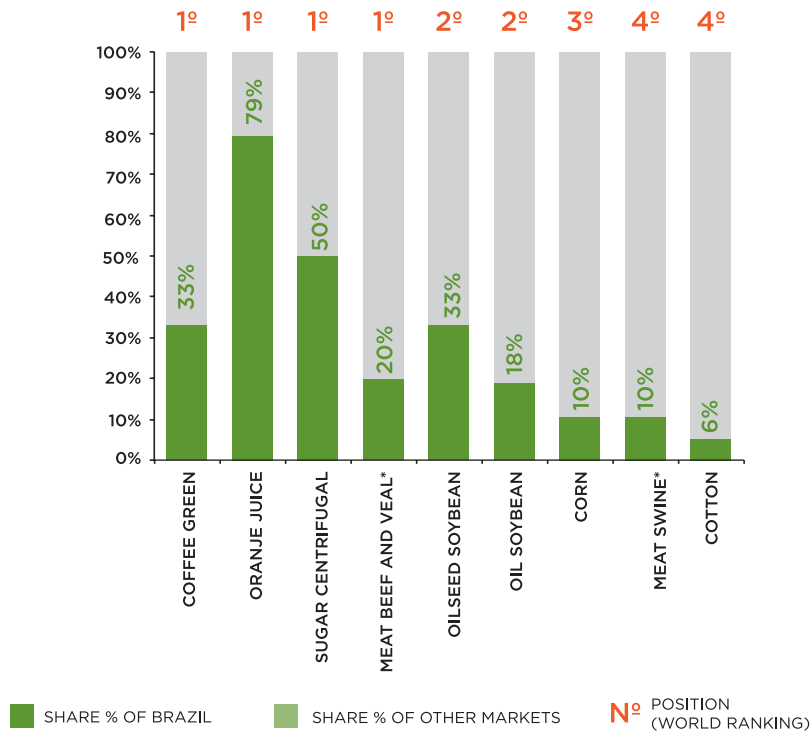


FIGURE 1  
BRAZILIAN POSITION AS A PRODUCER COMPARED TO THE WORLD MARKET  
(2010/11 HARVEST)



SOURCE: USDA  
NOTE: \*2010

FIGURE 2  
BRAZILIAN POSITION AS AN EXPORTER COMPARED TO THE WORLD MARKET  
(2010/11 HARVEST)



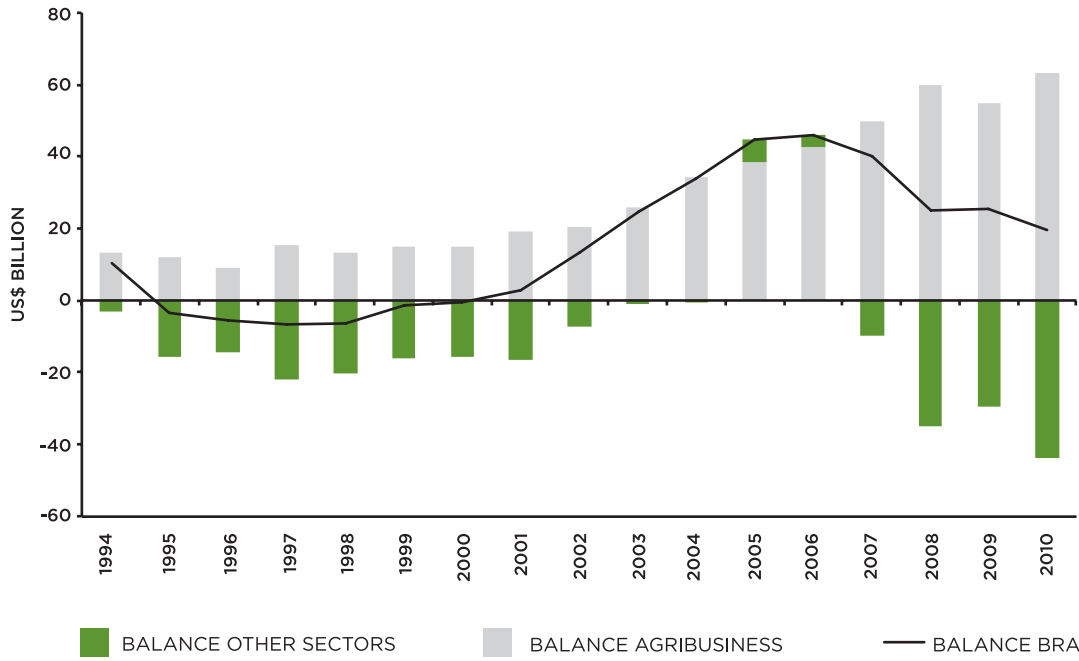
SOURCE: USDA  
NOTE: \*2010

TABLE 3  
BRAZILIAN TOTAL TRADE BALANCE AND THAT OF AGRIBUSINESS (US\$ BILLION)

YEAR	BRAZIL			ABRIBUSINESS			SHARE OF AGRIBUSINESS BALANCE IN TOTAL COUNTRY BALANCE
	EXPORTS	IMPORTS	BALANCE	EXPORTS	IMPORTS	BALANCE	
1994	43.5	33.1	10.4	19.1	5.7	13.4	129%
1995	46.5	49.8	-3.3	20.8	8.6	12.2	370%
1996	47.7	53.3	-5.6	21.1	8.9	8.9	159%
1997	53.0	59.7	-6.7	23.4	8.2	15.2	227%
1998	51.1	57.6	-6.6	21.5	8.0	13.5	205%
1999	48.1	49.3	-1.2	20.5	5.7	14.8	1233%
2000	55.1	55.8	-0.7	20.6	5.7	14.9	2129%
2001	58.2	55.5	2.7	23.9	4.8	19.1	707%
2002	60.3	47.2	13.1	24.8	4.5	20.3	155%
2003	73.0	48.2	24.8	30.6	4.7	25.9	104%
2004	96.4	62.8	33.7	39.0	4.9	34.1	101%
2005	118.3	73.5	44.7	43.6	5.2	38.4	86%
2006	137.5	91.4	46.1	49.4	6.7	42.7	93%
2007	160.6	120.6	40.0	58.4	8.7	49.7	124%
2008	197.9	173.0	24.9	71.8	11.8	60.0	241%
2009	152.9	127.6	25.3	64.7	9.8	54.9	217%
2010	201.1	181.7	19.4	76.4	13.4	63.0	325%

SOURCE: SECEX

FIGURE 3  
BRAZILIAN TRADE BALANCE EVOLUTION



SOURCE: SECEX

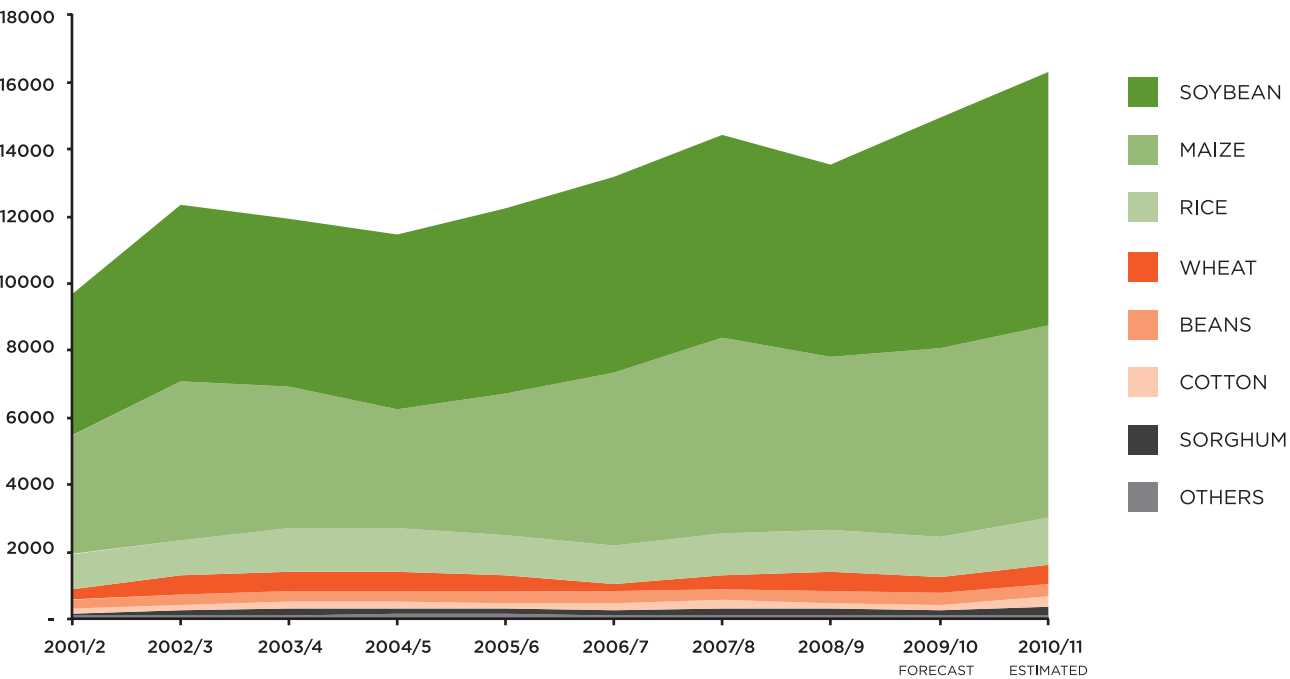


TABLE 4  
BRAZILIAN GRAIN PRODUCTION, PER PRODUCT (THOUSAND T)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10*	2010/11**
SOYBEAN	41,917	52,018	49,793	52,305	55,027	58,392	60,018	57,166	68,688	75,324
CORN	35,281	47,411	42,129	34,977	42,515	51,370	58,652	51,004	56,018	57,514
RICE	10,626	10,367	12,829	13,227	11,722	11,316	12,074	12,603	11,661	13,613
WHEAT	2,914	5,851	5,851	5,846	4,873	2,234	4,097	5,884	5,026	5,882
BEANS	2,983	3,205	2,978	3,044	3,471	3,340	3,521	3,491	3,323	3,787
COTTON SEED	1,245	1,365	2,099	2,110	1,686	2,384	2,505	1,891	1,843	3,226
SORGHUM	798	1,697	2,014	1,568	1,543	1,497	1,986	1,935	1,624	2,314
OATMEAL	285	390	411	433	517	378	230	232	244	379
BARLEY	235	304	367	387	399	206	265	237	201	284
PEANUTS	189	175	217	302	268	226	303	301	226	227
CASTOR BEAN	72	86	107	210	104	94	123	93	101	141
TRITICALE	177	240	229	221	306	204	212	185	172	115
SUNFLOWER	71	56	86	63	94	106	147	109	81	77
CANOLA	-	-	-	-	-	-	-	-	42	70
RYE	6	3	4	3	7	6	5	6	5	3
BRAZIL	96,799	123,168	119,114	114,695	122,531	131,751	144,137	135,135	149,255	162,955

SOURCE: CONAB  
NOTE: \*PRELIMINARY DATA; \*\*ESTIMATED DATA

FIGURE 4  
BRAZILIAN GRAIN PRODUCTION, PER PRODUCT (THOUSAND T)



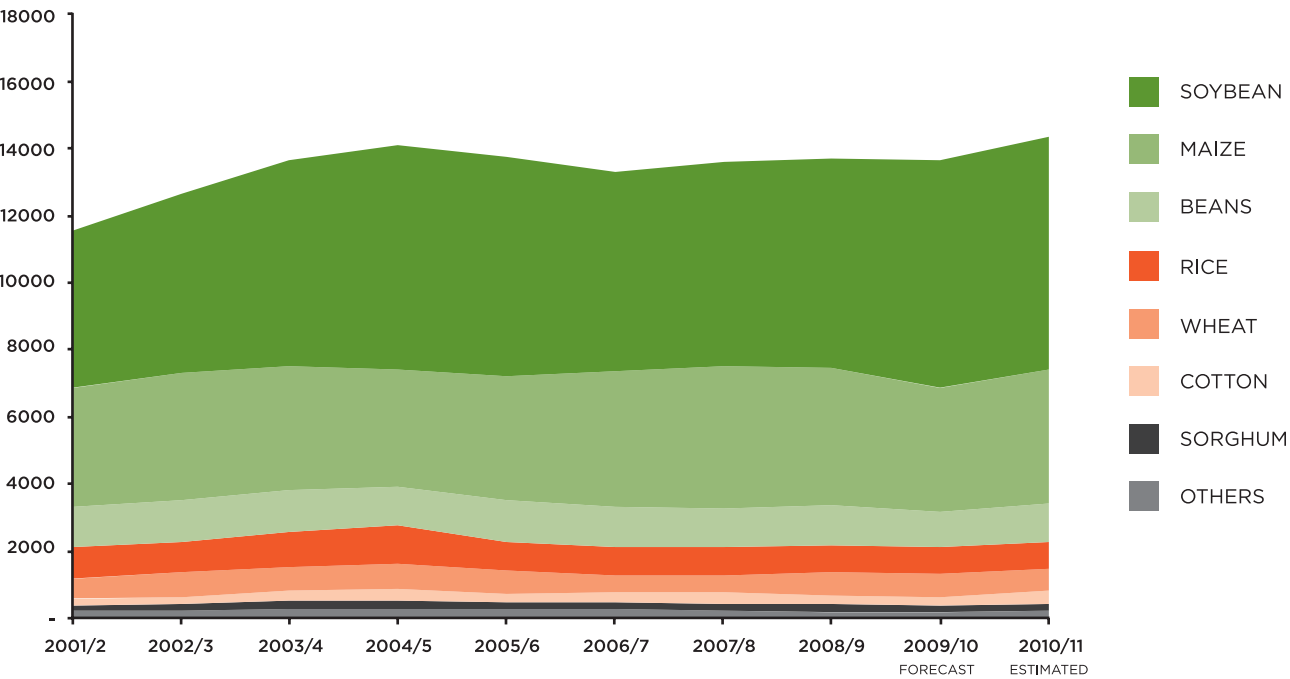
SOURCE: CONAB

TABLE 5  
BRAZILIAN CULTIVATED AREA WITH GRAINS, PER PRODUCT (THOUSAND HA)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10*	2010/11**
COTTON	747.7	735.1	1,100.0	1,179.4	856.2	1,096.8	1,077.4	843.2	835.7	1,400.3
PEANUTS	93.9	84.5	98.2	129.5	113.1	102.6	115.2	113.8	84.1	84.7
RICE	3,219.6	3,186.1	3,654.4	3,916.3	3,017.8	2,967.4	2,875.0	2,909.0	2,764.8	2,820.3
OATMEAL	256.5	267.2	299.2	326.2	356.8	321.4	106.1	111.2	126.4	153.8
CANOLA	-	-	-	-	-	-	-	-	31.0	46.3
RYE	5.5	2.6	2.6	2.6	4.3	4.3	3.7	4.7	3.6	2.4
BARLEY	154.1	112.5	137.1	140.0	142.9	90.0	98.3	79.3	77.5	87.9
BEANS	4,269.7	4,378.7	4,287.4	3,949.2	4,223.6	4,087.8	3,993.0	4,147.8	3,608.8	4,009.2
SUNFLOWER	52.6	43.2	55.1	50.1	66.9	75.4	111.3	75.0	71.0	61.0
CASTOR BEAN	126.1	128.3	166.2	215.1	147.9	155.6	162.7	157.5	157.7	219.3
CORN	12,318.8	13,226.2	12,783.0	12,208.2	12,963.9	14,054.9	14,765.7	14,171.8	12,993.9	13,838.7
SOYBEAN	16,329.0	18,474.8	21,375.8	23,301.1	22,749.4	20,686.8	21,313.1	21,743.1	23,467.9	24,181.0
SORGHUM	489.9	735.5	898.3	788.6	731.9	704.4	843.4	846.1	697.8	817.4
WHEAT	2,051.6	2,464.2	2,464.2	2,756.3	2,361.8	1,757.5	1,851.8	2,396.2	2,428.0	2,149.8
TRITICALE	120.0	107.9	101.0	105.6	131.1	107.7	94.5	75.7	67.5	46.9
BRAZIL	40,235.0	43,946.8	47,422.5	49,068.2	47,867.6	46,212.6	47,411.2	47,674.4	47,415.7	49,919.0

SOURCE: CONAB  
NOTE: \*PRELIMINARY DATA; \*\*ESTIMATED DATA

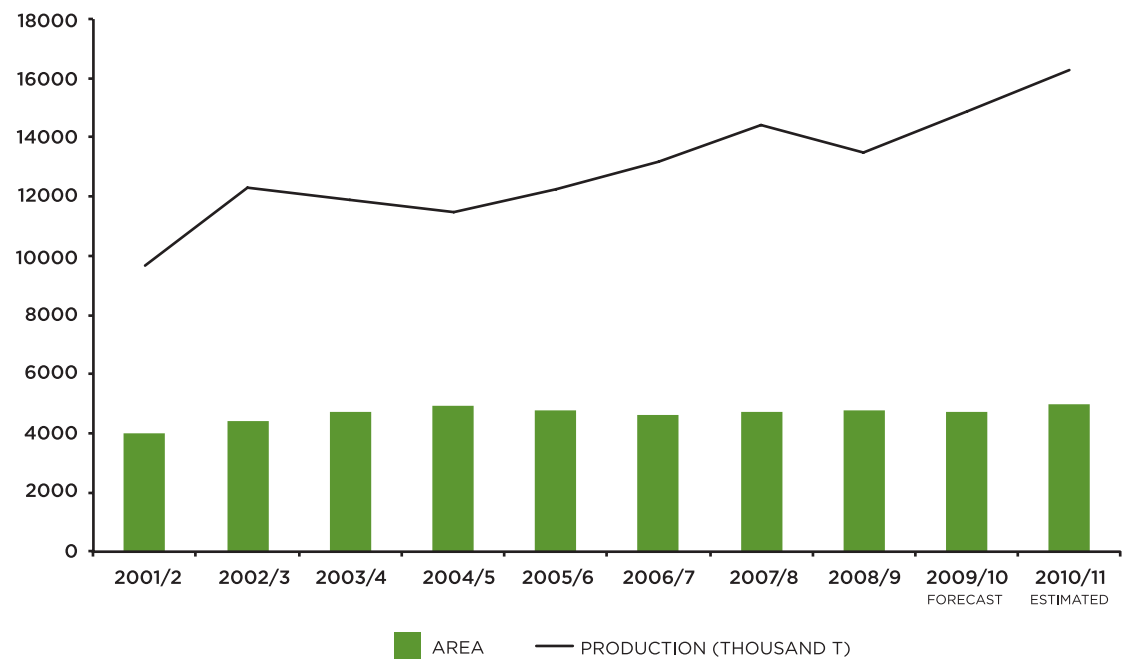
FIGURE 5  
BRAZILIAN CULTIVATED AREA WITH GRAINS, PER PRODUCT (THOUSAND HA)



SOURCE: CONAB



FIGURE 6  
BRAZILIAN PRODUCTION EVOLUTION AND CULTIVATED AREA WITH GRAINS



SOURCE: CONAB

TABLE 6  
BRAZILIAN BOVINE CATTLE PRODUCTION

	2005	2006	2007	2008	2009	2010	2011*
HERDS (THOUSAND OF HEAD)	207,157	205,886	199,752	202,287	204,854	208,952	215,220
MEAT PRODUCTION (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	9,229	10,184	10,084	8,835	8,474	8,917	9,184
IMPORTS (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	53	27	31	30	39	37	38
EXPORTS (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	1,923	2,178	2,285	1,920	1,703	1,747	1,799
DOMESTIC AVAILABILITY (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	7,358	8,033	7,830	6,950	6,811	7,207	7,423

SOURCE: IBGE; SECEX  
NOTE: \*FORECAST

TABLE 7  
BRAZILIAN POULTRY PRODUCTION

	2005	2006	2007	2008	2009	2010	2011*
HOUSING (MILLION OF HEAD)**	5,145	4,571	5,145	5,463	5,557	6,101	6,406
MEAT PRODUCTION (THOUSAND TONS)	9,348	9,354	10,305	11,033	11,021	12,266	12,880
EXPORTS (THOUSAND TONS)	2,846	2,713	3,287	3,646	3,635	3,844	4,036
DOMESTIC AVAILABILITY (THOUSAND TONS)	6,502	6,641	7,018	7,387	7,387	8,423	8,844

SOURCE: APINCO; SECEX  
NOTE: \*FORECAST; \*\*HOUSING, AND NOT THE PRODUCTION OF BROILER CHICKS, REFLECTS THE HERD THAT WILL PRODUCE MEAT

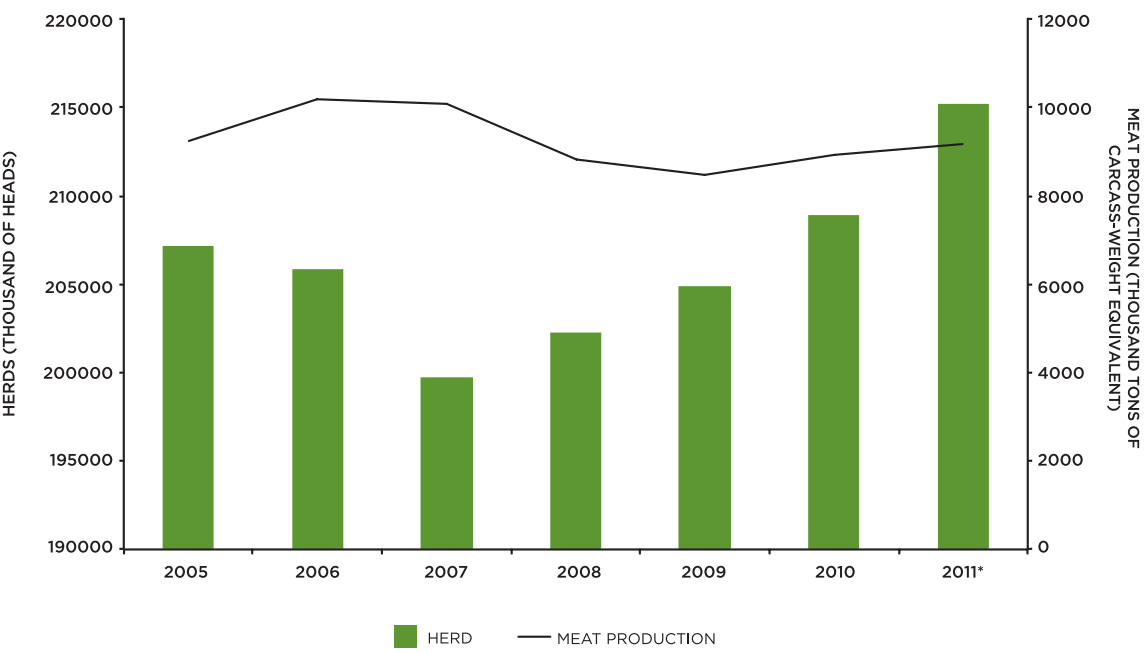
TABLE 8  
BRAZILIAN PORK PRODUCTION

	2005	2006	2007	2008	2009	2010	2011*
HERDS (THOUSAND OF HEAD)	34,064	35,174	35,945	36,819	37,840	38,975	40,145
MEAT PRODUCTION (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	2,708	2,943	2,998	3,026	3,190	3,286	3,384
IMPORTS (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	1	1	0	0	0	1	1
EXPORTS (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	622	525	604	537	618	556	573
DOMESTIC AVAILABILITY (THOUSAND TONS OF CARCASS-WEIGHT EQUIVALENT)	2,087	2,419	2,394	2,489	2,573	2,730	2,812

SOURCE: IBGE; SECEX; ABIPECS  
NOTE: \*FORECAST

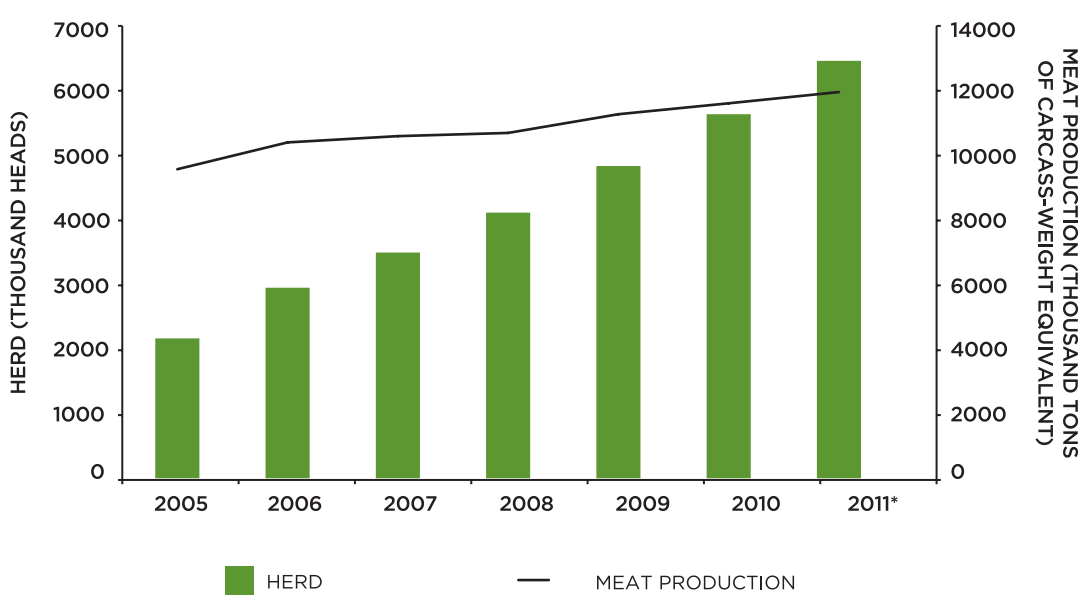


88 **FIGURE 7**  
BRAZILIAN BOVINE CATTLE PRODUCTION



SOURCE: IBGE; SECEX  
NOTE: \* FORECAST

**FIGURE 9**  
BRAZILIAN PORK PRODUCTION



SOURCE: IBGE; ABIPECS  
NOTE:\*FORECAST

**FIGURE 8**  
BRAZILIAN POULTRY PRODUCTION



SOURCE: BRAZILIAN BROILER CHICKS PRODUCERS ASSOCIATION (APINCO)  
NOTE:\*FORECAST, \*\* HOUSING, AND NOT THE PRODUCTION OF BROILER CHICKS, REFLECTS THE HERD THAT WILL PRODUCE MEAT

**TABLE 9**  
BRAZILIAN SUGARCANE PRODUCTION

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
AREA (THOUSAND HA)	5,022	5,207	5,377	5,634	5,815	6,390	7,087	8,211	8,846	9,081
PRODUCTION (THOUSAND TONS)	344,293	364,389	396,012	415,206	422,957	477,411	549,707	645,300	691,606	719,157
YIELD (T/HA)	69	70	74	74	73	75	78	79	78	79

SOURCE: IBGE

**TABLE 10**  
BRAZILIAN SUGAR PRODUCTION (THOUSAND TONS)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
NORTH-NORTHEAST REGION	3,246	3,789	4,505	4,536	3,821	4,098	4,826	4,299	4,328	4,605
SOUTH-CENTRAL REGION	15,972	18,778	20,420	22,085	22,085	25,784	26,201	26,750	28,747	33,564
BRAZIL	19,218	22,567	24,926	26,621	25,906	29,882	31,026	31,049	33,075	38,168

SOURCE: UNICA; CONAB



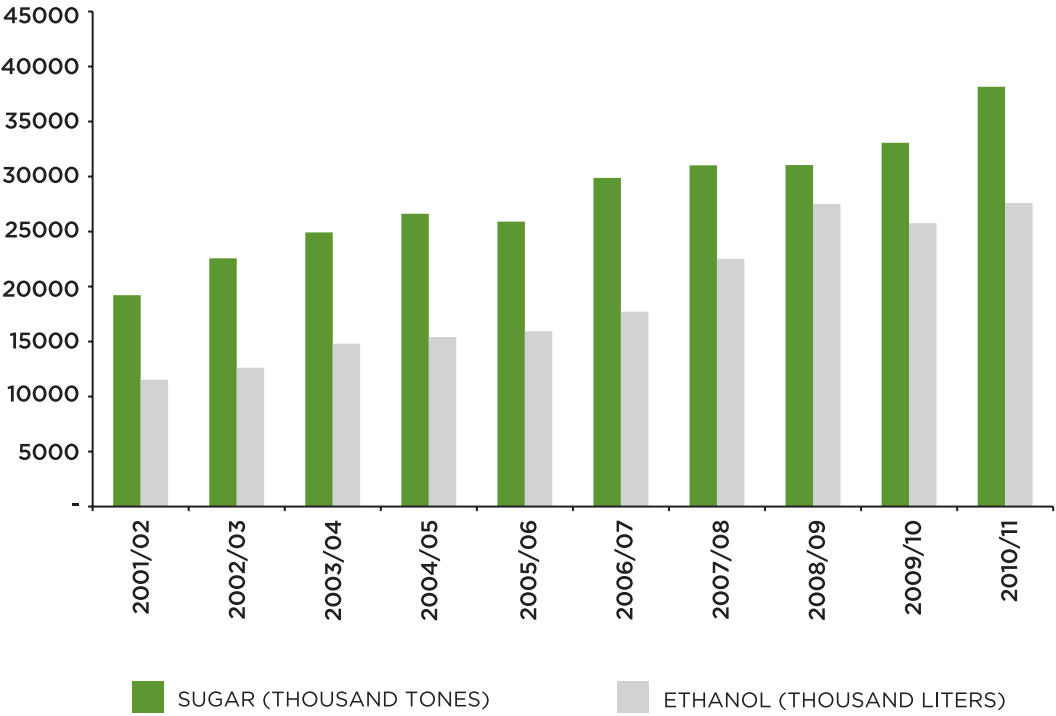
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TABLE 11  
BRAZILIAN ETHANOL PRODUCTION (THOUSAND LITERS)

	2001/02	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10	2010/11
NORTH-NORTHEAST REGION	1,360	1,471	1,740	1,825	1,594	1,713	2,193	2,411	2,026	1,983
SOUTH-CENTRAL REGION	10,176	11,152	13,069	13,591	14,353	16,006	20,333	25,102	23,737	25,613
BRAZIL	11,536	12,623	14,809	15,417	15,947	17,719	22,527	27,513	25,763	27,595

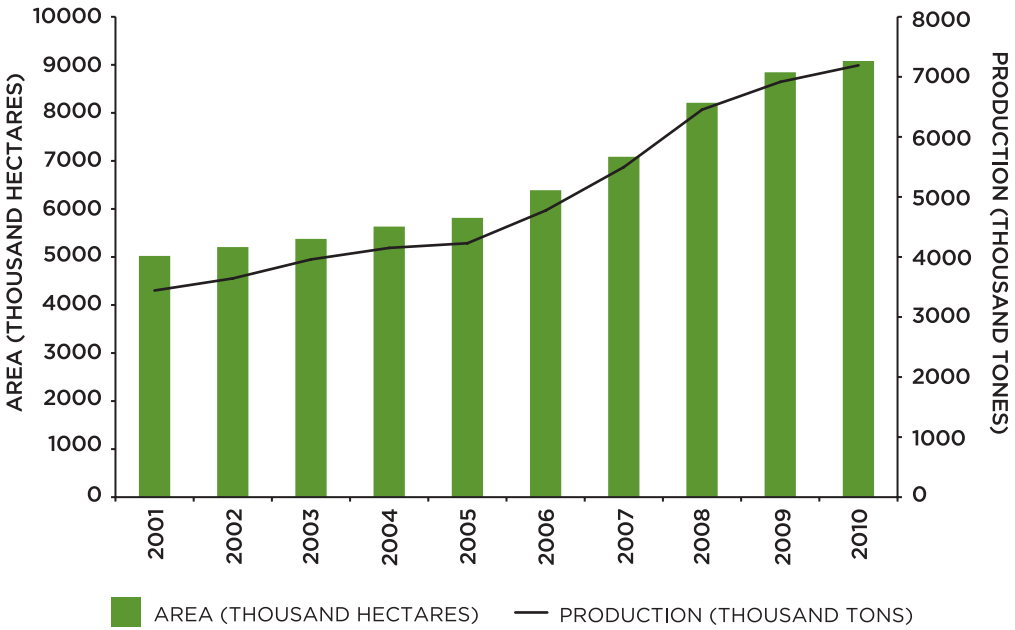
SOURCE: UNCA; CONAB

FIGURE 10  
BRAZILIAN SUGAR AND ETHANOL PRODUCTION



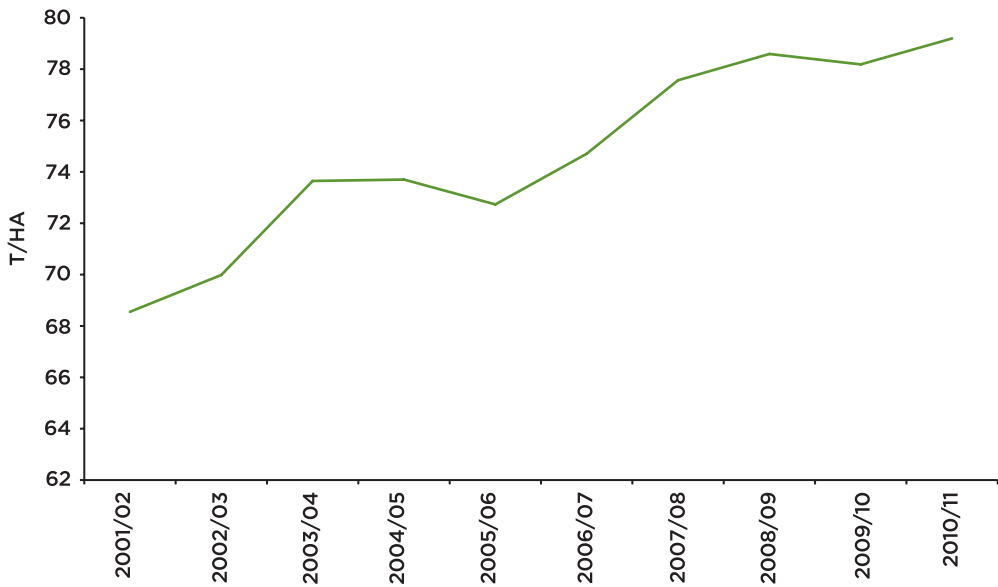
SOURCE: UNICA; CONAB

FIGURE 11  
BRAZILIAN SUGARCANE AREA AND PRODUCTION



SOURCE: IBGE

FIGURE 12  
BRAZILIAN EVOLUTION OF SUGARCANE PRODUCTIVITY



SOURCE: IBGE



102 TABLE 12  
BRAZILIAN PROJECTION FOR PRODUCTION, PER PRODUCT (MILLION OF TONS)

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	GROWTH RATE (%)
COTTON	1.7	1.8	1.8	1.9	2	2.1	2.2	2.3	2.3	2.4	4.3
RICE	12.6	12.7	12.8	12.9	13.1	13.2	13.3	13.5	13.6	13.7	1
BEANS	3.6	3.5	3.6	3.6	3.6	3.7	3.7	3.8	3.8	3.8	0.9
CORN	56.2	56.4	57.8	58.8	60	61.1	62.2	63.3	64.4	65.5	2
SOYBEAN	71.1	72.8	74.5	76.2	78	79.7	81.4	83.1	84.8	86.5	2.3
SOYBEAN MEAL	27.5	27.9	28.5	29.1	29.6	30.2	30.7	31.3	31.8	32.4	1.9
SOYBEAN OIL	7	7.2	7.3	7.4	7.6	7.7	7.9	8	8.2	8.3	1.9
WHEAT	5.3	5.4	5.5	5.6	5.7	5.8	5.9	6	6.1	6.2	1.6
POULTRY MEAT	13.1	12.9	13.9	13.6	14.6	14.3	15.3	15	16	15.7	2.6
BEEF	9.4	9.6	9.8	10	10.3	10.5	10.7	10.9	11.1	11.4	2.2
PORK MEAT	3.4	3.5	3.6	3.7	3.7	3.8	3.9	3.9	4	4.1	1.9
COFFEE*	50	58.9	54.5	64.2	59.4	69.9	64.8	76.2	70.6	-	4
SUGAR	35.9	35.8	36.8	38.4	38.7	39.6	40.2	41.2	42	42.3	2.2
CASSAVA	26.3	26.2	26.2	26.2	26.2	26.2	26.1	26.1	26.1	26.1	-0.1
ENGLISH POTATO	3.6	3.7	3.8	3.8	3.9	3.9	4	4.1	4.1	4.2	1.6
ORANGE	19.9	20.2	20.7	21	21.5	21.9	22.3	22.7	23.1	23.5	1.9
MILK	32.3	33	33.6	34.3	34.9	35.6	36.2	36.9	37.5	38.2	1.9
TABACCO	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	1	1	1.4
SUGARCANE	769.3	788	806.4	824.7	843.1	861.4	879.7	898	916.3	934.6	2.2
PAPER	10.3	10.5	10.8	11	11.3	11.6	11.8	12.1	12.3	12.6	2.3
CELLULOSE	15.1	15.5	16.1	16.5	17	17.5	18	18.5	19	19.4	2.9

SOURCE: AGE/MAPA AND SGE/EMBRAPA  
NOTE: \*MILLION BAGS

TABLE 13  
BRAZILIAN PROJECTION FOR CULTIVATED AREA, PER PRODUCT (MILLION OF HA)

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	GROWTH RATE (%)
COTTON	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.89	0.89	0.89	-0.2
RICE	2.48	2.38	2.28	2.23	2.12	1.99	1.89	1.78	1.69	1.61	-4.6
BEANS	3.72	3.63	3.63	3.62	3.57	3.54	3.52	3.49	3.46	3.43	-0.8
CORN	13.14	13.06	13.15	13.16	13.21	13.24	13.27	13.31	13.35	13.38	0.3
SOYBEAN	25.4	25.98	26.5	27.01	27.51	28.01	28.52	29.02	29.52	30.02	1.9
WHEAT	2.34	2.31	2.31	2.29	2.28	2.27	2.26	2.24	2.23	2.22	-0.5
COFFEE	1.97	1.9	1.85	1.79	1.74	1.68	1.62	1.56	1.51	1.45	-3.3
CASSAVA*	1.81	1.8	1.79	1.78	1.77	1.76	1.76	1.75	1.74	1.73	-0.5
ENGLISH POTATO*	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.12	-1
ORANGE*	0.87	0.88	0.89	0.9	0.91	0.92	0.93	0.94	0.95	0.96	1.2
TABACCO*	0.46	0.46	0.46	0.47	0.47	0.48	0.48	0.49	0.49	0.5	1
SUGARCANE*	9.64	9.85	10.06	10.27	10.48	10.69	10.9	11.1	11.31	11.52	2

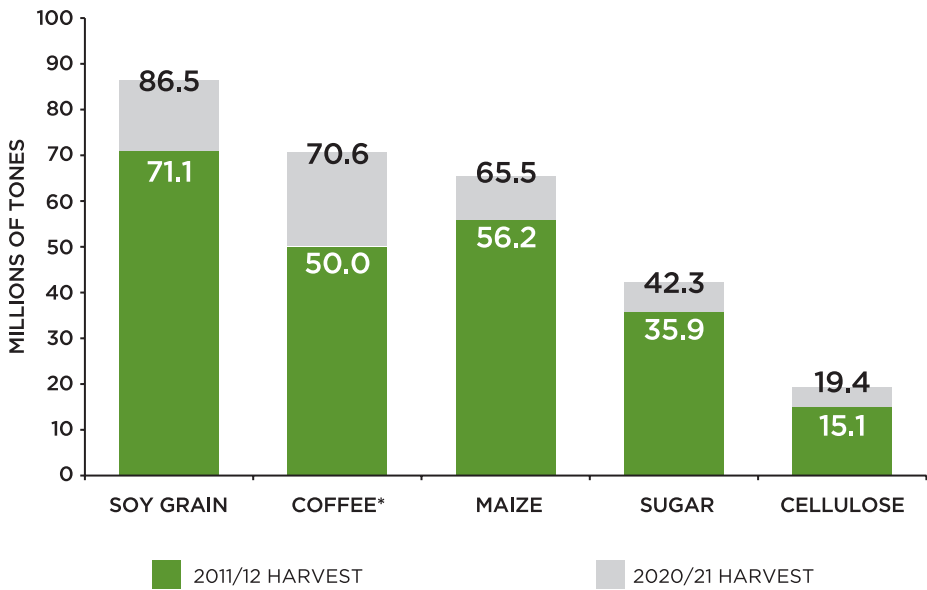
SOURCE: AGE/MAPA E SGE/EMBRAPA  
NOTE: \*HARVEST AREA

TABLE 14  
BRAZILIAN PROJECTION FOR EXPORT, PER PRODUCT (MILLION OF TONS)

	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20	2020/21	GROWTH RATE (%)
COTTON	0.55	0.59	0.62	0.65	0.69	0.72	0.75	0.79	0.82	0.86	5.1
CORN	9.19	11.16	11.11	10.92	12.16	12.67	12.66	13.42	14.09	14.3	4.6
SOYBEAN	30.9	32.99	33.57	34.26	35.71	36.97	37.67	38.6	39.77	40.74	3.2
SOYBEAN MEAL	13.89	14.13	14.26	14.44	14.59	14.75	14.9	15.06	15.21	15.37	1.1
SOYBEAN OIL	1.42	1.43	1.43	1.45	1.45	1.46	1.47	1.48	1.49	1.5	0.5
ORANGE JUICE	2.13	2.21	2.26	2.32	2.38	2.44	2.5	2.56	2.62	2.68	2.5
POULTRY MEAT	4.12	4.15	4.4	4.42	4.66	4.68	4.91	4.93	5.16	5.17	2.9
BEEF	1.85	1.9	1.95	2.01	2.06	2.11	2.17	2.22	2.27	2.33	2.6
PORK MEAT	0.6	0.62	0.63	0.65	0.67	0.69	0.71	0.72	0.74	0.76	2.8
COFFEE*	34.54	35.41	36.29	37.2	38.13	39.08	40.06	41.06	42.09		2.5
SUGAR	30	31.16	32.48	33.75	35.03	36.31	37.59	38.87	40.15	41.42	3.8
MILK**	0.22	0.23	0.24	0.25	0.26	0.27	0.28	0.29	0.3	0.31	4.2
PAPER	2.18	2.24	2.29	2.35	2.4	2.46	2.52	2.57	2.63	2.68	2.4
CELLULOSE	9.19	9.63	9.97	10.36	10.71	11.08	11.44	11.8	12.16	12.53	3.5

SOURCE: AGE/MAPA E SGE/EMBRAPA  
NOTE: \*MILLION OF BAGS; \*\*BILLION OF LITERS

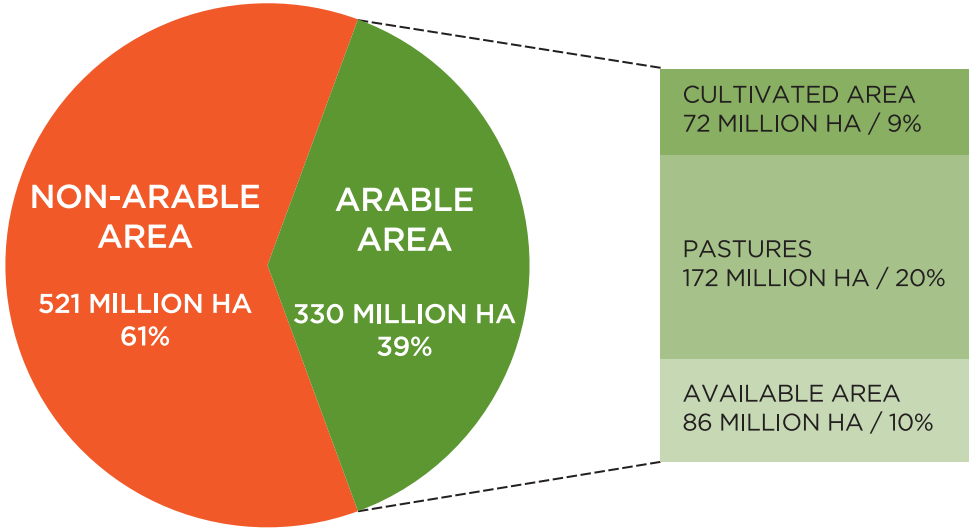
FIGURE 13  
BRAZILIAN PROJECTION FOR PRODUCTION, PER PRODUCT (MILLIONS OF T)



SOURCE: AGE/MAPA AND SGE/EMBRAPA  
NOTE: \* MILLIONS OF BAGS



104 **FIGURE 14**  
**BRAZILIAN LAND USE (MILLIONS OF HA)**



SOURCE: IBGE

