

The Commercial Benefits from Crop Biotechnology in Brazil: 1996/97 - 2009/10

- THE CASES OF INSECT-RESISTANT AND HERBICIDE-TOLERANT COTTON
- THE CASE OF INSECT-RESISTANT CORN
- THE CASE OF HERBICIDE-TOLERANT SOYBEANS

PREFACE

This document aims at commenting on the main results from the study on the “Commercial benefits from the adoption of biotechnology: 1996/97 – 2009/10”^{1/} conducted by Céleres^{2/} in the second semester of 2010. This document focuses on analyzing the results of the general commercial benefits obtained from the adoption of the insect-resistant cotton, insect-resistant corn, and herbicide-tolerant soybeans.

^{1/} The full report with the study on the “Commercial benefits from the adoption of biotechnology: 1996/97 – 2009/10” may be accessed at the website www.celeres.com.br

^{2/} Céleres is a consulting company that is specialized in the Brazilian agribusiness, headquartered in Uberlândia, Minas Gerais. Céleres conducts independent studies in the areas of agro-economy and business intelligence.

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Commercial benefits of biotechnology in Brazil: 1996/97 to 2009/10

For the fourth consecutive year, Céleres® has conducted research studies on the commercial benefits captured by farmers and the technology industry from adopting agricultural biotechnology in cotton, corn, and soybeans, carrying out field studies, which include trips to the major producing regions, gathering data with farmers, users of available and approved GM technologies.

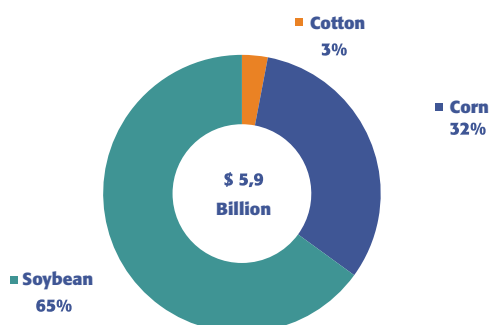
Based on these research studies, in the fourteenth year since the introduction of agricultural biotechnology in Brazil, it is estimated that the commercial benefits captured by the farmers who use this technology and by the industry that holds this technology have accrued, since 1996/97, the total sum of US\$ 5.9 billion.

From the commercial benefits that have been generated, soybeans, which was the first crop to employ biotechnology, accounts for the largest share of this benefit, 65% of the total, in comparison to 78% over the period from 1996/97 to 2008/09, mainly due to the increased participation of corn in this amount, which accounts for 32% of the total, an expressive increase in comparison to the previous year, i.e., 18% of the commercial benefit generated, in its first year of adoption. This shows the importance of biotechnology in the production of this cereal, which has only been employing this technology for two years. Cotton, which adopted biotechnology as of 2004/05, accounts for 3% of the total benefit. The small participation of this crop can be explained by the area planted having been much smaller than that destined for soybeans and corn.

Another important aspect of the analysis of the commercial benefits with the adoption of biotechnology in Brazil, over the last fourteen years, lies in the fact that out of the US\$ 5.9 billion resulting from the benefits, 52% of the benefit was an outcome of production cost reductions during this period and 27% of the production surplus from adopting biotechnology, as observed particularly in the cases of cotton and corn.

FIGURE 1:

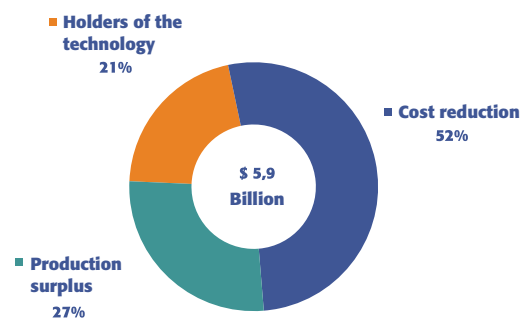
Commercial benefits of biotechnology in Brazil: 1996/97 to 2009/10, by crop



Source: CÉLERES® (2011)

FIGURE 2:

Commercial benefits of biotechnology in Brazil: 1996/97 to 2009/10, by benefit



Source: CÉLERES® (2011)

The farmers directly capture both benefit-generated factors, which translates into the fact that the farmers captured a total of 79% of the direct commercial benefit generated in the period under consideration. The holders of the technology, also an important part in the development of biotechnology, captured the remaining benefit, or 21% of the total commercial benefit.

It is important to highlight that the “production surplus” benefit, considered as being a direct benefit captured by the farmers, can also be translated into indirect benefits captured throughout the value chain of the feed and food industries, to the extent that such surplus will ensure the supply to the feed industry, contributing to maintain the prices of raw materials for feed stable, and thus, keeping the meat production under control, benefiting to say the least, the consumer as he purchases in the retail markets.

Currently, much debate revolves around the real benefits from adopting biotechnology. Therefore, it is important to keep in mind the size of the opportunity cost that would be incurred as a result of not adopting biotechnology. Thus, upon taking into consideration the delay observed in the adoption of biotechnology in Brazil, it can be estimated that the potential benefit that biotechnology could have brought about to the cotton, corn, and soybeans growers, in the period from 1996/97 to 2009/10, would be an impressive figure of US\$ 31.0 billion, or approximately fivefold the total of benefits actually captured.

The difference between the potential and actual benefits, amounting to US\$ 25.1 billion is a sum that could have been earned, particularly by the farmers themselves, who are the major beneficiaries of this technology.

The analysis of the previous results shows that over the last fourteen years, the adoption of agricultural biotechnology brought about expressive direct and indirect earnings for the farmers, technology holders, and consumers in general. It is also clear that in the case of biotechnology, the cost of its non-adoption – measured in terms of opportunity cost – ends up being significantly greater than the benefit itself resulting from its use.

Therefore, in view of the opportunity cost, the tardiness and delays in releasing GM technologies in Brazil, have cost to date, US\$ 25.1 billion, which represents the difference between the actual and potential benefits, although other intangible costs, such as well being, convenience, practicality, ease in management and less time spent in crop production also have, each, their commercial value.

Therefore, it is worth highlighting the importance of the improvement and consistent follow-up of public policies that ensure a favorable institutional environment for developing biotechnology in Brazil, as a way to contribute

towards maintaining national crop production competitiveness, at a time when the expectations over the growing global demand for food are the center of debates locally, and particularly internationally.

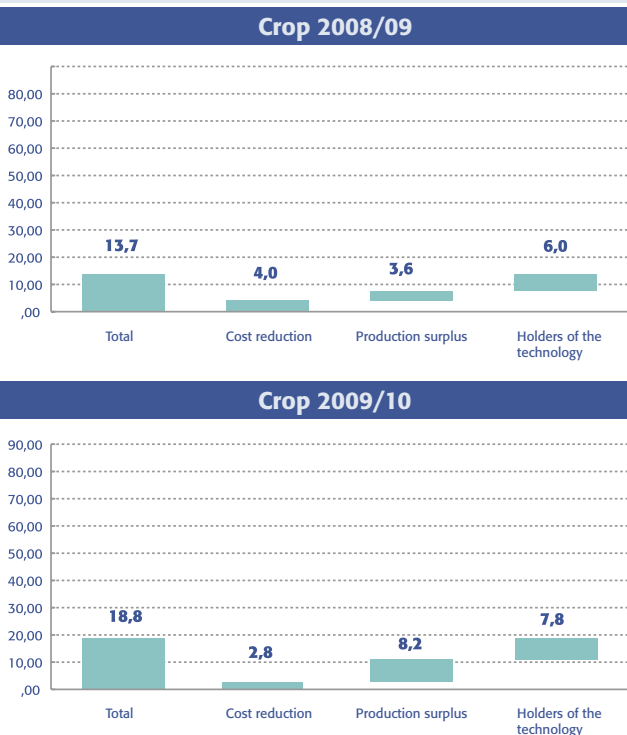
Within this context, agricultural biotechnology has the potential to exert a vital role to ensure food supply, which is already scarce in the world, in addition to biofuels for a growing global population, in numbers and purchasing power.

Commercial benefits from biotechnology in Brazil: 2008/09 x 2009/10

After drawing a comparison with the commercial benefits from biotechnology in the last decade, it is also important to take into consideration the recent comparative analysis between the current harvest (2009/10) and the last harvest (2008/09), captured by the farmers (production cost reduction and production surplus) and industry.

The cotton crop generated in 2009/10 a total of US\$ 18.8 million, 37.2% more than the last harvest. Out of this total, US\$ 9.0 million were captured by the cotton growers, 18.4% more than in 2008/09. Out of the 9.0 million captured by the cotton growers, US\$ 2.8 million were accounted for by cost reductions and US\$ 6.2 million by the production surplus, differently than the prior year, in which the cost reductions accounted for a greater benefit to farmers. The remaining commercial benefit of 2009/10 was captured by the industry, US\$ 7.8 million, 30.0% more than in the previous year.

FIGURE 3:
Cotton: Commercial benefits with the adoption of biotechnology



Source: CÉLERES® Values in US\$ million

For the corn crop, in the current harvest, the total commercial benefits generated were of US\$ 1.74 billion, 122.7% more than in the prior year. Out of this sum, US\$ 1.25 billion were captured by the farmers, 104.9% more than in the prior harvest. The remaining balance was earned by the technology holders (industry), US\$ 0.22 billion, or 340% more than in the previous harvest, due precisely to an accelerated adoption rate, higher seed cost, in addition to the improved industry efficiency in producing and delivering the seed to the farmers.

FIGURE 4:
Corn: Commercial benefits with the adoption of agricultural biotechnology



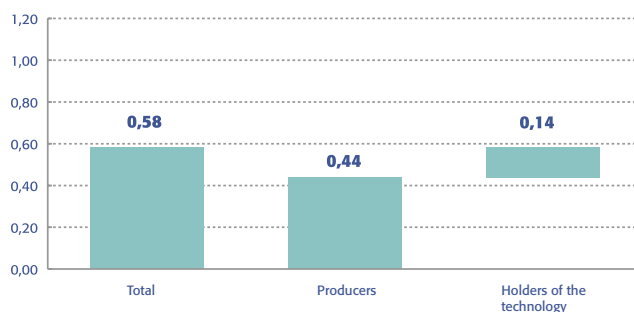
Source: CÉLERES® Values in US\$ billion

At last, for the soybeans crop, the total commercial benefit in the 2009/10 harvest was of US\$ 1.21 billion, 108.6% regarding the prior year. For the soybean grower, the commercial gain amounted to US\$ 0.8 billion, 81.8% higher than in the prior harvest. It is important to highlight that already in the 2009/10 harvest, the cost reductions and production surplus (grains) are considered as benefits to the soybean grower, since the RI/TH soybeans was approved for marketing. The remaining balance, US\$ 0.41 billion, was earned by the technology holders (industry), 192.9% more than in 2008/09.

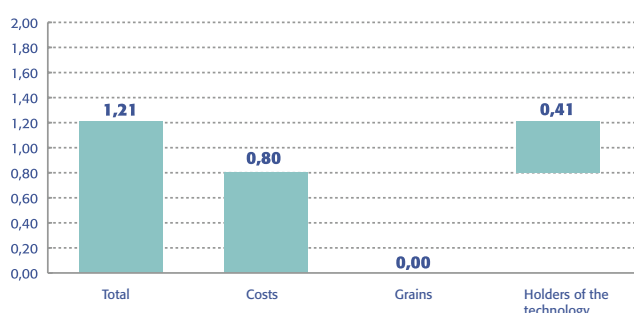
FIGURE 5:

Soybeans: Commercial benefits from the adoption of agricultural biotechnology

Crop 2008/09



Crop 2009/10



Source: CÉLERES® Values in US\$ billion

Growth predicted in crop production

The current global population growth assumptions, together with increased incomes, particularly in the developing countries, produce challenging situations for farmers around the world to significantly increase food availability over the upcoming decade. Based on different studies, in 2050 the Earth is expected to have a population of 9.2 billion inhabitants, around 2 billion more than today. And in the next 20 years, the global demand for food is expected to increase by approximately 50% (IFPRI, 2009). Norman Borlaug supported this forecast as he calculated that in order to meet the projected need for food until 2025, the average yield of all of the cereals will have to be about 80% higher than the average yield recorded in 1990.

Based on the economic and population growth assumptions for the upcoming decade, the global cotton production is expected to surpass the current 22.4 million tons to 32.2 million tons in 2019/20. In this horizon, China, India, and the United States will still be key players in the cotton production (Figure 2.16), however, Brazil may also potentially increase its share in the total volume produced, once it becomes more competitive (CÉLERES, 2010).

In view of this opportunity, the Brazilian cotton production is expected to grow over the upcoming decade as a way to meet the growing global demand. For this, we will also have, over the next decade, a greater need for areas to meet such demand, even with the increase in Brazilian cotton productivity. Thus, the area harvested with cotton is projected to exceed the current 820 thousand hectares (2009/10) to 1,471 thousand hectares for 2019/20. In this

same period, our projections indicate that the adoption of GM cotton will surpass the current 131.0 thousand hectares recorded in the 2009/10 harvest to 2.1 million hectares for the 2019/20 harvest.

Based on the economic and population growth assumptions for the upcoming years, projections indicate that the global corn production will surpass the current 788.6 million tons, reaching 954.1 million tons in 2018/19 (Figure 5). As the countries around the world differ in degrees of competitiveness amongst each other, the United States, China, EU-27, Brazil and Argentina are expected to continue, in the horizon of this analysis, to be the major global corn producers (CÉLERES, 2010).

Assuming that the Brazilian corn production will increase over the next ten years, as a way to meet the growing demand not only locally, but also globally, over the next decade there will also be a greater need for areas to fulfill such demand. However, differently than in the case of soybeans, the growth in corn production in Brazil depends mainly on more expressive gains in the cereal's average productivity.

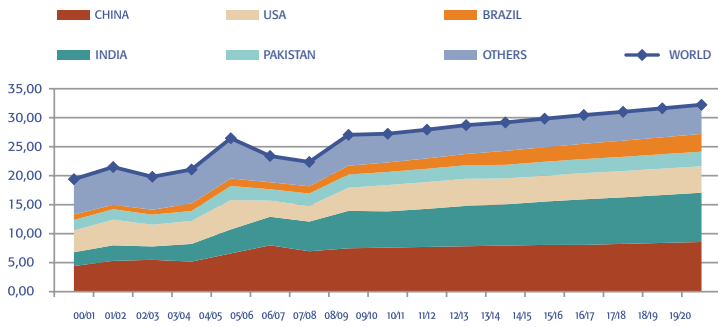
Thus, projections indicate that the area harvested with corn will surpass the current 13.2 million hectares (2009/10), rising to 16.9 million hectares in 2019/20. Over this same period, we considered that the adoption of GM corn will rise above the current 4.3 million hectares observed in the 2009/10 harvest, leaping to 13.3 million hectares in the 2019/20 harvest (Figure 6). Such figures are the assumptions used for the projections on the commercial benefits expected for the next decade, with the adoption of biotechnology in Brazil, in the corn crop.

Finally, for the soybean crop, based on the economic and population growth assumptions for the upcoming years, the global production is expected to grow from the current 254.1 million tons to 310.6 million tons in 2019/20 (Figure 7). Already taking into consideration the different competitiveness levels amongst the producing countries, we believe that the United States, Brazil and Argentina will continue to be, in the horizon of this analysis, the three major global soybean producers, with, however, different shares over time (CÉLERES, 2010).

With Brazil in second place in the global soybean production ranking, we will also have, during the next decade, a greater need for areas to meet such demand. Thus, the area harvested with soybeans is expected to increase from the current 23.0 million hectares (2009/10) to 32.1 million hectares in 2019/20. In this same period, we believe that the adoption of GM soybeans will leap from the current 16.4 million hectares observed in the 2009/10 harvest to 30.4 million hectares in the 2019/20 harvest.

FIGURE 6:

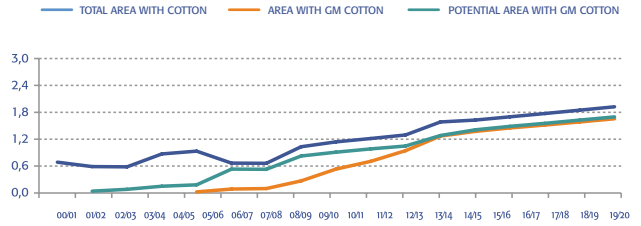
Global production of cotton



Source: USDA/CÉLERES
Figures in million t

FIGURE 7:

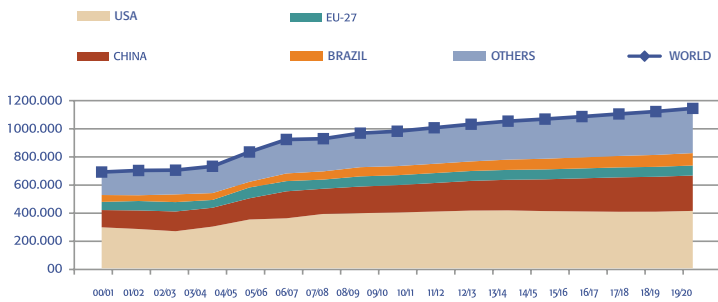
Area with cotton in Brazil



Source: CÉLERES®
Figures in million ha

FIGURE 8:

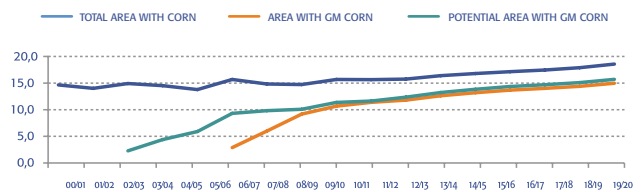
Global production of corn



Source: USDA/CÉLERES
Figures in million t

FIGURE 9:

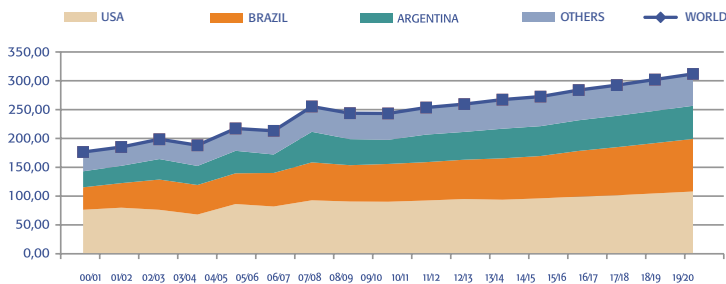
Area with corn in Brazil



Source: CÉLERES®
Figures in million ha

FIGURE 10:

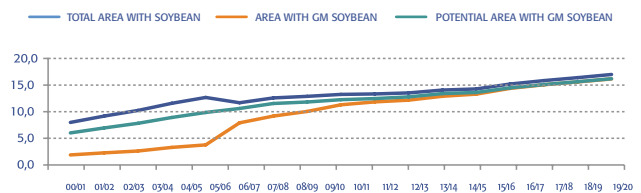
Global production of soybeans



Source: USDA/CÉLERES
Figures in million t

FIGURE 11:

Area with soybeans in Brazil



Source: CÉLERES®
Figures in million ha

Estimated commercial benefits of biotechnology in Brazil: 2010/11 x 2019/20

Given the favorable situation in the last decade, to the next, it is important to analyze the size of the commercial benefits to be achieved, before the arrival of new GM technologies, in order to facilitate and simplify the management of the farmers in the fields, in addition to promoting the commercial development of agriculture in the country.

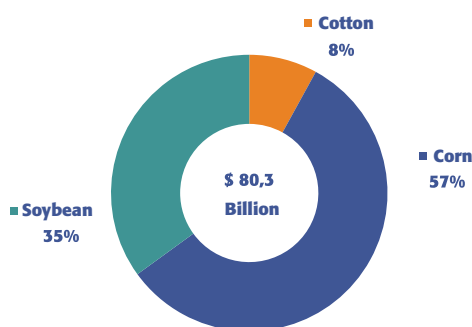
With the forecast of new technologies being released, greater adoption of technology by farmers and improvement of current technologies, the total benefit over the next decade could reach US\$ 80.3 billion.

From the commercial benefit generated, corn will surpass soybeans with a larger participation, 57% versus 35% for soybeans. This can be explained by the rapid adoption that corn had in previous years and this will continue to be a trend in subsequent years. Furthermore, the benefit is more evident in corn, due to lower costs and higher production when compared to cotton and soybeans. Another important factor worthy of note is that the industry is conducting research of new events. There is a greater concentration of research in corn in relation to other crops, which favors its greater participation in the overall benefit. Cotton will continue to participate less, around 8%, due to its smaller area compared to the other crops.

Another important aspect in the analysis of commercial benefits is in specifying which benefit has the largest participation in the sum of the US\$ 80.3 billion for the next decade. In the previous decade, 52% of the commercial benefit was created by reducing production costs. As for the next decade, the production surplus will exceed the cost savings and will hold 64% of that amount, due to the fact that the new events are being developed with a greater focus on increasing productivity and not just in reduction of production costs, which will have the participation of 19% of the total benefits. For these percentages, it appears that farmers will get 83% of benefits, while the remainder will go to holders of biotechnology (industry), or 17% of the total.

FIGURE 12:

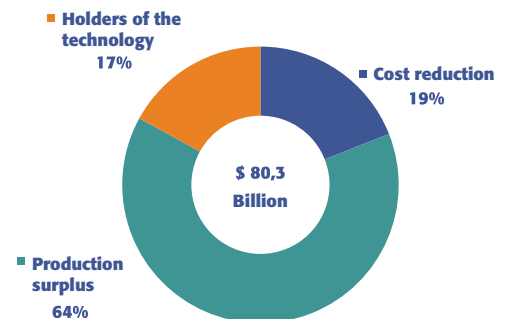
Commercial benefits of biotechnology in Brazil: 2010/11 to 2019/20, by crop



Source: CÉLERES® (2011)

FIGURE 13:

Commercial benefits of biotechnology in Brazil: 2010/11 to 2019/20, by benefit



Source: CÉLERES® (2011)

With the “production surplus” in the participation leadership in the direct commercial benefits, it should also be highlighted that indirect benefits were captured along with the value chain of the animal feed and human food industries, as mentioned in the analysis of the past decade, such as the supplies of the animal feedstock industry, keeping the price of raw materials stable, favoring also the production of meats. That is, greater benefits to the end consumer in the wholesale and retail markets.

So, with all the commercial benefits generated by the adoption of biotechnology in the next ten years, Brazil will remain in a prominent position in relation to the development of biotechnology, being more competitive in international markets, in addition to relieving the serious situation of food shortage in the world, ensuring also the supply of food and biofuels for the world population.

The potential commercial impact for not adopting biotechnology

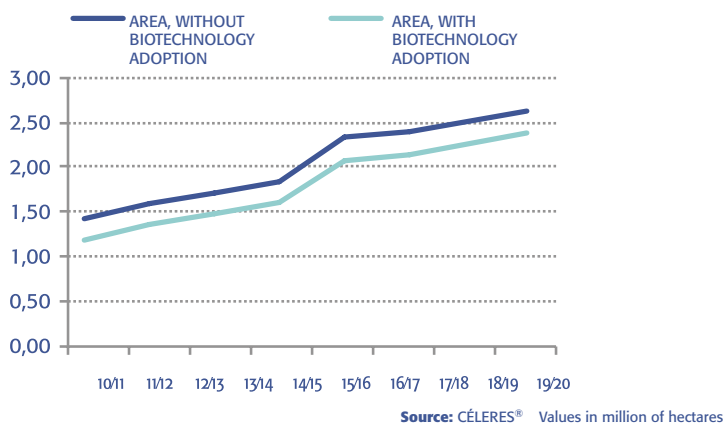
At the beginning of this summary, comments were made in respect of losses incurred by the tardiness and delays in the adoption of biotechnology in Brazil since the mid-1990s, when the potential loss was estimated to be fivefold higher than the total benefits.

In a scenario of non-adoption of biotechnology in Brazil, also for the next decade, the effort for expanding the areas under cultivation is expected to reach 49.5 million hectares (40.2 million for corn, 1.92 million for cotton, and 7.4 million for soybeans).

With the forecast of biotechnology adoption for cotton, between 2010/11 and 2019/20, 19.1 million hectares will be sown with the crop. As was the case in other countries, the improvement on the use of biotechnology in cotton allows for a potential leverage of the productivity growth curve of the product, leading consequently to a reduced need for planted area over time, as shown in Figure 14.

FIGURE 14:

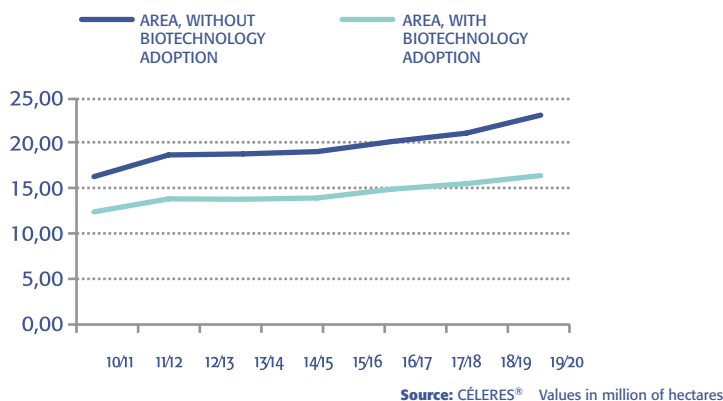
Growth pattern of the cotton area 2010/11 to 2019/20



Under the same perspective, in the case of corn between 2010/11 and 2019/20, 149.2 million hectares will be planted with corn during such period, assuming the rates of adoption of biotechnology under Figure 6. However, the non-adoption of GM corn would lead to a need of 189.3 million hectares, accumulated in the period, or about 26% more than what would be required, considering the use of biotechnology (Figure 15).

FIGURE 15:

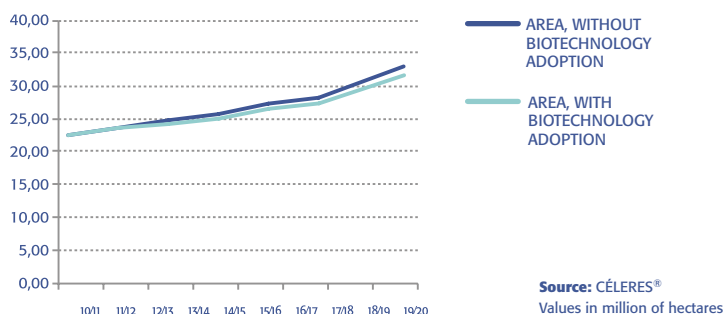
Growth pattern of the corn area 2010/11 to 2019/20



In the case of soybeans, in the period from 2010/11 (already considering the release of the RI / TH soybeans) to 2019/20, 273.0 million hectares should be planted with soybeans, assuming the adoption rates shown under Figure 16. However, non-GM soybean adoption would lead to an additional need of 280.4 million hectares (or 2.7%), accumulated in the period.

FIGURE 16:

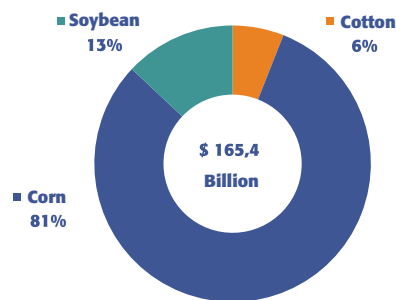
Growth pattern of the soybeans area 2010/11 to 2019/20



As a result of additional areas to be sown in a scenario without biotechnology, the financial amount necessary to cultivate such an area would be of \$ 165.4 billion over the next decade, considering not only the production cost of those hectares, but also additional investments in machinery, equipment, and needed agricultural infrastructure.

FIGURE 17:

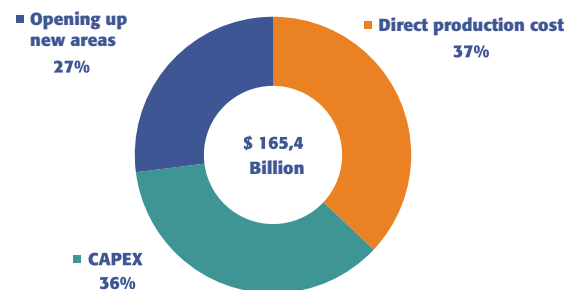
Estimated costs for not adopting biotechnology: 2010/11 to 2019/20, by crop



Also taken into consideration are the expenditures necessary for opening up new areas, both virgin and pasture areas that would necessarily have to be converted into farmland as a way of maintaining the supply and demand ratio balance for the crops considered herein.

FIGURE 18:

Estimated costs of not adopting biotechnology: 2010/11 to 2019/20, by cost item



Another important aspect, but not considered in this analysis is the commercial value of the environmental asset, in this case, the clearing of virgin land and the additional use of natural resources such as water, soil and fossil fuels required for the cultivation of additional hectares that would be needed.

Therefore, it is concluded that the cost of not adopting biotechnology - measured as opportunity cost - turns out to be substantially higher than the actual benefit from its use.

Assumptions used in the calculation of additional cost	
Item	US\$/hectare
Direct cost of production ^{1/}	\$ 1.289,9
CAPEX ^{2/}	\$ 1.151,9
Opening of new areas ^{3/}	\$ 908,6

^{1/}Considering the cost of production for a hectare of soybeans in the condition of Western Bahia

^{2/}Investment in machinery and equipment for the condition of Western Bahia

^{3/} Investment pattern for the opening of a hectare of virgin savannah in the condition of Western Bahia

Source: CÉLERES®

Final considerations

The analysis of prior performance shows that over the past fourteen years, the adoption of agricultural biotechnology has brought significant gains, both direct and indirect, for farmers, holders of the technology and consumers in general. It is also clear that in the case of biotechnology, the cost of its non-adoption - measured as opportunity cost - turns out to be substantially higher than the actual benefit from its use.

In 2010, the pace of approvals of biotech events enabled a major advance in the availability of these technologies for Brazilian producers of cotton, corn and soybeans. This places Brazil on an equal technology level with its major international competitors. To the extent that as such events, having been now approved, gradually reach the Brazilian fields, the level of commercial benefits from the adoption of biotechnology are expected to grow as a result of improved efficiency and adaptability of these technologies to the needs of Brazilian farmers.

Accordingly, we affirm that the level of expected commercial benefits in this study is somewhat conservative, given the intrinsic potential of earnings derived from such technologies. And especially if one considers the deployment of such benefits across the supply chain of grains, oilseeds and fibers, which ultimately benefits the local and the international food consumer.

This concern becomes more apparent at a time when the world is again alarmed with the fear of food crises caused by food shortages in the global market. In several recent reports of organizations like the United Nations for Food and

Agriculture - FAO, IMF, among others, there were warnings on the risks related to the framework of supply and demand of food that has been established and its implications on the commercial and political stability of several food consumer countries.

Thus, global markets cannot afford to give up on technologies such as agricultural biotechnology, which will enable the acceleration of productivity gains from agricultural crops.

And in this context of increasing need for food and fiber, we highlight here as in previous editions of this study, the importance of the improvement, implementation and continuous monitoring of public policies that ensure an institutional environment conducive to the development of biotechnology in Brazil as a way of contributing to maintain the competitiveness level of the domestic agricultural production, as the world is currently suffering from lack of food and Brazil can play a vital role for mitigating the food shortages and be an important player in this high demand for food scenario, being a major food producer, particularly of soybeans and corn.

Therefore, agricultural biotechnology has the potential of playing a key role in this context, and as seen previously, the new technologies to be approved over the next decade are to focus on the increase in productivity.