The commercial benefits from crop biotechnology in Brazil: 1996/97 – 2011/12

The case of GM cotton

The case of GM corn

The case of herbicide-tolerant soybeans

Introduction

This document aims at commenting on the main results from the study on the "Commercial benefits from the adoption of biotechnology: 1996/97 – 2011/12"[1/] conducted by Céleres[2/] in the second semester of 2012. This document focuses on analyzing the results of the general commercial benefits obtained from the adoption of GM cotton, GM corn, and herbicide-tolerant soybeans.

[1/] The full report with the study on the "Commercial benefits from the adoption of biotechnology: 1996/97 – 2011/12" 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 from biotechnology in Brazil: 1996/97 to 2011/12

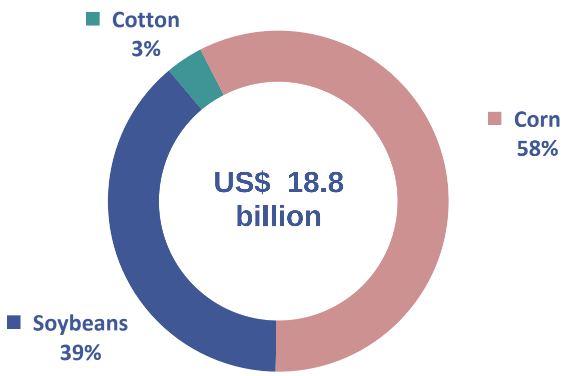
For the sixth consecutive year, Céleres® has studied the commercial benefits captured by farmers and the technology industry from adopting crop biotechnology for cotton, corn, and soybeans, carrying out field studies, which include annual trips to these crops' major producing regions, gathering relevant data with farmers, and users of GM technologies provided by the industry holding the technologies and having been approved by the Brazilian National Technical Biosafety Committee (CNTBio).

Based on these research studies, in the sixteenth year since the inception of crop biotechnology in Brazil, it is estimated that the commercial benefits captured by the farmers who use this technology and by the industry that holds it have accumulated, since 1996/97, to the total sum of US$ 18.8 billion.

Although corn was one of the last GM crops to be adopted in 2008/09, it has been the leading crop in terms of commercial benefits for the second year, accounting for 58% of the total benefits, in comparison to 49% in the 2010/11 crop year and 32% in 2009/10, which shows how important this grain is for Brazilian crop biotechnology. Soybeans accounts for 39% of the total, which shows its importance has diminished, as in 2010/11 it represented 47% of the total, and in 2009/10, 65%. Cotton, which has adopted biotechnology since 2004/05, accounts for 3% of the total benefits, as its cropped area is much smaller than that for soybeans and corn.

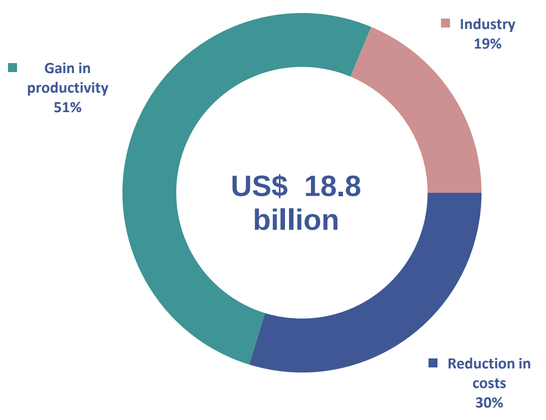
Another important aspect of the analysis of the commercial benefits from the adoption of biotechnology in Brazil lies in the fact that the gains in productivity were the major benefit generating factor, more important than the drop in production costs, since the last harvest. Thus, out of the US $18.8 billion generated as benefits, 51% of the benefits was generated through gains in productivity, as opposed to 44% in the previous year and 27% in 2009/10, mainly boosted by GM corn. Cost reduction accounts for 30% of the total benefit, well below the 37% recorded in the previous crop year, and 52% of the total, recorded in the 2009/10 survey.

Figure 1. Commercial benefits from biotechnology in Brazil: 1996/97 to 2011/12, by crop.



Source: CÉLERES® (2012)

Figure 2. Commercial benefits from biotechnology in Brazil: 1996/97 to 2011/12, by benefit.



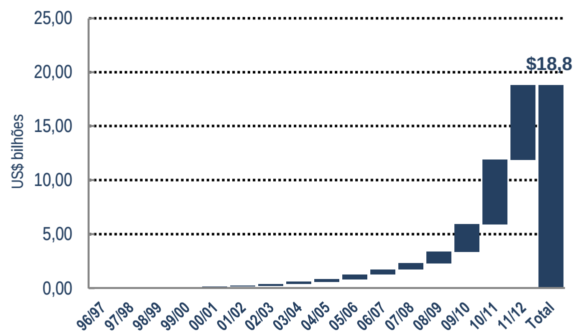
Source: CÉLERES® (2012)

The farmers directly captured both of these benefits, which translates then into the fact that the farmers captured a total of 81% of the direct commercial benefits generated in the period under consideration. The industry (holders of the technology), also an important part in the development of biotechnology, captured the remaining benefits, i.e. 19% of the total commercial benefits.

The "production surplus" benefit, considered as being a direct benefit captured by the farmers, deserves special attention, since it can also be translated into indirect benefits captured throughout the value chain of the feed and food industries, to the extent that such surplus ensures the supply to the animal 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 end consumer as he purchases in the retail markets.

Upon analyzing Figure 3, it is possible to observe that there has been an upturn in the accrued commercial benefits as a result of biotechnology adoption, since 1996/97, when soybeans were first planted in Rio Grande do Sul. The last three harvests were significant in terms of the accrued commercial benefits from the cultivation of GM crops, particularly boosted by GM corn. The 11/12 harvest generated accrued benefits of US$ 6.9 billion, i.e., 36.7% of the total benefits accrued over the last 16 crop years.

Figure 3. Accrued commercial benefits from biotechnology in Brazil: 1996/97 to 2011/12.



The size of the opportunity cost incurred as a result of not adopting biotechnology ought to be carefully examined, with the engagement in discussions and debates on the actual benefits from this technology. 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 soybean growers, in the period from 1996/97 to 2011/12, would be an impressive figure of US$ 47.6 billion, or nearly threefold the total benefits actually earned. The difference between the potential and actual benefits of US$28.75 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 sixteen years, the adoption of crop biotechnology brought about expressive direct and indirect earnings to 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 benefits per se resulting from its use.

Therefore, in terms of the opportunity cost, the tardiness and delays in releasing GM technologies in Brazil, have cost to date, US$ 28.75 billion, which represents the difference between the actual and potential benefits, although other intangible costs, such as wellbeing, convenience, practicality, ease in management and less time spent in crop production also have, each, their commercial value.

Thus, it is worth highlighting how important the improvement and consistent follow-up of public policies are, since they ensure a favorable institutional environment for developing biotechnology in Brazil. They also create more efficient protocols for the commercial release of biotech products, which are already been in place, modeling those adopted by Brazil's competitors, such as the U.S., for example. These protocols are created by CTNBio, the Brazilian National Technical Commission on Biosafety, which has some of the strictest standards in the world for conducting pre-market safety assessments of GM crops.

Thus, such factors 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, conferring crop biotechnology the potential to exert a vital role in ensuring food supply, which is already scarce in the world, in addition to biofuels for a growing global population, in numbers and in purchasing power.

Growth predicted in crop production (2012/13 – 2021/22)

The current global population growth assumptions, together with increased incomes, particularly in the developing countries, produce challenging situations for farmers across 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 9.3 billion inhabitants, nearly two billion more than what we have today. Currently, there are over 1 billion people starving in the world, particularly which implies directly in a much greater demand for food, as is observed today. In recent years, over one billion people have been starving in the world, particularly in the African and East Asian countries, aggravated by the constant domestic conflicts in these regions.

Based on the economic and population growth assumptions for the upcoming years, the global cotton production is expected to grow 11.5% over the next decade, surpassing 25.2 million tons in 2012/13 to 28.1 million tons in 2021/22. Within this horizon, China, India, and the United States will still be the key players in cotton production, together with Brazil, having a great potential of increasing its share in the total volume produced, and in need of more favorable circumstances to become more competitive. Forecasts indicate that Brazil will grow 106.8%, leaping from 1.65 to 3.41 million tons, in the period at stake (CÉLERES, 2012).

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 of land to meet such demand, even with the increase in Brazilian cotton productivity. With the new genetically modified technologies already having been approved, and those that are yet to come, the total Brazilian cotton growing areas are projected to expand from 1.09 million hectares, in 2012/13, to 2.06 million hectares for 2021/22, i.e. a rise of 89.2%. In this same period, our projections indicate that the adoption of GM cotton will surpass 546.5 thousand hectares, as recorded for the 2012/13 crop year to 1.79 million hectares for the 2021/22 crop year.

Based on the economic and population growth assumptions for the upcoming years, projections indicate that the global corn production will grow 21.5%, boosted particularly by the demand from emerging economies, besides its traditional use in developed countries (Figure 5). As the countries across the world differ in degrees of competitiveness between each other, the United States, China, EU-27, Brazil and Argentina are expected to continue, within the horizon of this analysis, to be the world's major corn producers (CÉLERES, 2012).

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 of land to satisfy 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, as seen in this current crop year.

Thus, projections indicate that the total corn cropped areas in Brazil, in 2021/22 will be of 19.1 million hectares, out of which the actual land areas for GM corn are expected to reach 15.4 million hectares, or 80.8% (Figure 7). 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 (CÉLERES, 2012).

Finally, for the soybean crop, based on the economic and population growth assumptions for the upcoming years, the global production is expected to reach, in 2021/22, 324.7 million tons, with Brazil taking over the leading position from the U.S., with 108 million tons, in comparison to 86 million tons of American soybeans. Argentina continues ranking third, still lagging a good ways behind the first two, with 78.6 million tons. (Figure 6). Among the first three leading producers, the highest annual growth rate in the period from 2012/13 to 2021/22 is expected to come from Argentina, with 3.8% per year, followed by Brazil, with 3.0% per year. The annual global growth rate is expected to be 2.3% per year. Production is expected to undergo satisfactory growth with the help of the biotech crops, particularly through new products being launched in the market, which also aim at improving the quality of the existing crops, such as oil, besides high productivity rates based on GM technology.

With Brazil having become the leading global soybean producer, we also will have, over the upcoming decade, a greater need for land to meet such demand. Thus, the Brazilian cropped area should reach 33.4 million hectares in 2021/22, of which GM soybeans should actually occupy 31.7 million hectares, or 94.9% of the total (CÉLERES, 2012).

Figure 4. Global cotton production

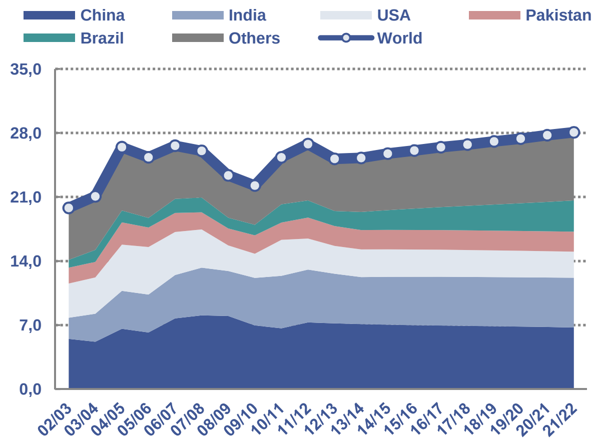


Figure 6. Global production of corn

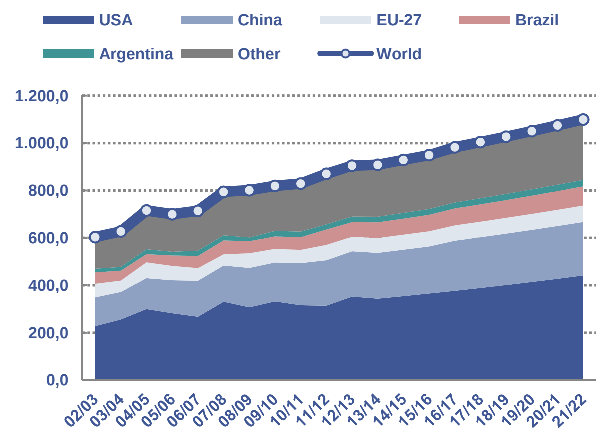
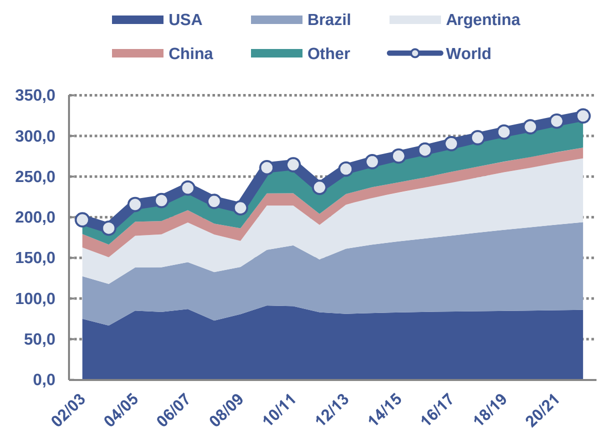


Figure 7. Global production of soybeans



Source: CÉLERES® Totals in million t

Figure 5. Cotton-growing areas in Brazil

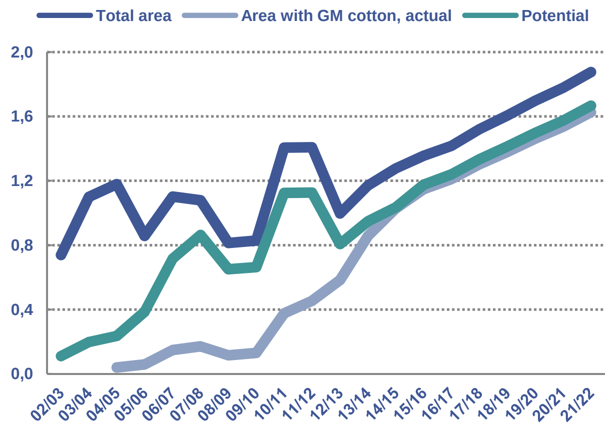


Figure 8. Corn-growing areas in Brazil

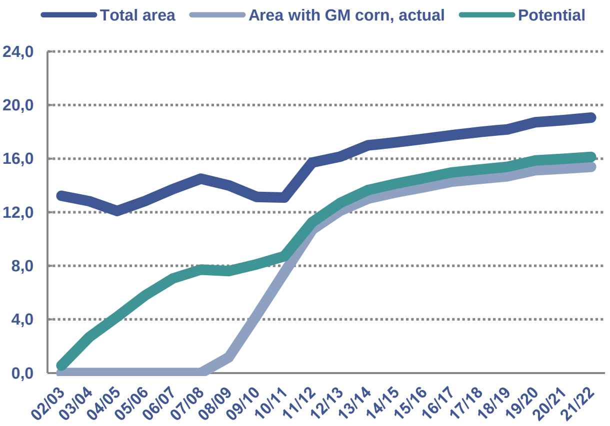
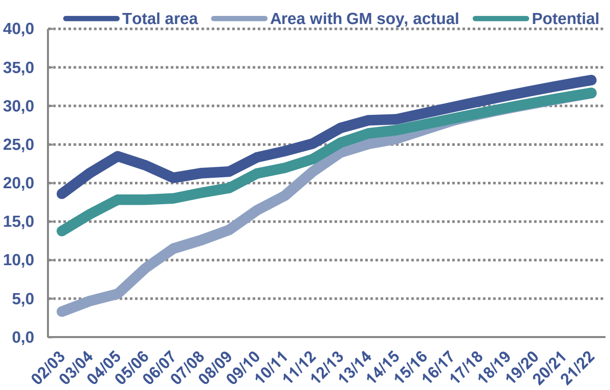


Figure 9. Soy-growing areas in Brazil



Source: CÉLERES® Totals in million hectares

Estimated commercial benefits from biotechnology in Brazil: 2012/13 x 2021/22

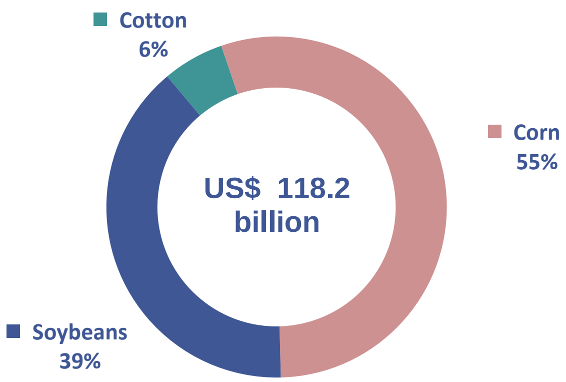
Given the favorable circumstances from the last decade to the following one, it is important to analyze the values of the commercial benefits to be achieved before the arrival of new GM technologies, in order to facilitate and simplify the management of the farmers in the fields, in addition to promoting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

With the forecast of new technologies being released, increased adoption of technology by farmers and the improvement of current technologies, the total benefit over the next decade could reach US$ 118.2 billion.

From the commercial benefit generated, corn will account for 55%, a slight downturn in comparison to the last decade. Soybeans will continue to keep their share at 39% of the total, even with the adoption of IR/HT soybeans, for which the Brazilian soybean growers have been waiting for so long. The rise in the corn participation can be explained by the rapid adoption that this grain experienced in previous years. The greatest benefit is more evident in corn, due exactly to the lower costs and higher production when compared to cotton and soybeans. Another noteworthy and important factor is that the industry is conducting research studies on new events. There is a greater concentration of research studies on corn in relation to other crops, which favors its greater share in the total benefit. Cotton will continue having a smaller market share, around 6%, due to its smaller land area in comparison to the other crops.

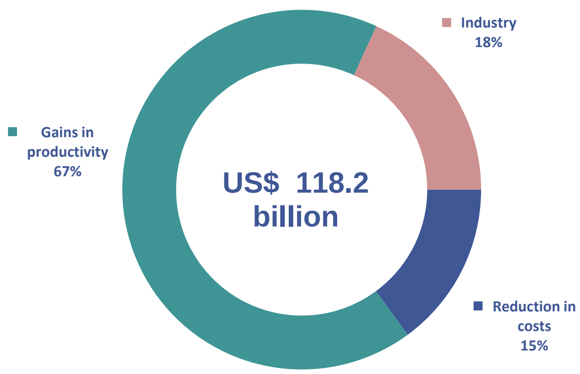
Another important aspect in the commercial benefits analysis is in specifying which benefit has the largest participation in the total of US$ 118.2 billion for the next decade. In the previous decade, 30% of the commercial benefits was created by reducing production costs, already losing participation to gains in productivity (production surplus), which were at 51%. As for the next decade, the gains in productivity (production surplus) will increase the participation in the total sum, having 67% of it, since the new events are being developed with a greater focus in increasing productivity, and not just in reducing production costs, which is expected to have a participation of 15% in the total benefits. From these percentages, it can be concluded that farmers will get 82% of the benefits generated, while the remainder will go to the holders of biotechnology (industry), i.e. 18% of the total, as compared to 19% in the prior decade.

Figure 10. Commercial benefits from biotechnology in Brazil: 2012/13 to 2021/22, by crop



Source: CÉLERES® (2012)

Figure 11. Commercial benefits from biotechnology in Brazil: 2012/13 to 2021/22, by benefit



Source: CÉLERES® (2012)

With "gains in productivity" being the leader in the direct commercial benefits participation, it should also be highlighted that indirect benefits were earned along the value chain of the animal feed and human food industries, as mentioned in the analysis on the past decade, such as the supplies to the animal feed industry, keeping the price of raw materials stable, which also benefited the production of meats. That is, greater benefits were handed down to the end consumer in the wholesale and retail markets.

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

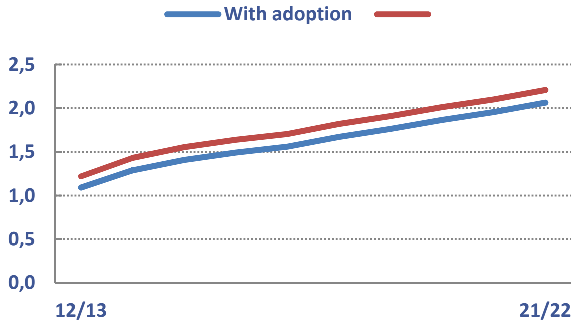
The potential commercial impact from not adopting biotechnology

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

Assuming there is a biotech non-adoption scenario in Brazil, also for the next decade, it is believed that the effort for expanding the area under cultivation will reach 53.1 million hectares (41.4 million for corn, 10.3 million for soybeans, and 1.4 million for cotton) over the coming decade.

With the forecast of biotechnology adoption for cotton, between 2012/13 and 2021/22, 16.2 million hectares will be sown with the crop. As was the case with other countries, the enhanced use of biotechnology in cotton may allow for a leverage of the productivity growth curve of the product, leading consequently, to a reduced need for cropped area over time, as shown in Figure 11.

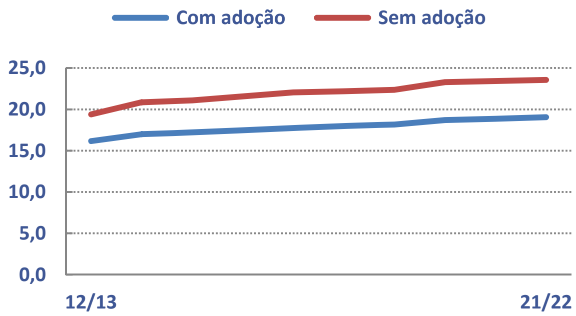
Figure 12. Growth pattern of the cotton-growing areas. 2012/13 to 2021/22.



Source: CÉLERES® Totals in million hectares

Under the same perspective, in the case of corn, between 2012/13 and 2021/22, 178.4 million hectares are expected to be planted with corn, assuming the biotechnology adoption rates under Figure 7. However, the non-adoption of GM corn would lead to a need of 219.8 million hectares, accrued in the period, or about 13.2% more than what would be required, assuming the use of biotechnology (Figure 12).

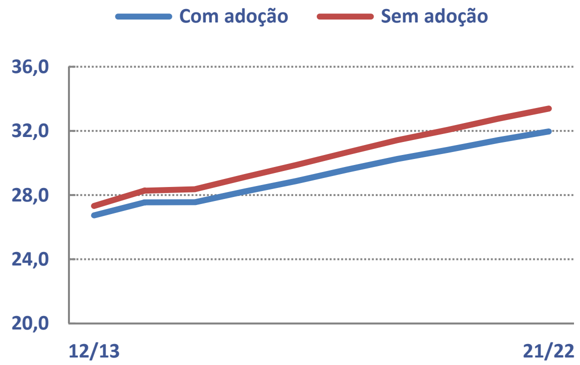
Figure 13. Growth pattern of the corn-growing areas. 2012/13 to 2021/22.



Source: CÉLERES® Totals in million hectares

In the case of soybeans, in the period from 2012/13 (considering the introduction of the IR/HT soybeans in 2012/13, which became effective since 2013/14) until 2021/22, 293.0 million hectares are expected to be harvested with soybeans, assuming the adoption rates shown in Figure 13. However, not adopting GM soybeans would lead to the need of 303.3 million additional hectares, over this period.

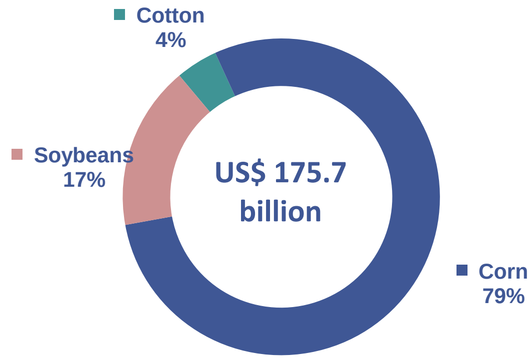
Figure 14. Growth pattern of the soy-growing areas. 2012/13 to 2021/22.



Source: CÉLERES® Totals in million hectares

As a result of additional areas to be sown in a scenario without biotechnology, the financial resources needed to cultivate such land areas would be US$175.7 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.

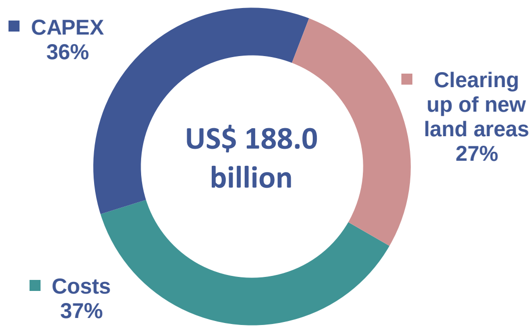
Figure 15. Estimated costs from not adopting biotechnology: 2012/13 to 2021/22, by crop



Source: CÉLERES® based on own research

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

Figure 16. Estimated costs from not adopting biotechnology: 2012/13 to 2021/22, by cost item.



Source: CÉLERES® based on own research

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

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

Assumptions used in the calculation of additional cost	
Item	U$/hectare
Direct production cost [1]	$ 4,201
CAPEX [2/]	$ 3,330
Clearing up of new land areas [3/]	$ 909

[1/] Considering the production cost for one hectare of soybeans, corn, and cotton under Western Bahia's conditions
[2/] Investment in machinery and equipment under Western Bahia's conditions
[3/] Investment pattern for the opening up of one hectare of native savannah under Western Bahia's conditions
Source: CÉLERES®

Final considerations

The analysis of prior results shows that, in general, over the past 16 years, the adoption of crop biotechnology has brought about both direct and indirect significant and notable gains for farmers, holders of the technology, and the end consumer. No doubt, also 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 resulting from its use.

In the 2011/12 crop year, the pace of approvals did not bring about many new biotech events, but some of the constructs that had already been approved in the previous years were substantially introduced in the market, particularly in the case of corn and cotton. It is important to highlight the fact that many constructs have already been approved, but are still not available in the market. With the possible use of these biotech crops, Brazil confirms that it is on similar technology platform conditions as its major international competitors. As such events, once approved, gradually reach the Brazilian fields, this will most likely increase the level of commercial benefits from the adoption of biotechnology, as a result of their enhanced efficiency and adaptability to the needs of the Brazilian farmers. Both using biotechnology and which technology to choose are up to the farmers.

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

Nonetheless, the individual results analyzed for each crop shows a high profit level for farmers that use GM seeds. However, for cotton, due to the low prices practiced in the market, there was a negative profit margin, R$ -1.30 for every R$ 1 invested in the purchase of GM seeds. In this case, it is important to stress the fact that the international cotton prices underwent a steep downturn in the 2011/12 crop year, as a result of its abundant supply and lower demand caused by the international economic crisis.

That is, the benefits achieved through GM technology were not sufficient for the farmers to obtain an operating margin, due to the low prices paid for their products. On the other hand, for the more expressive crops, such as corn and soybeans, there was an excellent profit margin level from adopting biotechnology. For corn, already taking into consideration the weighted average of the summer and winter harvests, this margin reached R$ 3.00 for every R$ 1 invested. And for soybeans, the profit margin reached R$ 2.10 for every R$ 1 invested, as shown in figure 16.

The profit margin analysis based on the use of the technology has proven to be extremely important, at a time when the world is again alarmed with the fear of food crises caused by food shortages in the global market, also deepened by the natural disasters that took place in 2011 and 2012. In several recent reports of organizations such as the United Nations' Food and Agriculture Organization - FAO, IMF, among others, there were warnings on the risks related to the adjusted food supply and demand framework and its implications in the financial and political stability of several food consuming countries.

Figure 17. Profit margin analysis resulting from the use of GM seeds

	Soja	Milho [1/]	Algodão
Resultado na margem operacional	R$ 2,10	R$ 3,00	R$ -1,30
Investimento em sementes transgênicas	R$ 1,00	R$ 1,00	R$ 1,00

Source: CÉLERES® based on the 2011/12 field research results | 1/ Weighted profit margin, considering the weight of the areas sown in summer and winter.

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

And in this context of a greater need for food and fibers, we highlight here as in previous editions of this study, the importance of the improvement, placement 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 currently suffers from the lack of food. Brazil can play a vital role for mitigating the food shortages and be an important player in this high demand for food scenario in the next crop years, being a major food producer, particularly of soybeans and corn. This is true even more so for corn, since Brazil is responsible for meeting the world's demand for this food, and in view of the crisis generated by the worst drought experienced by the United over the last years.

Therefore, crop biotechnology has the potential of playing a key role in this context, since, as seen previously, the new technologies to be approved over the next decade are focused on increasing productivity, creating direct benefits and preventing the need to clear up new land areas, which, in turn, creates more expenditures for farmers, and raises natural resource preservation environmental issues.