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The Adoption of Transgenic Crops in Argentine Agriculture

An Open Ended Story

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The Adoption of Transgenic Crops in Argentine Agriculture: An Open Ended Story

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Executive Summary

The intensification of agricultural production in Argentina during the 1990s constitutes, without a doubt, one of the positive impacts stemming from the structural reforms and economic policies implemented at the beginning of that decade.

The elimination of taxes and withholdings on agricultural exports; the substantial reduction of import tariffs on inputs and capital goods; and the Convertibility Plan and deregulation of some markets, all created favourable macroeconomic conditions and paved the way for a large expansion of production volumes for cereals and oilseeds (from 26 million tonnes in 1988–1989 to over 67 million in 2000–2001), and particularly for soybeans, which soon became Argentina's leading export. The increase in export value occurred within a context of erratic international prices and in the face of competition with other countries which, unlike Argentina, profit from government subsidies to production and exports.

This growth in agricultural production is a result of both a substantial expansion of the planted area (basically at the expense of livestock), and an incremental increase in physical productivity per unit area, derived from a significant adoption of new technologies. By dint of such an increase in the planted area, the Pampas agricultural sector succeeded in reversing labour dismissal trends observable over the last years, and went on to generate nearly 200,000 jobs from 1993 to 1999.

The process of adopting technologies involves the procurement of capital goods, fertilizers and agrochemicals (herbicides and pesticides) as well as a momentous change in terms of genetic inputs: the introduction of transgenic crops in Argentine agriculture.

In 1996, the first transgenic crop was commercially released into the Argentine market and was a soybean tolerant to glyphosate herbicide. Later on, transgenic varieties of corn and cotton tolerant to herbicides and resistant to insects were approved.

As from its release date, the rate of expansion of glyphosate-tolerant soybean in Argentina has increased considerably, and has exhibited a growth even higher than the one in the U.S., which was the first country to introduce this kind of crop. The area planted to herbicide-tolerant soybean shot up from less than one per cent of the total area planted to soybeans, in the 1996–1997 season, to more than 90 per cent (around nine million hectares) in the 2000–2001 season.

The adoption of Lepidoptera-resistant corn has also been of significance —yet with values lower than those observed for soybeans—accounting for 20 per cent of the total cultivated area during the last farming season (third year since its introduction). The diffusion of *Bt* cotton has, in turn, been very limited, amounting to 7–8.5 per cent of the total planted area. At present, Argentina ranks second, only to the U.S., in terms of agricultural surface cultivated with transgenic crops and is therefore a major player in the international arena.
Regarding the environmental impact of the sharp increase of Argentine agricultural production during the last decade, the main issue to be considered is the fact that this expansion has taken

place hand in hand with the outstanding increase of no-till (NT) practices, as the main farming management strategy for the Pampas crops.[1]

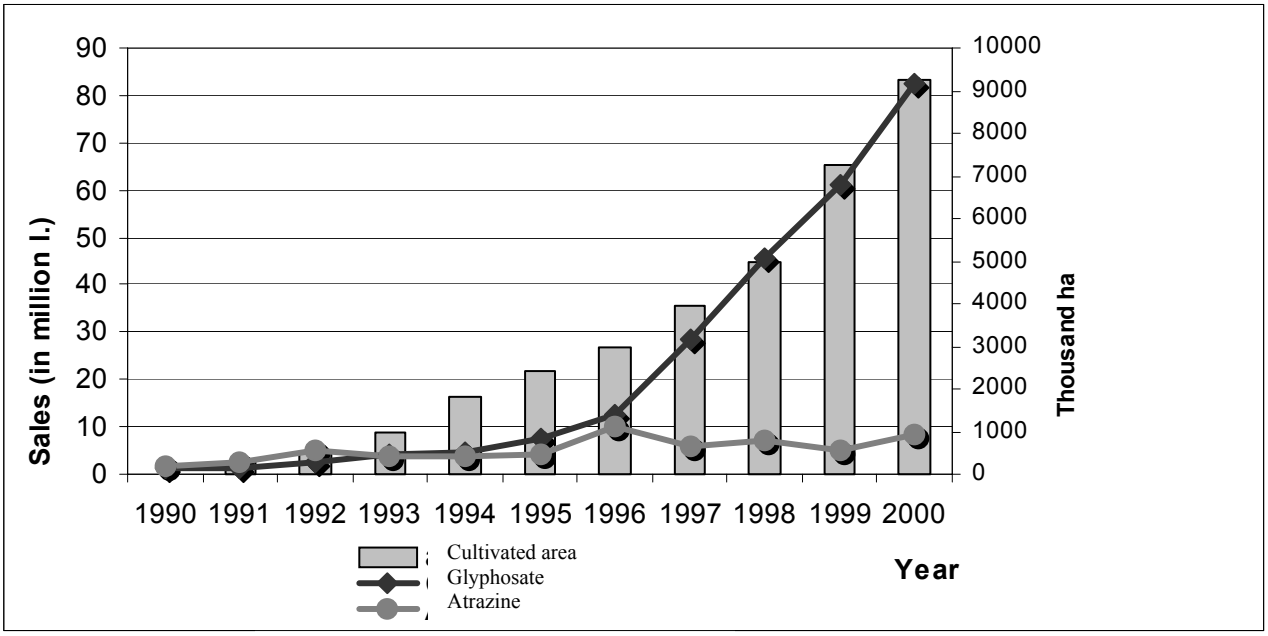
The use of the no-till planting system rose from approximately 300,000 hectares in the 1990–1991 period to over nine million hectares in the 2000–2001 season. This technology constituted an important factor in the expansion of production, as it promoted the increase of the area cultivated with late planted soybean (planted after the wheat harvest) to new production areas. During the 1999–2000 season, for example, this was translated into a virtual increment of three million hectares of arable land.

However, the most important aspect of the widespread adoption of no-till techniques, coupled with the introduction of transgenic soybean, is the "virtuous intensification" or "environmentally friendly" nature it has bestowed upon the process of technological change.

The combination of no-till planting techniques with herbicide-tolerant soybean joins two technological concepts: new mechanical technologies that modify crop interaction with the soil and the utilization of general-use, full range herbicides (with glyphosate in first place), which are environmentally neutral, due to their high effectiveness in controlling any kind of weed as well as their lack of residual effect. Both factors imply a more intense use of inputs. However, as pointed out in Chapter III (Figure III-6) and Chapter V (Table V-1), this intensification is, at the same time, deemed "virtuous," because it has simultaneously lowered the consumption of herbicides with the highest toxicity level.

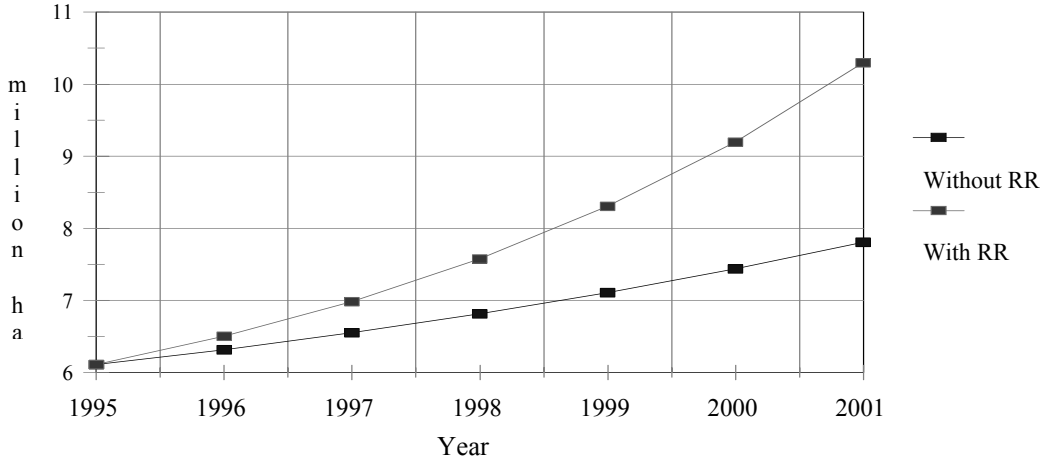
[1] The no-till planting system consists basically of laying the seed in the ground at the required depth with a minimal disturbance of the soil structure. This is done through specially designed machinery that eliminates the need for plowing and minimizes the tillage required for planting a crop.

Figure III-6: Evolution of no-till techniques and composition of the type of herbicides used in Argentine agriculture



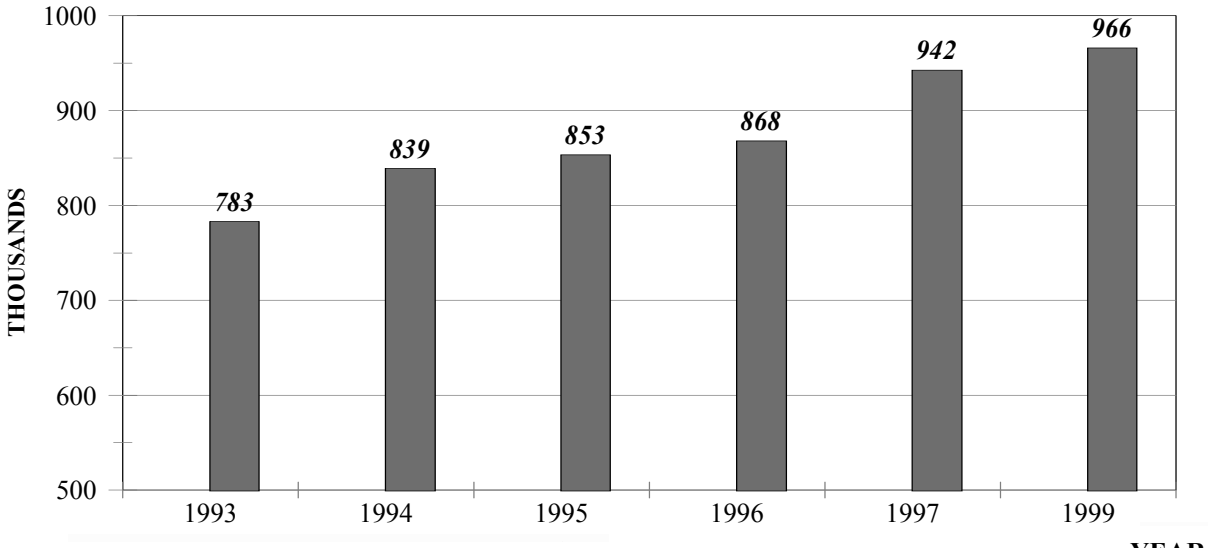
Source: Prepared by the authors based on data supplied by the Cámara de Sanidad Agropecuaria Y Fertilizantes (CASAFE) and the Asociación Argentina de Productores en Siembra Directa (AAPRESID). (http://www.casafe.org y http://www.aapresid.org.ar)

Table V 1: Argentine: Evolution of soybean area (in two alternative scenarios)



Source: Prepared by the authors. "Without RR" technology figures are based on data provided by the Secretaría de Agricultura, Ganadería, Pesca y Alimentación (SAGPyA) - http://www.sagpya.mecon.gov.ar. "With RR" technology figures were simulated with Sigma V 2.02.

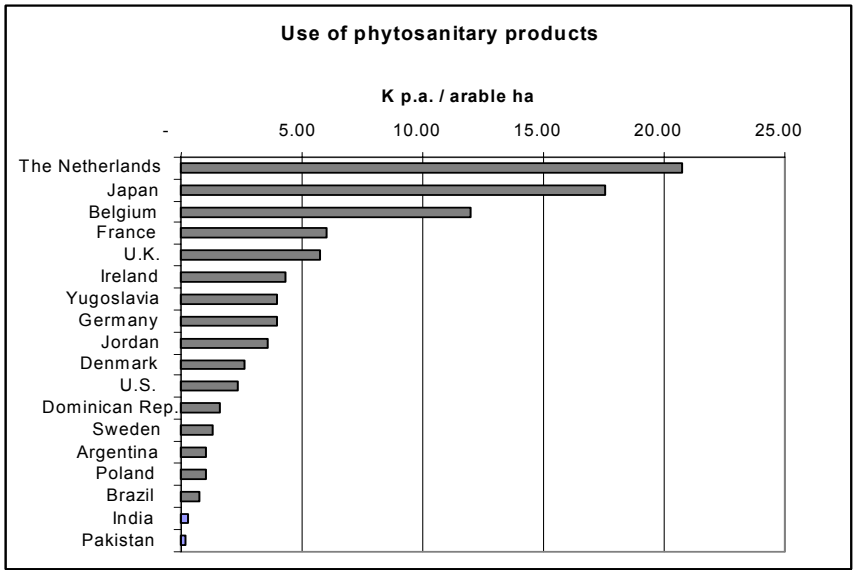
Figure III-11: Evolution of the employment in the agricultural sector (1993–1999)



Source: Prepared by the authors based on data supplied by the Instituto de Estudios Económicos sobre la Realidad Argentina y Latinoamericana (IERAL: http://www.ieral.org), Instituto Nacional de Estadística y Censos y Cuentas Nacionales (INDEC: http://www.indec.mecon.gov.ar)

It is worth noting that, even after the increase in the use of agrochemicals throughout the period, the total use per hectare of arable land was still far below the one recorded in other countries (see Figure III-7). Furthermore, the utilization of agrochemicals appears to have stabilized after the 1996–1997 season.

Figure III-7: Use of phyto-sanitary products in selected countries - Year 1998



Source: Instituto de Investigaciones Económico-Financieras y del Mercado de Capitales. Bolsa de Comercio de Córdoba - http://www.bolsadecordoba.com.ar. Based on data supplied by CASAFE, Cámara de Sanidad Agropecuaria y Fertilizantes - http://www.casafe.org

If we also consider the favourable externalities generated through the progressive recovery of soil fertility along with other potential impacts—such as benefits on the greenhouse effect reaped from this type of practices, there is no doubt that the overall environmental impact of these transformations has been positive.

From this perspective, Argentina would fit into a win-win model in which commercial release facilitates the expansion of agricultural production at the same time that it fosters the adoption of environmentally-friendly technologies developed abroad. Therefore, this technological package seems to have produced positive effects from the social point of view as well, for it has encouraged a dramatic increase in jobs derived from the agricultural sector (see Figure III-11). Moreover, the significance of this effect is reinforced by the fact that it took place simultaneously with an increase in labour productivity within the sector, and during a period in which the rise in unemployment rate constituted one of Argentina's thorniest social problems.

In fact, Argentina enjoyed favourable conditions for a rapid adoption of GMOs. The Argentine seed industry profited from the active participation of national companies and subsidiaries of multinational corporations as well as public institutions; and, to top it off, the country also cherished a long-standing tradition in the field of germplasm improvement. At the same time, momentous institutional decisions were made, particularly with regard to biosafety regulations—the creation of the CONABIA, in 1991, being one of the most important ones.

The fact that Argentina constitutes a major area, amounting to 26 million ha. of cultivable land, for the potential use of new technologies outside their country of origin, combined with the aforementioned elements, provided the proper incentives and a most suitable "landing field" for the rapid adoption of these biotechnological inputs.

By contrast, public (and private) resources allocated to research and development in Argentine agriculture—especially in the area of biotechnology—are scarce compared to corresponding efforts at the international level. Beyond their meaningful contribution to R&D activities on some crops (such as alfalfa) and into the sphere of veterinary science, institutes devoted to agricultural biotechnology research in Argentina have hardly participated in the events approved by the CONABIA. As it is shown in Table IV-3, it has been multinational companies who in Argentina—as well as in many other countries—have taken the lead in the process of releasing new technologies into the environment. However, it is important to bear in mind that, so far, only RR soybean stands out as an exceptional case in the diffusion of GMOs.

Table IV-3: Permits for the release of GMOs into the environment by type of organization

	1991/93	1994	1995	1996	1997	1998	1999	2000	2001	Total
Transnational corporations	11	17	26	28	62	65	70	52	49	**380**
Local companies	8	4	6	6	12	12	10	10	4	**72**
Government agencies	2	-	4	6	4	13	1	-	8	**38**
Universities	-	-	-	-	-	-	-	3	2	**5**
Total	**21**	**21**	**36**	**40**	**78**	**90**	**81**	**65**	**63**	**495**

Source: prepared by the authors based on data obtained from the Comisión Nacional Asesora de Biotecnología Agropecuaria CONABIA (http://www.sagpya.mecon.gov.ar/0-0/index/programas/conabia)

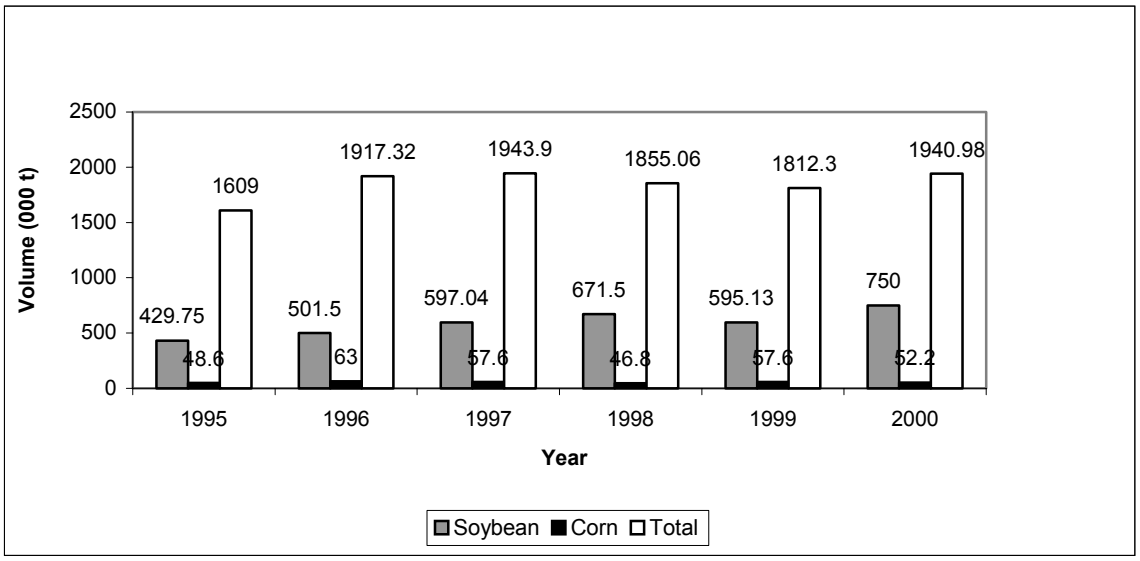
The massive adoption of the RR soybean can be accounted for by the reduction in production costs (regardless of the size of the crop farm) and, above all, by the expansion of cultivable area brought about by the RR soybean.

These elements are not unique to the Argentine case. What does draw a distinction in this specific case, however, is the instrumental role played by certain idiosyncratic institutional factors in the rapid and effective expansion of RR soybean. The first factor refers to the manner in which the RR gene was first transferred to Argentina. Originally, access to the RR gene was achieved through negotiations between Asgrow and Monsanto in the U.S., whereby Asgrow Argentina was granted the use of the gene in its registered varieties. Later on, when Nidera acquired Asgrow Argentina, it gained access to the gene and widely disseminated it in Argentina. Consequently, when Monsanto tried to patent the gene in Argentina, it was unable to do so because it had already been "released." However, through private settlements that expressly identify the ownership over this patent and stipulate the royalties to be paid, Monsanto was able to license the RR gene to other companies that commercialize it in Argentina. Therefore, conditions were never met for the breeder company (i.e., Monsanto) to be entitled neither to charge the technology fee nor to restrict the use of the seed by farmers, as is the case in the U.S.

The second factor is related to the operational aspects of the seed market and its effect on the price of RR soybean. On the one hand, under the UPOV Convention of 1978, farmers can legitimately keep seeds for their own use; on the other hand, there are clandestine operations (the so-called "white bag") through which seed multipliers offer seed without the authorization of the companies holding the corresponding legal production rights. Both factors have driven down the price of RR soybean, thus promoting its rapid adoption.
Within this context, the stunted growth of the seed market over the last years should come as no surprise, regardless of the sharp increase observed in the acreage planted to soybean, which is the leading crop in the market. Therefore, the plateau experienced by the seed market as from 1996–1997 may be explained by the introduction of transgenic seed and the resulting need of obtaining original seed on the part of farmers (and even of clandestine seed producers) (see Figure IV-1).

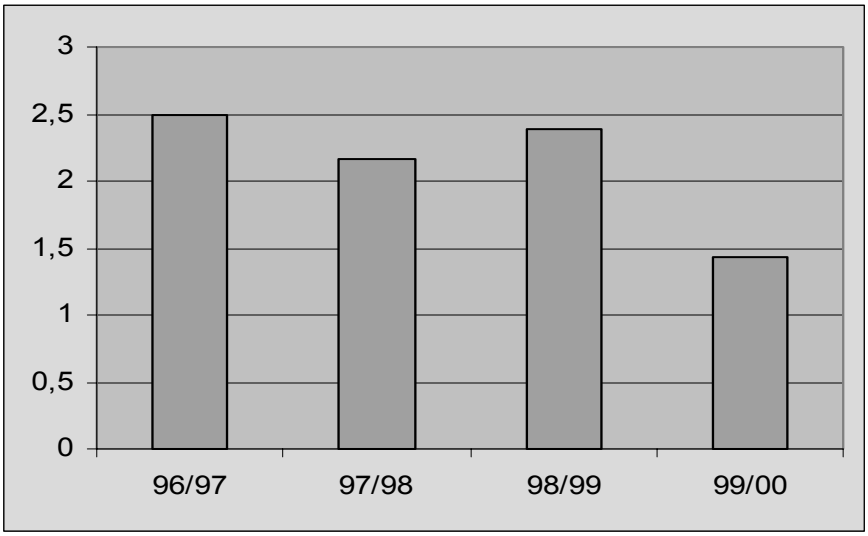
The use of "white bag" seed as well as farmers' own seed would account for the evolution of the market in the following years, a practice which surely had an impact on the substantial reduction in the price of RR soybean seed as compared to that of conventional seed over the 1999–2000 period (see Figure IV-2).

Figure IV-1: Argentine seed market (in thousand tonnes)



Source: Asociación de Semilleros Argentinos, ASA - www.asa.org.ar

Figure IV-2: Price ratio of transgenic soybean seed as compared to conventional soybean seed

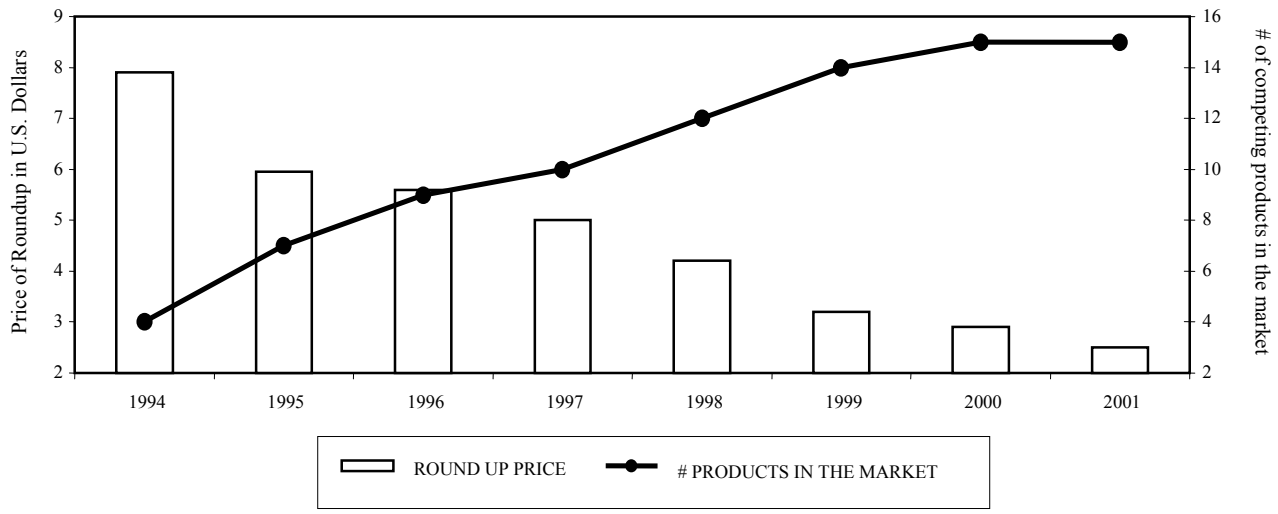


Source: prepared by the authors based on data of Márgenes Agropecuarios – http://www.margenes.com

It should be noted that this situation is also linked to the fact that soybean seed falls into the category of autogamous species, in which genetic quality can be maintained through seed retained by farmers for their own use—or which may be used for clandestine multiplication practices. Along these lines, we should also take into account the relevance of the widespread adoption of the wheat-soybean double-crop system during the period under analysis, which undoubtedly constituted an additional inducement to keeping seeds for the next season.

The third factor contributing to the wide diffusion of RR soybean in Argentina is the increasing reduction in the price of glyphosate (see Figure IV-3), which stemmed from a fiercer competition in local markets by dint of the introduction of new agents in the manufacturing and commercialization of glyphosate.

Figure IV-3: Evolution of the price of glyphosate and number of products offered in the Argentine market (1994–2001)



Source: Prepared by the authors. Based on information supplied by CASAFE - http://www.casafe.org, and the Secretaría de Agricultura, Ganadería, Pesca y Alimentación, SAGPyA - http://www.sagpya.mecon.gov.ar

Keeping in mind that so far Argentina has encountered no difficulties in accessing target markets for its RR soybean exports and that, in spite of the perceptions of foreign consumers, price differentials between conventional and RR soybeans in the world market do not penalize the latter (see Chapter I), it is hardly surprising that almost all Argentine soybean crop is RR. Neither is it surprising that not only input suppliers but also farmers, the scientific community and government authorities are all in favour of this new technology.

Only a few NGOs, such as Greenpeace, have introduced part of the international debate in Argentina. Yet, Argentine public opinion—overwhelmed by major issues such as unemployment, poverty and corruption, and in the face of anti-globalization campaigns focusing their criticism on banks and privatized companies—has offered not much fertile ground for negative views about these new technologies.

Unlike RR soybean, *Bt* corn and *Bt* cotton feature a much less dynamic performance. Firstly, *Bt* varieties have been released much more recently, and secondly, farmers tend to consider *Bt* crops as some sort of insurance, yielding higher or lower profits depending on pest behaviour during each season.

In addition, a technology fee to be charged to farmers is applicable to transgenic corn and cotton varieties and, in some cases, this fee is higher than in the U.S. This is related to the fact that, in both crops, there are patent applications for the involved events and that, in the case of corn, it is a hybrid variety. As a consequence, farmers may not keep their own seed for planting, and therefore, the relative weight of the certified seed in the corresponding market increases.

As far as cotton is concerned, the real issue lies on the commercialization strategy, which is based on formal agreements between the sole supplying company and the farmers, whereby the latter's

right to their "own use" of the seed is restricted. As a result, farmers have no choice but to pay for the seeds which is four times the price of conventional varieties, which, in turn, hinders the diffusion of this technology in the country.

It is clear from the above discussion that one of the main problems in Argentine agriculture is the illegal trade of seeds, potentially amounting to 35–50 per cent of the market. Besides the risks that this situation might entail in terms of a potential reduction in productivity (seed with lower genetic quality and germinatory power) or with respect to phyto-sanitary issues, the existence and growth of illegal practices might also mean that many of the breakthroughs in biotechnology—and in other conventional technologies as well—may not find an effective way to be incorporated into production. In other words, the dissemination of new knowledge takes much longer than it actually would if the seed market worked under normal conditions. The dissolution of the National Institute of Seeds (INASE), at the end of 2000, aggravated the situation for it constituted the regulating authority responsible for the enforcement of effective rules and regulations. Hence, at present, there has been no clear reassignment of responsibilities as to the police power within the sector; and this in fact has extended to the GMO's market given that, in terms of sanctions, GMOs are regulated by the same rules and regulations applicable to the conventional seeds' market. It is critical that this problem be urgently dealt with, in view of the evident adverse impacts that it may have on the operation of the overall genetic input industry.

Finally, some clear and obvious differences arise from the comparison of RR soybean to both *Bt* corn and *Bt* cotton. In the case of soybeans, it is a win-win situation with the fact that the adoption of this new technology has proved neutral to farm size, and the equitable distribution of benefits among input suppliers, farmers and the Argentine economy as a whole (see Figures V-2 and V-3),. The evidence available for *Bt* corn and *Bt* cotton does not point in the same direction, although the performance observed in these cases does not differ much from the one found in other contexts. It can thereby be concluded that the situation depicted is not attributable to country-specific conditions, but to results stemming from the nature of these technologies and to the way in which this is reflected on the performance of the actors in the process of adopting such technologies.

Figure V-2 Adoption of RR soybean and distribution of benefits. ("white bag" seed not included)

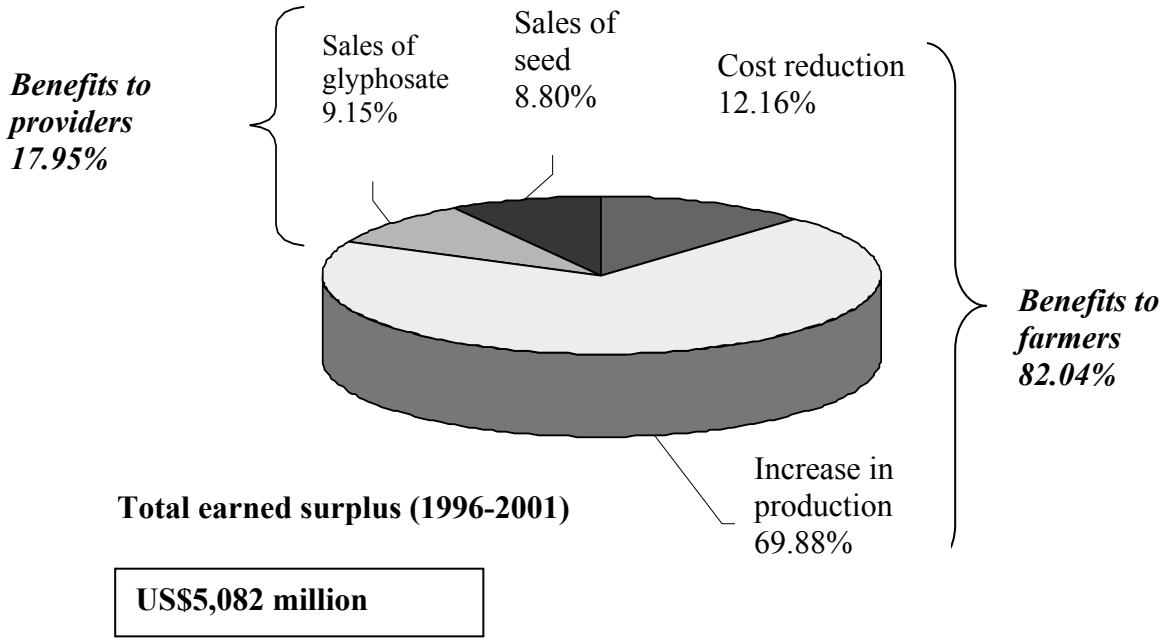
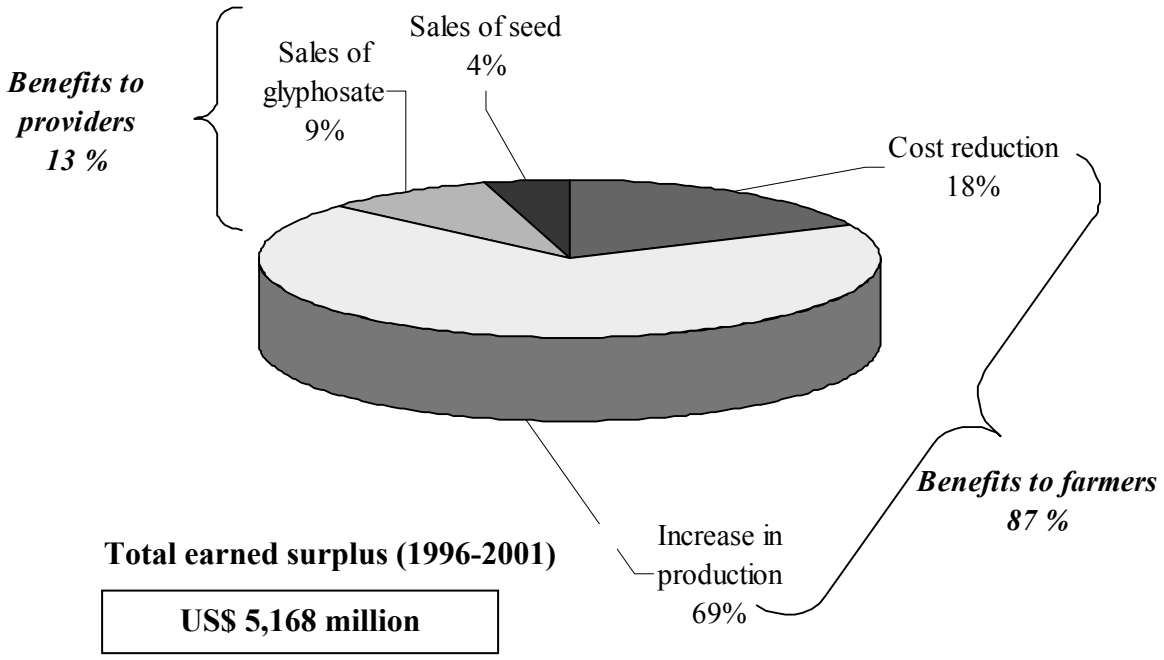


Figure V-3 RR soybean adoption and benefits distribution. (including "white bag" seed)



Source: prepared by the authors based on information analyzed with the SIGMA v2.02

Looking ahead

The crisis Argentina is currently experiencing poses a major obstacle to the analysis of any future scenario. The country's current situation is substantially different from that of the previous decade.

Whereas the default of the foreign debt, the lack of international financing and the stagnation of the local financial system aggravated the already critical economic and social situation of the country, the devaluation of the local currency —regardless of withholdings on exports (particularly agricultural and energy exports) being in force once again— should prove beneficial to the performance of tradable sectors and, especially, to the performance of agriculture.

Though not enough time has yet elapsed to analyze the effects of the abandonment of Convertibility in January 2002, there is no doubt that the devaluation of the peso has modified economic relations between the agricultural sector and the rest of the economy as well as among the different actors in the agro-industrial chain. In view of the impact of exports within the farming production, changes are likely to be propitious for the primary sector, exhibiting quite significant increases in the share of the total income currently received by farmers vis-à-vis their situation prior to devaluation.[2] In this context, no change should be brought forward in the macro- and micro-economic performances described above; on the contrary, the new scenario should promote the consolidation of trends observed over the last years, at least in the case of price ratios.

Based on the aforementioned findings and the characteristics of Argentine agriculture, it is possible to draw some conclusions and highlight some implications.

In the first place, we cannot fail to single out the exceptional nature of the RR soybean case and the highly unlikely reoccurrence of the set of factors converging on it; therefore, all policies and strategies to be adopted hereafter cannot be a simple "projection of past situations." Moreover, it is worthy of mention that, even within the crisis that Argentina is undergoing, there are several sustained positive factors which should be taken into consideration when developing a strategy in this field.

A review of technologies in the pipeline suggests that, in the next five to ten years, there will be a flow of incremental innovations rather than radical innovations. This process will go hand in hand with a steady increase in the number of species adopted as well as with a diversification of the sources of supply of new technologies, with countries such as China becoming major suppliers of new transgenic events.
This means that, even if the innovative flow that is to come does not have the radical impact featured by soybeans, Argentine agriculture will still find it attractive. Firstly, the focus will remain on temperate and subtropical crops, broadening out to encompass a wider range of options in term crops and events. Secondly, the coming second and third generations of innovations will benefit consumers. Thirdly, despite the dire state of affairs, Argentina still fulfills the required structural conditions to reap the benefits of innovations generated abroad. This refers to the 26

[2] According to a study carried out by the "Instituto de Economía y Sociología" of INTA on the basis of data furnished by the Secretaía de Agricultura, Ganadería, Pesca y Alimentación (SAGPyA) and *Márgenes Agropecuarios* magazine, the gross margin (in U.S. dollars) for soybean for the 2002/2003 season is estimated to have increased by 52 per cent, thus reflecting the dramatic drop in the "non-tradable" components of the production cost.

million ha.of commercial farming done by farmers used to adopting technological changes, and with a dynamic area of technological services and inputs along with an extensive logistic and territorial network. As already stated, these have been the factors determining the processes that have taken place so far, and they will—no doubt—continue to promote and offer significant incentives in order to ensure a steady expansion of new breakthroughs towards Argentine agriculture, and even more so within the context of a real effective exchange rate more beneficial for the agricultural sector, such as the one that may be anticipated for the coming years.

However, foreign innovative processes are likely to mirror the priorities and the biases of the economies of their countries of origin, which most probably are quite different from Argentina's. This suggests that the encouragement of biotechnological research in the country must always constitute an overriding priority, even in such a case when it may be deemed incompatible with the immediate concerns of the country. In the mid- and short-term, this issue will most probably consist of having a keen perception of the idiosyncratic characteristics of Argentine agriculture and trying to incorporate them into the negotiations related to the transfer of technology and investments in the sector.

Other GMOs are likely to feature higher costs of adoption than those of RR soybean—such is the case of *Bt* cotton, among others. This prospect further highlights the significance of a proactive policy at a national level in terms of research in agricultural biotechnology, not only to ensure that idiosyncratic issues concerning Argentine agriculture are duly addressed, but also as a tool to come up against the competition by promoting alternative sources of "events" in order to prevent possible monopolistic behaviors within the seed market.

Argentina has a modern legislation on competition defense approved in 1999 (Act 25156) and in force since 2000. However, the contestability of the genetic inputs' market can only be secured if, besides the required legal instruments, the country is in a condition to diversify the supply of innovations.

Regardless of the concentration of supply in the seed market and the potential need for instruments to promote competition within the market, the dissolution of the INASE has strongly weakened the regulatory framework, which is far from being the one currently required. As previously mentioned, the genetic inputs market has been deprived almost completely of a regulating body entitled with police power to prevent unfair competition, anti-competitive conduct and other problems arising from the spread of "white bag" transactions. Therefore, steps must be urgently taken to address and solve these issues for they do not only have repercussions within the seed market but also in the biosafety regulatory system.

All the aforementioned aspects, along with: the consensus needed to establish and enforce proper protection standards against risks (effective or perceived); ensuring consistent availability to the public; and the strong possibility of an increasing degree of complexity from a scientific, technical and commercial perspective in terms of issues, crops and events to be dealt with, indicate that it is absolutely necessary that the CONABIA be institutionally vested with the power required, and that its scientific and technical capabilities should be reinforced. Accordingly, it is imperative that the discussions started in 2001 and interrupted by dint of the institutional events of December 2001 should be continued.

The rule applicable to market analyses for the approval of the new transgenic events should be further reviewed. Moreover, all topics related to the labelling and traceability of GMOs and their derivatives should also be addressed.

With regard to market assessment, the rule in force—whether the event has or has not been already approved in the major export markets—proved effective during the relatively quiet decade of the 1990s, but in the face of a scenario of events increasingly diverse and complex, along with those that can be anticipated, it will probably end up producing an adverse effect on investments, particularly in the field of R&D at the national level. In other words, it would not appear profitable to invest in the development of biotechnology solutions to country-specific problems—for instance, the Río IV disease that strikes corn—if knowing in advance that such innovations will not pass market assessment when the time comes for their release. The fact that RR soybean had already been approved in the EU—the main destination of Argentine exports—has definitely been a contributing factor to the dynamism that characterized the diffusion process of the crop. But today's scenarios differ considerably from the ones in 1996 and it would therefore constitute a mistake to make market access projections on the basis of such data.

On the one hand, the Cartagena Protocol is about be ratified; yet, on the other hand, regardless of the Protocol's regulations, there is an increasing number of countries whose national legislations are adopting higher labelling and traceability requirements concerning GMOs. This will apparently pave the way for the gradual development of differentiated markets for conventional and transgenic products—a process that would be further consolidated as second and third generation GMOs are released into the market.

Unfortunately, Argentina is in no condition to defray the costs of the aforementioned processes. The only data available has been furnished by the few studies carried out in other countries (mentioned in Chapter II). There is no information, neither in the private nor in the public sectors, that can be used for an assessment of the potential economic implications stemming from the segregation of products, both for the primary sector and the food processing industry. Efforts should be undertaken to generate this information and to attract the investments required to develop the logistics that the new market conditions demand.

Lastly, those issues requiring the formulation of specific policies should be clearly identified. Furthermore, the complexity of the topics addressed in the debate calls for capacity building in terms of follow-up and analysis of ever-changing national and international realities. The release of GMOs in Brazil and the eventual amendment of the European Union moratorium as well as the significant role played by China—and lately by other countries such as India—in this technology should contribute to the redefinition of the international and regional strategy adopted by Argentina on these issues. This paper is a contribution to the permanent task that should be systematically carried out, not only with the support of international organizations but, above all, with the staunch support of the Argentine public and private sectors.