

Study on the Implications of Asynchronous GMO Approvals for EU Imports of Animal Feed Products

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Undertaken by

**Agricultural Economics Research Institute (LEI) – Wageningen UR
(Lead Contractor)**

**Economics and Management of Agrobiotechnology Center (EMAC) –
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Plant Research Institute (PRI) – Wageningen UR

Executive Summary

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General overview

This report addresses the implications of asynchronous authorisations of genetically modified organisms (GMOs) on the competitiveness of the European Union (EU) livestock sector, which represents approximately 40% (€152 billion) of the whole agricultural production (FEFAC, 2009). The EU is highly dependent on imported vegetable protein as an ingredient for livestock feed and this is increasingly produced with genetically modified (GM) crops in terms of area and also in terms of crop/trait combinations¹. The question arises as to what will happen in terms of the EU having sufficient feed material if trading partners increasingly plant GM crops that are not authorized for import to the EU.

Definition of the problem of low level presence of EU unauthorized GMOs in imports of feedstuffs and possible trade disruptions

It is now almost fifteen years since the first GM crops were introduced into agriculture. During the period 1996-2009, GM varieties with novel agronomic traits have quickly been adopted in many areas of the world, being grown on 130 million hectares in 2009 (Gómez-Barbero & Rodriguez Cerezo, 2008; James, 2009). Many other new GM crops are being developed in major feed exporting countries at a high rate (Stein and Rodriguez-Cerezo, 2009).

The regulatory procedures for the authorization of these GM crops either for cultivation or for the use of their derived products in feed and/or food (e.g. grain, beans, meal, oil) in the EU differ significantly from those of feed exporting countries (e.g. USA, Brazil, Argentina). There are indeed significant discrepancies in the amount of time required to review and authorize new GM crops between the EU and major trading partners. This fact can lead to “asynchronous authorisations” where a GMO is fully authorized for commercial use in food and feed in one of these countries but not in the EU.

The full segregation in these exporting countries of GMOs which are authorized in the EU from those which are not is becoming an issue. A major concern is therefore the low level presence (LLP) of unauthorized GMOs in food and feedstuffs imported into the EU. Food and feed consignments arriving to an EU harbour containing unauthorized GMOs – even at minuscule levels – have to be sent back or transferred to other destinations. The EU regulatory framework for GMOs has “zero tolerance” for the presence of unauthorized varieties of these organisms even if the presence is accidental or adventitious. This is true regardless of whether or not these GMOs are

¹ For the whole period of the history of commercial GM crops, two agronomic traits have been dominant. First is Herbicide Tolerance (referred to as HT crops in this report). Herbicide Tolerance refers here to so-called total herbicides (glyphosate and gluphosinate) obtained by transgenesis (Genetic Modification, GM). Herbicide Tolerance has been followed by Insect Resistance (referred to as Bt crops since the gene conferring resistance comes from the soil bacterium *Bacillus thuringiensis*). Finally, the “stacked” HT/Bt crops combine the two traits.

authorized elsewhere. Trade operators face serious economic risks implying the possibility of trade frictions and shortages in feed supply.

The above-mentioned trade frictions and shortages in feed material supply have financial and technical consequences for all parties concerned. For the trade operator, it is a significant loss of revenue to have a cargo ship, destined to deliver to the EU, that cannot discharge its content at an EU port due to LLP of EU unauthorized GMOs. For the EU, often the supply disruption of feed material cannot be immediately replaced. As a result EU livestock producers either have to reduce the number of livestock or to compete with other users for the existing feed material meeting the requirements of EU legislation available. Such increasing competitive pressure would in any case lead to higher prices for the EU. In addition, the EU risks to lose well established trade connections with a supplier, at least for the time of asynchrony. However, this could become a permanent problem as the introduction of new traits through GM events continues at an accelerating rhythm (Stein and Rodriguez-Cerezo, 2009). Farmers and traders in the exporting countries may not have the capacity to ensure segregation of GM soy and maize that is authorized by the EU. This is the case of the USA with regard to the provision of maize (in the form of maize gluten feed) since 2006 (see EC, 2007).

As several countries are involved in the production of feedstuffs, there is a technical possibility to transfer demand to alternative suppliers, but this requires time, given the usual approach of forward contracting for material that has its specific growing season. Furthermore, seasonal availability is constrained by the fact that production in the northern hemisphere takes place at a half year time-lag from the production in the southern hemisphere. Although the USA is far from being the principal supplier of soy to the EU, it does provide shipments when the stocks in the southern hemisphere are low. Therefore, in October or November, any disruption affecting the shipment of soy feedstuff coming from the USA cannot be mitigated by replacements from other sources, as soybeans and soymeal are simply not available in large quantities on the international market.

What it is the size of the problem as regards EU demand for soybean and maize?

Soybeans, soymeal, maize, wheat, rapeseed and rapeseed meal are used in livestock feed. Yet not all the ingredients for livestock feed used in the EU, either prepared by commercial firms or on-farm, are solely sourced within the EU market. Among the imported ingredients are maize and soy as well as the products derived from them (e.g. maize gluten feed and soy meal).

The import of protein feed is a particularly sensitive issue where countries (including EU Member States) do not have the capacity to meet domestic needs of either soy or/and maize, and therefore depend on the capacity of a few key suppliers². Among those countries/regions are the EU but also China, which together represent over half of world demand for imported livestock feedstuffs.

² Argentina, Brazil, Paraguay, Serbia, Ukraine and the USA are the primary EU sources for soy and/or maize.

During the last three marketing years (2006/07 to 2008/09), the EU imported on average 34.1 million metric tons of soymeal equivalents³, which accounted for 30% of the total tradable amount in the world market. As regards maize, the EU imported on average 7.9 million metric tons per year and over the same period (9% of the total tradable amount) (USDA-FAS, 2010a and 2010b).

The global demand of crop protein, however, is being amplified around the world by the rapid economic growth of developing countries, which are catching up to the more mature economies (e.g. China imports of soybean increased by 43% during the last three marketing years; see USDA-FAS, 2010a and 2010b). It is in this context that the prospect for EU demand is to be considered.

Rationale for this study, objectives and methodology

Very little research has been conducted *ex ante* or *ex post* on the impacts on the EU livestock sector of asynchronous GMO authorization between the EU and trading partners and the subsequent LLP problems (EC, 2007; Backus et al., 2008; Aramyan et al., 2009). Using different methodologies, from desk research and expert interviews to computable economic models, the existing studies coincide in pointing out that economic difficulties can be expected for the EU livestock sector. These vary from a limited to a severe impact depending on the bilateral trade flow(s) affected and the length of the trade disruption.

Apart from the general objective of assessing the implications of asynchronous GMO authorizations, a set of specific considerations underlying the present study differs from the previous investigations in a number of ways. First, the 2007 study of the European Commission did look at the EU as a whole, while providing no breakdown by Member State to explore possible differences. Second, it did not build their scenarios based on empirical data but on theoretical assumptions. Third, as compared to Backus et al., 2008, and Aramyan et al., 2009, this new study elaborates on:

- The technical possibility and economic incentive for foreign producers of maize and soy to segregate different types of GM material in order to cope with zero tolerance for EU non-authorized GMOs, governing EU imports.
- The substitution possibilities as regards different origins (other suppliers), ingredients (other sources of vegetal proteins) and combinations of them.

In order to fulfil its objectives, this study combines both qualitative (literature review, case studies, scenarios building) and quantitative tools (computable supply and market models).

A number of scenarios were considered where restrictions were placed on the exports as follows: (a) a temporary loss of USA supplies during 3 months in 2012; (b) a structural loss of USA, Brazilian and Argentinean supplies in 2012; (c) a structural loss of USA supplies in 2020 and (d) a structural loss of most North and South American supplies, except Canada, for soy; structural loss of all the Americas and Western Balkans for maize.

³ This includes soybeans multiplied by the conversion factor 0.8 and soymeal

To understand the general effects of different scenarios of trade disruption of feed materials on the volume and price of livestock feed material imported into the EU, the spatial equilibrium model Takayama-Judge (T-J) is used. In addition, the partial equilibrium model Common Agricultural Policy Regional Impact (CAPRI) is used to simulate changes in livestock feeding rations following upon the same scenarios. This later model is also used to simulate the economic impact of potential shortages in livestock feed material.

The simulation of disruption in the trade of feed supplies to the EU occurs at two time horizons as illustrated before, 2012 and 2020. EU feed demand and world supplies in agricultural commodities are projected for each of them. For each scenario at each time horizon, the T-J model covers the short run response to changes in trade patterns, over a period lasting between one and two years. The shift in trade at the global level is accompanied by price signals around the world. The new trade pattern, along with restricted supply of feed material within the EU, would lead to progressive adjustments in livestock numbers and arable crop production until a new equilibrium is reached, which takes around 5 years. This long run market equilibrium is calculated with CAPRI.

Main Results

Feasibility and potential costs of segregation of EU authorized from unauthorized GM events faced by trading partners

The critical factor concerning a possible disruption in the supply of imported livestock feedstuffs, in the form of soy and maize, is the degree of risk that GM feed supplies may be prohibited from entry to the EU. Past incidents are one guide to understand this factor (e.g. Hercules maize, L601 rice). However, as the number of GM events available is increasing rapidly, so is the complexity in understanding the feasibility for segregation of EU approved and non-approved GM material. In the past, the segregation capacity in many supplier countries was not a limiting factor, as only GM events approved by the EU were available commercially. This is not necessarily the case any longer, and therefore the possibilities for segregation at the level of trading partners (exporting countries to the EU) have become a matter of concern.

This study suggests that the logistical capacity of segregation in the main exporting countries to the EU, as far as infrastructure logistic are concerned, is not able to cope with the requirement of segregating GM material that is EU authorized from unauthorized. This result is to a large degree due to the circumstances of an increasing variety of GM plant material. Traders are therefore confronted with an increasing risk of shipments possibly containing *trace amounts* of EU unapproved GM material that might be detected upon arrival in the EU. As example, the LLP risk concerning maize gluten feed has already resulted in exports from the USA to the EU having virtually ceased by 2008. As traders are not willing to take the risk of losing considerable amounts of money, even if the probability of LLP were low, trade of maize and soy between the EU and North and South American sources may cease by 2020.

Costs of segregation of EU unauthorized GM plant material in exporting countries are difficult to isolate. However, an estimation based on available data of the traditional identity preservation programmes (GM separated from non-GM) will give an idea of

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the order of magnitude. The current producer premiums for *non-GMO* soy and maize have more than quadrupled in the USA from 2000-2009.

Substitution possibilities for feedstuff imports

Animal feed, which includes compound feeds and feed material, represents the main input into livestock sector. Within the EU, about 468 million metric tons of feed are consumed by livestock each year (FEFAC, 2009). These feed materials mostly consist of roughages (228 million metric tons) which are grown and used on the farm of origin. The rest (240 million metric tons) includes cereals grown and used on the farm of origin (51 million metric tons) and feed purchased by livestock producers to supplement their own feed resources. In the dairy sector, roughage is the main feed ingredient, while in other sectors, a large amount of compound feed is used (Burger et al., in preparation).

The substitution options such as changing import of raw materials, changing feed production in the EU, adapting the number of animals and changing feed composition differ over the short run (1-2 years) and the long run (5 years or more). In the short run, the price impacts for substitutes are expected to be larger than in the long run due to difficulties to adapt the production systems for substitutes as well as to change the supply flows of substitutes. Therefore, some adjustment may be required in livestock numbers as well as in livestock feed compositions to cope with the short term and long term effects of feed trade disruptions.

The effects on trade in the case of disruption in supplies to the EU because of asynchronous GMO approvals in the near future (horizon 2012)

In the event of a disruption in the supply of maize from the USA to the EU, only small amounts of maize would be involved, meaning practically no impact on EU supplies and prices. In the event of a disruption in the supply of maize to the EU from Argentina, Brazil and USA, 1.8 million metric tons of maize would no longer be available to the EU. This would result in a 4.7% increase in the price of maize imported to the EU from the world market. With a larger than average annual demand by the EU for maize, as observed in the marketing year 2007/08, the price increase would be 23.6%.

In the event of a disruption in the supply of soybeans and derived products from the USA to the EU, an estimated shortage of 3.5 million metric tons would be provided by Brazil. Given the dynamics of shifting trade patterns, the resulting increase in prices for imported soybeans to the EU would be 0.6%, and for soymeal 0.3%. In the case that the EU would lose soybean imports from Argentina, Brazil and the USA simultaneously, this would involve a shortage of some 15 million metric tons of soybeans. EU soybean production could increase by about 0.5 million tons within the time span of one harvesting period. Another 7 million metric tons could come from other exporting sources (principally Ukraine in Eastern Europe and Paraguay in South America). However, total supplies to the EU would decline by 7.5 million metric tons. If there were to be a loss soymeal imports to the EU from Argentina, Brazil and the USA simultaneously, this would represent a loss for the EU of 20 million metric tons of soymeal from these three countries. The overall short-term price increase would be in the order of 220% for soybeans and 210% for soymeal.

In the case of the loss of soybeans and soymeal imports from all the current major suppliers, the calculated result would cause major changes in global trade patterns. Accordingly, prices increases would be significantly higher than those calculated in the above-mentioned scenarios and would trigger much more significant adjustments to be made on the demand side within the EU.

Impact on the competitiveness of the EU livestock sector and welfare effects if trade disruptions are to occur in the long run (horizon 2020)

The competitiveness of the EU livestock sector is reflected in gross margins of livestock farmers. In the worst case to be envisaged for the EU livestock sector, which is the disruption of soybean and soymeal imports from all the major suppliers, gross margins would decrease in the long run by 3% for the dairy sector, by 16% for beef production, by 14% for pig fattening and by 7% for poultry meat production. These figures are a reflection of the relative importance of feed in total costs of production and the capacity of the livestock farmer to increase the total price – including gross margin – per livestock product at the farm gate. Profits could decrease by €1.2 billion for the dairy sector, by €3 billion for the beef sector, by €1 billion for the pork meat sector, and by €380 million for the poultry meat sector. The net agricultural sector income would be €500 million, however, which reflects the expansion in arable production to cover part of the loss of soybeans and soymeal imported to the EU.

In this worst case situation, there would be shifts in the levels of livestock production among different Member States with relatively little change in livestock production of EU-15⁴ as a whole, a slight decrease in the beef, dairy and pig sectors within the EU-10⁵, and a an increase on the order of 2-3% for the beef, dairy and poultry sectors in Bulgaria and Romania. In terms of overall economic welfare effects in the EU, the effects on livestock farmers, arable farmers, and consumers would differ. To the degree that livestock farmers would be able pass on the major part of the added feed costs to consumers, the latter would pay an additional €10.5 billion annually for meat and livestock-based products. Assuming possibilities for substitution by domestic feed production, EU arable farmers would benefit. The total cost to the economy would be €9.6 billion. In as far as EU livestock producers face are exposed to global competition, possibilities for passing on increasing costs to consumers would diminish, which implies that the costs squeeze stays largely on the side of the farm sector. As a result, disruptions in feed supply and result feed price increases would severely damage the competitiveness of EU livestock production.

Main findings

The main findings of the study are as follows:

- Based on the analytical framework, structural responses to asynchronicity – and given zero tolerance – are: (a) changes in trade patterns, (b) substitution of feed ingredients in feed rations (re-optimization subject to animal specific nutritional requirements) and (c) adjustments in primary production (land use adjustments within and outside the EU).

⁴ Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

⁵ Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia and Slovenia.

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- There is, however, only a limited possibility to replace livestock feedstuffs by restructuring of trade patterns, particularly because segregation of supplies of approved events does not seem possible. Hence, asynchronicity in GMO approvals between the EU and exporting countries will continue to result in trade disruptions.

Segregation

- The feasibility of consistently segregating EU approved from EU unapproved GM maize and soybeans in exporting countries was examined through a number of detailed country studies. Extensive supply chain analysis revealed that:
 - global maize and soybean production and exports are concentrated in just a few countries, most of which are GMO adopters;
 - the number of new GMOs authorized outside the EU is rapidly increasing in both maize and soybeans;
 - production of conventional and GM maize and soybeans overlap geographically;
 - storage, processing and distribution of conventional and GM maize and soybeans occurs through a limited and shared infrastructure built to maximize throughput and efficiency.
- All of these findings, in turn, imply that commingling and aggregation of maize and soybeans throughout the supply chain is likely, making guaranteed segregation of continuous supplies to the EU difficult.
- Segregation programs depend on prevention (supply chain controls) and remediation (testing and redirection of non-conforming grain). Because of continuous commingling and aggregation, the rate of grain diffusion throughout the supply chain is expected to be high. High grain diffusion rates are confirmed through case studies of extensive testing programs both with and without segregation in place. The results suggest that LLP of non-conforming grain in segregated supply chains is likely and the chances of failures are therefore high.
- The study also shows that segregation of approved from unapproved GMOs is further limited by the inability to test for some unapproved events quickly and in cost-effective ways at multiple critical points in the supply chain. Hence, remediation is also incomplete. Imperfect prevention and remediation procedures along with zero tolerance, in turn, imply high segregation and failure costs.
- The study finds that (a) high costs of segregation, (b) testing and analytical uncertainty and (c) high failure risks and costs will lead economic agents (producers, traders, processors) to avoid segregation. Given zero tolerance for EU unapproved GMOs, asynchronous GMO approvals result in major risks of trade disruption.

Short Term Changes in Trade and Price Impacts

- A number of plausible disruptions in the EU trade of maize, soybeans and soybean products were examined through spatial equilibrium analysis. The analysis revealed that disruptions in the bilateral trade flows between the EU and major exporters would result in adaptations in global trade. EU imports could shift, at least in part, to non-traditional suppliers. At the same time, EU demand decreases (due to reductions in the size of livestock, changes in livestock diets, and substitution by alternative feedstuffs); EU domestic supplies of protein feed increase; crushing activity inside the EU declines; and EU maize, soybean and soybean product prices increase.
- A number of factors are found to influence the scope of these price and supply reactions, which includes the EU's import levels, its share in global exports, market developments in other countries, the relative costs of processing and transporting, the location of processing capacity, trade policies, and others.
- The EU is a major producer of maize and almost self-sufficient. EU maize imports are therefore limited and price increases due to asynchrony are found to vary between 5% (for a year of low imports) to 23% (year of higher imports).
- EU soybeans/soymeal imports are very high, supplies to the world market are dominated by USA, Brazil and Argentina and supplies from alternative suppliers are limited. When trade disruptions occur between the EU and the USA, price impacts are in the order of 25%. With trade disruptions involving three or more of the major exporters, the supplies to the EU are severely curtailed and prices of soybeans and soy meal increase by 210% or more over the short run (one to two years).
- The substitution options such as changing import of raw materials, changing feed production in the EU, adapting the number of animals and changing feed composition differ over the short run (1-2 years) and the long run (5 years or more).
- In the short run, the price impacts will be larger due to difficulties to adapt the production systems and limited availability of substitutes. This will result in reduced livestock numbers in the EU, with some mitigation offered by changes in livestock feed compositions.

Long run substitutions in rations and feedstuffs used

- In the long run, there may be more possibilities for substitution within the EU for imported maize and soy. Where these possibilities do not exist, reductions in the number of animals will be unavoidable. Substitution could be imagined by growing or importing more rapeseeds, peas, and other substitutes, or using industrial by-products in higher quantities. Taking into account some time-lags in the adaptation, price impacts will be smaller in the long run than in the short run.

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- In two of the scenarios analysed, the supply disruptions include a massive displacement of imported soybeans and soybean products away from the EU market. With the current pace of GMO approvals in the EU, such an outcome is most probable in the long term (2020), while in the short term (2012) this probability is lower, while a severe crisis due the temporary unavailability feed imports might arise occasionally.
- For understanding the medium to long run equilibrium, the availability of substitution options, the inelastic demand for livestock products, and the presence of effective border protection for meat are decisive. Border protection would ensure that the reduction in domestic livestock supply drives prices up, thereby improving the revenues of the livestock sector who effectively pass on increasing feed costs to the consumers.
- With adjustments in the livestock sector being limited, the latter would bear the brunt of the adjustments that have to take place. In the feed markets substantial price changes might be observed (in particular for soybeans, soy meal and maize), driving a range of complex substitution processes.
- Substitution possibilities, the share of feed costs in total costs, and the share of total costs in total revenues determine the impact of increasing feed prices on the final product value. Large price increases of for feed stuff (e.g. 95% long run soybean price increase in case of the worst case scenario) ‘translate’ into relatively modest price increase for livestock products that will roughly vary between 5% and 15%.
- Given the inelastic demand for livestock products, in the worst case scenario (assumed for 2020) the demand for livestock products declines, but less than proportionally (e.g. between 2% and 10%). It should be noted that the CAPRI model – which is the principal tool used for the analysis of livestock products – has a comparative static nature, comparing different equilibrium states, while not giving information regarding the adjustment and transition process. Thus, nothing can be said about effects faced in the short run (one to two years). In the worst case of a loss of soy imports to the EU from all major suppliers, the short run price increase might be twice as large as the long run price increase.
- As shown by the T-J modelling analysis (which can be argued to reflect a more short run nature with a lower amount of substitution possibilities) as well as from the assessment of the short term (2012) scenario of temporary shortages of feedstuff supplies, short run impacts can be very substantial, with the livestock sector suffering from extreme price increases.
- The modelling analysis suggests that the livestock sector can pass on a substantial part of the increase in feed costs to the consumer of the livestock products. Nevertheless, also gross margins were found to decline due to the increase in costs. Depending on the supply disruption scenario, type of livestock production (especially in pigs and poultry), and Member State concerned (including key producers such as Denmark, France, Germany, Netherlands and the United Kingdom), substantial losses in farm income could not be excluded.

Potential Policy Adjustments

The choice of farmers around the world to plant GM crops is based on perceived benefits from increased net revenues resulting from increasing yields while reducing the costs of production. In addition, the demand for maize and soybean, and their derived products, is growing rapidly around the world, especially in China. At the same time the relative importance of the EU market – which has a stable demand over the period considered in this study – inevitably diminishes. This will discourage efforts by producers and traders in exporting countries to invest in segregating EU approved from non-approved GM material and to continue trading with the EU, considering current “zero tolerance” for EU unauthorized GM events.

One possibility to avoid the situation above from occurring is to speed up the authorisation processes for novel GM events, especially with the likely proliferation of stacked traits (a single solution for a multitude of production related risks or benefits). In this context, it is necessary to additionally take into account the increasing number of countries which are embarking on the development of GM events, and which will be submitting applications to the EU for authorisation of the novel events.

A second possibility is to introduce a practical tolerance threshold for EU unauthorized GM events that would allow LLP in shipments to the EU. In this regard, harmonisation of rules regarding LLP at the global level would be an advantage in view of minimising potential trade frictions.

A third possibility is to anticipate the consequences of potential shortages by exploring the possibilities for increasing the range of feed ingredients. This could benefit from an applied research programme within the EU.

Limitations of the study

The limitations of the study reside in two points. First, the use of the models beyond their normal conditions. Second, the fact that the transition between the beginning of a structural feed supply shortage and the new equilibrium in EU livestock composition (taking into account changes in the nature and cost of feed ingredients) has only been briefly explored within the study. This last point merits a full investigation when an appropriate methodological capacity has been developed and peer-reviewed by the scientific community.

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