*STOWARZYSZENIE EKONOMISTÓW ROLNICTWA I AGROBIZNESU*
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# COSTS OF CO-EXISTENCE BETWEEN GMO, ORGANIC AND CONVENTIONAL PRODUCTS IN EU AGRICULTURAL BASED SUPPLY CHAINS

# *KOSZTY WSPÓŁISTNIENIA PRODUKTÓW MODYFIKOWANYCH GENETYCZNIE, KONWENCJONALNYCH I EKOLOGICZNYCH W ŁAŃCUCHU ŻYWNOŚCIOWYM UE*

**Key words: co-existence, costs, supply chain, organic products, GMO**
*Słowa kluczowe: współistnienie, koszty, łańcuch żywnościowy, produkty ekologiczne, GMO*

**Abstract.** This paper discuss the issue of costs of co-existence between GMO, organic and conventional products in EU agricultural based supply chains, which has been investigated in different scientific works. Co-existence concerns the economic implications of GMO admixture, the measures to achieve sufficient segregation between GM and non-GM production and the costs of such measures. There could be pointed out different categories of co-existence's costs that arose due to specific measures.

## Introduction

Agriculture is an open process, which means that perfect segregation of the different agricultural production types, namely conventional, organic or based on genetically modified organisms (GMO) is not possible in practice. Co-existence of these production types, which will not lead to a systematic exclusion of one or more of them, can only be ensured if the segregation measures are designed in a way that the limitations are taken into account.

Co-existence therefore refers to the ability of farmers to make a practical choice between conventional, organic and genetically modified (GM) crop production, in compliance with legal obligations for labeling and/or purity criteria [OECD 2000]. On other hand, the possibility of adventitious presence of GM crops in non-GM crops cannot be dismissed, and may have commercial implications for the farmers, whose crops are affected. Consequently, suitable measures during cultivation, harvest, transport, storage, and processing are necessary to ensure the co-existence. Co-existence, thus, concerns the economic implications of GMO admixture, the measures to achieve sufficient segregation between GM and non-GM production and processing, and the costs of such measures.

Consumers, food and feed industry, as well as wholesalers and retailers in the European Union (EU) demand a reasonable degree of choice between GMO and non-GMO-derived products. But, different modes of European agricultural production are not naturally compartmentalized. If GM crops increase their share in then EU agriculture (which is now very low) questions arise concerning their possible co-existence with non-GM crops (conventional and organic) through the food and feed value supply chains. The European Commission recommendations [European Commission 2003] state that co-existence measures should not go beyond what is necessary to ensure that accidental traces of GMOs in non-GM products stay below EU labeling thresholds in order to avoid any unnecessary burden for the operators concerned. Most of these questions are of an economic nature, and regards the costs.

## Implications of GMO production

2005 marks the tenth anniversary of the commercialization of genetically modified (GM) or transgenic crops, now more often called biotech crops [James 2005]. In 2005, the 400 millionth hectare of a biotech crop, was planted by one of 8,5 million farmers, in one of 21 countries. Over the last decade, the cultivation of biotech crops showed a double-digit growth rates every single year since such crops were first commercialized in 1996, with the number of biotech countries increasing from 6 to 21 in the same period. The global area of approved biotech crops in 2005 was 90 million hectares, up from 81 million hectares in 2004 (fig. 1). The increase was 9,0 million hectares, equivalent to an annual growth rate of 11% in 2005.

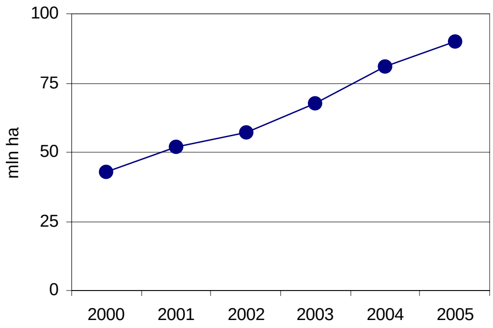


**Figure 1. Global area of biotech crops**
Source: James 2005.

In 2005, the US, followed by Argentina, Brazil, Canada and China continued to be the principal adopters of biotech crops globally, with 49,8 million hectares planted (table 1). Biotech soybean continued to be the principal biotech crop in 2005, occupying 54,4 million hectares (60% of global biotech area), followed by maize (21,2 million hectares at 24%), cotton (9,8 million hectares at 11%) and canola (4,6 million hectares at 5% of global biotech crop area).

In 2005, the global market value of biotech crops was 5,25 billion USD [James 2005]. This represented 15% of the 34,02 billion USD global crop protection market in 2005 and 18% of the 30 billion USD 2005 global commercial seed market. The 5,25 billion USD biotech crop market comprised of 2,42 billion USD for biotech soybean (equivalent to 46% of global biotech crop market); 1,91 billion USD for biotech maize (36%); 0,72 billion USD for biotech cotton (14%), and 0,21 billion USD for biotech canola (4%). The market value of the global biotech crop market is based on the sale price of biotech seed plus any technology fees that apply The global value of the biotech crop market is projected at over 5,5 billion USD for 2006.

Experience with the cultivation of GM crops remains limited in the EU [European Communities 2006]. However, the EU premitted over 30 varieties of biotech crops to be grown on its areas. The commercial cultivation has so far been limited to two types of GM maize and rapeseed. Those are grown in Spain, Portugal, UK and Czech Republic. In Spain, GM maize has been grown since 1998 under a non-binding code of good practice. In 2005 the GM maize cultivation amounted to over 0,1 million hectares, or about 18 percent of total Spanish maize cultivation. In other Member States, cultivation is limited to a few hundred hectares [Binimelis 2005].

Portugal resumed planting of Bt maize after a five year gap. Portugal planted an introductory area of approximately 1.000 hectares in 1999 for one year. In 2005, approximately 750 hectares were planted to Bt maize [James 2005]. As a member country of the EU, Portugal's government has passed a decree, which requires a minimum distance of 200 meters between biotech and conventional crops and 300 meters between biotech and organic crops; buffer zones can substitute for these distances. The decree is also designed to facilitate the establishment of biotech-free zones. Implementation of co-existence laws will probably result in biotech maize being grown in the central and southern regions of Portugal where the farms are bigger, and where co-existence distances can be accommodated.

France resumed planting of Bt maize in 2005 after a four-year gap. In 2005, approximately 500 hectares were planted of which 200 hectares were for environmental monitoring, 100 hectares for experimental use, and 200 hectares for purely commercial purposes [James 2005]. As an EU Member State, France authorizes a number of biotech products for imports under the EU approval process.

**Table 1. Global Area of Biotech Crops in 2005**

| Rank | Country | Area [mln ha] | Biotech crops |
|---|---|---|---|
| 1 | USA | 49.8 | Soybean, Maize, Cotton, Canola |
| 2 | Argentina | 17.1 | Squash, Papaya |
| 3 | Brazil | 9.4 | Soybean, Maize, Cotton |
| 4 | Canada | 5.8 | Soybean |
| 5 | China | 3.3 | Canola, Maize, Soybean |
| 6 | Paraguay | 1.8 | Cotton |
| 7 | India | 1.3 | Soybean |
| 8 | South Africa | 0.5 | Cotton |
| 9 | Uruguay | 0.3 | Maize, Soybean, Cotton |
| 10 | Australia | 0.3 | Soybean, Maize |
| 11 | Mexico | 0.1 | Cotton |
| 12 | Romania | 0.1 | Cotton, Soybean |
| 13 | Philippines | 0.1 | Soybean |
| 14 | Spain | 0.1 | Maize |
| 15 | Colombia | <0.1 | Maize |
| 16 | Iran | <0.1 | Cotton |
| 17 | Honduras | <0.1 | Rice |
| 18 | Portugal | <0.1 | Maize |
| 19 | Germany | <0.1 | Maize |
| 20 | France | <0.1 | Maize |
| 21 | Czech Republic | <0.1 | Maize |

Source: James 2005.

The Czech Republic as a first from EU New Member States approved the commercial production of a biotech crop for the first time in 2005 [Sokup et al. 2005]. As a member of the EU, the Czech Republic follows the EU's legislative framework for biotechnology. Since the EU accession on May 1, 2004, biotech food and feed products approved by the EU are valid in the Czech Republic. Provisional co-existence rules apply with 100 meters between GM cultivars and conventional ones (or alternatively 50 meters and 6 buffer rows) and 600 meters between GM and organic cultivars (or alternatively 300 meters and 6 buffer rows). These rules were valid only for 2005 as they are expected to be revised in the near term in a new decree.

## Costs of co-existence of the agricultural based value supply chains in EU

Most EU Member States have based their approaches on management measures applicable at the level of individual farms or in coordination between neighboring farms. The responsibility of implementing segregation measures has generally been placed on GM crop growers. The very diverse nature of EU farming means that co-existence measures have to be adapted to local conditions and crop types, and make it imperative to ensure the maximum degree of flexibility for the Member States in developing their national approaches [European Commission 2003]. The co-existence measures applied at the next steps of the value supply chains, both food and feed covering: processing and trade, including transportation and storage should be applied with regard to food safety regulations, especially with Hazard Analysis of Critical Control Points (HACCP). However these measures, aiming on segregation and traceability, needs to be also applicable to very specific conditions of each single company, which due to its business nature operates under the specific legislative environment.

The study done by JRC- IPTS [JRC-IPTS 2002] for three crops for which GM varieties are available (oilseed rape for seed production, maize for feed production and potatoes for consumption), and for several farm types (both organic and conventional) that were defined to cover the variability present in EU farming infrastructure shows the importance of measure the costs of co-existence in EU. For all crop-farm combinations, a hypothetical share of GM crops of 10% or 50% in the region was considered. A share of 50% resembles the situation in countries that adopted GM crops readily (for example the share of GM oilseed rape in Canada is currently 54%), while the 10% figure represents a scenario of slow adoption of GM crops in the EU.

In these scenarios, an estimation of the expected levels of adventitious presence of GM crops in non-GM crops was done with a combination of computer modeling and expert opinion. The results showed that the estimated levels of adventitious presence of GM crops do not change significantly between the two scenarios of GM crop share (10% or 50%). The possibility of changing practices to meet very low thresholds for all crops, near the analytical limit of quantification (~ 0.1%) has been also considered. This reflects the situation in organic farming where the use of GM varieties is not permitted by the Council Regulation (EEC) 2092/91 [European Commission 1991], setting a de facto threshold. The 0.1% limit will be extremely difficult to meet for any farm-crop combination in the scenarios considered (10% and 50% GMOs in the region), even with significant changes in farming practices. These desk results have been proved by the field studies done for the Catalonya region in Spain, where has been proved that the organic farms could not ensure the purity in case of the neighborhood with GM crops [Binimelis 2005].

The costs of co-existence at the farm level have been calculated without taking into account any changes in demand or market prices that would probably accompany an increased level of GM crops in agriculture. In the analysis all costs are allocated to conventional or organic crop production, including those affecting primarily GMO production in case of co-operation. Compliance with the 1% and 0.3% thresholds through changes in farming practices and introduction of a monitoring system as well as likely insurance needs may result in additional costs of 1% - 10% of current product price for the farm-crop combinations studied (in the 50% scenario). Exceptions are found in the production of seed of oilseed rape, where costs can be much higher in particular farm types (up to 41%). In all cases, monitoring activities account for a large part of the additional costs.

There have been also analyzed another elements of the EU agricultural value supply chains. The scenarios for Dutch feed productions identify the scope of the co-existence costs on the processing level [Meijer et al. 2005]. There have been chosen different scenarios, to cover the full range of legal and potential consumer demands. Besides the GMO also the organic products were considered, especially due to its special requirements for quality assurance and the maintenance of the organic status. Three non-organic and non-GM feed scenarios were addressed, one at the level <0,9% unintended inclusion in line with the current legislations [see European Parliament 2003], one at 0,0% GM inclusion as a parallel to organic farming, and one intermediate scenario of 0,5% GM. The economic effects were related to the costs of the required quality assurance systems, costs of associated analysis protocols and necessary management adjustments to guarantee the non-GMO status. The results of the scenarios' analysis were compared to those of conventional feed manufacture. However, it is important to mention that changes in market prices for raw material have not been taken into account, due to the separation of the total market in GMO and non-GMO, nor was the substitution of specific raw materials in feeds by other non-GM crops. The estimated extra costs per metric ton of raw material ranged from 36 EUR for the scenario <0,9% GM to 82,50 EUR in case of the 0,0% GM scenario, adding 41-92% to the market value of maize (95,40 EUR/metric ton). These extra costs were mainly associated with necessary management changes (31-77%), further with quality guarantees (3,8-9,4%) and testing (6,3%).

## Conclusions

The global increase of the GMO production should be considered as a major risk in all further development's scenarios of co-existence. With regard to this risk the specific co-existence measures have been applied in EU. Co-existence thus concerns the economic implications of GMO admixture, the measures to achieve sufficient segregation between GM and non-GM production and the costs of such measures. In general there could be pointed out different categories of such costs. There are co-ordination or organizational costs that are incurred with application of special management actions related to co-existence, i.e. to organize buffer zones, to separate the transportation, finally organize and control the correct segregation practices on each element of the chain. Another category of co-existence costs is the logistical costs that may include testing equipment, as well as necessary asset upgrades and modifications. They may also involve single season expenditures such as incremental labor for identity handling, additional material and maintenance costs.

However the opportunity costs of co-existence may also exist. In to- date executed desk and field scientific investigation this category has not been taken into account respectively. The opportunity cost should be considered as a result of the farmer's decision what kind of crop to cultivate and then the decision of other stakeholders, which product: conventional, organic or GMO to use in the processing, trade and finally purchase. Therefore to conclude, further researches are very needed to identify exact areas of costs rising and asses the influence of the specific co-existence measures on different supply chain levels in EU.

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## *Streszczenie*

*W artykule omówiono zagadnienia kosztów współistnienia produktów modyfikowanych genetycznie, konwencjonalnych i ekologicznych w łańcuchu żywności i pasz dla zwierząt w Unii Europejskiej. Podstawą do rozważań są analizy w tym zakresie opublikowane przez różne ośrodki i grupy badawcze. Współistnienie odnosi się w głównej mierze do ekonomicznych konsekwencji mieszania produktów modyfikowanych genetycznie i niezmienionych, wpływu zastosowania odpowiednich działań w celu właściwego odizolowania tych produktów oraz kosztów tych działań. Można wyróżnić kilka kategorii kosztów, które powstają bezpośrednio w związku ze współistnieniem.*

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