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Benefits and costs of co-existence between GM and non-GM supply chains[1]

Key words: GMO, co-existence, costs, benefits, rapeseed, supply chain

Synopsis:
Co-existence refers to the ability of farmers and consumers to make a practical choice between conventional, organic, and genetically modified (GM) products. The paper aims to present the issue of co-existence between GM and non-GM supply chains, as well as to analyze the benefits and costs of this co-existence based on the example of Polish rapeseed chain. The conducted analysis show that the co-existence issues from benefits and costs point of view are difficult to analyze due to the early stage of GM implementation. However different qualitative and quantitative benefits and costs were discussed.

Introduction

Although the first commercial GM crops were planted two years earlier, 1996 was the first year in which a significant area (1,66 million hectares) of crops containing GM traits was planted globally. Since then, there has been a significant increase in plantings. The worldwide acreage of genetically modified (GM) plants is growing year by year and amounted to 114 million ha in 2007 [ISAAA, 2007]. According to the most recent data more than 10 million farmers in 23 countries (of which 11 are industrialized countries and 12 developing countries) have grown GM plants, mainly GM soybean, GM maize, GM cotton and GM rapeseed, but GM varieties of e. g. papaya, alfalfa or squash are grown on a very limited area too. EU experience with the cultivation of GM crops remains extremely limited in comparison with other regions of the world. The only GM crop currently cultivated in the EU is GM maize which is resistant to certain lepidorpteran pests. In 2008, GM maize was produced in the Czech Republic, Germany, Spain, Portugal, Romania, and Slovakia on a cultivation surface of about 100 000 ha, equaling 1,2 percent or the EU's total maize area. [ISAAA, 2007]. One should point out that despite

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prohibition GM maize is grown in Poland too, on the area of ca. 3000 ha in 2007 [Maciejczak, 2008]. It is important to mention that the EU imports around 40 million tons of soybeans mainly from USA and Latin America, which are at least partly GM.

In contrast to the increasing use of GM plants in world-wide agriculture, the acceptance of GM food is still low in the European Union [Costa Font et al, 2008]. Similar situation is observed particularly in Poland [Zakowska-Biemans and Maciejczak, 2007]. In order to deal with the opposition of EU consumers and several member states, the EU adopted a series of regulations related to genetically modified organisms of which the regulations (EC) No 1829/2003 and 1830/2003 (dealing with the admission, labelling and traceability of GMOs) have special impact on the food and feed industry. Important targets of these regulations are to ensure freedom of choice for consumers and users of GM and non-GM products as well as to avoid environmental and health risks associated with the commercial use of GM products. However, it is important to remember that the above regulations deal with GM food and feed products which have been approved in the EU either for commercial use, import or export. GM food and feed should only be authorized for placing on the EU market after a scientific evaluation of any risks which they might present for human and animal health and for the environment, i.e. GM food and feed which are approved for commercial use in the EU are regarded by the regulatory authorities to be safe for consumers and do not cause any adverse effects to the environment or ecosystems - at least at the current stage of knowledge.

According to regulations (EC) No 1829/2003 and 1830/2003 food and feed products have to be labelled to contain GMOs or GM material in case a tolerance threshold of 0.9 % is exceeded for EU authorized GMOs and 0.5 % for unauthorized GMOs if they have already received a favourable EU risk assessment. Products containing traces of GMOs below the appropriate regulatory thresholds are exempted from labelling provided that compliant traceability systems are in place and traces of GMOs are adventitious and technically unavoidable. Also animal food products which were produced with GM feed compounds do not have to be labelled. Products containing GMOs (above the threshold) must be labelled as such, even when the GM material is undetectable by analytical tests. In these cases, product traceability has to be mandated through documentation systems and implementation of these systems for the entire supply chain.

Data and Methods

This empirical analysis of co-existence was based upon rapeseed supply chain analysis and stakeholders' interviews in Poland. Interviews focused upon a general description of companies

and processes, and on the solutions currently adopted to deal with co-existence between GM and non-GM products. There were 5 companies interviewed, which process majority of rapeseed in Poland. Additionally ca. 25 stakeholders were interviewed. The researches were conducted in the period 2007-2008.

In the analysis the most important levels of the analyzed rapeseed value chain in Poland have been taken into account. While farmer, elevator and processors are included in the calculations, seed production, imports and exports as well as whole and retail trade are excluded mainly due to lack of existing data. It is important to mention that an empirical exaltation of quantified benefits of applied segregation and traceability systems (based on practical schemes and measures in companies) was not possible as the case of GM co-existence currently is not present in Polish rapeseed value chains. Due to this lack of knowledge and experience the interviewed stakeholders could not give concrete information of the (beneficial) impacts of introducing such systems. However, some interviewees see the main beneficial effects of applied co-existence systems that the market partners (in particular food retailers) and finally consumers might be willing to be interested and in the long-run might accept GM food products in Europe. In order to get some insights in possible benefits arising through the implementation of product differentiation systems a literature research was conducted too.

The cost calculations for co-existence measures at each level of analyzed rapeseed value chain follows the principle to aggregate all incurred costs for cultivating and transportation of crops or processing of the raw material crops on the different levels and to increase the price of the final product at each level. This means that e. g. the commodity price of rapeseed is increased by the costs of co-existence measures on the farm level in order to comply with the threshold of 0.9 % for adventitious presence of GM material. The resulting price for secured non-GM rapeseed is automatically the non-GM commodity price in the next level of the value chain, while the price of GM commodity represents the current price level without any co-existence measures. This principle is used at all stages of the supply chain thus aggregating the additional costs for respecting the 0.9 % threshold of adventitious presence on all and setting the price for the non-GM product at the end of the value chain.

The issue of co-existence

The European Commission is liberalizing the introduction of GM cultivations in the EU very carefully. The EU decision to introduce labeling thresholds for adventitious presence of genetically modified material in non-GM products, necessary to safeguard consumer choice,

paved the way for a regulated co-existence between GM and non-GM crops. Co-existence in principle refers to the ability of farmers to make a practical choice between conventional, organic or genetically modified crop production, in compliance with the legal obligations for labeling and/or purity criteria. Co-existence between GM, conventional and organic farming is governed in the EU by the principle of "subsidiarity"[2]. It means that the Member States are to adopt their own national strategies to promote co-existence. The European Commission is in charge of gathering and coordinating information on the topic, developing guidelines based on that information and monitoring Member States' progress. Consequently, in 2003 the EC adopted a Recommendation on guidelines for the development of national strategies and best practices to help the Member States develop national legislative or other strategies for co-existence between GM, conventional and organic farming [EC, 2003]. According to these guidelines, co-existence is concerned with the potential economic impact of the admixture of GM and non-GM crops, the identification of workable management measures to minimize admixture and the cost of these measures. Thus co-existence measures and liability laws can generate extra costs at different levels of value chain. Generally, the trend followed by the Member States has been to place the burden of these costs on the producers of GM products [EC, 2006]. According to the EC guidelines, the farmer who introduces the new type of production should bear responsibility for implementing the farm management measures necessary to limit gene flow. The segregation measures applied under co-existence rules enable the cultivation of GM crops, while protecting farmers of non-GM crops from adverse economic consequences of accidental mixing of crops with GMOs. Following the Commission Recommendation of 2003, co-existence measures shall be science-based and proportionate and must not generally forbid the growing of GM crops. Published recently in April 2009 second report on national strategies to ensure co-existence of genetically modified crops with conventional and organic farming concludes that Member States have made significant progress in developing co-existence legislation during the last years. This development of the legislative framework has gone hand in hand with a moderate expansion of the cultivation of GM crops. At the present time there is no indication of the need to deviate from the subsidiary-based approach on co-existence [EC, 2009]. In 2008 European Commission initiated the work of European Co-Existence Bureau [http://ecob.jrc.ec.europa.eu/]. By 2009, 15 Member States have adopted specific legislation on co-existence (AT, BE, CZ, DE, DK, FR, HU, LT, LU, LV, NL, PT, RO,

[2] Defined as the principle that the EU does not take action on a particular subject unless it is more effective than action taken at national, regional or local level (http://europa.eu/scadplus/glossary/subsidiarity_en.htm).

SE, and SK). In some of these Member States, the competence lies at regional level (AT, BE), and not all regions may be covered by the legislation in place. Draft legislation of three further Member States has been notified to the Commission, including Poland.

Benefits of co-existence

At the farm level simple implementation of GM varieties reduces the production risk through stabilization and increase of yield, as well as reduction of some variable costs in comparison to the conventional technologies. Moreover, the application of GM technology in the EU influences also the profit risk. In this case, the analysis showed that the level of profit risk depends largely on the costs of co-existence measures enforced by the EU legal regulations of GM production [Maciejczak, 2008]. Additionally the rapeseed supply chains stakeholders in Poland indicated only very few benefits of segregation and traceability during interviews. The following qualitative and quantitative benefits could be mentioned there:

- Premiums for non-GM characteristic
- Improvement of management
- Increase of credibility for business partners
- Increase of credibility for consumers.

As data for Polish rapeseed chain are very limited the literature research shows benefits of co-existence in other countries. Smyth and Phillips [2002] gathered and described examples of functioning product differentiation systems and their benefits appearing at the particular rapeseed supply chain levels (they are all settled for Canadian production practice but show the potential benefits for a transmission to EU market means). The segregation system HEAR originated a developed rapeseed breeding program at the University of Manitoba that sought to increase the level of eruic acid to 55% and was installed between producers under registration, an elevator company and a bigger food provider. The registration is mandated by a national food inspection agency. Producers receive financial benefits in three different forms. First they receive a price premium above the market price at the time of delivery or contract price lock-in. Second, all producer freight costs are paid by the food company. Finally producers are compensated for dockage, which results from the limited weed control options that producers have with these special rapeseed varieties. Another example described by Smyth and Phillips is the launching of a system for grains and oilseeds named COFFS. The goal of this program is to provide assurance to export markets and domestic consumers at the same time that the domestic production and marketing of the crops has the highest standards possible and bases on the

HACCP approach. The argument being used to justify this system is that the entire supply chain has to accept responsibility for food safety. The appearing benefits are global summarized for all actors along the supply chain. Premiums and the argument of continued market access will be available initially to attract producers to the traceability program.

Costs of co-existence

An herbicide (glyphosat) tolerant GM oilseed rape is considered in the calculations. The only available ex-ante analysis of this rapeseed production in Poland executed by Aniol and Brookes [2005] indicated that the yield of GMO varieties might be ca.15% higher then the conventional. Accordingly, the total variable costs might increase from 8 to 11%. This increase is connected to the prices of the GMO certified seeds, which might be higher by 3 times then conventional. A scenario where 20% of the total production is conventional non GM and 80% is GM is regarded as the most realistic, with some annual deviations [Maciejczak and Was, 2008]. The most realistic co-existence measures to be applied are non-GMO buffer zone on the GM field, field monitoring and certification. There are also taken into account possibilities of time isolation as a co-existence measure.

With regard to transport, storage and processing strategy of spatial specialization is not considered as a practicable option, since the setting up of a separated, storages or parallel processing line in the facilities would not be economic viable. Similarly, strategy of spatial segregation – is not likely to be economic viable either. Strategy based on time specialization, appears to be the first best option. In this case the production involves shifts between GM and non-GM rapeseed, the shutting down of the processing line and its thorough cleaning at intervals depending on the production capacity. The sequence will be non GM production followed by GM production in order to minimize downtime and cleaning costs.

According to the calculations, the major extra cost for the production of non GM rapeseed oil compared to the traditional one under Polish conditions at the farm level appears to be costs of co-existence measures and the auditing and certification. At the storage and the processing level the cost of the non GM raw material should be taken as the dominating. The cost of testing can vary quite significantly, though this cost is still minor when compared to the cost of the non GM raw material.

The results of the calculations for the farm level in Poland show that although GM farmer will need to spend more money for variable costs such as certified seeds, the non GM production is associated with higher costs. The most expensive measure are the buffer zones, which costs

under assumed conditions amounts to 63.09 €/ha. The second group of expenses forms costs of administration and control (certification and audits). The cheapest are measures involving work of farmer itself, i.e. cleaning and monitoring. The calculations show that the additional co-existence costs at the farm with regard to rapeseed production will be 71.43 €/ha, or 17.86 €/ton accordingly (see table 1).

The calculations under assumed conditions show that the co-existence costs for the elevator will be influenced especially by the additional commodity costs, i.e. 72,5% and audit costs 21,8%. As the elevator will apply the strategy of contamination's prevention the testing costs are not too high comparing to other stakeholders. The share of prevention costs in the elevator's turnover has been calculated for 6,1%. Under the assumption that the elevator stores 1000 tons of rapeseed and 50% of it is non GM the additional commodity cost equals to 26,6 €/ton, certification amounts to 8,0 €/ton and the testing costs will be 1,4 €/ton, while the cleaning costs based on flushing will be 0,65 €/ton.

The co-existence costs for the crusher will be influenced mainly by the additional commodity costs, i.e. 99,6%. All other costs are of minor significance. The share of prevention costs in the crusher's turnover has been calculated for 3,6%. Under the assumption that the processor processes annually 400.000 tons of rapeseed and 50% of it is GM and 50% is non GM the additional commodity costs amounts to 16,2 €/ton, while other costs remain minor. The total additional co-existence costs at the processor level has been calculated for 16,31 €/ton.

Table 1: Costs of traceability and co-existence measures for non-GM rapeseed oil for human consumption on the different levels of the value chain in Poland

Level of the value chain	Measures to ensure co-existence and traceability	Additional costs: total costs (€/ton)
Farmer	Additional production costs Non-GMO	-46,11
	Cleaning costs	1,85
	Costs of buffer zones	63,09
	Monitoring costs	2,60
	Costs of administration/certification	25,00
	Miscellaneous costs	25,00
	total	17,86
Elevator	Additional commodity costs	26,60
	Testing costs	1,44
	Cleaning Costs	0,65
	Certification costs	8,00
	total	16,51
Processor	Additional commodity costs	16,20
	Testing costs	0,06

	Miscellaneous costs	0,03
	Cleaning costs	0,01
	Training costs	0,01
	total	16,31

Source: own calculations

Conclusions

The importance of co-existence issues is growing in Europe simultaneously to the growth of implementation of GM varieties. Adventitious mixing of GM material with a non-GM product can occur at various stages along the product supply chain, thus it is important to implement the relevant measures to avoid admixture. The conducted analysis show that the co-existence issues from economic point of view are difficult to analyze due to the early stage of GM use. One needs to remember that at the end the gain or loss from implementation of GM production is always depending on consumer and its willingness to pay for GM or non-GM product. Finally the conducted analysis shows also the urgent need for further researches of this important and new – from economic point of view – issue.

Summary

Co-existence refers to the ability of farmers and consumers to make a practical choice between conventional, organic, and genetically modified (GM) products, based on compliance with the legal obligation for labelling and/or purity standards. Adventitious mixing of GM material with a non-GM product can occur at various stages along the product supply chain, from the field where the crop is grown to the handling and processing plant. The paper aims to present the issue of co-existence between GM and non-GM supply chains, as well as to analyze the benefits and costs of this co-existence based on the example of Polish rapeseed chain. The conducted analysis show that the co-existence issues from benefits and costs point of view are difficult to analyze due to the early stage of GM implementation. Although it was shown that in case of Polish rapeseed chain the additional co-existence cost might reach ca. 17 euro/t of ultimate product while the benefits might be connected to premiums paid for non-GM products, improvement of management, increase of credibility for business partners and increase of credibility for consumers.

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Korzyści i koszty współistnienia produktów modyfikowanych genetycznie i niezmienionych w łańcuchach dystrybucji

Streszczenie

Wraz z dynamicznym rozwojem produkcji rolniczej wykorzystującej gatunki roślin modyfikowanych genetycznie (GMO) rośnie znaczenie kwestii współistnienia produktów GMO i niezmienionych w łańcuchach żywności i pasz dla zwierząt. Współistnienie pociąga za sobą konieczność wdrożenia, niezbędnych praktyk i działań, które umożliwiają zachowanie czystości i integralności produktów. Podstawowym warunkiem współistnienia jest zagwarantowanie konsumentom możliwość rzeczywistego wyboru spośród dostępnych produktów pochodzących różnych systemów rolniczych. Współistnienie rodzi określone korzyści i koszty. Na podstawie przeprowadzonych analiz w odniesieniu do łańcucha rzepaku w Polsce scharakteryzowano je kwantytatywnie i kwalitatywnie. Stwierdzono, iż koszty współistnienia dla ostatecznego produktu wynosi ok. 17 euro/tonę, zaś korzyści związane są z marżami płaconymi za produkty niemodyfikowane, podniesieniem poziomu zarządzania a także wzrostem zaufania partnerów biznesowych i konsumentów.

Słowa kluczowe: GMO, współistnienie, koszty, korzyści, łańcuch dystrybucji, rzepak

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