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The impacts of the global financial and economic crisis on the agro-food sector of Central and Eastern European and Central Asian countries

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Abstract

This paper assesses the impacts of the global financial and economic crisis on the agro-food sector of Central and Eastern European, Caucasus and Central Asian countries on the basis of research conducted in Hungary, Ukraine, Armenia and Kyrgyzstan. The objective of the study was to propose policy options to the Food and Agriculture Organisation of the United Nations and other public authorities which can be applied to lessen the undesirable effects of the current or future crises in the sector. Results of interviews of stakeholders were analysed in the context of primary economic data and sixteen policy recommendations were formulated.

Keywords

financial and economic crisis, agro-food sector, Central and Eastern Europe, the Caucasus and Central Asia

Introduction

This paper assesses the impacts of the global financial and economic crisis, hereinafter 'crisis', on the agro-food sector of Central and Eastern European, Caucasus and Central Asian countries on the basis of research conducted in four representative countries, namely: Hungary, a central European country and a member of the European Union (EU); Ukraine, a large eastern European country occupying a strategic position between the EU and the Russian Federation; Armenia, located in the Caucasus region on the border of eastern Europe and western Asia; and Kyrgyzstan, located in central Asia.

Among developing regions, Eastern Europe and Central Asia has been hit hardest by the global crisis. For several countries, a combination of international support, adjustment programmes, and perhaps even private sector debt restructuring will be needed to avoid large-scale defaults. Growth plummeted from 7.6% in 2007 to 4.7% in 2008, and was projected to be -5.6% in 2009 driven by a collapse in capital inflows, a sharp deterioration in terms of trade, and contraction in both domestic and external demands. The robust domestic demand that supported growth throughout 2007 and through the first three quarters of 2008 began to wane at the height of the crisis in September 2008. In several countries with data available for the first quarter of 2009, output deteriorated further on a year-on-year basis. Economic activity continued to shrink in Hungary (4.7%), Lithuania (13.6%) & Latvia (17.9%), while Romania and Russia recorded negative growth for the first time (6.4% and 9.4%, respectively). Poland, the only economy to show resilience, posted a GDP increase of 1%. See World Bank (2009) for a comprehensive overview of the financial and economic crises in the region.

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Agriculture in Hungary has been losing its share of Gross Domestic Product since the change of regime in 1990 because it has developed at a slower rate than other sectors of the economy. In 2008 agriculture, forestry and fishery produced 3.7% of GDP, while a further 2.3% was contributed by food processing, figures which are close to the data of the developed EU member states. The share of GDP of the agro-food industry together with input manufacturers and different supporting services is estimated at over 8%. In 2008, 174 thousand employees worked in agriculture and 127 thousand people in food processing together representing 7.8% of the active population. In both sectors employment declined by over 10% in five years. There are regions though where the agro-food sector is still one of the major employers. Agricultural and food products account for about 6-8% of Hungarian exports and 4-6% of imports. In 2008 the value of agro-food exports exceeded EUR 5.7 billion, while the value of imports was over EUR 3.8 billion. The surplus in trade is an important contribution to the state fiscal balance. National self sufficiency is assured for most products but, because of the unstable supply chains and the low competitiveness of food processing, imported products have been increasing their share of the Hungarian market since the EU accession in 2004. Due to the favourable weather and high prices agriculture performed well in 2008, but in 2009 a strong correction was expected. According to the first official estimates of the Economic Accounts for Agriculture, agricultural output value was forecast to decrease in 2009 by 19% as a consequence of 9% lower prices and 11% lower volume.

Ukraine's agrarian sector is the only branch that has not worsened its performance during the crisis. According to the State Statistics Committee of Ukraine, aggregate output of agricultural products in Ukraine in all entity categories grew by 3.3% over January-September 2009 compared to the same period of 2008, including by 6.1% at agricultural enterprises and by 1.4% in private farms. Output of plant growing products has increased by 3.4% over the first nine months of 2009 as compared to the same period of the previous year (including by 4.1% at agrarian enterprises and by 2.9% in private farms), mainly due to accelerated rates of harvesting of sunflower and sugar beet as well as owing to greater output of vegetable, fruit and berry products. The total output of animal breeding products during January-September 2009 increased by 3.2% as compared to the same period of 2008, including a 9.8% rise at agrarian enterprises and 0.9% decrease in private farms (SSC, 2009). However, whereas the sector looked rather successful in comparison to the entire Ukrainian economy, agrarian nongovernmental organisations, some politicians and agrarian scientific institutions point to considerable problems in Ukraine's agro-food sector that have aggravated under the crisis and can become yet sharper in the future. These problems concern financing and lending for all the actors of the agro-food supply chain, their operating performance, assets renovation and engagement of investments, expansion of sales markets, etc.

Armenia, being an in-transition nation, greatly depends on agriculture. The share of agriculture in the GDP for the last five years (2004-2008) averaged about 18.8% (Agrolratu, 2009). About 46% of employment in Armenia and about 60% of income in rural areas was due to the agricultural sector over the past five years. During that period (2004-2008), the average annual growth in agriculture was about 7.4%. This helped the case of food self-sufficiency, which in 2008 increased to 60% in the country. The local demand for plants, potatoes, main fruits, grapes and veal is 98% satisfied by the local production, whereas the self-sufficiency level is quite low for wheat (40%), other grains (50-55%), poultry (15-17%) and pork (50-55%). All these just point to the fact that agriculture is critical for Armenia. Specifically, improving agriculture could lead to poverty reduction, food security, increase in quality of life especially in rural areas, stability, and strategic improvement of the other sectors.

Although only 7% of the land area is of Kyrgyzstan is suitable for productive agriculture, at least 80% of the country has been classified as range-land suitable for grazing. Agricultural land covers 10.6 million hectares with arable land accounting for 1.1 million ha. Agriculture, hunting and forestry make 29% of the total GDP of Kyrgyzstan, with crop production making 58% of the total agricultural output (2008). However, agriculture growth thus far has been driven more by the desire of rural households to increase food security then as a response to market incentives. Agricultural reforms led by the government and supported by various donors have so far focused on creating new public institutions and infrastructure. Productivity is very low, there is a lack of knowledge and technologies at farmer levels, markets are not developed and access to existing markets is limited. Inputs and outputs are limited and vulnerable to changes in prices and demand.

In summary, therefore, Ukraine and Hungary are both net exporters and maize and sunflower exports of the latter are significant even on the world market. Both countries are considered to be very vulnerable to the effects of the crisis. Hungary is supported by and in some ways also trapped by the Common Agricultural Policy (CAP) of the EU. Armenia is an open economy entering the crisis after recent spectacular economic development and the impact of the crisis here might be the most adverse in terms of decline in GDP. The shift from subsistence to market oriented farming is almost finished but the country is still highly dependent on food imports. Kyrgyzstan is a small, closed economy in comparison, where agriculture is based on traditional household farming where the majority of production is for self consumption. In recent years the country's total agricultural trade has come close to balance. Dairy products account for half of agricultural exports, representing 7% of foreign trade; however only 7.1% of the milk produced is exported.

The objective of the study was to propose policy options to the Food and Agriculture Organisation of the United Nations (FAO) and other public authorities (including those in countries represented in the study) which can be applied to lessen the undesirable effects of the current or future crises in the agro-food sector. As the data available to assess the impacts of the crisis on the sector in the region are limited, the research took the form of interviews of stakeholders in selected supply chains, the results of which were analysed in the context of primary economic data. The research also sought to gather useful country-specific, qualitative information on rural incomes, poverty and food insecurity/malnutrition, on exports and on other factors beyond the supply chain. Factors which were independent from the crisis (i.e. legal environment, weather, etc.) have of course also contributed to the state of the agro-food sector in every country. As far as possible, their impacts have been distinguished from those of the crisis. Although the results of the study are not necessarily applicable to all of the agro-food sectors and countries in the region, they are indicative of the present trends and thus provide an adequate basis for drawing conclusions and recommending policy options.

Methodology

Summary of the research questions

The research focused on the effects of the economic downturn, indirect or direct credit constraints, trade and trade credit impacts on production and consumption. Credit issues included trade financing, payments, investments and foreign direct investment. Partly through the choice of supply chains and partly through the structure of the interviews, the impact of the crisis on poor farmers was taken into account. The overall research questions addressed in the study were therefore: (a) what are the key factors affected by the financial and economic downturn; (b) to what degree have the key factors been affected; (c) has the downturn affected different sectors or different parts of the

supply chain in different ways; and (d) what policy options can be recommended. To address these questions, a common framework was adopted for all interviews, as follows:

- What is the current state of the agro-food sector compared to three years ago (i.e. 2006)?
- What are the principal factors causing changes to the state of the agro-food sector?
- What strategies have businesses adopted to cope with these changes?
- How is the situation likely to change?
- Policy responses and recommendations
- Other issues

Rationale behind the choices of supply chain

It was anticipated that the crisis would have different effects in the different agro-food supply chains in the four countries. Therefore it was planned that the study would cover at least one crop supply chain and one livestock supply chain in each. The supply chains were selected as having a significant share in the country's production output, or of its trade. The fact that the choice of supply chains should facilitate the analysis of the impact of the crisis on poor farmers was also taken into account. It was also decided that that one commodity for which supply chain information is available from all four countries would be included. The obvious candidate was wheat, a major crop in all four countries which is widely traded internationally. Due to its importance (food security, social aspects, rural livelihoods, etc.) wheat production is one of the few sectors which are subsidised by government. As wheat products are a significant component of the household food budget in all four countries, its study would also offer insights into food insecurity and poverty.

In Hungary in 2008, wheat production represented 29.5% of the total agricultural output. Since livestock production in Hungary is dominated by the pig and poultry sectors, part of the harvested wheat (0.7-1.2 million tons a year) is used for feed. Wheat deliveries alone represented EUR 464 million of the EUR 5.7 billion of Hungarian agro-food exports in 2008. Growing grain crops provides more than 20% of Ukraine's gross annual agricultural production output and accounted for 38.6% of the export of agro-food commodities in 2009. In 2008, 4.088 million tonnes of wheat were exported (MAPU, 2009). The share of winter wheat production is: agricultural enterprises: 66%; personal peasant farms: 21%; private farmers: 13% and the bread market is tightly regulated. Armenia depends heavily on wheat imports, with the level of self-sufficiency being as low as 31-43% (NSS, 2008), and is very vulnerable to price fluctuations. In 2008, the government developed a programme for wheat self-sufficiency which could be implemented by bringing in high value seeds, providing agricultural machinery and subsidising lands for wheat production. In Kyrgyzstan wheat occupies about 42% of arable land. Over 95% of wheat is produced by private farms: in 2008 there were just under half a million farms registered with arable land growing wheat. 650-800,000 tonnes are produced annually in Kyrgyzstan and a further 300,000 tonnes are imported from Kazakhstan and Russia. Flour and flour goods account for more than 36% of household expenses for food.

Sunflower in Kyrgyzstan was selected for this study as the crop is produced at the small household level (mostly on farms with less than 5 ha of arable land). Having become a significant support for the poor, which is mostly rural dwellers, homemade sunflower oil production has been increasing from year to year. There are prospects for replacement of imported sunflower oil by locally produced oil but there is a problem that the home-made products are not completely refined. A by-product of production, cake, is used as a fodder additive for livestock.

Following land privatisation, farmers in Armenia destroyed most of the vineyards and wineries stopped their production. In recent years, however, grape production has been revitalised and

grapes are produced not only by individual, small-scale farmers who own 95% of the 35,000 ha of vineyards in the country, but also by large farms. The total annual grape supply in the country (160,000-230,000 tonnes) is mainly produced locally and Armenia is 98-100% self-sufficient. Most goes to brandy production. Armenian brandy accounts for 90% of exports of alcoholic beverages.

Pig breeding is one of the most important traditional sectors both in Hungary and Ukraine. In Hungary, pig meat has about a 45% share in both meat production and meat consumption. Many smallholders and households are still active in pig breeding and rearing (although the numbers have declined dramatically in recent years) while the processing industry is predominantly supplied by large scale producers. In December 2008, the registered 3.4 million pigs were divided between slightly more than 530 agricultural enterprises possessing two thirds of the livestock and over 260,000 private holders and households with the rest. In Ukraine the share of pork now is equal to about 35% (or 620,000 tonnes) of the total production of meat of all kinds. Since 1990, the stock of pigs has declined by 2-3 times and the structure of pig raising has changed. Before disintegration of the Soviet Union the major part of livestock were concentrated in public sector, while now about 63% of pigs are kept in private farms. Issues include ageing of equipment, distortion of infrastructure and meat markets and increased competition from imports.

Livestock is one of the major parts of the rural economy in Kyrgyzstan and 87% of the territory is occupied by meadows and pastures. Milk is an important element of the diet, with almost 90% of households reporting to consume it. Most milk is produced by smallholders who generally own two or three cows and who sell excess production to processors either directly or through local traders or collected by the processors themselves of which there are more than 390 in the country. In Armenia, milk production and milk processing have increased significantly during the last eight years. All 42 former state-owned dairy factories were privatised during the 1990s and many small plants emerged. No single dairy processing company dominates the market. Farmers have gradually integrated into market relations and switched from subsistence to commercial farms.

Interviewee target groups

Interviews were conducted with representatives from all tiers of each supply chain. Besides agricultural producers, the impacts of the crisis were discussed with input suppliers, processors, integrators, traders and retailers. Participants of the survey were major players in these supply chains with respect to market share, annual income etc. and the interviewees were key informants who were able to provide an overview of the chain. The selection of interviewees was the responsibility of the country representatives, since they have the specific local knowledge, and preference was given to companies that are vertically integrated in the supply chain.

Representatives of banks and government officials were also interviewed in each country. The government sector covered those who are related to policy making and implementation, especially government officials, and also decision makers and/or government advisors. Some additional guidelines given to project partners were as follows:

- Farmers were to be representatives of business oriented entities
- A small number of NGOs (e.g. farmers' organisations) may also be included (possibly one per sector), as may a representative of a consumer organisation
- Banks can also include foreign investors and international donor money (if appropriate)

Results

Wheat and sunflower supply chains (four countries)

The crisis had no significant impact on grain production in most countries in the 2008/09 crop year. Although it became more difficult to obtain money from the banks even if credit applications were approved, wheat farmers, in general, were still able to finance their businesses. But consecutive above-average world wheat crops in 2008/09 and 2009/10 boosted supplies while use was constrained by the slow-down in the global economy, deteriorating farmer confidence significantly in comparison with the first half of 2008. However, in most cases, this had more to do with the decline of producer prices or the general macroeconomic environment than with the crisis directly.

However, as farmers became less sure of their financial situation (partially due to the decrease of remittances in some countries) and the scant precipitation failed to support crop growth in most regions of Central and Eastern Europe and Central Asia during the last months of the 2008/09 crop year, sales volumes of all inputs, in particular of fertilisers and crop protection products, started going down. In most Central and Eastern European countries, the demand for agricultural machinery was noted to have dropped back significantly too. In some Central Asian countries, even the purchase of fuel for the harvesting and the following sowing season represented a problem.

Due to the limited selling opportunities and to the bearish wheat market outlook, arable farmers favoured further cost saving production technologies in the first half of the 2009/10 crop year. Grain producers began to look for cheaper seeds and agrochemicals and some changed their crop rotation to reduce the need for inputs. Land lease contracts were terminated, mostly on less fertile parcels in marginal areas. The aims at cost savings were not only reflected in the choice of technology but also in production decisions: in the autumn of 2009, winter wheat plantings declined in many of the Central and Eastern European and Central Asian countries.

Most market leading multinational input suppliers and traders use EUR or USD based credits provided by their parent companies with substantially lower interest rates than bank credits in national currencies. The increase in interest rates of parent company credits was described as insignificant during 2008 and 2009. As opposed to the multinationals, domestic input distributors, integrators, processors and traders as well as arable farmers who sell their grain on the market largely depended on external credits. These stakeholders reported the review and modification of already approved credit applications, the re-evaluation of their collaterals, stricter credit conditions and increased credit charges in all countries. In general, banks prolonged the process of credit approvals, carried out more cautious risk analyses and shifted decision making to a higher level. Notwithstanding these changes in the procedures, credit applications were more often declined, even when the value of offered collaterals was several times above that of the credit amount. The funds of some banks shrunk to such an extent that even their customers with high reputation and excellent credit history faced difficulties in accessing credits. Banks preferred not to finance grain inventories any more, and even refused public warehouse receipts as collateral (e.g. in Hungary).

The bulk of the individual wheat farmers tried to exist without credit. These market players usually took short-term loans from integrators to cover their variable costs but, due to the crisis, these external financial sources became more expensive too. Smallholders use financial lease and bank credits almost exclusively for implementing relatively large-scale investments (i.e. buying a new machine or constructing a new grain store, etc.). Integrators often claimed that, as a consequence of the increasing liquidity problems, low crop prices and weak demand, payments by farmers

were overdue by far more than a month. Distributors became more careful about which producers to supply and put tough audit checks in place.

Increased foreign exchange risks represented a serious challenge for most businesses in the wheat supply chain of every country. Outside the EU, notably in Central Asian countries, input prices are often set and credits are often provided in USD, whereas the revenues of farmers and processors are in national currencies.

Vertically integrated enterprises with strong business ties and sufficient capital reserves were said to be less impacted by the financial and economic crisis. Agricultural holdings were also thought of as die-hards since their structure allows for expenses and financial flows to be optimised and funds to be redistributed when necessary.

In both the Central and Eastern European and the Central Asian region, most stakeholders in the wheat supply chain postponed their investments. However, in the new EU member states, farmers and processors tried to complete their already running investment projects partially financed from EU funds, but within an extended time period, whenever it was possible. Despite the cold investment climate, to secure their future market positions, some of the large agricultural holdings in Ukraine were desperate to spend more especially on the development of their logistics (new river terminals, grain stores, etc.) while well managed bakery firms in Hungary pursued product development and strengthened their marketing efforts. Large and financially sound enterprises were expected to carry out acquisitions of the weaker ones with attractive regional sales markets, raw materials base, storage facilities, etc.

Due to their liquidity problems, processors preferred to buy grains and flour on a daily basis and held smaller stocks, thereby trying to transfer the cost of storage on to stakeholders upstream. To reduce costs, many input suppliers and processors shortened working weeks, sent workers on paid or even unpaid leave, or cut wages. The major agrochemical factories in Ukraine were reported to operate at only half capacity. More attention was paid to energy use and outdated machinery was disposed of whenever it was possible. Millers and bakers turned towards cheaper low quality raw materials such as feed wheat. As a consequence, the quality of most bakery products, in particular of bread in the low price segment declined significantly, especially in Ukraine.

While large processors had to cut production, many of the smaller ones were forced to close their businesses[2]. Due to the financial and economic downturn, the unfavourable macroeconomic and legal environment, many tried to avoid paying taxes and social contributions (e.g. in Hungary). Processors faced extra difficulties in countries still in transition where the importers of raw materials are few and have a strong bargaining power (e.g. in Armenia), because the decrease in world market prices were not transmitted entirely. Mills in Ukraine tried to limit the increased risks in the flour business by pursuing other, mostly unrelated business activities which are good examples of diversification.

As regards grain trading, in 2009, the prompt buying of grains became dominant, while forward contractors preferred deliveries in 3-6 months rather than 6-12 months as before. This made markets more nervous and greatly increased price volatility. Many of the foreign buyers aimed to cover their needs from their domestic markets as much as possible, thereby minimising grain imports. Large grain importers in some countries, also within the EU, became more sensitive to swings in the foreign exchange rates and cancelled tenders more often than before. This made the organising of logistics very difficult for exporters. In addition, business trust between farmers and

[2] As for the sunflower sector in Kyrgyzstan, where processing is extremely fragmented about 60% of the oil mills had been closed within 18 months since 2008.

traders weakened considerably. With the creditability of buyers declining, and due to their liquidity problems, most suppliers demanded pre-payment or other guarantees. Banks and thus traders too turned their attention from country risk to individual company risk. Regarding risk management, traders, in general, aimed to reduce credit risk on clients, to secure payment conditions and to use credit insurance whenever possible. Traders experienced difficulties in obtaining credit to cover the cost of their stocks, therefore, in most countries, only limited quantities of grain were procured in the 2009/10 crop year and these could be stored for only a short time. Not only were grain prices low but, due to their increased fluctuations, and also because of the exchange rate volatility, banks valued grain inventories of traders considerably below their futures markets quotations.

Although traders, due to weakened bargaining position of farmers and integrators, were quite often referred to as winners in the crisis situation, opportunist grain dealers, whose number increased in recent years when prices were high, were expected by professional market players to go out of business as they were less able to pay to producers and finance inventories even at low prices. This was thought to be beneficial for most of the stakeholders because transaction costs may decline; however, many individual arable farmers could suffer from being cut off from their main source of financing. Indeed, in some countries (e.g. Armenia) buyers' payments were several months overdue.

In Ukraine, local authorities can set limits of profitability for production of lean-formula bread (flour, yeast, salt, water) weighing over 500 g as well as limits of trade mark-ups to the wholesale price of that bread's producer. About 50% of bread made in Ukraine is subject to such regulation.

Grape/brandy supply chain (Armenia)

Farmers were generally affected by the higher prices of inputs. Those who were able to market their produce stated that prices were much lower in 2009 compared to 2008. However, there were many farmers who were not able to sell because of the limited demand by processors. Moreover, the processors often failed to make timely payments and farmers needed to obtain loans to continue farming and the availability of these was limited by the banks. Hence, most of the farmers used up all their personal funds living at a subsistence level.

Due to the crisis, processors and traders were affected by an approximately 30-50% decline in the sales volume of cognac and other processed goods. All the grape processors sell over 90% of their production outside of Armenia, particularly to Russia, hence the decline in sales volume was mainly a result of reduced foreign demand. One the one hand, the AMD depreciation helped most of the grape processors as a large portion of their products was exported. On the other, many processors stated that their costs increased due to high raw material prices, high inventory costs and expensive credit. Many small companies which were not major players went out of business or were on the verge of bankruptcy, while the big players in the market were surviving with hope. The outlook for the sector as a whole was uncertain and largely dependent on the global economic situation. The long term outlook for those that survived the crisis was good, however, because of the vanished small-scale competitors from the market.

Pigmeat supply chain (Hungary and Ukraine)

Although the pre-crisis situation of the pig breeding sector was different in Hungary and in Ukraine the perception of the crisis was similar and at most points in the chain the impact has been somewhat less so far than most stakeholders expected. In Hungary a significant increase in pig prices, 14% in the first half of 2009, and the demand driven market put producers in a favourable

position. The compound feed price dropped by 24% and energy prices by 7%. Even though veterinary products are partly imported, as in Ukraine, producers paid only 8% more for them at the start of 2009 than a year previously. The input suppliers interviewed had not noticed a big decrease in the domestic demand for their products but they did note astonishing price volatility and an unpredictable income situation. The perceived problem was the solvency of some domestic buyers, apparently because the banks were not financing production. On the other hand, expensive or lacking financial sources did not allow suppliers to finance producers as before. Their response to the crisis was not to supply customers who were considered to be a risk, as well as cost-cutting.

In Ukraine the situation was slightly different. Input suppliers to the pig breeding sector, producers of compound feed and suppliers of veterinary preparations found themselves in a difficult position. Before the crisis, their services were used mainly by small pork producers and households. Large pig-breeding complexes had their own veterinary units and compound feed plants. However, the sudden devaluation of the UAH slashed demand from small pork producers in early 2009. This concerned both veterinary preparations, which are almost completely imported, and mixed feeds that include valuable imported components and additives (minerals and vitamins, proteins, amino acids). A move by small entities away from mixed feeds to simple grain in pig raising made feed plants alter their recipes towards lower costs and poorer quality. However, even those products did not secure much increase in demand. As a result, feed plants curtailed production, shut down, cut staff or moved workers to part-time work, and reoriented towards production of feed for poultry.

Hungarian pig farmers were expecting serious consequences when the economic-financial crisis developed but in fact seasonality, i.e. the classical pig cycle, had a stronger impact than the crisis. There was a significant deficit in the market and feed prices had declined, resulting in higher prices and higher margins for pig farmers in the first three quarters of 2009. Though prices were at an acceptable level, buyers began to delay their payments, thereby weakening the liquidity of pig farmers towards input suppliers who were requiring prompt payments. In order to avoid using credit, some farmers extensified their production and owed more to input suppliers. Concerning streamlining of operations and cost cutting in production, adjustments in such a short time were not possible for pig farmers. However, on the input side salaries were frozen and people were laid off. The feeding of on-farm produced grain and scraps became more common. Whenever possible farmers preferred cash transactions because money transfers had been delayed. Investments were postponed, even EU regulated compulsory investments for manure storing and handling, which are the conditions of future operation. Those who were not capable of financing these investments were expected to quit farming in 2009. The pig stock in June 2009 was 14% less than a year earlier, 10% less enterprises and 20% less individual farms were holding pigs than in the previous year. By contrast, the number of pigs raised by private households was thought to have increased. Those who endure believed if the necessary investments can be completed, their competitive disadvantages will not become greater. There were worries that stakeholders operating illegally would benefit from the crisis. Interviewees were not aware of any specific government policy measures which had been taken in response to the crisis.

Livestock changed in the opposite way in Ukraine. The pig population as of 1 October 2009 had increased by 8.0% over the previous year, to 7.462 million. The growth of pork output by Ukrainian agricultural producers was promoted by a considerable decrease in meat imports due to the dramatic devaluation of the UAH. Besides, controls on meat smuggling were rather tough. As a result, imported pork, which created competition in the domestic market, decreased. This secured a growth in meat prices and a higher demand for meat produced by domestic manufacturers. Despite the decline in people's purchasing power, pork prices in Ukraine remained high: as of 1 October

2009, the purchase price of pigs in live weight was 10-15% higher than 12 months earlier. A drop in demand in early 2009 was temporary and was rather easily survived by most producers, especially agro-holdings. The profitability of pig farming was minus 27-20% in 2007-2008 whilst in 2009, positive profitability (2-4%) was forecast for the entire branch. Agricultural enterprises and complexes could increase their pig population in Ukraine, as of 1 October 2009 the number was 17.4% greater to the same date last year. Rural households also reacted flexibly. Cheap feeds encouraged pig population growth in household backyards. As of 1 September 2009 the pig population in households had increased by 1.6% compared to the same period of 2008.

The crisis impacted the supply of raw materials for Hungarian processing. Processors reported that not only the pig market but also the entire meat sector was in a better and more stable situation than the crisis would suggest. It seemed that the consumption of basic food did not decrease to the same extent as of other products, therefore the drop in consumption had a smaller effect on producer prices. The supply of live slaughtering pigs had been decreasing in Europe independently of the crisis and prices jumped from HUF 240 to 330 HUF per kg in the year to August 2009. The peak producer price was unrealistic and in the Hungarian pig market live-pig imports started to increase again in the second half of 2009.

The vast majority of processors agreed that retailers' private label products undoubtedly benefited from the changes in consumer behaviour (consumers had become even more price sensitive). In the retail chains, the share of private label products was growing and was thought to have reached 60% of the total sales. Although it was recognised that banks have had to re-evaluate credits, none of the processing companies in the survey had been significantly affected, but they consider that they had good credit histories. Some processors who were already struggling before the crisis failed at the end of 2008. Retailers tried to delay payments a bit more often. Processors cut back on spending where possible, but invested in improving efficiency. They laid off some employees but recognised that if they were to expand production in the future, it could be extremely difficult to find skilled and experienced work force on the labour market. The increase in the rate of VAT was to the advantage of the illegal market players in the food supply chain. Processers and traders also claimed that in Hungary the retail sector was in favour of the financial crisis because they had a stronger negotiating position with the suppliers.

Due to the decline in people's income and aggravation of the economic situation in Ukraine, meat demand and consumption in 2009 declined by about 5-10%. Additionally a sharp shift towards less expensive poultry meat occurred. An especially acute diminution in demand for meat was seen in the first ten months of 2009 which caused a decline in pork output. By the middle of the year, people adapted themselves to the new conditions and the demand for pork slightly increased. Processing enterprises found themselves in a somewhat worse position relative to pork producers. First of all, demand for products in more expensive and more profitable segments had dropped. On the other hand, meat products in the low-price segment and, to a considerably lesser extent, in the medium-price segment, became highly sought after in 2009. The devaluation of the UAH, together with higher energy prices, resulted in a considerable increase of costs of meat product output (almost 50% of raw meat and all ingredients such as spices, additives, casing, etc. for sausage production were imported). However, processing enterprises could not adequately increase prices of their products since a change of prices of cheap meat products was subject to endorsement by the State Price Inspectorate (c.f. also wheat). As a result, the profitability of processing enterprises fell to a minimum. According to managers of processing enterprises, most pork producers supplied pigs for processing only against prepayment, while retailers delayed payments for meat products sold.

In response to the crisis, suppliers tended to replace quality meat with cheap chicken products and reduced support personnel. Their product range also changed. For example, the output of prepared meat products decreased by 30% (because people cook much more foodstuffs at home). According to estimates by Ukrmyaso National Association of Meat and Meat Product Makers, up to 50% of meat-processing enterprises were expected to be shut down in 2009 because of shortage of finance. Small and medium-sized enterprises facing a lack of floating assets could be especially affected.

Milk supply chain (Armenia and Kyrgyzstan)

The dairy supply chain was largely impacted by the crisis. Dairy farmers and processors were affected by higher input prices and declining demand in both local and international markets. The price of milk and dairy products at the retail chains did not drop as compared to 2008, while the procurement price for milk from farmers went down at least two times. Interviewees claimed that to alleviate the adverse affects of the crisis, no significant policy measures were introduced.

In Armenia, the crisis had perhaps the most impact on agricultural producers. Most of the dairy farmers operated at a loss. The price of milk declined by about 20% relative to 2008 and there was still a large surplus in the market. It was not only the case that farmers were paid less for milk, but payments were delayed by up to three months. Farmers looked for alternatives to make a profit from their cattle, thus most of the remaining cows were held rather for the production of calves. This was more cost efficient and farmers hoped to profit more from meat than from milk. Without any government support dairy farmers were thought to give up production in large numbers, threatening the whole dairy supply chain which has strategic importance in the country.

In Kyrgyzstan, smallholders, who produce the bulk of the milk and who generally own two or three cows, complained about the price of milk falling two times in 2008-2009, and that even direct sales at local markets were often unprofitable. Whilst there may be regional differences, households generally consume about 40% of their milk production and sell the remaining 60% (during the summer). During the winter, with yields falling heavily, most households consume all their own milk. The sector employs some 1,400 workers, principally in a number of large dairy farms around Chui Oblast, which supply 80% of exports. These large farms were also impacted by the crisis.

Although the milk prices declined in Armenia compared to last year, some of the processors, being socially responsible, purchased milk at higher prices than the competitors. Many milk processors stated that their cost increased due to the high cost of utilities, raw material prices and interest rates. In addition, the raw material prices increased in AMD as a result of the 3 March exchange rate policy. The major investment most of the interviewed firms consider was the acquisition of modern technology that was energy efficient and will cut utility costs. On top of all the problems already threatening the operations of processing firms, actions by government were not matched with what is needed under the current crisis situation. However, they were optimistic about the future.

There are more than 390 dairy processing enterprises in Kyrgyzstan but the sector was dominated by several medium and large enterprises. These companies processed 85-88% of the milk which came onto the market and the remaining share is processed through small local companies. Generally, in the past few years, the output of the dairy industry had been decreasing. Exports of milk decreased in 2008 in comparison to 2006 almost six times. The stakeholders most affected by the global financial and economic crisis were thought to be dairy farmers. Traders and processors also experienced problems but their losses were partly covered by farmers.

The demand for Armenian dairy products on the export markets decreased. Russia, the main export destination of Armenian dairy products, was highly impacted by the crisis. The restriction of dairy products shipped to Russia through Georgia as a consequence of the recent war created additional problems for Armenian dairy exporters. Dairy products had to be transported either through Iran or by air which increased transport costs significantly.

Retailing

As a consequence of the crisis, consumer purchasing power declined drastically in many countries in the region. This is illustrated by the example of Tesco Global Kft. in Hungary where FMCG (fast moving consumer goods) sales dropped by 12% year on year in November 2009[3]. In Ukraine, one out of every five retail chains, including giants like Velyka Kyshenya, had to close their less profitable stores as a consequence of increasing accounts payable, growing energy prices, rents and credit charges, and dearer utility services[4]. On the other hand, most of the discount chains (e.g. Ukrainian Retail, ATB-Market, etc.), targeting consumers with average or below average income levels, and some of the large multinational retail chains, offering a wide choice of private label products or pursuing an aggressive expansion policy, were able to strengthen their market positions. Nota bene: retail chains targeting high income level consumers, such as Yeritsyans and Sons in Armenia, were less impacted by the economic downturn because the preferences of the social strata they provide service for changed little. In Armenia, the demand for flour decreased by 20-30%.

Price is the most important factor in the purchasing decisions of consumers and it became even more so in the crisis. Thus, in general, the crisis impacted first the demand of goods/brands which can easily be substituted by less expensive alternatives. Many food products belong to this category and, in general, consumers at least in Central and Eastern Europe are believed to be less loyal to brands than their Western European counterparts. For these reasons, and also because competition was very tough due to the presence of many retail chains in some of the countries, the choice of relatively cheap food products increased and special price offers became more frequent. Consequently, suppliers of low priced mass products had to deliver greater volumes while others needed to change their production structure. The demand for private label products increased considerably, and these will definitely have a larger share of turnover in the future. It was also underlined that, due to the crisis, consumers were spending less on high value added processed goods, while the demand for basic foods (e.g. flour, sugar, many lower value added bakery products, fruits and vegetables) remained rather stable.

Quite often, the calls for tenders by multinational retail chains for the production of private label food products are international. Experience in Central and Eastern Europe showed that suppliers in Poland and the Czech Republic were less affected by the crisis than in Hungary or Slovakia, where the impacts were more severe either due to the macroeconomic instability, or to the introduction of the euro. Retailers claimed that contract terms and conditions with suppliers did not alter, and stakeholders were expecting no major changes in front and back margins in the near future. It was pointed out that in some sectors, production and processing had long been facing difficulties and thus the decline of production and sales was only partly due to the crisis.

In some countries, protectionist and even nationalist rhetoric has inevitably gained some popularity. For example in Hungary, to increase the proportion of domestically produced goods on the shelves of retail chains, and to regulate contract conditions, a new Ethical Codex was drafted by

[3] Food product sales represent about 70% of the turnover of Tesco in Hungary. According to CSO data, the total food and non-food turnover of the retail sector in Hungary was 3.5% lower year on year in the first half of 2009.

[4] According to SSCU data, the total turnover of the retail sector and the restaurant business declined by almost 20% year on year to UAH 144.6 billion during January-August 2009.

the Ministry of Agriculture and NGOs, and signed by most of the stakeholders. However, the initiative did not prove to be effective and thus remained a mere symbolic step towards farmers and the processing industries battered inter alia by the crisis, mainly because the Codex failed to provide a clear definition of 'domestically produced' goods. (It was also heavily criticised by the Hungarian Competition Authority). Notwithstanding the failure of efforts like this, the preference of domestic goods by consumers increased in 2009, mainly due to the devaluation of the national currencies. This trend was observed in Hungary as well as in Ukraine.

In many countries (including Hungary, Ukraine, Armenia, Kyrgyzstan), the direct marketing of agricultural goods increased substantially. This was particularly true for milk and basic dairy products, in which case the declining purchasing power of the consumer and the oversupply on the dairy market shortened the distribution chain, especially in rural areas. Another development has been a reversal in the decline in the number of pigs kept by rural households as part of a move towards greater economic self-sufficiency, and this has negatively impacted on retail sales.

Banks and lending institutions (four countries)

Owing to the varying degrees of integration into the world economy of the four countries in the study, the different ownership profile of the banks and the contrasting fiscal approaches of national governments, in this section developments in the four countries are reviewed separately.

Banks in Hungary tended to lower their credit/deposit ratio. They looked more carefully at the total credit portfolios of enterprises and required a much higher share of own sources (at least 10-15% for the financing of 20-25% of a project), even when an investment was supported from EU funds. The placing of investment credits declined by 5-10%. The total debt of the agribusiness sector had dropped by around 5-10% by mid-2009, but started to increase again in August. Credit conditions were made tougher and the maximum amount of credit per hectare land was cut from HUF about 100,000 (EUR 374) to HUF 70,000 (EUR 262). Credit costs increased markedly, by 2.0-2.2% to 12-14 %. With the devaluation of the HUF, there was an increase in loan defaults, especially with those in foreign currencies (e.g. CHF). Banks cleared their portfolios and lowered their operational costs by quitting their less profitable activities and cutting their staff. Many did not take on new customers but they were not worrying about the crisis radiating to the agro-food sector. According to the interviewees, small enterprises will be excluded from credit granting in the future. Banks reckoned the market environment would be unpredictable for the next 2-3 years, thus the returns on most investments could be judged as rather dubious.

Ukrainian banks and other financial institutions became hostages of a credit boom in foreign currency in 2006-2008. UAH devaluation caused failure to repay loans by many bank clients. This in turn led to banks in many cases not being able to return deposits. As a result, in late 2008 a moratorium on deposit refund obligations was introduced. Despite this measure, a number of banks went bankrupt. In 2009, banks provided UAH 3.3 billion (EUR 0.3 billion) worth of new loans to agrarian sector enterprises. Interest rates on bank loans increased to 16.5-30.0% (including loans for agricultural enterprises). The number of banks willing to grant credit to the agrarian sector decreased and the ones who still provided such loans demanded more rigid conditions. Due to the crisis, many agrarian sector borrowers faced debt servicing problems. According to the Ministry of Agrarian Policy of Ukraine, more than 3,400 applications on loan restructuring, amounting to almost UAH 12 billion (EUR 1 billion), had arrived from agrarian sector enterprises as of late summer 2009. Although bank revenues grew by 41.9% in the first eight months of 2009 compared to the same period of 2008, their expenditure increased by 88.9%. As of 1 September 2009, losses of Ukrainian banks amounted to UAH 20.5 billion (EUR 1.7 billion), whereas the same period in 2008 saw

a profit of UAH 6.9 billion (EUR 0.6 billion). Of Ukraine's 15 largest banks, only seven showed a profit in the third quarter of 2009.

The crisis reached Armenia through the real economy instead of the financial markets. Even so, all interviewed banks and lending institutions claimed that credit was less accessible than pre-crisis. In fact, most banks in Armenia stopped providing consumer credit. Banks tried to deal with increased default risk by raising interest rates, applying stricter conditions to potential debtors and giving preference to short-term loans. Although the number of depositors decreased, most banks were able to provide more loans to agri-businesses because the government provided funds specifically for the sector at a lower interest rate. In March 2009, the introduction of the floating exchange rate depreciated the AMD by about 20%. Although Armenian law prohibits it, banks provided credit mainly in USD and required loan payments in either USD or AMD equivalent. Therefore, many debtors had difficulties in making payments. There were also other discrepancies between the law and practice: banks provided the designated government loans to the agricultural sector at much higher interest rates. Although market conditions were tougher, the basic market structure remained unaltered. However, banks expect changes in the sector within a year or two, when big banks can resume their planned investments, potentially acquiring smaller banks.

Interviewed banking institutions in Kyrgyzstan cited the devaluation of the national currency, increase in the inflation rate, low rate of transfers from nationals living abroad as well as repayment of credit to financing institutions as major problems for the sector. In response to these, banks toughened their deposit policy and raised credit rates. The latter were increased to 22% for agricultural activities and to 27% for processing and other sectors in 2008. Credit conditions were also tightened: while previously only credit history was deemed relevant, clients had to go through The Central Collateral Registration Office if the amount of a loan exceeded KGS 30,000 (EUR 450). An important measure to help agriculture was to provide subsidised loans for farmers through banks. The interest rate of these loans was 22%, but if a farmer repaid the credit in time he received a 10% interest compensation. Credit was given in KGS in order to avoid exchange rate risk.

The government sector (four countries)

Governments in the four countries adopted different approaches to mitigating the effects of the crises in the agro-food sector. In Hungary, membership of the EU limited the space for manoeuvre, Ukraine introduced some short-term measures, Armenia was very exposed to external factors whilst the Kyrgyz government thought that the country may be less exposed to the crisis. In most if not all countries the communication of the existence of these measures to the supply chains was an issue.

Officials in Hungary shared the view that the financial and economic crisis impacted the agro-food sector significantly; however, to a lesser extent (at least in the first half of 2009) than some other sectors of the national economy. The negative effects of the crisis had been amplified by the inflexibility of the decision making and administration system of the EU, and the inefficiency and the weak communication of the national administration. Although most of the stakeholders appeared to be unaware of any agro-food sector specific action taken by the government in response to the financial and economic crisis, the list of the policy measures aimed to lessen the negative effects included guarantees for agricultural investments via the government-owned Hungarian Development Bank; advance payments to enterprises for which investment support from the EU Rural Development funds had been granted; working capital loan programmes for cereal producers and dairy farmers; abolition of milk quality analysis fees; additional coupled payments to dairy and cattle farmers tobacco farmers and fruit and vegetable producers from 2010; aid to wineries for the

distillation of excess wine stocks; earlier payment of EU direct support; and lower VAT on bakery and dairy products. On the other hand, the budget for cofinancing EU direct payments was cut in 2009, with a further cut due in 2010.

Agriculture in Ukraine was without any productive support until March 2009 when a law, inter alia, encouraging banks to roll over loans to agricultural producers came into force. To increase demand for grain, in late 2009 the government formed a financial pool used by the Agrarian Fund (a state organisation supervised by the Ministry of Agrarian Policy) to accomplish intervention purchases of grain, and established a Stabilising Anti-crisis Fund. All the measures were mainly short-term: producers obtained a financial resource at the Agrarian Fund's expense to secure current agricultural works, money from the Stabilising Fund went to subsidise compensation of bank loans for agricultural producers, cattle-breeding, agricultural machinery leasing, implementation of some investment projects, and partial reimbursement of expenses incurred for sowing of spring crops.

The government in Armenia set up several programmes intended to intensify the support to producers of agricultural products although in late 2009 the level of financing from the state budget was less than 40% of the projected level. They included seed development, plant protection, agricultural animal vaccination, state support to agricultural land users, provision of agricultural animals by the government on different payment terms, credit to agricultural enterprises and small-scale agricultural traders, credit for the economic development of rural areas, and requirement for dairy producers to include the proportion of milk powder and natural milk in the labels (to encourage consumer selection of natural products). The Armenian government is perceived to have neglected the sector in its policy making over a period of years, even although it publically stresses the importance of agriculture. The Ministry of Agriculture expressed intentions of helping the sector overcome the crisis, but the government appeared to favour the residential construction sector.

In Kyrgyzstan, the government initially announced that the global crisis would hit the economy. Later, it judged that since the country was not fully integrated into the global economy, it would not be hurt significantly. However, several actions were adopted to mitigate the impact of the crisis and ensure food security including a new Law on Food Security, several resolutions on socio-economic development, discussions with Russia and Kazakhstan on waiving quarantine on import of dairy products, and the Ministry of Agriculture initiated VAT exemption from home based processing of dairy products. Additional credit resources were provided to Aiyl Bank (former Agricultural Financial Corporation, recently established as a bank) for on lending to farmers and the state Agro-ProdCorporation (a state joint stock company set up in 2008 to regulate prices for wheat through market activities) bought wheat directly from farmers to offset their credits. However, interviewees in the supply chain claimed not to have noticed any significant support. For example, the wheat procurement mechanisms were not clear and transparent, whilst AgroProdCorporation is becoming a dominant player in the wheat sector and is pushing small and medium size mills out of the market.

Discussion

The current state of the agro-food sector

The crisis affected Eastern Europe and Central Asia only after some delay. The negative impacts were felt first in the construction, metallurgy and car-making sectors and until now more strongly than in the agro-food sector. The effects of the crisis on agriculture are still masked by the good conditions in the 2007/2008 season and in previous years. (Table 1.) The reaction of stakeholders will be apparent only later due to the uninterrupted biological nature of production. Not only was

the arrival of the crisis in the region late but it is now obvious that the recovery will also be slower than in the developed world, in India and in China. The economies of the latter showed the first early signs of growth in the third quarter of 2009, thanks to the enormous and effective monetary and fiscal stimuli, whilst the downturn in Eastern Europe and Central Asia is continuing. Since the demand for agricultural products is linked to purchasing power either on the domestic or on the export markets, it is still questionable what legacy the crisis will leave on the sector and on rural society.

Table 1

Change of GDP in the four countries in the study representing forecasts and estimations available in February 2010; volume index, previous year = 100

Sector	Country	2006	2007	2008	2009	2009/2007 %
National economy, total	Armenia	113.2	113.7	106.8	85.6	91.4
	Hungary	104.0	101.0	100.6	93.7	94.3
	Kyrgyzstan	103.1	108.5	107.6	102.3	110.1
	Ukraine	107.3	107.9	102.1	85.0	86.8
Agriculture	Armenia	100.4	109.6	101.3	99.9	101.2
	Hungary	93.5	78.7	154.3	81.1	125.1
	Kyrgyzstan	101.7	101.6	100.7	107.4	108.2
	Ukraine	101.1	115.6	135.6	101.9	138.2

Source: Country Statistical Offices

Growing unemployment, wage cuts, increased payments for loans, a shift to part time working as well as declining remittances from citizens working in more developed countries have led to a decline in overall consumption in the region. The decline was strongly driven by the psychological effect; initially people reduced their expenditure more than their income dictated. Since food has a relatively low price elasticity, the drop was less in the case of food products than other goods, and occurred to a different extent with different food items. The contraction was more noticeable for products with higher value added (e.g. Armenian brandy). Consumers are now even more price sensitive and demands for more expensive goods have been replaced by less expensive alternatives. Both feed and industrial non-food use of agricultural products are lower as a result of the slowdown. The usage of biofuels was expected to expand less rapidly as the sector matures.

The prices of agricultural commodities have declined from their peak in 2007 and early 2008. There is some agreement that this peak was caused by a number of temporary phenomena, such as a decline in global stock levels, poor weather conditions in core grain producing countries, temporary trading restrictions in some countries and, according to some analysts, the activity of market speculators investing in commodity futures. Input prices increased in parallel with the prices of products, but their decline appears to be much slower. In countries which are depending strongly on imported inputs (like Armenia and Kyrgyztan), this price increase has been even more harmful due to the devaluation of their national currency. As a result, input usage has dropped in the region and many farmers have been forced to extensify production.

Not only were the price changes adverse for farmers, but sales opportunities are now rare, too. This is in part a clear consequence of the lower demand, but it is also due there being fewer solvent and reliable partners. As increasing numbers of farmers, integrators and traders faced liquidity problems or went into liquidation leaving behind unpaid claims, business trust evaporated. Fewer transactions are now made and many of them on different terms than previously. Dairy and wheat

farmers in Kyrgyztan, dairy and grape farmers in Armenia and wheat farmers in Hungary all claimed that they had suffered increasing difficulties to market their products. Stocks in the supply chains have accumulated; wheat stocks at the end of the 2009/2010 crop year are estimated to be the highest in eight years, for instance. Dairy farmers turned to making cheese, processors invested in extending product shelf life, and underpriced imported milk powder pushed out dairy farmers.

Although agricultural trade was influenced by the crisis less than international trade overall, it could not provide as much help to reduce imbalances than it could in previous years. Trading flows were disturbed by unpredictable currency changes and by protectionism, sometimes hidden in the form of sanitary and food safety measures. Exchange rate change have helped exporters in Hungary and Ukraine and promoted domestic food processors, but the overall long term impact on national economies in the region is judged by experts as rather damaging.

Banks pulled out of financing agriculture when the crisis intensified and credit availability and credit conditions are now poor in all four countries in the research. Since all market oriented enterprises in the region can be considered "new" compared to other parts of the world, they are financially less stable and their dependence on credits is relatively higher. Due to the lack of financing, investments were postponed, trading flows have slowed, and the financing of stocks and purchasing of inputs have become more expensive. Shifting from subsistence to market oriented farming is now extremely difficult but by contrast financially strong companies and holdings, and well organised integrations have developed steadily and have extended their market share.

The principal causes of changes to the state of the agro-food sector

In recent decades, the agro-food sector has become not only more globalised through international trade (as it sources and sells across the globe) but also more integrated into the modern financial system. Consequently it is more subject to the exogenous fluctuations originating in the macro-economy. Impacts of the crisis on the specific agro-food sectors and countries have come to depend on the strength of their linkages to the financial system and the global economy (OECD, 2009).

Hence the state of the agro-food sector is mainly determined by the general macroeconomic, legal and social/cultural environment in each country, although in the countries of the EU the CAP is a major influencing factor. In the following we only focus on factors which are either derived from or have gained weight and importance due to the global crisis. These we believe to be as follows.

The crisis is one of confidence rather than the result of any abrupt change in the underlying dimensions of the economy: population and income growth, resource constraints and the world wide application of advancing technology that changes the relative values of labour, capital and land (RuSource, 2008). This lack of confidence is most clearly expressed through limited credit availability and consequent liquidity problems. Credit stimulates business and drives the economy. Reduced credit availability puts increased pressure on cash flow, sets back demand and trade, and hampers investments. The high level of interest rates impairs the competitive position of domestic enterprises both in the domestic and foreign markets. The consequences are the decline of production and services, the loss of jobs and increasing poverty. It could further weaken the food security of importer countries as they may become more dependent on financially stronger external suppliers, ultimately contributing to the strengthening of protectionism.

Differences between countries in their susceptibility to the crisis and in the responses of their governments have contributed to high foreign exchange risk which can scare off foreign capital from a country and obstruct growth prospects. In short, this risk impacts on the income of domestic

enterprises while increasing trade volatility and slowing down investments. Furthermore, increasing price volatility, i.e. the greater amplitude and speed of price swings, affects the income of all stakeholders of a particular supply chain. Dependence on commodities coupled with high volatility of prices results in significant fluctuations in trade. In general, trade volatility worsens income distribution, raises poverty and impedes economic growth and domestic investment.

The economic slowdown and global credit crunch have had serious implications for migrants and their families. The decrease in consumer incomes and remittances sent by migrant workers to their families at home (described in section 1.2.) suppress demand, thereby contributing to the shrinking of the economy and to the decline in production and services. Incidentally, the higher competition for jobs and economic resources by returning migrants can lead to social and political tensions in many local communities and increasing pressure on already fragile healthcare and social welfare infrastructure in many local communities (Abazov, 2008).

The crisis has directly impacted on the behaviour of stakeholders in the supply chains. There has been a loss of business trust as market transactions have shifted from a trust and credit base towards a cash base. This lack of trust weakens contract relations, renders integration and concentration, and impedes investments and technical progress. In a crisis situation, market players value trust more than property or money. Also, in order to make competitive offers and to remain in business, more stakeholders try to operate illegally. As with the lack of business trust, the black economy makes integration, concentration and professional consulting in the supply chains more difficult, as well as efficient representation and assertion of interests. Black marketers exercise huge pressure on buying and selling prices thereby forcing legally operating competitors out of business. The lack of information available to stakeholders in the supply chains restricted their ability to understand how the crisis was developing and therefore how to effectively adapt their business strategies. For example, farmers in Armenia faced two major challenges in the crisis: overestimation of demand of certain crops that encouraged risk-taking in purchase of inputs and problems with monopolies of wholesale purchasers and access to markets.

The economic slowdown resulted in a lower level of grain consumption in 2008/09, especially for feed and industrial uses (IGC). At the same time, consecutive above-average world wheat crops boosted the level of grain stocks. These were projected to fall slightly in the mid-term but the ample supply outlook should maintain them at comparatively higher levels thereby depressing prices.

Most of the discount retail chains, targeting consumers with average or below average income levels, and some of the large multinational retail chains, offering a wide choice of private label products or pursuing an aggressive expansion policy, have very strong market positions. Due to their bargaining power, retail chains have already or will soon become the ultimate price setters in most of the agro-food supply chains in most regions. The strong push towards mass production represents a huge challenge for the suppliers in many countries and has led to calls for restructuring.

Effects on stakeholders in the supply chain

Most of the negative effects on stakeholders were discussed in the previous section but little has been said about who may benefit from the situation. The crisis has exposed all the weaknesses of the sector and can be a turning point insofar as its impacts in the near future may act as a selection force which creates beneficiaries and losers among stakeholders in all tiers of the agro-food sector.

Although it is impossible to generalise which parts of the different supply chains gained the most from crisis, in most countries, the banks could certainly benefit a lot because (1) governments, especially in Europe, do not let banks go bankrupt, (2) banks not only enjoy support but have a chance to clean their portfolios and get rid of their troubled customers and (3) they could and have well overpriced the actual risks. Besides banks, market and price determining multinational trading companies were expected to strengthen their positions. This is due to their reputation, credit history, own equity, liquidity, ownership and to the speed at which they can react to market developments.

Subsistence farmers were thought to be less affected by the limited availability of financial resources, the rise in credit charges, the increased volatility of the exchange rates, etc. because they were less dependent on bank loans and less integrated into the supply chain. By contrast, smaller professional producers who are potentially more flexible but who did not have the financial resources to withstand the crisis have been lost, leading to concentration in the sector as larger companies, especially those whose input suppliers and buyers are few but financially stable, strengthen their positions. The crisis has strengthened the polarisation within the agro-food sector. In addition, credit access of businesses, the level of integration, production structure and management skills were also factors which made a difference in exposure to the crisis.

Whether retail chains benefited or not, it is difficult to answer yet. Undoubtedly, the share of private label products has increased which has placed them in an even better bargaining position; however, the margins are usually lower on these products and most chains have suffered a drop in demand and turnover. Are private labels the big winners of the crisis? The question cannot be answered with a simple ‚yes' or ‚no'. According to one survey, more than 70% of the consumers were convinced that the crisis will last longer than one year which means that they continued to adapt their purchasing behaviour accordingly. It is too soon to know how strong the shift back to more premium products will be. In many countries (including Hungary, Ukraine, Armenia, Kyrgyzstan), the direct marketing of agricultural goods has increased substantially; however, currently there are no guarantees that with the economies on the rise again, the demand for that will not shrink.

Impacts on rural poverty

Poverty and food security were improving strongly in Eastern Europe and Central Asia before the food and financial crises periods hit the region. In the first half of 2008, the region was confronted with rising food prices as the consequence of the worldwide food crisis. In the second part of the same year, effects of the worldwide financial crisis started to become apparent. Although the food and financial crisis developed from different underlying causes, they are interacting through their implications for financial and economic stability, food security, and political security. The financial crisis and the accompanying slow down of the economy reversed the increase in commodity prices (caused by the food crisis), yielding benefits for the food security and poverty of net consumers of food. However, at the same time, lay-offs across all sectors of the economies coupled with a decline in the use of agro-industrial capacity, a reduction in real wages and employment rates and a decline in remittances from migrant workers have negatively affected the income of households in the region and increased poverty and food insecurity.

Thus the financial crisis has caused an increase of overall poverty in the region, as reflected in the responses of the interviewees. The year 2009 even saw a small rise in the number of low-tech subsistence farmers (e.g. in Ukraine) to compensate for lost income through wages. This analysis is supported by Philippe Le Houérou, World Bank Vice-President for Europe and Central Asia who stated “The global financial and economic crisis has literally hit home in many parts of Emerging Europe and Central Asia ... What started as a financial crisis has become a social and human crisis.

The global crisis has come on the heels of the food and fuel crises, which had already weakened people in the region by reducing their purchasing power. Today, rising poverty and joblessness are pushing households into poverty and making things even harder for those already poor".

In addition to the direct impact on household income, the crisis has also negatively affected government budgets. Preliminary data from a few countries found a significant decrease in the number of social security beneficiaries between June 2008 and June 2009, the period when more households have become vulnerable. This could have a negative impact on government spending on social assistance programmes at a time when these programmes in fact need to be expanded (IMF, 2009).

Response strategies adopted by businesses, banks and government

Stakeholders throughout the supply chain suffered from loss of confidence and sought to cut their costs and reduce their dependence on credit. Arable farmers reduced their use of fertilisers and crop production products and purchases of machinery also declined. Crop rotations were sometimes altered, land lease contracts were terminated and in some cases farm-saved seed was used for sowing. Cuts in the use of inputs were particularly high in countries where the lower value of the currencies increased prices. Livestock producers began using home produced feeds, and/or extensified their production. Cattle farmers in Armenia fed the milk they produced to calves.

In response to concerns about the financial viability of some of their customers and an increasing tendency to delay payments, input suppliers became more careful about which farmers to supply and put tough audit checks in place. Most demanded pre-payment or other guarantees, partly to minimise risk and partly so as not to finance producers as in the past. Many input suppliers shortened working weeks, instituted unpaid leave or even cut wages. Animal feed plants reduced costs and reoriented production towards feeds for more prosperous supply chains e.g. poultry in Ukraine.

Contractors who normally make forward purchases of grain sought to do so more promptly and buyers aimed to cover their needs from domestic markets, thereby minimising imports and exposure to exchange rates. Due to liquidity problems, processors preferred to purchase on a daily basis and held smaller stocks, thereby trying to transfer the cost of storage upstream. Cheaper, lower quality raw materials were purchased, outdated machinery was disposed of wherever possible and more attention was paid to energy use. Many sought to cut their wage bills, but recognised the value of the skills of their employees and tried to retain staff, as recruitment as part of any future expansion could be difficult. Similarly, in Armenia, at least, some processors purchased milk at a higher price than their competitors in order to safeguard their supplies. Some processors and traders tried to limit risks by diversification, seeking out niche markets or diversifying into unrelated business activities.

Most stakeholders throughout the supply chains postponed their investments, even if, as sometimes in the case of pig farmers in Hungary, these were demanded by the EU, although efforts were made to complete ongoing investments particularly if co-financed by public sector funding. Stronger players, with a view to their future market position, maintained their investments and their marketing activities. Large and financially sound enterprises acquired their weaker competitors, particularly those with attractive assets such as real estate or good customer bases.

Retail supply chains further increased their shares of sales of private label products in response to the higher price sensitivity of consumers, and often strengthened their market positions. Retailers also tried to delay payments, but this was reported to occur more with national than with multinational companies. Less profitable stores were closed and special price offers became more frequent.

Banks cut back substantially on providing credit to the agro-food industry. Already approved credit applications were reviewed and modified, collaterals were re-evaluated, and stricter credit conditions and increased credit charges were imposed in all countries. In general, banks prolonged the process of credit approvals, carried out more cautious risk analyses and shifted decision making to a higher level. Credit applications were more often declined and even customers with high reputation and excellent credit history faced difficulties in accessing credit. Banks preferred customers who managed their risks with derivative market instruments (e.g. in Hungary).

Governments implemented a range of measures in response to local circumstances and there was a move towards protectionist measures. The EU reported that some 223 potentially trade restrictive and distorting measures, affecting around 5.2% of EU exports, were taken by the EU's main trading partners in the year to October 2009 (Agra Europe, 2009).

Assessment of future changes

Due to the central role of international trade in agriculture, the prospects of the sector depend on future global economic trends. Continued weakness in the general economy will further dampen commodity prices over the next 2-3 years, which should then strengthen with economic recovery. The reduction in agricultural prices, production and consumption, associated with lower incomes is likely to be moderate, as long as economic recovery begins within 2-3 years (OECD, 2009). The following factors could potentially have a negative impact on output and productivity in the region (Swinnen and Van Herek, 2009):

- An overall decrease in investments, because banks provide less credit to individual house-holds and (foreign and domestic) investors reduce their investments in the agro-food sector
- A decrease in demand for higher value agricultural products and a switch to basic products due to a decrease of the household's disposable income. Demand for higher cost livestock products, such as beef, pork and dairy, would be the most seriously affected.
- Government interventions could be positive if they boost investments. However, one should be careful it does not lead to a (partial) reversal of reforms in the agricultural sector, which could have a negative effect on efficiency.

Thus the recovery of consumer demand could play a key role, especially for high value-added food products. In Ukraine, for example, retail representatives expect greater consumer confidence already in early 2010; as a consequence, Auchan, a recent entrant to the Ukrainian market plans expansion in the near future. However, even with the return of demand to normal levels, the market structure will not stay unaltered: Armenia could see significant mergers between retailers, along with the disappearance of many small businesses.

In the coming ten years, the prices of agricultural commodities will remain at a higher average level than over the past decade, and will continue to remain volatile. This analysis suggests that income from farming and the price of food to consumers are likely to be subject to some fluctuation, and some uncertainty, this year and in the years ahead. This can only partly be attributed to the impacts triggered by the economic downturn, as there are other structural changes at play which will provide a stronger and longer lasting influence on farm management and farming income (CAP2020. 2009).

In the cereals and oilseeds supply chains, a consolidation process was foreseen to begin at the end of 2009 as a result of the bankruptcies and mergers at virtually all tiers. As the economies of Central and Eastern Europe and Central Asia rebound, the area sown to cereals and oilseeds is expected to expand again in the next five years, especially in the CIS countries.

On the production side, there is clearly room for optimism. Due to the relatively bearish wheat market tone during the first months of the 2009/10 season, winter wheat plantings declined in some countries in the region in autumn of 2009. However, as their economies rebound, the wheat area is expected to expand in the next five years, especially in the CIS countries. Although stocks were projected to fall slightly in the next five years, the more ample supply outlook should maintain them at comparatively higher levels (IGC). The planting of new, higher yielding varieties and the more intensive use of inputs will continue to boost global productivity in the next five years, with the strongest gains expected in the CIS countries. However, this growth could be hindered by land overuse and a lasting preference toward inexpensive but low-quality inputs (seeds and fertilisers).

The outlook for pig producers is relatively encouraging in Ukraine. Experts forecast a slight increase of pork output, mainly owing to pigs of bacon and meat breeds reared by specialised pig-breeding complexes. Hungarian pork breeders calculate with higher demand and prices, although the EC projects falling pig prices on the European market until May 2010.

As a consequence of the liquidity crunch and due to the loss of trust, it will be more difficult to reach deals and there will be more breaches of contracts and more bankruptcies in the short term. In the long term, a more selective financing of the agricultural businesses can be expected and the rigorous screening of the financial situation of the partners will not be eased, resulting in the decrease in investments referred to above. Government measures (loan compensations, direct subsidies, bank regulations) can be effective in easing credit accessibility and raising long-term investment attractiveness.

Relationships between surviving businesses will certainly be stronger but, in general, business trust will be restored only slowly. Farmers are expected to be more economical in the use of agricultural services (e.g. machinery, etc.) and more input suppliers and agricultural service providers may quit. Mergers are likely as small businesses both in production and retail exit the market. Market and price determining multinational trading companies could strengthen their positions, especially in the oilseeds markets. This is not only due to their reputation, credit history, own equity, liquidity, ownership, etc. but also to their access to information, to their structures and capabilities which makes them more efficient in processing and evaluating information, and to the speed at which they can react to market developments. Thus, officials in Hungary, for example, expect agriculture to become more specialised, a process which will include a further rapid decline in the number of semi-subsistence farms.

Policy recommendations

The proposed policy options are of necessity general (i.e. not always linked with agriculture) for several reasons, not least because (a) the roots of the macroeconomic shock lie outside the sector and (b) despite the similarities noted in this report in terms of the impacts of the crisis, the countries across the Eastern European and Central Asian region have widely differing economies and agro-food sectors. Responses should be implemented in the context of more global strategic objectives.

The relationship between the crisis and other issues affecting agriculture and food security is clear. The first Millennium Development Goal states that the United Nations „is to eradicate extreme hunger and poverty" and „agricultural productivity is likely to play a key role in this if it is to be reached on time". David Nabarro, coordinator of the UN secretary-general's task force on the global food security crisis, stated that the economic crisis further „complicates and exacerbates the situation ... price volatility and a global credit crunch are discouraging new planting and new investment, while food prices in many poor countries remain at historically high levels" (EurActive, 2009).

Thus, in formulating policy options, the financial crisis must be considered in the overall context of food security and poverty. We note that governments are claiming to give high priority to stabilising the macroeconomic and legal environment. However, Philippe Le Houerou, whilst recognising that the financing needs in Emerging Europe and Central Asia are the highest of any region of the world, recently stated that "as the impact of the stimulus packages dissipate at the global level, the private sector will need to take over as the engine of economic recovery and growth" (ECA, 2009).

By contrast, given the entrenched nature of global poverty, the arrival of peak oil, and the evidence that climate change will have a major impact upon food provision in the long term, there is growing concern that the world food crisis will deepen over the next decade (Lawrence et al. 2009). Thus when the most immediate effects of the financial crisis have passed, these issues will still remain to be addressed though government and trans-national interventions. Recommendations relating to these wider issues are beyond the scope of this report, but it should be stressed that it is necessary to avoid short-term policy responses which conflict with long-term development goals.

On the basis of the foregoing, we have sought to identify what steps governments could take, in addition to stabilising the macroeconomic and legal environment, in order to make the agro-food sector less exposed to future financial crises. It is not our place to offer recommendations to governments on how to lower interest rates, to modify the tax system or how to crack down on illegal operations although these issues were regularly raised by interviewees. However, governments need to agree on common goals in order to be better prepared for future shocks to the global food system, such as another financial crisis, and to devise coherent policies to achieve them, to monitor progress, to identify best practices and to draw up contingency plans.

In all four countries, several measures have already been implemented but many interviewees were not aware of, or did not perceive, their existence. When they did, they frequently criticised them as being ineffective or incorrectly targeted. Equally, many stakeholders, with the exception of multinationals, called for measures such as more subsidies, more state intervention including price controls, more protectionist measures and even the creation of state owned monopolies, which we understand (as they arise from each respondent's particular vision of the situation and his/her perception of possible political solutions) but cannot support. They are examples of the short-term policy responses which can have negative impacts of rural poverty. Where governments do intervene in the market, they must ensure that they minimise the risk of causing market distortions.

A deteriorating economic situation may encourage protectionism and, for example, to delay the implementation of legislation and other efforts geared towards environmental sustainability. Any price movement due to the increased volatility of the market should not be interpreted as a trend, but may encourage protectionist responses amongst governments. Protectionist measures are not a way out of the crisis situation and are not able to avert the occurrence of crises in the future.

Similarly, state intervention, especially in pricing agricultural commodities, and state owned monopolies can discriminate against rural areas. Governments often keep prices of basic grain at such artificially low levels that semi-subsistence producers cannot accumulate enough capital to make investments to improve their production and are effectively prevented from getting out of their precarious situation. When a government monopolises trade, farmers may find that they are free to grow cash crops for export but, under penalty of law, are only able to sell their crops to government buyers at prices far below the world market price. The government then is free to sell the crop on the world market at full price, pocketing the difference. This creates an artificial "poverty trap", from which even the most hard-working and motivated farmers may not escape (EurActive, 2009).

Governments should distinguish between agro-economic priorities and social policy issues. Our recommendations focus on the establishment of resilient, economically viable, diverse, innovative agro-food chains which are capable of meeting changing market needs such as consumer desire for safe, healthy foods, perhaps coupled with issues such as lower environmental impact farming and improved animal welfare. In the longer term, rising food prices and an efficient and productive agro-food chain, the latter encouraged into existence in part by effective government measures, could, as envisaged by David Nabarro, help rural communities in some countries in the region to escape poverty by increasing farmers' incomes. We recognise that governments need to enhance social security safety nets to combat the consequences of developments such as the reduction in remittances and the return home of migrant workers, but as a quite separate issue.

Our recommendations, based on the frequent observation of interviewees that companies with adequate financial reserves for 1-2 years are not suffering from the crisis, and the ideas in the country reports, are as follows:

1. Target the limited funds for investment subsidies at the professional viable enterprises with a long-term business plan. Increased investments have been a major driving force behind the recent economic growth in the agro-food industry. However, as national budgets tighten, there will be implications for agricultural spending. The economic downturn may add further impetus for policymakers to re-evaluate the uses to which agricultural expenditure is put, and to re-focus it where it might provide the greatest level of benefit.

2. Support initiatives which can ensure more reliable access to credit. Access to credit was viewed as the key issue by many interviewees and the problem was compounded by a reduction in asset values which reduced stakeholders' capacity to borrow money. We agree that governments were right to avoid direct crediting to agricultural producers and processors in terms of loans, rather to use banks as the means of increasing financing for the agro-food sector. To maximise reliable access to credit, initiatives may include expanded credit guarantee funds and support for credit insurance in order to improve the financial circulation within the agro-food supply chains. Other possibilities include credit warrants, credit unions, cooperative banks, microcredit, an insurance system against natural disasters and better information about the availability of credit.

3. Avoid the offsetting of debts, taxes and other liabilities. Offsetting of debts etc. is never applied to the general population and the implementation of such measures in response to the financial crisis would further weaken business trust and increase political and legal risks perceived by stakeholders, would nurture corruption and weaken social integrity.

4. Improve technology. Many parts of the agro-food supply chain in the region are undercapitalised. This can lead directly to production losses. For example, many wheat farmers in Armenia ascribe around 15% crop loss to worn-out machinery. The greatest technical challenge to avoid soaring food prices is to develop and introduce more productivity increasing (or at least stabilising) farming technologies that are sustainable. New technology can increase gross value added (GVA) throughout the supply chain, ensure compliance with Health and Safety and other regulations, as well as allow new market opportunities to be exploited through new products. Government cofinancing should take into account not just the needs of the beneficiary but also the potential impact of the investment on the wider local economy.

5. Encourage horizontal and vertical integration along the agro-food supply chains in order to facilitate cooperation between stakeholders, to strengthen business relations and restore

business trust, to reduce transaction costs and to increase bargaining power. The means for achieving this include changes to the legal environment, preferential taxation, co-financing aid for investments, state guarantees, etc.

6. Encourage consolidation, rationalisation and specialisation, particularly but not only within the processing industries, in order to create viable market players which can competitively supply retailers with respect both to quantity and quality of products. In addition to full-scale mergers, farm associations, grain procurement cooperatives and export groups can strengthen the negotiating positions of their members through collective purchasing and selling. Capacity building measures are needed to help their establishment, plus changes to the legal environment and co-financing aid. Less formal cooperation could include the setting up of representative farmers' associations whose members could benefit from shared services. Such cooperation could be encouraged with tax incentives.

7. Increase spend on innovation and R+D. All tiers in the supply chain must continue to innovate both in terms of new products and production systems to maintain their economic viability and to access new markets. Whilst such innovation can often be led by the private sector, substantial investment in public sector agricultural research and development is also required, particularly in developing countries. Technological support to farmers and other stakeholders, including advisory services and effective animal and plant breeding programmes can help to strengthen the entire agro-food industry. Measures to promote information and technology transfer, particularly from the public to the private sector, are a crucial but frequently neglected component of this process.

8. Support marketing activities to strengthen the market position of the domestic processing industries. Tax simplification could encourage new entrepreneurs into the market.

9. Support the development of logistics to lessen the costs of handling, storing and transporting goods and thereby increase the competitiveness of the supply chain.

10. Provide risk management subsidies to farmers to help them to cope with increasing price volatilities. Governments should encourage the use of derivative market instruments such as commodity futures and option contracts, for example to manage the price risks which have increased due to the volatility of the markets. Before this happens, they should ensure that stakeholders have more information about the use of these instruments and also create an environment where market participants can accumulate the necessary capital to cover the costs of using such instruments and where regional commodity futures markets could perhaps emerge which would be able to attract liquidity (contract volume).

11. Improve the transparency of policy making and communication in order to restore government credibility. The process could be facilitated by involving NGOs in the decision making process. The trading environment for all stakeholders in the supply chain would be encouraged by more helpful public administration, respect for existing laws by public officials and other stakeholders, and transparency in government and government measures. Investors should not be faced with unnecessary political risks through unnecessary government intervention. Measures aimed increasing quality standards for imports and exports, and stronger food safety regulations in general are to be welcomed, but such regulations should not simply be a 'front' for trade barriers.

12. Facilitate the gathering, processing and disseminating of market information, and create reliable and accessible databases, thereby making shorter and more efficient the decision making

and adjusting process of enterprises. Improved market information services will help stakeholders to respond more quickly and effectively to any future crises, and could possibly be delivered through greater use of ICT.

13. Facilitate niche markets for speciality products. The consumer shift to cheaper products has clearly benefited own label brands and may have strengthened the position of the major retailers, who can call on strong negotiating positions and economies of scale, in the agro-food chain. However, some stakeholders have already responded to the crisis by exploiting 'niche' market opportunities. Support for producing goods with ‚added value', bearing in mind the longer-term trend towards safe, healthy foods mentioned above, may help smaller players in the supply chain to exploit new business opportunities.

14. Make more effort to educate consumers and children about agriculture, nutrition and kitchen culture. Whilst it might seem inappropriate to look beyond the issues of poverty and basic food security at a time when these are increasing, the gradual 'westernisation' of the diet has attendant health issues such as obesity. Healthy eating, including the greater consumption of so-called 'functional foods' can have both social (e.g. greater life expectancy) and economic (a healthier workforce) benefits.

15. Promote land reform. The process of land reform and land registration needs to be completed as secure tenure of farm plots is essential to allow farmers to invest with confidence in machinery and other equipment and if necessary to use the land as collateral in return for credit. Achieving this objective requires:

    - establishing a uniform state land cadastre in each country where this does not yet exist and creating a uniform state system of registration of titles for immovable property including for land plots
    - creating conditions for development of mortgage lending on the security of land
    - providing conditions for free purchase and sale of agricultural land plots

16. Support liberalisation of the land market. Several countries are amending their national laws to encourage the purchase or lease of farmland abroad, or to attract foreign land investors. In our research, interviewees in different countries held conflicting views on liberalisation, particularly with respect to foreign ownership. Gana (2009) stated that "Land rights alienation to foreign companies represents a major threat for farm and rural households (and) will increase the actuality and relevance of issues such as land rights, tenure systems, land reforms, land conflicts and struggles". We do not agree that it is a "major threat". Liberalisation can provide access to investment capital which can revitalise the economic performance of primary agricultural production which in turn is the basis of agro-food supply chains which can employ large numbers of people and contribute considerable GVA to the economy. Hence we support liberalisation of the land market implemented by each government in the form most appropriate to local conditions.

The key messages arising from the research are (a) the need to create prosperous, vertically and horizontally integrated agro-food supply chains which are more resilient to future financial crises and (b) to ensure more reliable access to credit. Our recommendations, while focusing on these issues, only address what to do, not how to do it. Inevitably their implementation would need to be adapted to fit with local needs and further research is needed regarding this. Such research should be conducted in the international sphere to allow cross-border identification and exchange of good practice. The FAO is uniquely well placed to drive forward this research agenda.

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How does it work for Hungarian food consumers? A medium-term analysis

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Abstract

The accession of Hungary to the European Union (EU) in 2004 was expected to lead to price convergence to the EU levels. The influence of national and EU policies on Hungarian producers and consumers is important as they were facing a new situation. Consumers' welfare depends on the constantly altering world- and common market, and political actions. The purpose of this study is to analyse welfare changes and distributional impacts on Hungarian food consumers. The paper focuses on Laspeyres index, compensating variation and elasticities of demand.

Keywords

Food consumption, consumer welfare, compensating variation, price change, elasticity

Introduction

Ten countries joined the European Union in 2004. The accession means economic and political challenges for Hungary to achieve economic convergence as well as the adoption of the single currency. Hungary was to come under the Common Agricultural Policy (CAP) farm support programme. On the basis of the CAP, crop and dairy producers were forecast to benefit from the programme, while fruit, vegetable, poultry and pork producers were expected to face more competitive markets and receive less financial support. Rising feed grain prices were forecast to cause higher costs for pig and poultry farmers. Changes in producer prices lead to changes in consumer prices (Clark, 1995). As increased price uncertainty reduces consumer welfare, a survey of food consumption and the food market is of great interest (Lőrincz et al, 1999).

The effects of economic policies and reforms on consumer welfare can be evaluated by welfare economics. Welfare economics formulates the economic and political recommendations that are sufficient for maximising welfare. The concept of welfare economics was set up by Pareto (1897) and Pigou (1920), and broadenied by Arrow and Debreu (1954) due to their research in the field of general equilibrium. One measure of welfare is the consumption-based measure that is a comprehensive indicator for poverty assessments (Demery, 1993, Appleton, 1996). Instead of a total consumption-based welfare measure, a food consumption-based measure is claimed to be superior (Anand and Harris, 1990). There are three central methodologies of welfare in economics: consumer surplus (CS), compensating variation (CV) and equivalent variation (EV). Willig (1976) showed that the differences between the three measures are small for small price changes regardless of the elasticities. Thus, the three measures of welfare give very similar answers even for aggregate goods.

Indifference curves are also to analyse the welfare effect of an increase in price. An alternative welfare indicator is the food share. According to Engel's law if the consumer's income rises, the proportion of income spent on food falls, i.e. food shares should decrease with income (Appleton, 1996).

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Compensating variation is a measure of utility change introduced by John Hicks (1939). It can be used to calculate the effect of a price change on individuals' welfare. It refers to the amount of additional money that a consumer would need to reach his/her initial utility after a change in prices. Compensating variation can be used to find the effect of a price change on consumer's net welfare. Tiezzi (2005) calculated the welfare effects and the distributive impacts on Italian households after the Italian Carbon Tax had been introduced. True Cost of Living index was used to determine the compensating variation. The conclusion was that all welfare changes were positive due to the reform, representing losses to households rather than gains. The welfare loss increased with income for each household profile.

A more sophisticated method of measuring welfare effects is Laspeyres index. This is a price index that was developed to measure changes in the cost of living and to determine the amount of additional wage to maintain the consumer's constant welfare. It defines a basket of goods in a base period, and uses recent prices for the selected goods to examine changes over time. It reflects new prices and old utility level.

Hubbard and Thomson (2007) studied the short-term welfare effects on Romanian food consumers after Romania's accession to the EU. They distributed the Romanian households by socio-economic category and by area. On the basis of the Laspeyres index and initial income, the CV was computed for each type of household. They found that rural households require a higher increase in their initial income compared to urban households to be able to consume the same bundle of goods as before. Within the socio-economic categories they observed that rural farmer households were the most affected, while urban employer households were the least affected due to the accession. Hubbard and Podruzsik (2006) conducted similar research to study the welfare changes of Hungarian food consumers after EU accession. They concluded that in the short term the accession had a negative impact on all consumer groups and that the poorest households needed a 2 per cent increase in their net income to maintain their welfare.

The aim of this study is two-fold. Firstly, a possible Hungarian food basket is defined. The study by Ferenczi et al. (2002) forecast slight or negligible increase in Hungarian food prices due to the EU accession as food products are non-tradable goods. Price changes of the concerned food products after the accession are demonstrated between 2003 and 2009. Secondly, the changes in consumers' welfare and market attitude are calculated using a pre-accession year (2003) and the post-accession years (2004-2008) to compare the two periods. Consumer welfare is analysed by the Laspeyres index. Our intention is to point out the additional cost burden on consumers if they want to consume the same bundle of goods as before the price changes. Consumer welfare effects are measured by the compensating variation which reflects the additional amount of money that a household would need in order to reach its initial utility.

Laspeyres index and CV considers only the price change of the given food basket. To analyse the response rate of demand by the consumer it is important to know how the share of different products changed in the food basket due to price and income changes. In order to receive information about changes of market share of the food products, own, cross and income price elasticities are calculated as appropriate.

Database and methods

In our study the food consumption of Hungarian consumers is assumed to be the indicator of welfare. Food consumers are divided into ten deciles according to their income. Households from the first decile earn the least while decile 10 has the highest standard of living. Three types of data are analysed; two of them are in connection with food consumption: quantity demanded (q) and monthly price of the concerned food products (p). The following products were chosen to represent the food basket of Hungarian food consumers: rice, bread, wheat flour, potatoes, sugar, sunflower oil, pork, poultry, beef, milk, margarine, cheese, eggs, onions, apples and oranges. These products are basic in the Hungarian diet. In addition to these raw or processed food products, many others could have been chosen but the price or consumption data were limited or insufficient for the secondary analysis. The third data set that is used for the calculations refers to the consumers' income (I) in HUF. For the income elasticity calculations, yearly disposable income data per consumer deciles is utilised.

The consumption data were derived from the Household Budget Survey, collected by the Hungarian Central Statistical Office (HCSO). HCSO regularly conducts this extensive household consumption survey in which The households are representative of the population. HCSO surveys cover the entire geographic range of Hungary and contain detailed consumption data on a total of 960 food and non-food goods.

Recent income and price data were also supplied by the HCSO. The data contain yearly average price observations for 19 counties throughout the country. The year 2003 is the first survey before the onset of the EU accession, while year 2009 is the most recent one. In order to eliminate the effect of inflation, an index value is used as a deflator. Instead of Consumer Price Index (CPI), which reflects the prices of a representative basket of goods and services, the GDP deflator is chosen for the calculations, as it refers to prices of all goods and services produced in the country. The value of the GDP deflator between 2003 and 2009 (where 2003=100%) originates from the Economic Statistics Database. Prices of the chosen food products were deflated as from the year 2004. It is assumed that prices of all other goods remain constant during the examined period and that total income equals total expenditure (no net savings). Differences in tastes of households and quality of food products are assumed to be negligible.

To estimate results for the medium-term impact of the accession, the Laspeyres index is calculated. It gives the changes in the cost of living for each consumer decile as a result of changes in food prices due to the accession, *ceteris paribus*. Laspeyres index can be calculated using the following formula:

$$L_I = \frac{\sum_{i=1}^{n} q_{i_0} * p_{i_1}}{\sum_{i=1}^{n} q_{i_0} * p_{i_0}} * 100 \qquad (1)$$

where:

q_{i_0} = purchased quantity of item i in the base period

p_{i_0} = price of product i in the base period

p_{i_1} = price of product i in period t

If $L_I > 1$, consumer welfare loss, if $L_I < 1$, consumer welfare gain can be recognised.

Firici developed the model in 2003 considering non-food expenditure to be constant. In this study the method of Firici is adopted. With the support of the Laspeyres index Slutsky Compensating Variation is counted using the following formula.

$$CV = I_{total} * (L_i - 1) \quad (2)$$

where:

I_{total} = total disposable income, monthly average

Laspeyres index measures the change in cost of purchasing for the same food basket in the base and the current period but quantities do not need to be calculated. Income effect from the formula is also extracted. In order to measure changes of the quantity consumed due to a price and income change, own, cross and income price elasticities are estimated. For the calculations the formulae devised by Marshall (1890) are utilised.

$$\varepsilon_{own} = \frac{\Delta q_a / q_a}{\Delta p_a / p_a} \qquad \varepsilon_{cross} = \frac{\Delta q_a / q_a}{\Delta p_b / p_b} \qquad \varepsilon_{income} = \frac{\Delta q_a / q_a}{\Delta I / I_0} \quad (3), (4), (5)$$

where:

q_a = demand quantity of product a
Δq_a = change in demand of product a
p_a, p_b = price of product a, b
Δp_b = change in price of product a, b
ΔI = change in disposable income of consumer
I_0 = income of consumer in the base year

Results and discussion

After deflation of the food products prices, the price changes and trends between 2003 and 2009 are shown in Table 1. The figures in Table 1 show the increasing price tendency among meat products and most of the cereals (except vegetable oil). Some of the animal products (cheese, milk) and fruit and vegetable (potatoes, onions) decreased; however the tendency among other products is to increase.

The estimated results for the medium-term impact of the EU accession are indicated in Table 2. Laspeyres indices give the changes in cost of living for each decile as a result of changes in food prices due to the accession, *ceteris paribus*. Laspeyres index exceeded 100 per cent for all consumer deciles in the examined years except in 2005. The increasing food prices mean a negative impact on overall consumer welfare. The low values in 2005 might be a reflection of the price fall indicated in Table 1.

Table 1

Real price changes in Hungary of some food products between 2003 and 2009

Product		2004/2003	2005/2003	2006/2003	2007/2003	2008/2003	2009/2003	Trend
		2003=100%						
Livestock	Pork	8.8	11.6	16.6	7.8	15.6	18.4	↑
	Beef	3.2	8.8	14.4	17.6	17.9	23.3	↑
	Poultry	4.7	5.7	4.9	15.3	25.2	25.6	↑
Animal prod.	Eggs	5.9	-1.3	4.3	16.5	29.4	28.8	↑
	Milk	-4.8	-8.6	-5.4	-0.5	12.2	-0.8	↓
	Cheese	5.2	-16.1	-16.7	-11.7	-3.9	-24.6	↓
	Margarine	3.6	4.9	6.1	10.3	28.7	38.6	↑
Crops/ cereals	Flour	15.2	-11.3	-8.7	19.6	48.4	31.2	↑
	Rice	3.3	-1.7	-3.4	7.0	36.4	57.4	↑
	Bread	9.3	4.0	3.4	17.3	28.7	21.9	↑
	Sugar	11.8	3.7	8.6	8.3	-4.8	-5.7	↑
	Vegetable oil	-6.2	-15.2	-15.3	-8.3	42.5	16.7	↓
Fruitveg	Potatoes	-6.0	-45.4	-7.3	24.8	-14.1	-15.7	↓
	Onions	-11.3	-41.0	-11.9	7.8	-10.8	-17.0	↓
	Apples	-8.7	-10.0	5.8	27.4	52.3	2.8	↑
	Oranges	5.4	-2.8	-1.9	-1.0	1.8	0.3	↑

Source: authors' calculations according to HCSO (2003-2009) food price data

Table 2

Laspeyres indices per deciles

Year	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
2004	100.9	100.6	100.6	100.5	100.4	100.5	100.4	100.3	100.3	100.2
2005	99.7	99.6	99.6	99.6	99.6	99.7	99.7	99.7	99.7	99.8
2006	100.6	100.4	100.4	100.3	100.2	100.3	100.2	100.2	100.1	100.1
2007	102.1	101.6	101.4	101.3	101.1	101.1	101.0	100.8	100.7	100.4
2008	104.0	102.9	102.7	102.5	102.1	102.1	102.0	101.6	101.4	100.9
2009	102.9	102.0	101.9	101.7	101.3	101.4	101.3	101.0	100.9	100.5

Source: authors' calculations according to HCSO, 2010

The results of the CV calculation are summarised in Table 3, which shows the monthly CV values in HUF that a person from each decile should receive to remain at the same welfare as before the food prices changed. The average amount of the compensation varies between 182 and 233 HUF in 2004 while it is three times higher in 2009 for all household profiles. The results correspond with Tiezzi's findings (2005) that welfare loss increased with income for each income group. The highest compensation should be added to D6 and D7 in order to remain as well off as in 2003.

Table 3

Compensating variation per deciles

Year	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
2004	182	195	205	218	201	233	219	221	215	213
2005	-63	-119	-151	-160	-186	-151	-190	-188	-224	-228
2006	119	124	130	144	108	154	120	113	87	63
2007	446	481	532	555	528	558	563	524	534	488
2008	834	893	989	1,034	1,027	1,086	1,123	1,062	1,097	1,071
2009	600	621	684	710	661	731	721	677	684	624

Source: authors' calculations according to HCSO, 2010

However it does not mean that these two deciles are the most vulnerable due to the accession. In Table 4 the per cent of initial income is indicated that should be added to a consumer as compensation. According to the results, the low income groups are the most vulnerable. D1 suffered from notable losses over the years. In 2008 a four per cent increase in disposable income was necessary to maintain their initial welfare. It is only 0.1-1.6 per cent for the richest income groups, even the compensating amount in HUF is higher for D10 than for D1. The reason for the situation is that food expenditure represents a greater share of total income for poorer households, meaning higher compensation to be added to them.

Table 4

Compensation per initial income, %

Year	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
2004	0.9	0.6	0.6	0.5	0.4	0.5	0.4	0.3	0.3	0.2
2005	-0.3	-0.4	-0.4	-0.4	-0.4	-0.3	-0.3	-0.3	-0.3	-0.2
2006	0.6	0.4	0.4	0.3	0.2	0.3	0.2	0.2	0.1	0.1
2007	2.1	1.6	1.4	1.3	1.1	1.1	1.0	0.8	0.7	0.4
2008	4.0	2.9	2.7	2.5	2.1	2.1	2.0	1.6	1.4	0.9
2009	2.9	2.0	1.9	1.7	1.3	1.4	1.3	1.0	0.9	0.5

Source: authors' calculations according to HCSO, 2010

In Table 5 the food share of Hungarian consumers is shown. The data highlight the proportion of expenditure on food products in the total income comparing the years 2003 and 2007. It is obvious that Engel's law is valid for Hungarian food consumers. Food share is the highest in D1 and the lowest in D10. Although it has decreased from 2003 the food share is still high for the lowest income groups compared to the EU average.

Table 5

Percentage of food expenditure in Hungary in 2003 and 2007

Year	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10
2003	33.3	30.9	30.4	29.5	27.7	28.1	26.2	24.9	23.0	18.1
2007	30.9	24.3	21.8	20.2	19.3	19.0	18.5	16.5	15.3	10.9

Source: authors' calculations according to HCSO, 2009

According to Tables 2, 3 and 4, D1 of the Hungarian food consumers was the most vulnerable consumer group in 2008 due to the price change of the given food basket, while the highest amount in monetary terms should have been added to groups 6 and 7.

After studying the changes of quantity demanded as a result of price and income changes for these deciles the price and income elasticities are summarized in Table 6, 7 and 8. For D1 the own-price elasticities of demand are on the diagonal of Table 6. Except for cheese and onions the elasticities are negative. The price elasticity of demand is positive for cheese and onions meaning that they behaved as Giffen goods. From these products the quantity demanded went up despite the fact their prices also went up. As HCSO treated cheese as a single product in 2003, it became aggregated with quark until 2008, meaning that the elasticity calculation is distorted and cheese could have been omitted from the sample. The highest values are for oranges, beef and sugar. In the case of a price increase of one per cent, the quantities would be reduced by 2.20, 0.65 and 0.63 per cent.

The cross-price elasticities are also indicated in Table 6. Cross-price elasticities may show complementary or substitute relationships between the different food groups. For example the price of cheese rose, D1 reduced their consumption of all other goods except onions. The cross-price elasticity is positive when the two goods are substitutes. However for D1, all cross-price elasticies except cheese and onion are negative, meaning that household do not substitute good *a* with good *b*.

The elasticity values for D1 and D7 are different. In general higher elasticities are observed for poor households and lower elasticities are found for richer households. Estimates of the own price elasticities for D7 are on the diagonal of Table 7. Except cheese and onions the elasticities are negative in this case as well. The highest values can be observed for potatoes, oranges, apples and bread. If the price increases by one per cent, the quantities of potatoes and citrus fruits would be reduced by 2.45 and 1.94 percent respectively while a one per cent increase in apple and bread prices leads to a reduction of quantities by 0.38 and 0.36 per cent. Cheese elasticity is useless, onions behaved as Giffen goods in D7, as well. The own price elasticities of the other goods are low. In the case of beef meat perfectly inelastic demand is noticeable. The quantity demanded was not affected by the price change that occurred over five years, it was consequently 1.3 kg/capita both in 2003 and 2008 for D7.

The cross price elasticity of demand is negative when the two goods are complementary. As the price of margarine rose, D7 reduced their consumption of bread, sugar and vegetable oil. At the same time they increase their demand for pork meat by 0.07 and 0.06 per cent when the price of poultry or beef meat increases, behaving as substitute products. The cross price elasticity of demand is zero for beef meat. The price changes of the other goods caused no change in demand for beef meat (1.3 kg/capita).

Income elasticity reflects changes in demand for a good due to a change in the income of the people. Income elasticities are calculated for the poorest (D1) and the richest (D10) income groups and for the middle class (D6). Increases in income caused higher onion consumption for D1 and D10. D6 decreased their onion consumption. In Table 8 negative income elasticity for almost all food groups is noticeable. Negative income elasticity means that the increase in income was not followed by the increase of demand. The analysed food products behave as inferior goods instead of normal goods.

Table 6

Own and cross price elasticities in 2008/2003 for Decile 1.

q \ p	Pork	Beef	Poultry	Bread	Sugar	Veg. Oil	Marg	Milk	Eggs	Cheese	Potatoes	Apple	Orange	Onion
Pork	**-0.23**	-0.21	-0.18	-0.16	-0.58	-0.13	-0.16	-0.25	-0.16	-0.54	-1.92	-0.11	-0.39	-1.05
Beef	-0.70	**-0.65**	-0.54	-0.50	-1.77	-0.39	-0.50	-0.77	-0.49	-1.65	-5.89	-0.33	-1.18	-3.21
Poultry	-0.53	-0.50	**-0.41**	-0.38	-1.35	-0.29	-0.38	-0.59	-0.38	-1.26	-4.48	-0.25	-0.90	-2.45
Bread	-0.40	-0.38	-0.31	**-0.29**	-1.03	-0.22	-0.29	-0.45	-0.29	-0.96	-3.41	-0.19	-0.68	-1.86
Sugar	-0.25	-0.23	-0.19	-0.18	**-0.63**	-0.14	-0.18	-0.28	-0.18	-0.59	-2.09	-0.12	-0.42	-1.14
Veg. Oil	-0.08	-0.07	-0.06	-0.06	-0.20	**-0.04**	-0.06	-0.09	-0.06	-0.19	-0.66	-0.04	-0.13	-0.36
Marg	-0.11	-0.10	-0.08	-0.08	-0.27	-0.06	**-0.08**	-0.12	-0.08	-0.25	-0.90	-0.05	-0.18	-0.49
Milk	-0.27	-0.25	-0.21	-0.20	-0.69	-0.15	-0.20	**-0.30**	-0.19	-0.65	-2.30	-0.13	-0.46	-1.26
Eggs	-0.54	-0.50	-0.42	-0.39	-1.37	-0.30	-0.39	-0.60	**-0.38**	-1.27	-4.54	-0.26	-0.91	-2.48
Cheese	1.88	1.76	1.46	1.35	4.77	1.04	1.35	2.09	1.33	**4.45**	15.85	0.90	3.18	8.65
Potatoes	-0.01	-0.01	-0.01	-0.01	-0.02	0.00	-0.01	-0.01	-0.01	-0.02	**-0.07**	0.00	-0.01	-0.04
Apple	-1.20	-1.12	-0.93	-0.86	-3.05	-0.66	-0.86	-1.33	-0.85	-2.84	-10.12	**-0.57**	-2.03	-5.53
Orange	-1.30	-1.22	-1.01	-0.93	-3.31	-0.72	-0.93	-1.44	-0.92	-3.08	-10.97	-0.62	**-2.20**	-5.99
Onion	0.23	0.22	0.18	0.17	0.59	0.13	0.17	0.26	0.16	0.55	1.94	0.11	0.39	**1.06**

Source: authors' calculations according to HCSO, 2010

Table 7

Own and cross price elasticities in 2008/2003 for Decile 7.

q \ p	Pork	Beef	Poultry	Bread	Sugar	Veg. Oil	Marg	Milk	Eggs	Cheese	Potatoes	Apple	Orange	Onion
Pork	**0.08**	0.07	0.06	0.06	0.20	0.04	0.06	0.09	0.06	0.19	0.68	0.04	0.14	0.37
Beef	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Poultry	-0.23	-0.22	**-0.18**	-0.17	-0.60	-0.13	-0.17	-0.26	-0.17	-0.55	-1.98	-0.11	-0.40	-1.08
Bread	-0.50	-0.47	-0.39	**-0.36**	-1.28	-0.28	-0.36	-0.56	-0.36	-1.20	-4.26	-0.24	-0.86	-2.33
Sugar	-0.09	-0.08	-0.07	-0.06	**-0.22**	-0.05	-0.06	-0.10	-0.06	-0.20	-0.73	-0.04	-0.15	-0.40
Veg. Oil	-0.05	-0.04	-0.04	-0.03	-0.11	**-0.03**	-0.03	-0.05	-0.03	-0.11	-0.38	-0.02	-0.08	-0.21
Marg	-0.24	-0.22	-0.18	-0.17	-0.61	-0.13	**-0.17**	-0.26	-0.17	-0.56	-2.01	-0.11	-0.40	-1.10
Milk	-0.22	-0.21	-0.17	-0.16	-0.56	-0.12	-0.16	**-0.24**	-0.16	-0.52	-1.85	-0.10	-0.37	-1.01
Eggs	-0.31	-0.29	-0.24	-0.22	-0.78	-0.17	-0.22	-0.34	**-0.22**	-0.73	-2.59	-0.15	-0.52	-1.41
Cheese	1.67	1.56	1.30	1.20	4.25	0.93	1.20	1.86	1.18	**3.96**	14.09	0.80	2.83	7.70
Potatoes	-0.29	-0.27	-0.23	-0.21	-0.74	-0.16	-0.21	-0.32	-0.21	-0.69	**-2.45**	-0.14	-0.49	-1.34
Apple	-0.80	-0.75	-0.62	-0.57	-2.03	-0.44	-0.57	-0.89	-0.56	-1.89	-6.73	**-0.38**	-1.35	-3.68
Orange	-1.14	-1.07	-0.89	-0.82	-2.91	-0.63	-0.82	-1.27	-0.81	-2.71	-9.66	-0.55	**-1.94**	-5.28
Onion	0.14	0.13	0.11	0.10	0.36	0.08	0.10	0.16	0.10	0.34	1.20	0.07	0.24	**0.65**

Source: authors' calculations according to HCSO, 2010

From Tables 6, 7 and 8 mainly negative own price, cross price and income elasticities were observed. The reason for this is that according to the HCSO secondary consumption data almost all examined consumer groups had a decreasing food consumption tendency in 2008 compared to 2003. For example D1 reduced their bread consumption by 17 per cent, and poultry and egg consumption by 22-23 per cent respectively. Sugar consumption was 24 per cent lower for D6 in 2008 than in the base year. D7 decreased their apple consumption by 33 per cent, while the difference was 43 per cent for D10's orange consumption.

Table 8

Income elasticities for D1, D6 and D10 in Hungary

	D1	D6	D10
Pork	-0.33	-0.34	-0.11
Beef	-1.00	-0.20	-0.56
Poultry	-0.76	-0.26	-0.23
Bread	-0.58	-0.68	-0.47
Sugar	-0.36	-0.67	-0.35
Vegetable oil	-0.11	-0.14	-0.08
Margarine	-0.15	-0.44	-0.21
Milk	-0.39	-0.60	-0.30
Eggs	-0.77	-0.33	-0.29
Cheese	2.69	1.90	1.39
Potatoes	-0.01	-0.49	-0.13
Apple	-1.72	-0.88	-0.20
Orange	-1.86	-0.83	-1.30
Onion	0.33	-0.46	0.69

Source: authors' calculations according to HCSO, 2010

Conclusions

The analysis enables us to conclude that all main groups are affected by the price changes. They should be compensated by 0.1-4 per cent of their basic income on the basis of the given consumer basket. The low income groups are the most vulnerable; at least 4 per cent increase in disposable income is necessary for the poorest deciles while only 0.9 per cent is needed for the richest households. This welfare loss seems to be not too high compared to results of 3-6 per cent for Argentina (Porto, 2003), 11.9 per cent for Vietnam (Niimi, 2005) and 73-85 per cent for Indonesia (Friedman and Levinsohn, 2001). The values of the Laspeyres index calculations are also lower in Hungary than in a neighbouring country. In Romania in 2008, the consumer's welfare loss varied between 4 per cent for decile 10 and 12 per cent for decile 1 (Hubbard et al., 2010). Thus we can conclude that the EU accession caused slight changes in Hungarian consumers' welfare if only the above listed 18 food products are considered in the consumer basket, *ceteris paribus*.

Own price elasticities are different for the poor and the middle class groups. The larger elasticities showed that poor consumers are more sensitive to price changes than the gentility. For instance, the price elasticity for pork was -0.23 among the poor and only -0.08 among the middle class. Cross price elasticities were mainly negative for D1 and D7.

Income elasticity of demand is used to see how sensitive the demand for an income changes. It is found that almost all goods are inferior and negative income inelastic. Only onions behaved as a normal good. The observed reduction in food quantities may lead to the assumption that food consumption patterns shifted toward different type of foods such as fast food or pre-prepared meals.

There is no economic model, that explains perfectly an economic situation, but the above method can lead to more accurate results if it is possible to meet the following criteria:

- expanding the consumer basket with more food products that are also often consumed goods (like tomatoes, pasta, mineral water and wine);
- expanding the consumer basket with durable goods, considering food consumption to be constant;
- instead of single-price-change multiple-price-change should be counted, where not the food consumption, neither durable good's consumption is constant;
- choosing an earlier year than 2003 to be the base year could also lead to more reliable results. Although 2003 was the last year before Hungary's EU accession, prior to access, agricultural and food trade were already increasing, so the connection has not reported such a major change. 2003 was even not a good year in agricultural production. Low crop yields due to high prices were observed, and if it is considered the base year, it also might distort the welfare effects of EU accession.
- multivariate logistic regression can be used to assess the effect of food prices on the likelihood of consumption, controlling for socio-demographic variables as well.

Although welfare changes are negligible after the EU accession in the medium-term, a forthcoming study might focus on changes in the long-term. Beside the CAP support programme, more events may occur that bias consumer welfare. Economic recession in 2008, extreme currency exchange rates in 2009 and flood-damaged crop plantations in 2010 could also impact directly on prices and indirectly on consumers. Government policies should broaden the social net in order to compensate the aggrieved consumers.

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The impact of crop protection on agricultural production

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Abstract

Chemical pesticides will continue to play a role in pest management for the future. In many situations, the benefits of pesticide use are high relative to the risks or there are no practical alternatives. The number and diversity of biological sources will increase, and products that originate in chemistry laboratories will be designed for particular target sites. Innovations in pesticide delivery systems in plants promise to reduce adverse environmental impacts even further. The correct use of pesticides can deliver significant socio-economic and environmental benefits in the form of safe, healthy, affordable food; and enable sustainable farm management by improving the efficiency with which we use natural resources such as soil, water and overall land use. Genetically engineered organisms that reduce pest pressure constitute a "new generation" of pest management tools. The use of transgenic crops will probably maintain, or even increase, the need for effective resistance management programmes. However, there remains a need for new chemicals that are compatible with ecologically based pest management and applicator and worker safety. Evaluation of the effectiveness of biocontrol agents should involve consideration of long-term impacts rather than only short-term yield, as is typically done for conventional practices. But it makes sense to establish a legal framework that enables organic and pesticide-free markets to emerge and prosper so that consumers can be given an informed choice between lines of products that vary with pest management. The justifications of government intervention in the management of pest control include the need to address the externality problems associated with the human and environmental health effects of pesticides. There is underinvestment from a social perspective in private-sector research because companies will compare their expected profits from their patented products resulting from research and will not consider the benefits to consumers and users. Another reason why public research might lead to innovations that elude the private sector is the different incentives that researchers in the private and public sectors face.

Keywords

Crop protection, pesticide, biopesticide, crop losses, cost and benefit, agriculture

Introduction

Globalisation is affecting pest management on and off the farm. Reduction in trade barriers increases competitive pressures and provides extra incentives for farmers to reduce costs and increase crop yields. In a global marketplace, farmers of one country can compete with farmers from other countries where labour, land and input costs are lower only by being more "productive", with higher yields per hectare. Other forms of trade barriers create disincentives for adopting new technologies (such as the reluctance of the EU to accept genetically modified organisms). It is likely that trade will increase the spread of invasive pest species and pose risks to domestic plants and animals, as well as populations of native flora and fauna.

The goal in agriculture should be the production of high-quality food and fibre at low cost and with minimal deleterious effects on humans or the environment. To make agriculture more productive and profitable in the face of rising costs and rising standards of human and environmental health, the best combination of available technologies has to be used. These technologies should include chemical, as well as biological and recombinant, methods of pest control integrated into ecologically balanced programmes. The effort to reach the goal must be based on sound fundamen-

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tal and applied research, and decisions must be based on science. Accomplishing the goal requires expansion of the research effort in government, industry and university laboratories.

The beneficial outcome from the use of pesticides provides evidence that pesticides will continue to be a vital tool in the diverse range of technologies that can maintain and improve living standards for the people of the world. Reducing pesticide use can provide growers with direct economic benefits by decreasing the cost of inputs and increasing net returns. Some alternative methods may be more costly than conventional chemical-intensive agricultural practices, but often these comparisons fail to account for the high environmental and social costs of pesticide use. The economic and environmental impacts of agricultural policies on pesticide reduction also deserve scrutiny and policies that encourage adoption of ecologically sound farming practices need to be implemented.

The general public has a critical function in determining the future role of pesticides in agriculture. Sometimes objections to pesticides are an issue of subjective preference even when scientific evidence cannot support the objections. Investments in research by the public sector should emphasise those areas of pest management that are not now being (and historically have never been) undertaken by private industry. The justifications of government intervention in the management of pest control include the need to address the externality problems associated with the human and environmental health effects of pesticides. The public sector must act on its responsibility to provide quality education to ensure well informed decision making in both the private and public sectors.

Methods

The paper is based on the national pesticide benefit studies from the United States, where research covered fifty crops, including 5-10 crops for each state in the U.S. Several international specialist publications support the analysis (e.g. Oerke et al. 1994; Oerke and Dehne 2004, Oerke 2006, FAO, 2009; IWMI, 2007; Pimentel, 2005). The database of FAO, USDA, EUFADN and the Hungarian Research Institute for Agricultural Economics has also been used in the examination. The study focuses mainly on crop protection in the context of agricultural production, crop losses due to pests and cost-benefit analysis of crop protection measures.

Crop protection in the context of agricultural development

Improved crop management systems based upon genetically improved (high yielding) cultivars and soil cultivation techniques, enhanced soil fertility via chemical fertilisation, pest control via synthetic pesticides, and irrigation were hallmarks of the Green Revolution. The combined effect of these factors has allowed world food production to double in the past 50 years. From 1960 to the present the human population has more than doubled to reach almost 7 billion people (FAO, 2009). The doubling of grain production since the early 1960s was associated with a 6.9-fold increase in nitrogen fertilisation, a 1.7-fold increase in the amount of irrigated crop land, and a 1.1-fold increase in land in cultivation, and has resulted in a global food supply sufficient to provide adequate energy and protein for all (Tilman, 1999). The proportion of yield increase that may be attributed to genetic improvement of crops by breeders is about 0.5-0.6 providing farmers with high yielding varieties responsive to improved fertilisation (McLaren, 2000). In addition, the intensity of crop protection has increased considerably as exemplified by a 15-20 fold increase in the amount of pesticides used worldwide (Oerke, 2006). Much of the increase

in yield per unit of area can be attributed to more efficient control of (biotic) stress rather than an increase in yield potential.

Human population is projected to grow by 75 million per annum, increasing by 35% to 9.1 billion by 2050 (FAO, 2009). This increased population density, coupled with changes in dietary habits in developing countries towards high quality food (e.g. more consumption of meat and milk products) and the increasing use of grains for livestock feed, is projected to cause the demand for food production to increase by 70%. The increase in production has to happen whilst the climate is changing and becoming less predictable, as greenhouse gas emissions from agriculture need to be cut, and as land and water resources are shrinking or deteriorating. The provision of additional agricultural land is limited, as it would have to happen mostly at the expense of forests and the natural habitats of wildlife, wild relatives of crops and natural enemies of crop pests. Furthermore, a higher proportion of agricultural land may be used industrially to produce biofuel or fibre instead of food. Thus, we may need to grow food on even less land, with less water, using less energy, fertiliser and pesticide than now. Given these limitations, sustainable production at elevated levels is urgently needed. Increasing productivity on existing land is by far the better choice. Globally, an average of 35% of crop yields are lost to pre-harvest pests (Figure 1). In some developing countries pre-harvest losses can reach 70%. The conservation of fertile soils, the development of high-yielding varieties and the reduction of current yield losses caused by pests, pathogens and weeds are major challenges to agricultural production.

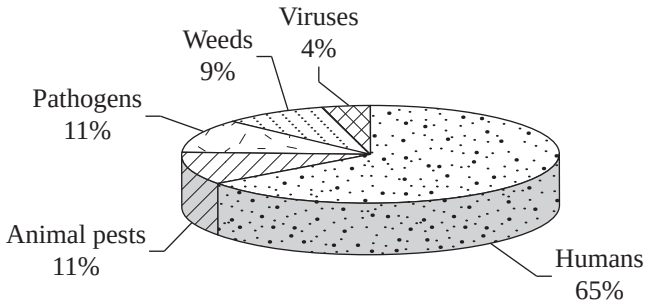

Figure 1: The world agricultural cake, 2001-03

Source: Oerke (2006)

Whilst technology will undoubtedly hold many of the keys to long term global food security, the development and testing of new varieties or techniques takes time. It may be ten years or more before people see the benefits. However, there is a lot that can be done today with existing knowledge. Part of the key is also to avoid waste along the whole length of the food chain. In addition to the pre-harvest losses (35% of crop yields) transport, pre-processing, storage, processing, packaging, marketing and plate waste losses are relatively high too (Figure 2). Insects, weeds and microbial pests cause the most problems but research, education and training can play a key role in helping the world lose less after harvest along the food chain.

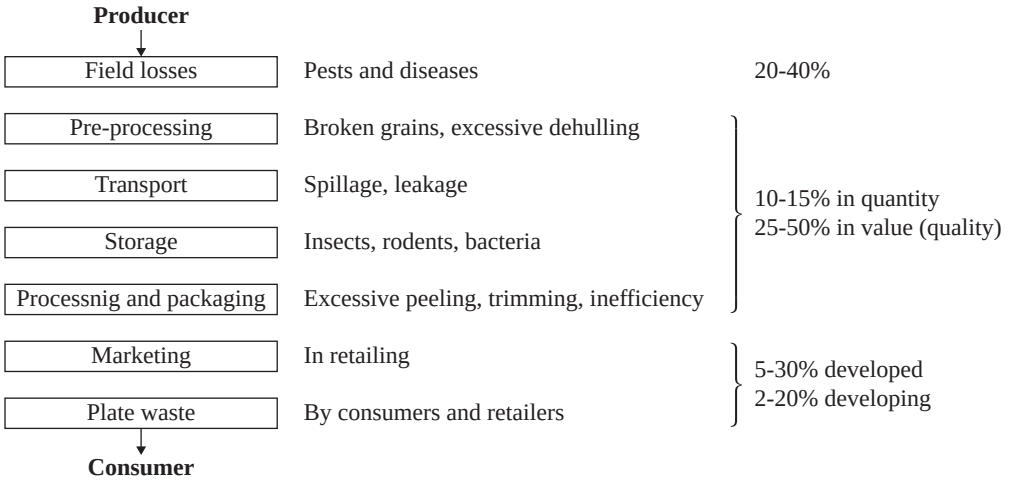

Figure 2: Losses along the food chain

Source: IWMI (2007).

Helping farmers to lose less of their crops will be a key factor in promoting food security, but even in the poorest countries those rural farmers aspire to more than self-sufficiency. They want to improve their livelihoods so as to buy higher quality, more nutritious food and to afford a better standard of living, healthcare and education. So we also need to build the knowledge and skills that will help them earn more for their crops. In an increasingly global food system, this is about quality as well as quantity. Even though tariff barriers to trade are being lowered, regulations to reduce pesticide residues and prevent the spread of plant diseases can act as major barriers to farmers who want to access the high value markets in Europe and America. More and more farmers move from growing staples into higher value horticulture and introduce techniques of integrated pest management that allow them to meet the standards for export of fruit into Europe. Food security is then only the first step towards greater economic independence for farmers.

The three annual crops, namely maize, rice and wheat, occupy almost 40% of global crop land and are the primary sources for human nutrition worldwide. As yields of these crops and some cash crops like soybean, cotton and sugar beet positively respond to high production levels and/or cultivation may be largely mechanised, in recent decades worldwide crop production has focused on a limited number of plant species. Diverse ecosystems have been replaced in many regions by simple agro-ecosystems which are more vulnerable to pest attack. In order to safeguard the high level of food and feed productivity necessary to meet the increasing human demand, these crops require protection from pests.

We are currently using around USD 40 billion worth of pesticides each year in agriculture, worldwide. What will the benefits and risks be if this level of pesticide use is continued or increased? What will they be if pesticide use is discontinued? Farmers in highly developed, industrialised countries expect a four or five fold return on money spent on pesticides. Is this still true? Can we meet world food demands if producers stop using pesticides because of reduced economic benefits? Can better integrated pest management (IPM) preserve the economic benefits of pesticide use? Although crop losses are currently greatest in less industrialised countries, can we meet the educational and training requirements to safely increase pesticide use in these areas? These are just some of the questions facing scientists and pest management experts as agriculture faces its greatest challenge in history between now and the year 2050.

Crop losses due to pests

Since the beginnings of agriculture about 10,000 years ago, growers have had to compete with harmful organisms – animal pests, plant pathogens and weeds (i.e. competitive plants), collectively called pests – for crop products grown for human use and consumption. As with abiotic causes of crop losses, especially the lack or excess of water in the growth season, extreme temperatures, high or low irradiance (factors which can be controlled only within narrow limits) and nutrient supply, biotic stressors have the potential to reduce crop production substantially. These organisms may be controlled by applying physical (cultivation, mechanical weeding etc.), biological (cultivar choice, crop rotation, antagonists, predators etc.) and chemical measures (pesticides). Crop protection has been developed for the prevention and control of crop losses due to pests in the field (pre-harvest losses) and during storage (post-harvest losses). This paper concentrates on pre-harvest losses, i.e. the effect of pests on crop production in the field, and the effect of control measures applied by farmers in order to restrict losses to an acceptable level.

Crop losses may be quantitative and/or qualitative. Quantitative losses result from reduced productivity, leading to a smaller yield per unit area. Qualitative losses from pests may result from the reduced content of valuable ingredients, reduced market quality, e.g. due to aesthetic features (pigmentation), reduced storage characteristics, or due to the contamination of the harvested product with pests, parts of pests or toxic products of the pests (e.g. mycotoxins). Crop losses may be expressed in absolute terms (kg/ha, financial loss/ha) or in relative terms (loss in %). The economic relevance of crop losses may be assessed by comparing the costs of control options with the potential income from the crop losses prevented due to pest control. Often, it is not economically justifiable to reduce high loss rates at low crop productivity, as the absolute yield gain from pest control is only low. In contrast, in high input production systems, the reduction of low loss rates may result in a net economic benefit for the farmer.

Two loss rates have to be differentiated: the potential loss and the actual loss. The potential loss from pests includes the losses without physical, biological or chemical crop protection compared with yields with a similar intensity of crop production (fertilisation, irrigation, cultivars etc.) in a no-loss scenario. Actual losses comprise the crop losses sustained despite the crop protection practices employed. The efficacy of crop protection practices may be calculated as the percentage of potential losses prevented. In contrast, the impact of pesticide use on crop productivity may be assessed only by generating a second scenario considering changes in the production system provoked by the abandonment or ban of pesticides – use of other varieties of the crop, modified crop rotation, lower fertiliser use, etc. – and often associated with a reduced attainable yield.

Crop losses to weeds, animal pests, pathogens and viruses continue to reduce available production of food and cash crops worldwide. Absolute losses and loss rates vary among crops due to differences in their reaction to the competition of weeds and the susceptibility to attack of the other pest groups. The overall loss potential is especially high in crops grown under high productivity conditions as well as in the tropics and sub-tropics where climatic conditions favour the damaging function of pests. Actual crop protection depends on the importance of pest groups or its perception by farmers and on the availability of crop protection methods. As the availability of control measures greatly varies among regions, actual losses despite pest control measures differ to a higher extent than the site-specific loss potentials. Actual loss rates show higher coefficients of variation than absolute losses.

The economically acceptable rate of crop losses is well above zero in most field crops. Some crop losses may not be avoidable for technological reasons (or availability of technology in developing countries); others are not or will not be available furthermore because of ecologi-

cal hazards (soil disinfectants). In many cases, however, higher pesticide use in order to produce extra yield from preventing crop losses is economically not justified because other environmental factors than pests, especially water availability, are yield-limiting. Therefore, a drastic reduction of crop losses is highly desirable for many regions from the point of view of feeding the human population; however, pest control and the use of pesticides in particular are mainly applied according to the economic benefits of the farmer. The increased use of pesticides since 1960 has not resulted in a significant decrease of crop losses; however, in many regions they have enabled farmers to increase crop productivity considerably without losing an economically non-acceptable proportion of the crop to pests.

Although crop protection aims to avoid or prevent crop losses or to reduce them to an economically acceptable level, the availability of quantitative data on the effect of weeds, animal pests and pathogens is very limited. An assessment of the full range of agricultural pests and of the composition and deployment of chemical pesticides to control pests in various environments would be an impossible task because of the large volume of data and the number of analyses required to generate a credible evaluation. The generation of experimental data is time-consuming and labour-intensive, losses vary from growth season to growth season due to variation in pest incidence and severity, and estimates of loss data for various crops are fraught with problems. The assessment of crop losses despite actual crop protection strategies is important for demonstrating where future action is needed and for decision making by farmers as well as at the governmental level.

According to German authorities in 1929, animal pests and fungal pathogens each caused a 10% loss of cereal yield. In potato, pathogens and animal pests reduced production by 25 and 5%, respectively; while in sugar beet, production was reduced by 5 and 10% due to pathogens and animal pests respectively (Morstatt, 1929). In the USA, in the early 1900s pre-harvest losses caused by insect pests were estimated to be seldom less than 10% (Marlatt, 1904). Later, the United States Department of Agriculture (USDA) published data on pre-harvest losses in 1927, 1931, 1939, 1954 and 1965 (Cramer, 1967). This book gives the most comprehensive overview on crop losses throughout the world; however, due to significant changes in area harvested, production systems, intensity of production, incidence of pests, control options, product prices the loss data became outdated.

Estimates of actual losses in crop production worldwide were updated nearly 30 years later for the period 1988-90 on a regional basis for 17 regions by Oerke *et al*. (1994). Increased agricultural pesticide use nearly doubled food crop harvests from 42% of the theoretical worldwide yield in 1965 to 70% of the theoretical yield by 1990. Unfortunately, 30% of the theoretical yield was still being lost because the use of effective pest management methods was not applied uniformly around the world and it still is not. Without pesticides, natural enemies, host plant resistance and other nonchemical controls, 70% of crops could have been lost to pests. Since 1965 worldwide production of most crops has increased considerably. Simultaneously, crop losses in wheat, potatoes, barley and rice increased by 4 to 10 per cent, in maize, soybean, cotton and coffee losses remained unchanged or slightly decreased. These estimates should be taken only as a rough guide to the scope of the problem (Figure 3).

Since crop production technology and especially crop protection methods are changing continuously, loss data for eight major food and cash crops – wheat, rice, maize, barley, potatoes, soybeans, sugar beet and cotton – have been updated for the period 1996-98 on a regional basis for 17 regions (Oerke and Dehne, 2004). Among crops the loss potential of pests worldwide varied from less than 50% (in barley) to more than 80% (in sugar beet and cotton). Actual losses were estimated at 26-30% for sugar beet, barley, soybean, wheat and cotton, and 35%, 39% and 40% for

maize, potatoes and rice, respectively. The percentage of losses prevented ranged from 34-35% in Central Africa and the European part of the Commonwealth of Independent States (CIS) to 70% in Northwest Europe. In East Asia, North America and South Europe efficacy was calculated to reach 55-60% (Figure 3).

Since the early 1990s, production systems and especially crop protection methods have changed significantly, especially in crops such as maize, soybean and cotton, in which the advent of transgenic varieties has modified the strategies for pest control in some major production regions. Loss data for major food and cash crops were last updated by CABI's Crop Protection Compendium for six food and cash crops – wheat, rice, maize, potatoes, soybeans, and cotton – for the period 2001-2003 on a regional basis (CABI, 2005, Oerke, 2006). Nineteen regions were specified according to the intensity of crop production and the production conditions. Among crops, the total global potential loss due to pests varied from about 50% in wheat to more than 80% in cotton production. The responses are estimated as losses of 26-29% for soybean, wheat and cotton, and 31, 37 and 40% for maize, rice and potatoes respectively (Figure 3).

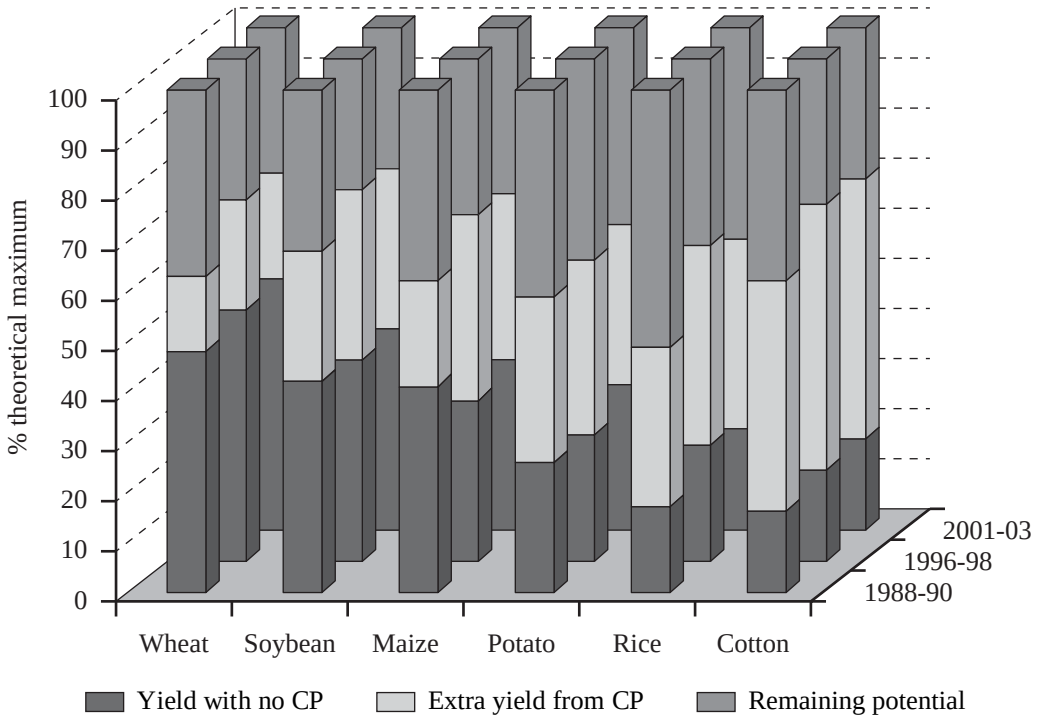

Figure 3: Development of crop losses from 1996-98 to 2001-03

Source: Oerke et *al*. (1994), Oerke and Dehne (2004), Oerke (2006) and own calculations

Comparing crop production and actual losses to pests for 1988-90 and 2001-03 to data from 1965, when Cramer (1967) estimated crop losses for more than 60 crops using a similar methodology, the differences between regions and crops, respectively, are evident. Worldwide, production of food and cash crops increased considerably, the actual losses of the six food and cash crops have decreased considerably in relative terms during the last 40 years (Table 1).

Table 1

Estimates of actual and potential crop losses due to pests of six food and cash crops

Crop	Actual loss rate (%)			Potential loss rate (%)		
	1988-90[1)]	1996-98[2)]	2001-03[3)]	1988-90[1)]	1996-98[2)]	2001-03[3)]
Cotton	38	29	29	84	82	82
Rice	51	39	37	82	77	77
Potato	41	39	40	73	71	75
Maize	38	33	31	59	66	68
Soybean	32	28	26	59	60	60
Wheat	34	29	28	52	50	50

1) From Oerke *et al*. (1994)
2) From Oerke and Dehne (2004)
3) From Oerke (2006)
Source: Oerke et al. (1994), Oerke and Dehne (2004), Oerke (2006) and own calculations.

It was estimated that for the period 1988-90 42% of the production of the eight major food and cash crops of the world – wheat, rice, maize, barley, potatoes, soybeans, cotton and coffee – were lost to pests, with 15% attributable to insects and 13.5% each to weed and pathogens, despite the application of an estimated 2.5 million tonnes of pesticides in a year at a cost of USD 26 billion, plus the benefits of various nonchemical controls. An additional 10% of the potential value was lost postharvest. Potential losses worldwide were estimated to be as high as 70%. Weeds produced the highest potential loss (30%), with animal pests and pathogens being less important (losses of 23 and 17%). The efficacy of crop protection was higher in cash crops than in food crops. Worldwide, disease control reduced the potential losses by 23%. The yield limiting potentials of animal pests and weeds were reduced more efficiently by 31 and 55%, respectively. Due to the small share of Western Europe in worldwide production of 8%, the efficacy of actual crop protection worldwide was only 40%. However, regional variation was higher than the differences among crops. In total, the loss potential of about 70% was reduced to actual losses of 42% (Figure 4).

For the period 1996-98 weeds had the highest loss potential (32%) with animal pests and pathogens being less important (18% and 15%, respectively). Although viruses cause serious problems in potatoes and sugar beets in some areas, worldwide losses due to viruses averaged 3%. In terms of the efficacy of actual pest control measures by pest group, weed control, which can be done manually, mechanically or chemically achieved an overall efficacy of 71%. The control of animal pests and diseases caused by fungi and bacteria was considerably lower at 42% and 34%, respectively, with virus control reaching an efficacy of only 13%. The efficacy of actual crop protection worldwide was 52%. In total, the loss potential of about 67% was reduced to actual losses of about 32% (Figure 4).

In many crops, weeds are the most important pest group, and as these may be controlled manually, by mechanical weeding or by the use of synthetic herbicides, weed control is more effective than the reduction of crop losses from diseases or animal pests. For the period 2001-2003 weeds produced the highest potential loss (34%), with animal pests and pathogens being less important (losses of 18 and 16%). The efficacy of control of pathogens and animal pests only reached 32 and 39%, respectively, compared to 74% for weed control. The control of soil-borne pathogens and nematodes, in particular, often causes problems. In most regions, the potential loss due to viruses is relatively low (4% on average) and virus control reduced the potential losses by

5% since the efficacy of the control of viruses was largely restricted to the use of insecticides for the control of the virus vectors. However, there are big differences in the efficacy of pest control. In Northwest Europe, from 2001 to 2003, efficacy was as high as 71%, in North America 63%, in South Asia 42%, in West Africa 43% and in East Africa 32%. The efficacy of actual crop protection worldwide was around 52%. In total, the loss potential of about 72% was reduced to actual losses of about 35% (Figure 4).

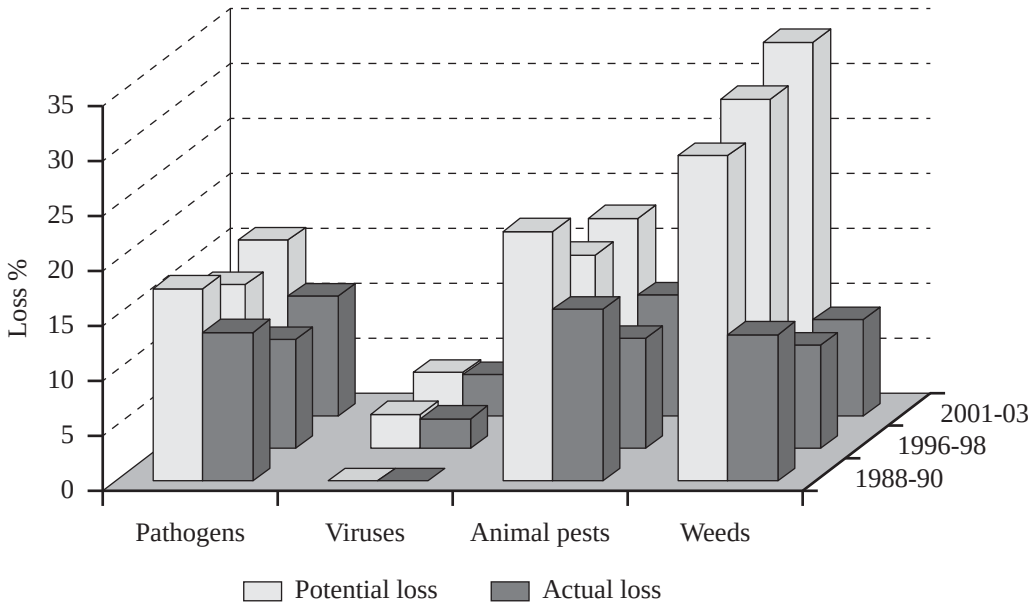

Figure 4: Development of efficacy of actual crop protection practices from 1996-98 to 2001-03
Source: Oerke et al. (1994), Oerke and Dehne (2004), Oerke (2006) and own calculations.

Due to the increased use of pesticides the absolute value of crop losses and the overall proportion of crop losses appear to have decreased in the past 40 years (Table 1). Worldwide estimates for losses to pests in 1996-98 and 2001-03 differ significantly from estimates published earlier (Cramer, 1967; Oerke *et al*., 1994). Obsolete information from old reports has been replaced by new data. Despite a broader database the lack of systematically collected data is still evident. Alterations in the share of regions differing in loss rates in total production worldwide are also responsible for differences. Moreover, the intensity and efficacy of crop protection has increased since the late 1980s especially in Asia and Latin America where the use of pesticides increased above the global average.

Irrespective of the availability of control measures, the control of pests having a low potential loss is not economically justifiable. Therefore, the efficacy of pest control often increases with the loss potential. These figures indicate that in the regions with the highest need for additional food there is still a great deal of room for increasing productivity simply by reducing the current yield losses through improved crop and postharvest protection. Crop losses from biotic stresses are likely to increase from future attempts to intensify agricultural production. These will include the use of varieties with higher yield potential, large-scale cropping with genetically uniform plants, reduced crop rotation and expansion of crops into marginal land. In addition, because of climate change many weeds, pests and diseases will reproduce faster and spread more widely causing significant yield losses over what is experienced today.

However, new scientific knowledge and modern technologies provide considerable opportunities, even for developing countries, to further reduce current yield losses and minimise the future effects of climate change on plant health. Continuously finding new cost-effective and environmentally sound solutions to improve control of pest and disease problems is critical to improving the health and livelihoods of the poor. The need for a more holistic and modernised IPM approach in low-income countries is now more important than ever before.

The efficacy of pest control strategies has changed in many regions. The use of pesticides has increased dramatically since the early 1960s; in the same period also the yield average productivity in the production of wheat, rice and maize, the major sources for human nutrition, has more than doubled. The intensity of pest control has increased sometimes dramatically, e.g. in Asia and Latin America, where the use of pesticides increased well above the global average (McDougall, 2010). There are new compounds available that are highly effective against pests which were formerly less controllable. Importantly, better training of farmers and advisors by governmental and non-governmental organisations has contributed to an improvement in pest control in recent decades. In large parts of Asia and Latin America great advances have been made in the education of farmers, whereas the situation is still poor in Sub-Saharan Africa and has worsened in the countries of the former Soviet Union because of the lack of resources.

The EC Directive 2009/128/EC on the sustainable use of pesticides establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of IPM and alternative approaches or techniques such as non-chemical alternatives to pesticides. Each Member State government needs to prepare an action plan which covers measures such as compulsory testing of application equipment, certification of operators, distributors and advisors, banning aerial spraying, protecting the aquatic environment, public spaces and conservation areas and minimising risk to human health and the environment. Member States should ensure that the appropriate decision support systems are in place to support plant protection (i.e. decision support systems and advisory services) as users must not simply record that they have used a pesticide, but also why they have used it on that particular occasion. Member States should set up a system for training of advisors and distributors if this does not currently exist, and all Member States should implement the Directive by 14 December 2011 by means of national laws. National governments can define the appropriate record keeping and reporting systems.

In conclusion, the global situation on pest problems and the relative effectiveness of the methods used to control them strongly suggests that unilateral control strategies such as chemical pesticides are unlikely to provide sustainable solutions to pest problems. Such observations also provide a warning to those who put much hope on single biotechnology approaches. Therefore, the global situation with pests and the methods used to control them underlines the need to develop and implement IPM on the broadest possible level.

Cost and benefit of pesticides

The costs of pesticides and nonchemical pest-control methods alike are low relative to crop prices and total production costs. Pesticides account for about 7-8% of total farm production costs in the EU (Figure 5). However, there is wide variation among member states fluctuating between 11% in France and Ireland and 4% in Slovenia (EUFADN, 2010). Pesticide use was relatively low in the new Member States prior to EU-accession. Pesticides account for 5-6% of total farm input in the USA (USDA, 2010).

Figure 5: Share of crop protection cost in total input (EU)
Source: EUFADN Database (2010) and own calculations.

EU farmers spend on average 90-100 euro per hectare of field crops on pesticides but there is wide variation among Member States (Figure 6). In 2008 farmers in the Netherlands spent 329 and in Estonia only 25 euro a hectare. Crop protection cost per hectare has increased in the new Member States following EU accession.

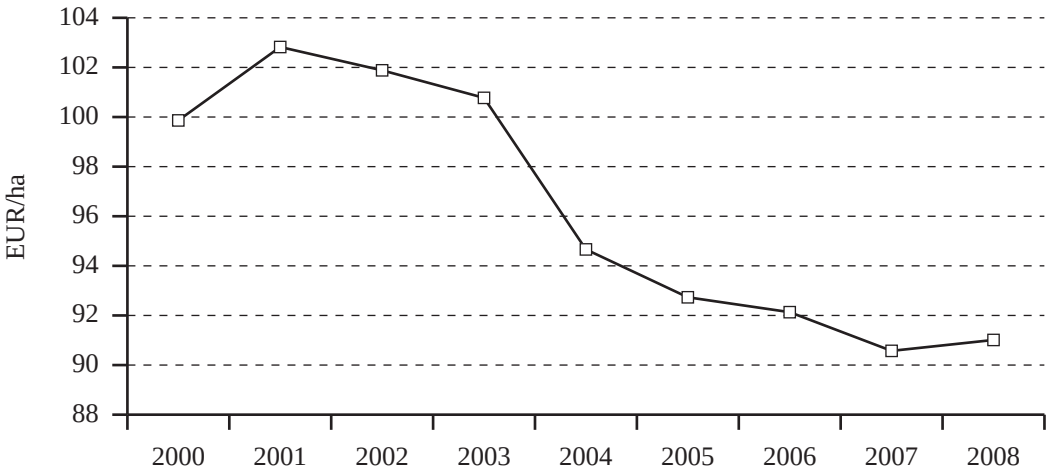

Figure 6: Crop protection cost in the EU
Source: EUFADN Database (2010) and own calculations.

The average cost of pesticides for all treated crop hectare in the U.S. was around USD 270 for the period 2002-2008 (Gianessi and Reigner, 2005, Gianessi and Reigner, 2006, Gianessi, 2009). Another rough calculation, with lots of assumptions and guesswork, is to divide recent USDA survey estimates of farm pesticide expenditures by crop land acres harvested. But the expenditure surveys summarise pesticide costs for all uses on the farm including livestock, pasture land, idled cropland and cropland planted but not harvested. In 2009 annual expenditures for all pesticides were

about USD 11.5 billion and crop acres harvested was about 340 million which implies about USD 34 an acre. It is known that much of the small grains (wheat, barley, oats etc.) acreage is not treated with any pesticides. Even at 300 million acres, that implies about USD 38 an acre or USD 95 a hectare. Pesticides account for about 5-6% of total farm production costs in the USA (USDA, 2010). Using other assumptions one can derive different ratios. However, there is wide variation in pesticide cost among commodities. For example, fruit and vegetable as well as cotton and rice production costs are much higher (USD 170-290/ha) than those of wheat, barley, soybean and maize production (USD 25-70/ha). Application costs are included in estimated pesticide costs. The increasing reliance on GMO seeds (e.g. herbicide resistant seed and seed with Bt traits for insect control) have shifted some of the costs from pesticides to seed especially for soybeans, corn and cotton.

There are many kinds of benefits that may be attributed to pesticides. The most obvious and easiest to calculate are economic benefits derived from the protection of commodity yield and quality, and the reduction of other costly inputs such as labour and fuel. These benefits can accrue to a variety of different recipients, such as farmers and other users of pesticides, the marketplace, consumers and society. Other kinds of benefits include the maintenance of aesthetic quality, the protection of human health from disease-carrying organisms, the suppression of nuisance-causing pests and the protection of other organisms, including endangered species, from pests.

When reliable commodity loss data are available, monetary benefits are relatively easy to calculate from current market statistics and economic theory. In this sort of analysis, benefits are equated with the potential value of the commodity that is lost because the pesticide is not used. This approach to analysing benefits is realistic only if no other methods of reducing commodity losses are available. While this is rarely the case for any pesticide, the analysis commonly employed in pesticide risk/benefits analyses does not consider other methods of reducing crop or other losses. Non-monetary benefits are more difficult to calculate. Policy makers have long wrestled with how to put USD-based values on such things as aesthetic quality, the survival of certain endangered species, and peace of mind. In practice, such non-market benefits are rarely considered by policy makers to be as important as benefits that can be measured in the marketplace and hence they are generally simply ignored.

Furthermore, the practice of using yield data from plants grown with and without a pesticide to determine the economic impact of banning that pesticide is certainly not realistic. Farmers and other resource managers will not simply stand by and do nothing if a specific pesticide is eliminated as an option. They are necessarily resourceful and will make adjustments to maximise their economic gain. Possible adjustments include adopting IPM, altering cropping practices, shifting to resistant varieties or alternative crops, or utilising new markets, such as those for organic produce. All of these possibilities should be incorporated into various reasonable alternatives that can be objectively evaluated for both economic and non-market benefits.

Loss data, including the importance of pests, key pests and their control and use of pesticides, are a prerequisite to the economic management of pests and for evaluating the efficacy of present crop protection practices. Based on these data, strategies for the use of limited resources may be developed in order to optimise productivity. Assessments of crop losses despite actual crop protection strategies are required to demonstrate where action is needed and for decision making. Overall, farmers have sound economic reasons for using pesticides on crop land. Despite of the yearly investments of nearly USD 40 billion worldwide pests cause an estimated 35% actual loss (Oerke, 2006). The value of this crop loss is estimated to be USD 2000 billion per year, yet there is still about USD 5 return per dollar invested in pesticide control (Pimentel, 2009).

Detailed pesticide benefit analyses have been made mainly in the United States. In the late 1990s, growers in the USA could expect a USD 4 return for each dollar they spent on agricultural pesticides (Fernandez-Cornejo *et al*., 1998). However, when all the indirect costs for pesticides were considered, there was only a USD 2 return to society at large for each dollar that growers spent on pesticides (Pimentel and Greiner, 1997). Later, the national pesticide benefit studies from the second half of the 2000s documented a huge net return of costs that growers spend on herbicides, insecticides, fungicides and their application. Research covered fifty crops, including 5-10 crops for each state in the U.S.

U.S. farmers have sprayed herbicides on close to 90% of the nation's crop land acreage for the past thirty years. The value of the use of herbicides in 2005 is estimated to have been USD 16 billion in increased crop yields and USD 10 billion in reduced weed control costs totalling a herbicide non-use net income impact of USD 26 billion. Increased fuel and labour costs have made the costs of alternatives to herbicides higher. The aggregate cost of cultivation and hand weeding as replacements for herbicides increased to USD 16.8 billion, resulting in a net increase in weed control costs without herbicides to USD 10 billion in 2005. The value of the crops, which means the loss in production without herbicides, were worth USD 16 billion. Cost estimate consists of three components: cost of the product, cost of application, and premiums for use of herbicide tolerant soybean, corn, canola, rice and cotton seeds. Nationally, it is estimated that growers spent USD 4.4 billion on herbicide products in 2005. The total costs of herbicide application are estimated at USD 1.9 billion and the total premium for planting herbicide tolerant seed is estimated at USD 0.8 billion, which represents a total cost of USD 7.1 billion (Gianessi and Reigner, 2006). It gives a net return of USD 3.7 for every dollar that growers spend on herbicides and their application (Table 2).

Table 2

Value of herbicides, insecticides and fungicides in U.S. crop production

USD billion	Herbicides 2005	Insectisides 2008	Fungicides 2002	Total 2002-08
Cost to growers	7.1	1.2	0.9	9.2
Non-use cost increase	9.7	-	-	9.7
Yield benefit	16.3	22.9	12.8	52.0
Net benefit	26.0	21.7	12.0	59.7
Return ratio: benefit/cost (USD)	3.7	18.1	13.3	6.5

Source: Gianessi and Reigner (2005), Gianessi and Reigner (2006), Gianessi (2009) and own calculations.

Most fruit and vegetable crops have been sprayed with insecticides for over 100 years. The key insect pests that led to the initial use of insecticides remain as annual threats. In addition, new invasive crop-feeding insects arrive regularly. Insecticides are the chief means of controlling 90% of the major insect pests attacking crops in the U.S. Farmers sprayed insecticides at a cost of USD 1.2 billion in 2008 (Gianessi, 2009). Growers gained USD 22.9 billion in increased production value from the control of crop-feeding insects with insecticides. For every dollar spent on insecticides, farmers gain about USD 18 in increased production value (Table 3).

The fungicide benefit study identified net return rates of USD 13.3 for every dollar spent on fungicides and their application. Growers gained USD 12.8 billion in increased production value from the control of plant diseases with fungicides in 2002 spending USD 880 million on fungicides and their application (Table 3). If left untreated, yields of most fruit and vegetable crops would decline by 50% to 95% (Gianessi and Reigner, 2005).

According to the national pesticide benefit studies in the United States, USD 9.2 billion are spent on pesticides and their application for crop use every year. This pesticide use saves around USD 60 billion on crops that otherwise would be lost to pests. It indicates a net return of USD 6.5 for every dollar that growers spent on pesticides and their application (Table 3). However, the USD 60 billion saved does not take into account any of the negative effects that result from pesticide use because most benefits of pesticides are based only on direct crop returns.

Such assessments do not include the external costs associated with the application of pesticides in crops. The external costs of pesticides include: productivity loss (crops, animals), pollution costs (water, soil, air), environmental costs (biodiversity, wildlife), human health costs (acute, chronic), information costs (regulation, monitoring), dependency (resistance, loss of beneficals), and equity issues (failure of the polluter pays principle). Assessments of the external costs of chemical pesticides from several countries around the world show that many of these assessments are incomplete in the sense that not all of the important externalities have been included. For example in Germany over 50% of the estimated external costs arise from ground water contamination. In the U.S. the biggest monetary value for externalities was attributed to bird losses. Too few studies have been carried out in this area. Case studies on external costs of pesticides should be added, previous studies should be repeated, and meta-analysis of external costs should be carried out. Similarly, meta-analysis of the economics of using benefit and cost analysis should be carried out for comparison.

A well-documented analysis on environmental and economic costs of pesticide use found that pesticides indirectly cost the U.S. USD 8.1 billion a year (Table 3). This includes losses from increased pest resistance; loss of natural pollinators (including bees and butterflies) and pest predators; crop, fish and bird losses; groundwater contamination; harm to pets, livestock and public health (Pimentel *et al*., 1992). Who pays this cost? Of this USD 8.1 billion a year in indirect costs of pesticide use, users of pesticides in agriculture paid directly for only approximately USD 3 billion, which included problems arising from pesticide resistance, destruction of natural enemies and crop losses. Society eventually paid the remaining USD 5.1 billion in environmental public health costs (including through taxes, insurance costs, etc.).

These costs increased since 1992, when this study was made, and these are just U.S. figures; the worldwide costs are much higher. An obvious need for an updated and comprehensive study prompted another investigation of the complex of environmental costs resulting from pesticide usage (Pimentel, 2005). The second study estimates that the total indirect cost of pesticide use was around USD 9 billion in 2005. The major economic and environmental losses due to the application of pesticides in the U.S. were: public health, USD 1.1 billion a year; pesticide resistance in pests, USD 1.5 billion; crop losses caused by pesticides, USD 1.4 billion; bird losses due to pesticides, USD 2.2 billion; and groundwater contamination, USD 2.0 billion. Users of pesticides pay directly only about USD 3.4 billion, which includes problems arising from pesticide resistance, destruction of natural enemies and crop losses, and society pays the remaining USD 6.2 billion in environmental and public health costs. These are the costs of only the damage that can be estimated monetarily, and the cost figures result from economic valuations of essentially non-economic things like a human life, human health and pet's health (Table 4).

From a strictly cost/benefit approach, pesticide use is beneficial. However, the nature of the environmental and public health costs of pesticides has other trade-offs involving environmental quality and public health. Pesticides provide about USD 60 billion per year in saved U.S. crops, the environmental and social costs of pesticides to the nation total approximately USD 10 billion. But the estimated full environmental, public health and social costs might double the USD 10 billion figure to USD 20 billion per year, in addition to the USD 9.2 billion spent on application of these

pesticides. Including the estimated full indirect environmental, public health and social costs associated with pesticides and the direct costs of pesticides to farmers the net benefit still accounts for USD 31 billion each year, showing a high profitability of pesticides. Each dollar invested in pesticide control returns at least USD 3 in protected crops (Table 3 and Table 4).

Table 3

Total estimated environmental and social costs from pesticide in the USA

USD mln/year

Impact	Cost, 1992	Cost, 2005
Public health impacts	787	1,140
Domestic animals deaths and contaminations	30	30
Loss of natural enemies	520	520
Cost of pesticide resistance	1,400	1,500
Honeybee and pollination losses	320	334
Crop losses	942	1,391
Fishery losses	24	100
Bird losses	2,100	2,160
Groundwater contamination	1,800	2,000
Government regulations to prevent damage	200	470
Total	**8,123**	**9,645**

Source: Pimentel et al. (1992), Pimentel (2005)

Biopesticide

Global sales of biopesticides are estimated to total around USD 1 billion annually, still small compared to the USD 38-40 billion in the worldwide pesticide market. Biopesticides are used most widely on specialty crops. Orchard crops hold the largest share of biopesticides use at 55%. Biopesticides are also used on non-food crops such as forage crops, as well field crops such as corn and soybeans. This class of products also has important applications outside of production agriculture in the areas of public health and forestry (Farm Chemical International, 2010). Some companies value the global biopesticide market at USD 700-900 million, while others say it is hard to quantify because of different definitions for what is considered a biopesticide. There is no up-to-date data on the market worldwide. It is always pegged at around 2% of the global crop protection market but the segment's market share is growing faster than conventional chemicals. Increasing demand for chemical-free crops and more organic farming has led to increased usage of biopesticides in North America and Western Europe (ICIS CBA, 2009).

Key factors in this growth include a larger overall investment in biopesticide R&D, a more established application of the IPM concept and increased area under organic production. Products not requiring registration and products which already have been registered have priority in the R&D of these companies. Big agricultural chemical companies will invest heavily in this area. The industry is very dynamic right now compared to a few years ago, looking for technology that complements what they already have or complements a segment that they are focused on. Several companies would bring more biological plant protection products into the European market if conditions for registration were more favourable; others prefer to focus on other geographical regions where the climate for this business is more favourable (North America, Asia).

Alliances of biopesticide companies with major agricultural chemical companies (Bayer and BASF) seem to be increasing. Other companies, such as US-based FMC, Japan's Arysta LifeScience, Switzerland's Syngenta, Israel's Makhteshim and US-based Monsanto, have their own development efforts in biopesticides through collaborations with smaller firms. Marrone Bio Innovations (MBI) has an exclusive licence with US-based chemical giant DuPont which provides them access to more than 20 proprietary natural product discoveries from DuPont's marine microorganism screen. DuPont's compounds and mixtures that are too complex for chemical synthesis often make good candidates for biopesticides. DuPont itself launched a new insect repellent active ingredient from the catmint plant *Nepeta cataria* in 2010. Another major agrochemical firm offering its own green pesticide, reduced-risk pesticides products is Dow AgroSciences. This product could very closely be considered to be a biopesticide but it has been registered under conventional pesticides.

Reduced-risk or green pesticides is a growing sector and companies are striving to discover new products for that market segment. While biopesticides may be safer than conventional pesticides, the industry is plagued by the lack of critical mass to effectively develop and market its products, as well as compete with multinational synthetic pesticide producers. The industry is composed mostly of small and medium sized enterprises and it is difficult for one company to fully and properly fund research and development, field development and provide the marketing services required to make a successful biopesticide company. Companies need to be clear in their objectives and allocate resources appropriately. Another problem is the lack of product stewardship. The industry is trying to become much better stewards of the technology so that people who use biopesticide products will be more confident and credible. The perception is changing but it is a slow process. Another challenge is the lack of innovative blockbuster products to the marketplace and the registration.

Efficacy testing is an issue in registration since efficacy testing could be 50% of registration costs for biologicals, but just 10% for chemicals. Chemicals can use quite small treatment plots, but biologicals need larger plots to achieve statistical significance because individual replicates are more variable. Efficacy trials also do not always work the first time, e.g. in one set of trials the pest was not present two times out of three. Biopesticides have an accelerated registration path in the US and could get to market in three or four years, versus eight to ten years for a synthetic pesticide, whereas in Europe, the times are six to eight years and eight to ten years respectively. Mutual recognition between the USA and the EU is another key issue in future development of the biopesticide area. The EU is supposed to have an internal market, which should help to overcome the problem of small market size.

While biopesticides are typically seen as an alternative to synthetic chemicals, some experts see biopesticides as complementary to conventional pesticides already on the market. Biopesticides can enhance and synergise synthetic chemical active ingredients and also fill unmet market needs. It is increasingly difficult to discover new chemical pesticides that meet all of today's environmental and safety requirements, so biopesticides can fill the market need for new active ingredients. Perhaps the single most important factor in the growth of the biopesticide market is advancements in biopesticide technology. Extensive and systematic research has resulted in enhancements to formulation, the ability to manufacture biopesticides through mass production, increased storage and shelf life capabilities, and improved application methods. Biopesticides can be added in a spray programme to reduce the amount of synthetics to their lowest label rate. Positioning biopesticide products as part of a low-chemical spray programme or in a tank mix alongside synthetics is an excellent way to reduce chemical load and manage resistance without sacrificing the efficacy conventional growers demand.

Conclusions

Chemical pesticides will continue to play a role in pest management for the foreseeable future, in part because the environmental compatibility of products is increasing – particularly with the growing proportion of reduced-risk pesticides being registered, and in part because competitive alternatives are not universally available. In many situations, the benefits of pesticide use are high relative to risks or there are no practical alternatives. Scientific advances and regulatory pressures have driven and continue to drive some of the more hazardous products from the marketplace. This trend has been promoted by regulatory changes that restricted use of older chemicals and by technological changes that lead to competitive alternative products. The novel chemical products that will dominate in the near future will most likely have a very different genesis from traditional synthetic organic insecticides; the number and diversity of biological sources will increase, and products that originate in chemistry laboratories will be designed with particular target sites or modes of action in mind. Innovations in pesticide delivery systems in plants promise to reduce adverse environmental impacts even further but will not eliminate them.

The correct use of pesticides can deliver significant socio-economic and environmental benefits in the form of safe, healthy, affordable food; contribute to secure farm incomes; and enable sustainable farm management by improving the efficiency with which we use natural resources such as soil, water and overall land use. Indeed, growing more from the same amount of land can help to protect biodiversity by ensuring that there is no further encroachment on wild spaces. Obviously, when pesticides are not used correctly, then the socio-economic and environmental benefits may not be realised and can in fact become a cost to society.

The new products share many of the problems that have been presented by traditional synthetic organic insecticides. For example, there is no evidence that any of the new chemical and biotechnology products are completely free of the classic problems of resistance acquisition, non-target effects and residue exposure. Genetically engineered organisms that reduce pest pressure constitute a "new generation" of pest-management tools but genetically engineered crops that express a control chemical can exert strong selection for resistance in pests. Thus, the use of transgenic crops will probably maintain, or even increase, the need for effective resistance-management programmes. Because pests will continue to evolve in response to pest controls, research needs to support development of pest-management tools that reduce selection pressure, delay selection for resistance and thus increase the life of chemical and other products. There remains a need for new chemicals that are compatible with ecologically based pest management and applicator and worker safety.

The best way forward for pest control is to maintain a diversity of tools for maximising flexibility, precision and stability of pest management. No single pest-management strategy will work reliably in all managed or natural ecosystems. However, chemical pesticides should not automatically be given the highest priority. Pesticides should be evaluated in conjunction with all other alternative management practices not only with respect to efficacy, cost and ease of implementation but also with respect to long-term sustainability, environmental impact and health. The most promising opportunity for increasing benefits and reducing risks is to invest in developing a diverse toolbox of pest management strategies that include safe products and practices that integrate chemical approaches into an overall, ecologically based framework to optimise sustainable production, environmental quality and human health.

Many biocontrol agents are not considered acceptable by farmers because they are evaluated for their immediate impact on pests (that is, they are expected to perform like pesticides). Evalu-

ation of the effectiveness of biocontrol agents should involve consideration of long-term impacts rather than only short-term yield, as is typically done for conventional practices. Some biocontrol pathogens used against weeds might cause as little as a 10% reduction in fecundity, which might not be a visible result but has a major long-term effect causing population decline. Low-efficacy biocontrol agents alone might not be acceptable for pest management but, in combination with other low-efficacy measures, they could be preferable because they avoid the selection for resistance for that is associated with high-efficacy measures.

The general public has a critical function in determining the future role of pesticides in agriculture. Sometimes objections to pesticides are an issue of subjective preference even when scientific evidence cannot support the objections. In this case, banning a pesticide is not appropriate. It makes much more sense to establish a legal framework that enables organic and pesticide-free markets to emerge and prosper so that consumers can be given an informed choice between lines of products that vary with pest management. Consumer interest in food and other goods perceived as safe and healthy fuels the rapid growth of the organic-food market; at the same time, consumer use of pesticides in the home and on the lawn continues to grow.

The justifications of government intervention in the management of pest control include the need to address the externality problems associated with the human and environmental health effects of pesticides. Public goods are products and services to which people have free access for which they do not need to compete (free air is a pure public good, as is national defence). However, few incentives exist for efficient and environmentally sound pest control strategies. Introduction of incentives that would reduce the reliance on riskier pest control strategies and encourage the use of environmentally friendly strategies is likely to lead to increased efficiency in pesticide use. Such incentives as taxes and fees for the use of various categories of chemicals have been recommended, but because of user objections they might not always be politically feasible. Users might prefer subsidies to reduce pesticide loads but this policy may strain the public budget. Establishing regional pesticide targets and implementing them through tradable permits is a better solution that will achieve the same outcome.

There is underinvestment from a social perspective in private-sector research because companies will aim to maximise only what is called suppliers' surplus (difference between suppliers' income and their production costs) rather than the social surplus. Companies will compare their expected profits from their patented products resulting from research and will not consider the benefits to consumers and users. Publicly supported research, through the process of technology transfer, has become a source of economic growth in several countries. Another reason why public research might lead to innovations that elude the private sector is the different incentives that researchers in the private and public sectors face. For the most part, private sector researchers emphasise projects that improve existing product lines. The advancement of public researchers is affected by their publications in refereed journals, where novelty and originality have a premium. A further argument for public support of research is that much of the funding is allocated to institutions of higher education and used to train future scientists for the private sector. Availability of trained scientists will be a key to future innovation in pest management technologies. The public sector should also conduct research in areas that are pursued by the private sector to have the information and background for regulatory purposes. There is a need to educate legislators and the general public about ecologically based pest management in research and in practice.

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The Comparative Cost and Profit Analysis of Organic and Conventional Farming

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Abstract

The cost-profit relations of organic and conventional farming were examined on the basis of natural and financial data of a large agricultural - company in western Hungary and of economic models characterising private farms in eastern Hungary. The differences in cost structures reflect variable conditions relating to certain crops, but they can be well explained by the differences in the technologies used. According to the production data, in organic farming direct costs per hectare were lower in all of the four examined crops. Even cost per production unit and contribution were more favourable in three of the investigated crops. Regarding the calculation done by economy models, the costs per hectare relating to the two production methods were not significantly different. Yields in organic plant production were typically lower but costs per unit and selling prices were higher. Differences in gross profits may be explained by different yields and selling prices. In a majority of the model variations organic farming is more profitable, but the extra bio price ensuring this, in accordance with trends from literature, is not sufficient for achieving a higher profit in every year.

Keywords

organic farming, conventional farming, costs, profit

Introduction

Organic farming in Hungary developed dynamically from the middle of the 1980s until 2004. Between 2004 and 2009 declined significantly with respect to both production size and number of producers *(Czeller and Roszík, 2009; Kormosné, 2008, Willer and Kilcher, 2009)*. Studies clarifying the cost-profit relationships of organic farming in Hungary and comparing them to other farming methods could help in understanding this phenomenon.

In the literature (e.g. *Stanhill, 1990; Offermann and Nieberg, 2000; Maeder et al. 2002; Podmaniczky, 2002; Takács, 2007*) a relatively uniform condition is reflected on differences between conventional and organic farming with regard to yields, prices, costs and profit. The authors conclude that organic farming is characterised by lower yields. On the other hand most of them highlight the fact that the differences may be extremely diverse in crop cultures *(e.g. Offermann and Nieberg, 2000; Denison et al., 2004)*. The decrease in yields after conversion is replaced by growth in yields after 3 to 4 years *(Hanson et al. 1997; Pimentel et al. 2005; Kis, 2007)*. There are significant differences between authors with respect to the extent to which the yields are lower in organic farming *(Offermann and Nieberg, 2000; Maeder et al., 2002; Pimentel et al. 2005; Cavigelli et al., 2009)*.

The authors stress that it is not obvious that there is a huge difference in costs per hectare relating to the two production methods, but converting to organic farming causes a significant change in the cost structure. Lower material costs (due to the lack of fertilisers and chemicals) is typical of organic farming, while the costs of labour and machinery work (handling manures, mechanical weed control) may increase. Such a change in the cost structure is shown by several studies in different

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crops *(e.g. Hanson et al. 1997; Tzouvelekas et al., 2001; Delate et al., 2003; Pimentel et al., 2005, Gündoğmuş, 2006; McBride and Greene, 2008).*

The price of organic products is generally higher than the usual market price *(Streff and Dobbs, 2004; Greene et al., 2005),* but the attainable extra price may be different according to markets, periods and product groups (higher in vegetable, cereals; lower in products of animal origin). The extra bio price influencing the success of organic farming is not only fluctuating but it is more and more decreasing for a longer period of time. *Podmaniczky (2002)* highlights that studies aiming at comparing profit do not reflect a uniform condition, but in many cases organic farming is more profitable "till the level while the smaller variable costs and advantages coming from prices are able to equalize the smaller yields". In the majority of the eight summarising studies of Welsh (1999) organic farming regarding extra bio price was more profitable than conventional farming.

Only few studies can be found on sector-specific cost-profit analysis of organic farming in Hungary, and analyses comparing organic and conventional farming methods are even less common. *Koch (2004)* studied the efficiency of winter wheat and sunflower production on the basis of data of 2002 in the case of six organic farms and one conventional farm. Yields in both crops were much lower in organic farming (especially in sunflower); however, the costs per hectare did not reflect significant differences. Due to the extra bio price and the highlighted subsidies wheat production was much more profitable in organic farms; on the other hand sunflower production was more favourable in conventional farming thanks to the much higher yields. The paper does not contain any data suitable for analysing cost structure. *Balikó (2006)* introduces the ratio of major cost elements of conventional wheat production for 2004 in the case of the Bólyi corporation but unfortunately detailed data are not included. *Mile (2006)* compared different farming methods (conventional, integrated, organic) on the basis of several indicators (yields, revenue, costs, profit) and concluded that organic products ensure the highest revenue with a safe purchasing market. Detailed cost data cannot be found even in this work.

Gyarmati (2007) analysed data of three corporations where organic and conventional farming takes place within an enterprise under similar conditions, thus the results of the two production methods may be compared. In the period between 2000 and 2005, the yields of conventional farming were typically higher, but this higher ratio depends on periods and crops. In the case of maize for silage and sunflower higher yields were typical in conventional farming. The costs per unit of certain products were different, so the author did not draw conclusions relating to this fact because of the lack of detailed cost data. It is also difficult to draw conclusions from comparing profit per hectare especially if calculations do not include the subsidies. Kis and Takácsné (2007) collected data for winter wheat for the period between 1996 and 2006 in the case of organic farms with the help of a survey and these data were compared to the national average. They concluded that yields in organic farming reached 73 to 100% of the conventional yields. 98% of the 110 organic farmers polled realised a maximum yield decrease of 30% comparing to conventional farming (*Kis, 2007*). The price advantage of organic wheat is extremely significant at the beginning of the studied period (twice as much or three times higher), but the price decreased to 25 to 30% at the end of the period. The costs per unit of organic wheat reflect huge differences. For example in 1999 the cost per unit of wheat ranged from 17500 HUF to 93 thousand HUF; however the averages reached 75 to 110% of the national one.

Based on the facts mentioned above, our investigations had two objectives.

1. Comparing the cost and profit relations of conventional and organic farming in four crops (winter wheat, maize, sunflower, rape) on the basis of data of an enterprise located in Transdanubia dealing with both of the farming methods.
2. Making a comparative analysis of cost and profit relations of organic and conventional farming according to model calculations based on producer's data collection, at different levels of subsidies under the conditions of Hortobágy area.

Database and methods

Regarding the dual objectives, the database and methods of the investigations are divided on the basis of the objectives.

Assessment of production and financial data of a large agricultural company in western Hungary

Data collection necessary for calculations was carried out in a company which deals with both conventional and organic farming. For the comparison it was necessary that the certain crop should be cultivated using both production methods in the same year. Because of this barrier the analysis could be carried out for only one year for each of the four crops (2008 in the case of rape and 2009 in the case of the other crops).

Data collection focused on preparing field operational cost calculations. The data necessary for this were partly natural data (such as denomination and time of operations, equivalent of normal hectare, quantity of utilised materials, sowing area, yields), and partly value data (selling prices, value of utilised materials, costs of machinery work etc.). Yields depending on crop were 7 to 41% lower in organic farming, while selling prices were higher by 18 to 90%. The biggest yield penalty and the smallest price advantage were detected in rape, the biggest price benefit occurred in case of wheat (Table 1).

Table 1

Yields and prices of products from both farming practices

Denomination		Yields (t/ha)	Selling price (HUF/t)
Organic farming	Rape	2.12	122,000
	Winter wheat	3.87	57,900
	Sunflower	2.96	84,000
	Maize	7.71	40,500
Conventional farming	Rape	3.58	103,000
	Winter wheat	4.68	30,400
	Sunflower	3.20	50,000
	Maize	8.85	28,500
Organic as a percentage of conventional farming	Rape	59	118
	Winter wheat	83	190
	Sunflower	93	168
	Maize	87	142

Source: own data collection and calculation, 2009

The organic and conventional technologies typical of the company of the certain crops were constructed by processing and aggregating data at the parcel level. Costs necessary for carrying out the field operations were adapted to the field operations listed in the technologies, as well as other costs which can be connected directly to the production of that crop (land rent, cost of soil examination, insurance and other fees paid for extension service or controlling organic farming). The gained value was considered as the direct production cost of the crop and the value projected to a single yield was considered as direct cost per unit.

Subsidies relating to the production of the crop were given to production value gained as multiplying yields and selling price3, and then this value was reduced by the direct costs determined previously. This value was considered as contribution.

$$CO = (Y \times P) + S - (Y \times DU)$$

where:

CO: contribution, HUF/ha
Y: yield, t/ha
P: selling price, HUF/t
S: subsidy, HUF/ha
DU: direct cost per unit, HUF/t

The differences of contributions of organic and conventional productions were divided into elements by chain substitution (e.g. *Sztanó, 2006; Sabján and Sutus, 2009*). The contribution in conventional farming was the first step, and then data for factors influencing the contribution of conventional farming were substituted by data of organic farming step by step. During this process subsidies were neglected as they were the same in both farming methods and did not have any effects on differences of contributions.

Investigation by economy-models based on production and financial data of a private farm in a subregion located in eastern Hungary.

Producer's datasheets were filled in among farms dealing with arable plant production and animal husbandry. The arable crops typical to the area (Hortobágy) include wheat, barley, rye, sorghums, sunflower, rape, pea and lucerne. Animal keeping may be characterised by sheep and cattle breeding, animal husbandry based on fodder is not significant. Data collection concentrated on technologies, data of purchases and selling, asset supply and information on overhead costs besides the general introduction of farming. On the basis of professional considerations, four typical organic and four conventional farms were selected regarding the following aspects: the production structure should be similar in the farms, their production standard should be acknowledged by local experts and the organic farms should already be converted farms.

The average farm size of the organic sample is 58 hectares. Beside winter wheat (30%) and sunflower (18%), lucerne, barley, oat, pea and mustard are continuously present in the crop structure. Two farmers of the four keep Hungarian merino on grassland in 0.4 livestock unit density. The average farm size of the conventional sample is 76 hectares. Beside winter wheat (55%), sunflower (20%), barley and mustard are present in a great ratio in the crop structure. Three of the conventional farms deal with ewe keeping. Every farm in the sample bases their field operation on family labour, but hire external labour for certain seasonal works (e.g. sheep shearing).

[3] Single Area Payment Scheme (SAPS) and the national TOP-UP, as well as refund of gas oil fiscal tax

Table 2

The crop structure of model farms in arable land of 40 hectares

Unit: %

Crop	Years of crop rotation						
	1	2	3	4	5	6	7
Wheat	25	25	25	-	25	25	50
Oat	-	-	25	25	25	-	-
Spring barley	-	-	-	-	-	25	-
Sunflower	25	-	-	-	25	25	25
Lucerne	25	25	25	25	-	-	-
Mustard	-	25	25	25	-	-	-
Pea	25	25	-	25	25	25	25
Total	100	100	100	100	100	100	100

Source: own calculation, 2009

Table 3

The yields and product prices of organic farming as a percentage of conventional yields and product prices

Unit: %

Denomination	Product	Year			Average of three years (2006-2008)
		2006	2007	2008	
Yields	wheat	86	90	84	87
	oat	93	91	87	90
	spring barley	86	91	86	87
	sunflower	91	100	86	91
	lucerne hay	94	98	99	97
	mustard	90	100	75	87
	pea silage	78	83	76	79
Product prices	wheat	176	158	147	159
	oat	172	148	149	154
	spring barley	132	146	126	135
	sunflower	146	131	143	139
	lucerne hay	100	100	100	100
	mustard	121	106	109	111
	pea silage	100	100	100	100
	straw	100	100	100	100

Source: own data collection and calculation, 2009

The most common practices were taken into consideration in the case of characteristics of farms as well as technological processes (e.g. machinery connections of field operations), and in the case of data being averaged (e.g. yields), weighted arithmetical mean was calculated. Data from the

registration of family farms did not allow a detailed cost-profit analysis, the comparison was only partial, thus basing on the features of the two sets of four farms and supplementing them by calculated data, an organic and a conventional model farm were constructed. When compiling the model, the principle *ceteris paribus* was followed to the greatest degree; the two-farm model contains only differences which are compulsory consequences of the different farming methods (technologies, prices, subsidies, extra costs of controlled production etc.). The size and production structure of the two model farms are the same, as are their natural conditions. The size of arable land is 40 hectares; half of it is rented. On the grassland of 20 hectares of partly rented, the average number of ewes is 50 (milking lambs are sold). The crop rotation recurring after eight years is the same in the two models. As the structure of the produced plants are different in certain years (Table 2), and it influences the revenue and the costs, the models were developed for seven years in accordance with the seven-year-cycle of the crop rotation in a way that prices and subsidies of sample farms from the data collection of producers were considered as the same within one model variety. In this way it made the examination of a seven-year-period possible under the same price and subsidy conditions.

The average yields of the organic farm are typically lower by 10 to 20%, but differences are significant in crops. The price advantage of organic farming is not common in every crop; it reaches 30 to 60% crops of selling purposes determining revenue (Table 3).

Subsidies of the year 2007 were built in the models; this year is not typical regarding the yields of plant production and product prices, thus 4-4 model variations were created with the average yields and product prices of different years: average yields of the year 2005 to 2007 and product prices of the year 2007; yields and product prices of the year 2006; yields and product prices of the year 2007; yields and product prices of the year 2008. Each of the 4-4 model variations were developed to 5-5 subsidy levels[4], which resulted in 20-20 model variations for organic and conventional farming.

Beside yields, prices and technologies the 20-20 model varieties were compared from the aspect of labourless costs neglecting the wages of the entrepreneur (but containing the cost of the required external labour), labourless per unit production cost, subsidies as well as gross profit involving the wage of the entrepreneur. The gross profit (GP) was calculated as revenue containing subsidies minus labourless costs (containing overhead costs). The deviations of gross profit were separated to the effect of five factors by chain substitution in a way that in every model variety, the gross profit in conventional farming was the first step, and then data of factors influencing gross profit of conventional farming were substituted by the data of the organic farms step by step

$$GP = (C \times Y \times P)+(C \times S)-(C \times Y \times CU)$$

The five factors are the following:

C: *Capacity* – number of ewes (item), field size (hectare). These are the same at each subsidy level, except for subsidy levels IV and V, due to the AEM national rules that require a given size of "organic compensational territory" in the case of organic arable land AEM programme and, because of this, grass boundaries of eight percentages of the parcels were calculated in the organic farming model.

[4] The five levels of subsidies: I. No subsidy. II. Level of SAPS and TOP-UP. III. Subsidies of II. level supplemented by subsidies of less favoured areas. IV. Subsidies of II. level supplemented by basic target programmes of agri-environmental farming measures (AEM) in the conventional model and by target programmes of plant production and grassland farming in organic farming. V. Subsidies of level II supplemented by subsidies of less-favoured areas and the mentioned target programmes of AEM.

Y: Yield (amount of product per ewe or hectare, in natural measurement units).

CU: *Cost per production unit, defined as direct plus overhead costs minus labour costs* (HUF/kg, HUF/t).

P: *Market price* (HUF/kg, HUF/t).

S: *Subsidies* (HUF/ewe, HUF/ha).

The applied calculations are quite the same as those in most of the analytical methodology books. The only difference is that our data do not cover only one product or one year, so the calculations are applied for the seven years of the crop rotation and all the products as a whole.

Results

Production and financial data in a big company

The cost per hectare in organic farming was lower in every case than that of conventional farming. The difference depending on crops is 15 to 33% of the costs of conventional technology, which is 25 to 54 thousand HUF/ha (Table 4). The lower cost per hectare of organic farming in three crops (wheat, sunflower and maize) compensated for the lower yields, thus the direct production cost per unit is lower than in conventional production. In rape produced in 2008, in spite of the lower cost per hectare by 21%, because of the significant yield penalty a higher cost per unit was realised in organic farming.

The yield penalty of 41% for rape could not be compensated by the extra bio price of 18%, in this way the production value per hectare reached in organic farming lags behind that of conventional rape production by 30%. In other crops the higher extra bio price (42 to 90%) as in rape production, the moderate (7 to 27%) yield penalty led to a significantly higher (by 24 to 57%) production value in organic farming.

In organic farming the production value minus direct production costs is relatively high even without subsidies in the case of each of the four crops. An ambivalent condition was reflected in conventional production. It is clear that winter wheat and sunflower production would have shown a deficit even without subsidies; however, the conventional rape production reached the highest contribution from all of the crops and technologies. Conventional maize production did not reflect a deficit even without subsidies, but its contribution altogether with subsidies hardly exceeds half of the contribution reached in organic farming.

Differences between costs per hectare of conventional and organic farming are shown in Table 5 on the basis of cost elements. It is clear that the lower fertiliser costs of organic farming in rape, winter wheat and maize played a dominant role in forming the differences of cost per hectare.

Table 4

Costs, cost per unit and contribution in case of the four crops
(CO1 = contribution without subsidies; CO2 = contribution with subsidies)

Denomination		Direct production cost (HUF/ha)	Direct cost per unit (HUF/t)	Production value (HUF/ha)	CO1 (HUF/ha)	CO2 (HUF/ha)
Organic	Rape	110,534	52,139	258,640	148,106	197,507
	Wheat	106,757	27,586	224,073	117,316	167,632
	Sunflower	141,906	47,941	248,640	106,734	157,050
	Maize	148,288	19,233	312,255	163,967	214,283
Conventional	Rape	140,234	39,172	368,740	228,506	277,907
	Wheat	160,294	34,251	142,272	-18,022	32,294
	Sunflower	167,145	52,233	160,000	-7,145	43,171
	Maize	187,903	21,232	252,225	64,322	114,638
Organic as a percentage of conventional farming	Rape	79	133	70	65	71
	Wheat	67	81	157	-	519
	Sunflower	85	92	155	-	364
	Maize	79	91	124	255	187

Source: own calculation, 2009

Table 5

Cost elements of organic farming compared to conventional farming

Denomination	Rape cost difference		Wheat cost difference		Sunflower cost difference		Maize cost difference	
	thousand HUF	%	thousand HUF	%	thousand HUF	%	thousand HUF	%
Fertilisation	21	68	49	91	-11	-45	21	54
Soil preparation	3	9	-2	-3	-5	-19	3	6
Sowing	2	8	-3	-6	6	24	-1	-3
Plant protection	-2	-6	9	16	32	127	14	35
Harvesting	7	23	4	7	1	4	6	14
Land rent	0	0	0	0	0	0	0	0
Other	-1	-2	-3	-5	2	9	-3	-6
Altogether	30	100	54	100	25	100	40	100

Source: own calculation, 2009

Only artificial fertiliser was used in conventional farming, while organic manure was utilised in organic farming. Organic manure has a long-term effect lasting for years, thus according to the counting practice in the company the costs of manure are calculated for four years in a decreasing rate (40-30-20-10) from year to year. Using manure on parcels occurred in different years, in this

way manure cost for the first year was calculated in sunflower, that for the second year in maize, and cost for the third year in rape. The organic winter wheat parcel did not get any manure, only the crop preceding wheat utilised the nitrogen accumulated by lucerne. In sunflower the costs of fertiliser of organic farming are higher than that in conventional production. This is shown by the fact that in organic farming sunflower of the four crops received the biggest manure ration and even bacteria fertiliser.

The cost of soil preparation in rape and maize was the lowest in organic farming. In rape in conventional farming one more combinator was used in conventional farming, otherwise the soil cultivation was the same. In maize in the case of conventional farming winter ploughing, while in the case of organic farming spring ploughing was used, being cheaper because of its smaller depth. On the other hand, the soil preparation costs in winter wheat and sunflower were higher in organic farming. The surplus costs in winter wheat may be explained by the fact that the plant preceding wheat was lucerne which had to be ploughed deeply. In the case of sunflower the deep loosening in autumn caused an extra cost in organic farming.

Machinery costs of costs relating to sowing were the same in organic and conventional production; the difference came from the price of the seed, which depends obviously on variety and quality. The reason for the higher seed cost by 27% in winter wheat is the fact that first class seeds were utilised.

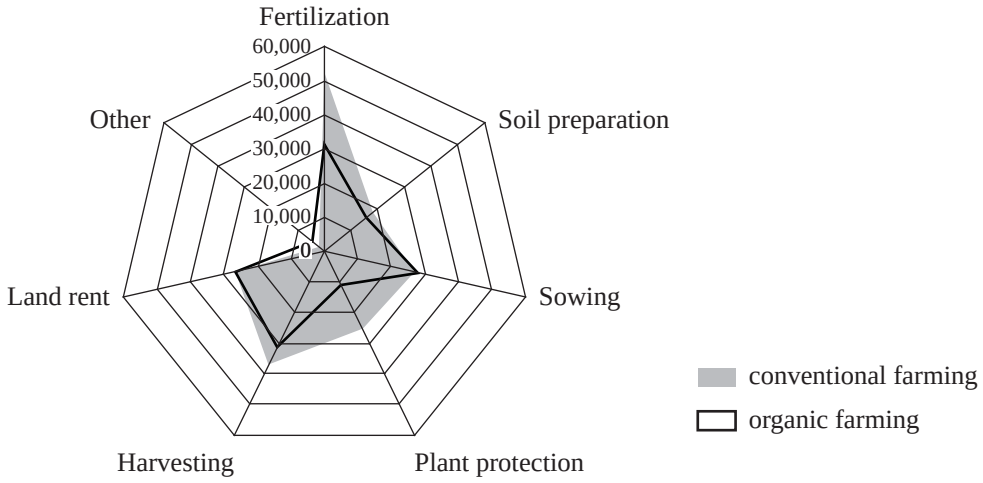

Figure 1: The costs of maize production (Unit: HUF/ha)

Source: own illustration

Machinery cost in connection with plant protection was higher in organic farming as mechanical weed control was used in several times. The difference between machinery costs is not significant compared to differences detected in costs of plant protection agents. Only a few agents were used in organic farming such as plant and soil conditioning agents and fungicides containing sulphur and mineral oil. By contrast, many agents were used in conventional farming. The cost of agent in organic farming was 18% of that of conventional farming in maize, 27% in sunflower and 60% in winter wheat. The cost of plant protection in rape was different compared to other crops. Here the cost of the agent was higher by 8% in organic farming. The reason is that soil and plant conditioning materials are used and plant protection took place twice in the biggest parcel instead of three times, unlike in other parcels.

Harvesting costs were lower in organic farming in each of the four crops which is due to the lower yields. Land rent though being not significant in value did not influence the differences, as it was the same in every crop and technology. Other costs were higher in organic farms in the majority of the crops due to the controlling fee.

Figure 1 illustrates the cost per hectare of maize production concentrating on cost elements. It is clear that the differences in costs of the two production methods are influenced by fertiliser to a great extent, by plant protection and harvesting to a significant extent, while the effect of the other cost factors is not considerable.

Table 6

The effects of factors influencing contribution per hectare

Unit: thousand HUF/ha

Denomination	Conventional CO1	Effects of factors (±)			Organic CO2
		Yields	Selling price	Cost per unit	
Rape	278	-93	40	-27	198
Winter wheat	32	3	106	26	167
Sunflower	43	1	100	13	157
Maize	115	-8	92	15	214

Source: own calculation, 2009

Table 6 contains the results of chain substitution. It is clear that in crops (winter wheat, sunflower and maize) where the contribution of organic farming was higher, higher prices played an important role in realising differences. In case of rape, the contribution of conventional farming was more favourable, due to the fact that the significant yield advantage of rape production could not be compensated for by the moderate price advantage of organic farming.

Results of comparing the economy-models

The differences regarding cost per ewe and per hectare between the two farming methods (Table 7) were not significant. A difference exceeding 10% may be found only in winter wheat in conventional farming at the first three subsidy levels, the biggest difference may be experienced in pea and barley in organic farming, but it reaches 15 to 16% at none of the subsidy levels.

In the case of winter wheat the material cost per hectare between conventional and organic farms was not significantly different; the costs of plant protection and fertilising were compensated for by the costs of soil and plant conditioning agents in organic farming, as well as the much more expensive seed. The extra cost of organic farming is mainly caused by the extra machinery cost in wheat, which may be explained by the more careful seedbed preparation and weed combing. In barley the extra cost of conventional production is due to the higher material cost (costs of fertiliser and plant protecting agent). The cost per hectare in pea silage is higher in conventional farming because of partly the surplus of material cost (fertiliser, bale net in accordance with the greater yields) and partly the surplus of machinery costs (fertilising, baling in accordance with greater yields).

On this basis, significant differences have not been realised relating to cost per ewe and per hectare between the two farming methods, but there are considerable differences in the cost structure and in costs per unit. Table 8 represents the effects of technologies on costs of field operations highlighting the examples of barley and sunflower (Table 8 does not contain overhead costs). It is clear

that the cost of soil preparation in organic farming is higher due to the more careful seedbed preparation. The higher costs of using nutrients in conventional farming is in accordance with fertilising, while the higher cost of plant cultivation is in connection with the use of plant protection agents.

Table 7

Costs per ewe and hectare regarding average yields of the years 2005 to 2007 and product prices of the year 2007

Model, unit	Branch	Subsidy levels				
		I.	II.	III.	IV.	V.
Organic	HUF/ewe					
	Sheep keeping	25,022	25,031	25,504	27,987	27,987
	HUF/ha					
	Wheat	150,734	150,931	151,908	143,995	143,995
	Sunflower	128,479	128,677	129,664	123,462	123,462
	Lucerne	98,334	98,533	99,274	96,413	96,413
	Pea	137,785	137,982	138,790	132,021	132,021
	Barley	109,235	109,435	110,433	105,754	105,754
	Oat	118,471	118,669	119,656	114,263	114,263
	Mustard	115,884	116,083	116,727	111,787	111,787
Organic as a percentage of conventional farming	%					
	Sheep keeping	97	97	99	102	102
	Wheat	111	111	111	104	104
	Sunflower	103	103	103	97	97
	Lucerne	98	98	98	94	94
	Pea	89	89	89	84	84
	Barley	89	89	89	85	85
	Oat	98	98	98	93	93
	Mustard	107	107	107	102	102

Source: own calculation, 2009

The differences in barley are not considered as typical or general. For example in the case of wheat (as it was reflected previously) the costs of fertilising and using plant protection may be compensated for by mechanical weed control as well as the use of permitted soil and plant conditioning agents. There is not a significant difference in the structure of costs of field operations relating to sunflower in Table 8 as in the case of barley, but the more detailed analysis shows more significant differences. The cost of fertilising per hectare is similar (12 to 14 thousand HUF) in the two farming methods, but the main reason is using artificial fertilisers in conventional farming and manure in organic farming in the case of sunflower. The cost of plant conditioning per hectare is even similar, but while its major part (72%) is the value of the used plant protecting agents in conventional farming, 100% of the plant conditioning costs is mechanical weed control (labour and machinery work). In sunflower, machinery costs take up 57% of the total direct costs in organic farming and 60% in conventional farming. There is a significant difference in the ratio of material costs (they are 34% and 14% for conventional and organic farming, respectively) and in the costs of external labour (0% for conventional farming, 17% for organic farming).

In Table 9 the average costs per unit of the four organic farming models were compared to those of the four conventional models at different subsidy levels. It is clear that the cost per unit became high in every product, which obviously cannot be explained by the organic farming itself; it reflects even the unfavourable conditions and uncertainty of scale economies. Clearing this last one would need further study. Here we only relate to the fact that the investigated model farms lag behind the size considered as viable in literature (e.g. *Baranyai and Takács*, 2007).

Table 8

Direct costs per hectare focusing on field operations

Operation, Cost group	Barley				Sunflower			
	organic		conventional		organic		conventional	
	thousand HUF/ha	%	thousand HUF/ha	%	thousand HUF/ha	%	thousand HUF/ha	%
Soil preparation	24.0	23	18.0	16	23.0	19	23.0	19
Fertilisation	12.2	12	20.3	17	12.2	10	14.4	12
Sowing	18.7	18	17.9	15	19.6	16	18.8	16
Plant conditioning	4.0	4	17.5	15	29.4	24	28.5	24
Harvesting	20.1	19	20.7	18	14.0	11	14.0	12
Ploughing after harvesting	5.0	5	5.0	4	5.0	4	5.0	4
Transport	3.8	4	4.4	4	0.9	1	0.9	1
Seed cleaning	1.8	2	2.0	2	0.9	1	0.9	1
Drying	0.0	0	0.0	0	3.3	3	3.3	3
Other costs	13.7	13	10.4	9	13.3	11	9.5	8
Altogether	103.3	100	116.2	100	121.6	100	118.3	100

Source: own calculation, 2009

There were not considerable differences between the costs per unit for lamb. It is reasonable as even the technology of ewe keeping does not contain more significant differences. The costs per unit for plant products are higher in every case in organic farming. The biggest difference may be detected in wheat (32 to 35%), as the price benefit of organic farming is the biggest in the case of this crop. It is reasonable to undertake higher costs per hectare (seeds of good quality, careful seed-bed preparation, mechanical weed control, soil and plant conditioning agents) in the case of even relatively low yields. There were significant differences in the case of mustard as well, where though the costs per hectare are higher by a few percentage points in organic farming, the yields are much lower. In pea silage in organic farming the cost per unit is higher by 12 to 15%, which indicates that the lower level of costs per hectare by 10 to 15% was over-compensated for by the yield disadvantage exceeding 20%.

Table 9 contains the average data of the four models, behind the averages, however, considerable differences evolved depending on primarily yield results. For example in the case of wheat in the model of farm dealing with organic production considering yields and prices of the year 2007 the biggest costs per unit developed at the subsidy levels of IV and V, which higher by 21% than the smallest cost per unit (organic farming in case of yields and prices of the year 2008, I subsidy level). In other crops there is a difference of 15 to 30% between the certain models.

Table 10 makes the significance of subsidies obvious in the case of both of the model farms. According to the data of Table 11 none of the farming methods would have been shown to be viable without subsidies. The conventional farming would operate with a significant deficit without subsidies on the basis of all of the four models. Supposing yields and prices of the year 2006 and in case of SAPS + TOP-UP subsidies it would not generate even the minimal wage for the owner, while on the basis of the other three models the gross profit would be 1.2 to 1.6 million HUF. By the increase of the subsidy levels a gross profit ensuring more and more respectable livelihood may be realised in the conventional model farm; the biggest is 3.3 million HUF (in the case of yields and prices of the year 2008, at the highest subsidy level).

Table 9

Labourless cost per unit in the average of the four models at different subsidy levels

Unit: HUF/kg for lambs, HUF/t for plant products

Way of production	Product	Subsidy levels				
		I.	II.	III.	IV.	V.
Organic	Lamb	1,113	1,114	1,136	1,252	1,252
	Wheat	46,719	47,013	47,120	48,663	48,663
	Sunflower	120,205	120,391	121,314	125,557	125,557
	Lucerne	15,152	15,183	15,297	16,148	16,148
	Pea	13,287	13,306	13,384	13,838	13,838
	Barley	44,906	44,994	45,434	47,427	47,427
	Oat	46,362	46,446	46,865	48,790	48,790
	Mustard	136,808	137,042	137,803	143,446	143,446
Organic as a percentage of conventional farming	Lamb	97	97	99	102	102
	Wheat	132	132	132	135	135
	Sunflower	109	109	109	112	112
	Lucerne	101	101	101	106	106
	Pea	112	112	112	115	115
	Barley	103	103	103	107	107
	Oat	110	110	110	114	114
	Mustard	121	121	120	125	125

Source: own calculation, 2009

In organic farming on the basis of two models (yields of the year 2005 to 2007 and prices of the year 2007, and yield and prices of the year 2007) a low gross profit would be generated, not enough for ensuring livelihood. According to the other two models, the deficit is considerable. In the first three models the gross profit in organic farming regarding subsidies is higher by 14 to 55% than in conventional model farms.

The ratio of subsidies from the total revenue of the entrepreneur is 24 to 30% even at the lowest level of subsidies. It may be near 50% at the highest level of subsidies. The differences of gross profit are not determined by the subsidies at all. It is clear from the data of chain substitution (Table 10), that the differences of capacities and subsidies contribute to a small ratio of the differences in gross profit, and only at subsidy levels of IV and V. Only at these subsidy levels is there a difference

in the sowing area (due to the already mentioned grass boundaries) and in subsidies (basic level in the conventional model, organic target programmes in organic models).[5]

Table 10

Percentage of subsidies in the total Revenue

Unit: %

Farming method	Model	Subsidy level				
		I.	II.	III.	IV.	V.
Conventional	Yields of the years 2005 to 2007, prices of the year 2007	0	25	33	36	41
	Yields and prices of the year 2006	0	30	38	41	47
	Yields and prices of the year 2007	0	27	35	38	43
	Yields and prices of the year 2008	0	26	33	36	42
Organic	Yields of the years 2005 to 2007, prices of the year 2007	0	24	31	37	42
	Yields and prices of the year 2006	0	29	37	44	49
	Yields and prices of the year 2007	0	24	32	38	44
	Yields and prices of the year 2008	0	26	34	40	46

Source: own calculation, 2009

Most differences in gross profit are due to the differences of products per hectare, cost per unit and selling price. As considerable differences between the model farms were not realised relating to costs per hectare, the differences of costs per unit were due to the differences in yields. The differences in gross profit are determined by the ratio of yield advantage of conventional farming and price advantage of organic farming. In the case of the first three model variations in Table 11, the price advantage of organic farming prevailed in a more significantly way, but it reversed regarding yields and prices in 2008, the price advantage could not compensate for the disadvantage of organic farms in yields and cost per unit.

[5] The positive value in the Capacity column shows the fact that besides the cost per unit exceeding selling price the decrease in arable land goes with the increase of gross profit (ceteris paribus).

Table 11

Effects of Factors Influencing Gross Profit

Unit: thousand HUF

Model	Subsidy level	Conventional farming gross profit	Effect of factors (±)					Organic farm gross profit
			Capacity	Product	Cost per unit	Selling price	Subsidy	
Yields of the years 2005 to 2007, prices of the year 2007	I.	-211	0	-63	-538	1,145	0	334
	II.	1,588	0	-62	-546	1,146	0	2,125
	III.	2,383	0	-58	-554	1,146	0	2,916
	IV.	2,635	-11	-51	-682	1,054	237	3,181
	V.	3,439	-11	-51	-682	1,054	237	3,985
Yields and prices of the year 2006	I.	-1,354	0	64	-667	815	0	-1,142
	II.	445	0	65	-673	815	0	652
	III.	1,239	0	70	-684	815	0	1,440
	IV.	1,491	81	67	-803	750	237	1,823
	V.	2,295	81	67	-803	750	237	2,627
Yields and prices of the year 2007	I.	-593	0	-21	-401	1,084	0	69
	II.	1,201	0	-20	-404	1,084	0	1,861
	III.	1,996	0	-17	-411	1,084	0	2,652
	IV.	2,248	20	-14	-549	997	237	2,939
	V.	3,052	20	-14	-549	997	237	3,743
Yields and prices of the year 2008	I.	-320	0	-69	-812	794	0	-407
	II.	1,482	0	-68	-821	794	0	1,387
	III.	2,277	0	-61	-834	794	0	2,176
	IV.	2,529	-2	-53	-941	730	237	2,499
	V.	3,333	-2	-53	-941	730	237	3,303

Source: own calculation, 2009

Conclusions

On the basis of analysing data in western Hungary, it can be concluded that the cost per hectare of organic farming is lower than that of conventional production in all of the four examined crops. The difference is 15 to 33% of the costs of conventional technology depending on cultures. The reason for the cost advantage of organic farming was that less money was spent on fertilisation and plant protection. There are significant differences in the cost structure, which may be explained by the differences between organic and conventional technologies.

Yields were lower in organic farming in all of the four crops, as in the literature (*Offermann and Nieberg, 2000, Takács, 2007)* but this yield disadvantage was less than the savings in cost per hectare. On this basis the cost per production unit was the smallest in wheat, maize and sunflower.

The extra bio price spread across a considerable interval (18-90%). The highest was detected in wheat and the smallest in rape. In crops (wheat, maize, sunflower) where the contribution of organic farming was higher, the margin came from the extra bio price. The lower contribution of rape is due to the great disadvantage in yields and moderate extra bio price.

On the basis of investigation focusing on model farms in eastern Hungary, differences in costs per hectare between the two production methods were not significant. On the other hand there were significant differences in the cost structure and cost per unit. The differences of cost structure reflect a variable condition, but do not contradict the literature and may be explained by the differences in the technologies used.

Yields in organic plant production were typically lower, but the cost per production unit and selling prices were otherwise higher. None of the production methods were shown to be viable without subsidies. The differences of gross profit arose not only from the amount of subsidies but also the different yields and selling prices. In a majority of the model variations, organic farming is more profitable, but the extra bio price ensuring this is not sufficient to reach higher profit in every year according to the trends known from the literature, as is detailed in the paper of *Podmaniczky (2002).*

The results of this analysis fit well with the results in the literature. As the price advantage of organic farming is decreasing, balanced yields and moderating the yield disadvantage will determine the future profitability of this production method. The application of knowledge based technology and decision making have to be the basis for the adequate yields and profit conditions in organic farming, the role of market conditions is becoming less important. This could be one of the answers as to why some of the farmers have turned to other production methods in the past few years.

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The Effect of Exchange Rate Volatility upon Foreign Trade of Hungarian Agricultural Products

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Abstract

This paper takes a new empirical look at the long-standing question of the effect of exchange rate volatility on international trade flows of transition economies in Central Europe by studying the case of Hungarian agricultural exports to their export destination countries between 1999 and 2008. Based on a gravity model that controls for other factors likely to determine bilateral trade, the results show that nominal exchange rate volatility has had a significant positive effect on agricultural trade over this period. This positive effect of exchange rate volatility on agricultural exports suggests that agri-food entrepreneurs are not interested in speeding up the process of joining Hungary to the euro zone.

Keywords

international trade, gravity model, exchange rate volatility

Introduction

There is a continuously growing body of literature dealing with the effects of exchange rate uncertainty on international trade since the breakdown of the Bretton Woods system of fixed exchange rates when both real and nominal exchange rates have fluctuated widely. Most of the studies are focused on estimating exchange rate volatility effects on international trade of developed countries, especially in the United States (U.S.) as well as on the trade between developed and developing countries. This topic has been neglected in Central and Eastern European Countries (CEEC), despite an expanding body of literature on agricultural trade in the region (e.g. Fertő, 2008; Bojnec and Fertő. 2008; Bojnec and Fertő, 2009) and macroeconomic aspects of the transition (e.g. Bakucs and Fertő, 2005; Bakucs et al., 2007; Bakucs et al., 2009).

This research focused on the relationship between exchange rate volatility and Hungarian agricultural exports, using a gravity model based on panel data. This issue is important in transition countries because international trade with agricultural products and macroeconomic environment have undergone major changes in the last one and half decades. The short- and long-term impacts of monetary policy have been very important for the agricultural sector in transition economies due to the lack of farm policy credibility, where farm incomes are increasingly influenced by the foreign trade in agricultural products. Consequently the central question of the present research is how the exchange rate affects the agricultural exports in Hungary, where agricultural exports have increased substantially in the past decade, from €2.17 billion in 1999 to €5.74 billion in 2008.

The article is organised as follows. Section 2 surveys the theoretical and empirical contributions in the literature. In section 3 the employed gravity model and some methodological aspects of examination of volatility effects on international trade are presented. Data and the measurement of exchange rate volatility are presented in sections 4 and 5 respectively. Section 6 reports the findings of gravity equation estimations. The last section summarises the results and draws some policy implications.

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The examination of the effect of exchange rate volatility on international trade has become effective after the abandonment of fixed exchange rate regimes which has resulted a growing body of theoretical and empirical literature. A conventional method applied in these studies is the use of gravitational models.

Exchange rate volatility

The widespread popular perception that greater exchange rate volatility reduces trade has helped to drive monetary union in Europe (European Union Commission, 1990) and is strongly related to currency market intervention by central banks (Bayoumi and Eichengreen, 1998). However, the theoretical and empirical contributions in the literature fail to conclusively support this notion. A number of models have been advanced which support the negative hypothesis that volatility acts to the detriment of international trade while other models have supported the positive hypothesis that exchange rate volatility may lead to grater levels of trade (McKenzie, 1999). Then, inevitably, many empirical studies have failed to establish any significant link between measured exchange rate variability and the volume of trade.

One possible reason for such mixed results is the different time horizons of the analyses. One common argument is that exporters can easily ensure against short-term exchange rate fluctuations through financial markets, while it is much more difficult and expensive to hedge against long-term risk. Peree and Steinherr (1989), Obstfeld (1995), and Cho et al. (2002) presented evidence that longer-term changes in exchange rate seem to have more significant impacts on trade than do short-term exchange rate fluctuations that can be hedged at low cost. On the other hand, Vianne and de Vries (1992) show that even if hedging instruments are available, short-term exchange rate volatility still affects trade because it increases the risk premium in the forward market. Furthermore, Krugman (1989), Wei (1999) and Mundell (2000) argue that hedging is both imperfect and costly as a basis to avoid exchange rate risk, particularly in developing countries and for smaller firms more likely to face liquidity constraints. Pick (1990) analyses the effect of exchange rate risk on United States (U.S.) agricultural trade flows and found that exchange rate risk is not a significant factor affecting bilateral agricultural trade from the U.S. to seven out of eight developed markets, but indicates that exchange rate risk adversely affects U.S. agricultural exports to some developing countries. DeGrauwe (1988) illustrated how the relationship between exchange rate volatility, whether long run or short term, and trade flows is analytically indeterminate when one allows for sufficient flexibility in assumptions.

Another possible reason for such controversial results is the aggregation problem. The effects of exchange rate volatility on export may vary across sectors (McKenzie, 1999). This may occur because the level of competition, the price setting mechanism, the currency contracting, the use of hedging instruments, the economic scale of production units, openness to international trade, and the degree of homogeneity and storability of goods vary among sectors. The differences among sectors in exporters' access to financial instruments, currency contracting, production scale, storability, etc., may be partly pronounced in developing countries. This contrast is only accentuated by the fact that agriculture is typically a notably competitive sector with flexible pricing on relatively short-term contracts. Furthermore, agricultural products are relatively homogenous, and typically less storable than the exports in other sectors (Such, 1974). Therefore Bordo (1980) and Maskus (1986) argue that agricultural trade may be far more responsive to exchange rate changes than the trade in manufactured products.

Wang and Barett (2007) estimated the impact of the conditional mean and conditional variance of real exchange rates on Taiwan's exports by estimating an innovative rational expectations-based on multivariate GARCH-M model using sector- and destination-specific monthly data. They

found that agricultural trade flows are quite significantly negatively affected by high frequency exchange rate volatility that does not seem to impact other sectors significantly. Agriculture appears far more responsive to both expected exchange rates and to expected volatility in the exchange rate and less responsive to importer incomes than do other sectors in Taiwan's economy. Similar results were obtained by Cho et al. (2002) employing gravity models for ten developed countries. They found that real exchange rate uncertainty had a negative effect on agricultural trade over the period between 1974 and 1995. Moreover, the negative impact of uncertainty on agricultural trade has been more significant compared to other sectors.

The available literature dealing with the effect of exchange rate volatility on international trade, focusing on an individual trade commodity, has also found a negative relationship. Sun et al. (2002) estimated the effect of exchange rate volatility on wheat trade worldwide employing a modified gravity-type model. They found that both measures of short-term and long-term exchange rate volatility showed negative effects on world trade, while the long-term effect was even larger. Yuan and Awokuse (2003) analysed the exchange rate volatility and U.S. poultry exports using gravity models with different volatility measures and found that exchange rate volatility has a negative effect on trade in all the three static models and are statistically significant in two of them. Bajpai and Mohanty (2007) found a weak impact of exchange rate volatility on U.S. cotton exports, which could be attributed to the high exposure of the cotton and textile sector to domestic and international policies.

The empirical estimation of the effect of exchange rate volatility on agricultural trade in the literature provided mixed results: the majority of the studies reported a negative impact of exchange rate volatility on trade, but some papers found a positive effect especially in the case of developed countries. This can be possible due to the different time horizon of the investigations and diverse methods of calculating exchange rate volatility.

The Gravity Equation

A gravity model has been employed in this study, which has been extensively applied in international trade analysis. Classical gravity theory[2] according to Anderson and Wincoop (2004) states that the attraction force a_{ij} between two entities i and j is proportional to their respective masses m_i and m_j, usually proxied by GDP and/or population, and inversely proportional to the squared distance d_{ij}^{-2} between these entities. Therefore, this law can be formalised as:

$$a_{ij} = \gamma m_i m_j d_{ij}^{-2} \tag{1}$$

where γ - *is a constant proportionality factor.*

The use of the gravity approach to model international trade flows date back to Tinbergen (1962), Poyhonen (1963) and Linnemann (1966). Linnemann extended the classical gravity equation by adding more variables and went further towards a theoretical justification in terms of Warlasian general equilibrium system. The theoretical aspects of the gravity model for trade are summarised in three main factors: the total potential supply (or exports) of a country to the world market, the total potential demand (or imports) of a country to the world market, and those factors that create a resistance to trade and thus affect the degree of trade intensity. These include ordinary tariff barriers and transport costs. The first and second factors are expected to be equal to one another if one disaggregates the international flow of capital, services or land transfers.

[2] Carey (1871) observed the presence of gravitational force in social phenomena, stating that the force was in direct ratio to mass and inverse to distance.

The basic form of the gravity model for examination of international trade according to Matyas (1997; 1998) is:

$$EXP_{ij} = \alpha_0 GDP_i^{\alpha_1} GDP_j^{\alpha_2} POP_i^{\alpha_3} POP_j^{\alpha_4} DIST_{ij}^{-\alpha_5} XV_{it}^{-\alpha_6} TARIF_{it}^{-\alpha_7} D_n^{\alpha_8} \quad (2)$$

where, EXP_{ij} represents the trade flow between country *i* and *j* in the year *t*, α_0 is a constant, and α_0, α_1, α_2, α_3, α_4, α_5, α_6, α_7 are coefficients, weighted geometric averages. GDP_i and GDP_j stand for domestic gross product per capita in country *i* and *j*, respectively. POP_i and POP_j represent the population in country *i* and *j*, respectively, while DIS_{ij} expresses trade resistance due to the geographical distance between countries *i* and *j* and D_n is dummy variable to take into account qualitative resistance factors between country *i* and *j*. The equation can be augmented to include other factors that may create trade resistance, such as exchange rate volatility (XV_{ijt}) and bilateral trade tariffs ($TARIF_{ij}$).

Database and methodology

Empirical Specification of the Gravity Equation

The effect of exchange rate volatility on Hungarian agri-food export (*i*) to the selected most important export destination countries (*j*) is tested, and this study did not combine bilateral trade between exporter and importer, therefore the gravity mass independent variables (GDP_i, POP_i) are not included in the econometric model of gravity equation as they are constant in any combination of export destination countries. We log-linearised equation (2) to arrive at the estimating equation (3):

$$\ln EXP_{ij} = \alpha_0 + \alpha_1 \ln GDP_j + \alpha_2 \ln POP_j + \alpha_3 \ln DIST_{ij} + \\ + \alpha_4 \ln XV_{ij} + \alpha_5 D_{1,BOR_{ij}} + \alpha_6 D_{2,EU} + \alpha_7 D_{3,CEFTA} + \varepsilon_{ij} \quad (3)$$

where ε_{ij} is an error term assumed to be statistically independent of the rest of the regressors, with a conditional mean of 0. Since estimating a panel data on Hungarian agricultural exports, equation (3) above acquires a time dimension as presented in equation (4) below:

$$\ln EXP_{ij} = \alpha_0 + \alpha_1 \ln GDP_{jt} + \alpha_2 \ln POP_{jt} + \alpha_3 \ln DIST_{ij} + \alpha_4 \ln XV_{ijt} + \\ + \alpha_5 D_{1,BOR_{ij}} + \alpha_6 D_{2,EU} + \alpha_7 D_{3,CEFTA} + \tau_t + \eta_{ijt} \quad (4)$$

where τ_t's are a full set of year dummies, and η_{ijt} is the error term. Additional factors which may enhance or resist exports are also typically included in equation (4). The most common are dummies for common border, common language and regional trade agreements (RTA). In the equation was included a dummy for common border, $D_{1,BOR_{ij}}$ with value 1 when country *j* shares a common border with country *i* and 0 otherwise, and dummies $D_{2,EU}$, $D_{3,CEFTA}$ for regional trade agreements. Hungary signed a preferential trade agreement with the European Union in 1991 and joined to the Central European Free Trade Agreement (CEFTA) in 1992. $D_{2,EU}$ with value 1 when the country *j* is member of EU and *CEFTA* with value 1 when country *j* is a member of Central European Free Trade Agreement (CEFTA) states; and otherwise 0. According to the gravity approach we expect positive sign for GDP_{jt}, POP_{jt}, $D_{1,BOR_{ij}}$, $D_{2,EU}$ and $D_{3,CEFTA}$, and negative sign for $DIST_{ij}$ variables.

Data

Economic theory would suggest that the income level of the domestic country should contribute to the determination of a country's exports, and since the marginal propensity to import with respect to income is positive, as well as the expected sign of a nation's trading partner's income should also be positive. The domestic and export destination countries' income is collected from the World Economic Outlook Database as well as the number of inhabitants (*POP*) in these countries, while the distance of export destination countries from exporter (*i*) country is obtained from the Pennsylvania State University World Tables. The values of GDP per capita were collected in national currencies and converted to euro at the yearly average exchange rate. The export data of Hungarian agricultural products are also expressed in euro and are taken from the EUROSTAT database; there are included eighty-one export destination countries where Hungary exported agricultural products in every year of the period analysed from 1999 to 2008 (see annex).

Table 1

Summary statistics for the variables used in the estimation of exchange rate volatility on Hungarian agricultural exports for the period of 1999 to 2008

Variable	Mean	St. Dev.	Min	Max
EXP_{ijt}	32,045,897	72,583,126	20	674,654,933
GDP_{it}	7,607	1,946	4,495	10,517
GDP_{jt}	12,869	13,687	103	80,566
POP_{it}	10,139,500	67,185	10,045,000	10,253,000
POP_{jt}	45,530,770	142,262,300	273	1,328,200,000
$DIST_{ij}$	3,833	3,982	159	18,128
XV_{ijt}	0.026	0.017	0.008	0.155

Source: Author's calculations.

Table 1 presents summary statistics for the variables used in the estimation of exchange rate volatility on Hungarian agricultural exports for the period of 1999 to 2008. Note that GDP per capita in Hungary (*i*) is 59% of the average of its export destination countries (*j*) and the variable POP_{it} is only 22% of average variable POP_{jt}. The row labelled XV_{ijt} represents the summary statistics for the estimated exchange rate volatility based on Standard Deviation (St. Dev.) of monthly nominal exchange rates, which is defined in the next section.

The exchange rate volatility of HUF in relation to the national currencies of eighty-one countries (see annex) is calculated and used for estimation. The monthly average nominal exchange rate series and returns[3] of EUR and USD to HUF variability for the analysed period are picked out for illustration and are presented in Figure 1 and Figure 2 respectively. In spite of the fact that the rate of return of exchange rate is increasing from the beginning of the analysed period the variation of exchange rate of HUF is not high as during the examined period it mostly does not exceed the limit of ±5% (Figure 2).

[3] The rate of return of exchange rate is calculated as follows: $(e_m - e_{m-1}) / e_{m-1}$, where e_m represents the monthly average nominal exchange rate.

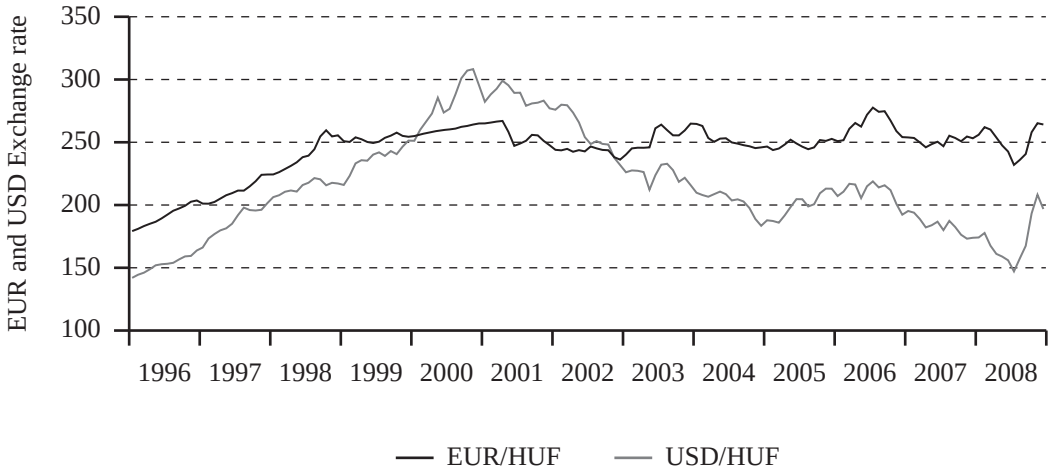

Figure 1: Nominal Exchange Rate Series of EUR and USD to HUF for the period 1996-2008
Source: Average monthly exchange rate from the Hungarian National Bank.

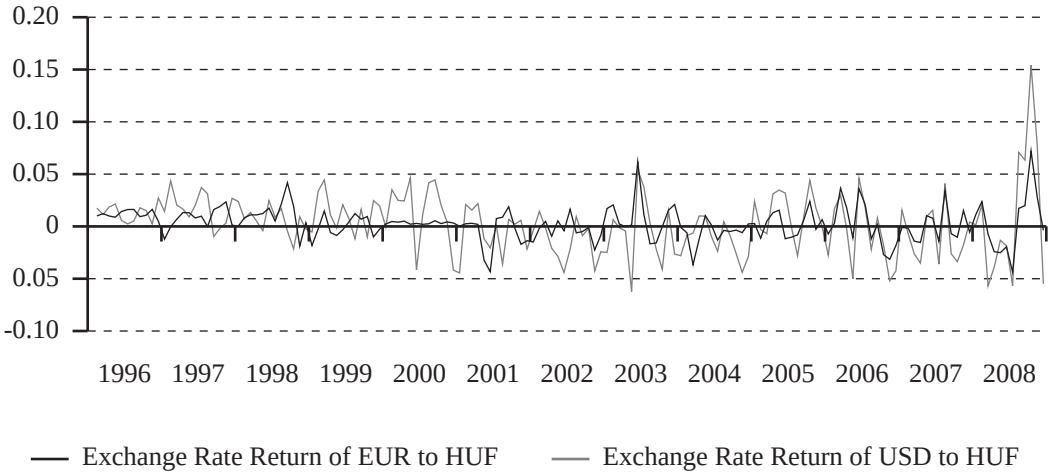

Figure 2: Exchange Rate Return of EUR and USD to HUF for the period 1996-2008
Source: Author's calculations based on average monthly exchange rate from the Hungarian National Bank.

Measuring Exchange Rate Volatility

A variety of measures of exchange rate volatility have been used in the literature. Usually, the measures used are some variant on the standard deviation of the difference in annual or quarterly or monthly exchange rates, for example, the standard deviation of the percentage change in the exchange rate or the standard deviation of the first differences in the logarithmic exchange rate. In this article, in order to capture ex-ante exchange rate uncertainty, the latter measure is used. We constructed the measure of exchange rate volatility based on monthly average nominal exchange rates for the period from 1996 to 2008 for every year analysed from the previous three years to year *t*. The measurement of exchange rate volatility is based on *nominal* bilateral exchange rates. Several studies highlighted that nominal and real exchange rate series generate very similar empirical results (McKenzie and Brooks, 1997; McKenzie, 1999; Quian and Varanges, 1994).

A moving standard deviation of the first differences in the monthly nominal exchange rate over the forty-eight months (m) prior to the year t and the prior three years (t`)[4] is applied to estimate exchange rate volatility for year t:

$$XV_{ijt} = \sqrt{\frac{\sum_{m=1}^{48} (x_{ij,m} - \overline{x}_{ij,t'})^2}{48}} \tag{5}$$

where $x_{ij,m} = \ln e_{ij,m} - \ln e_{ij,m-1}$, $\ln e_{ij,m}$ is the log of the monthly nominal exchange rate (e) between countries i and j at the time (month) m, and $\overline{x}_{ij,m} = \frac{\sum_{m=1}^{48} x_{ij,m}}{48}$ is the mean of $x_{ij,m}$ over the forty-eight months prior to year t and the previous three years.

Results

One advantage of using panel data is that unobservable cross-sectional effects can be accounted. However, there are some econometric issues that need to be addressed when estimating the gravity equation (4). Firstly, nonspherical error terms resulting from heteroskedasticity and autocorrelation across panel sets are anticipated in the dataset. In the case of trade between two smaller countries or between a smaller country and a larger country likely to be more volatile compared to trade between two large countries and heteroskedasticity may occur in this case (Frankel, 1997). Autocorrelation within panels may be present, partly reflecting sunk cost effects (Roberts and Tybout, 1997). To address these problems the heteroskedastic corrected standard errors (Prais-Winsten) approach is applied that controls for heteroskedasticity, and panel specific AR (1) is applied to control autocorrelation (Beck and Katz, 1995; 1996).

Table 2

Exchange Rate Volatility and Exports

Variable	$\ln EXP_{ijt}$
$\ln GDP_{jt}$	0.3020**
$\ln POP_{jt}$	0.0790
$\ln DIST_{ij}$	-1.407***
$\ln XV_{ijt}$	0.4000**
$D_{1,BOR}$	1.2870**
$D_{2,EU}$	0.2810
$D_{3,CEFTA}$	0.1400
R^2	0.9150
N	810
rho	0.4516

Note: The single (*), double (**), or triple (***) asterisk denote significance at the 10%, 5%, and 1% levels, respectively.
Source: Author's calculations.

[4] *t'* represents the period based on monthly data of the year s' *t-3*, *t-2*, *t-1* and *t*.

The results of the gravity model equation (4) using the moving standard deviations as a volatility measure are presented in Table 2. The coefficient on XV_{ijt} is positive and significant at the 5% level. This implies that the exchange rate volatility has a positive effect on Hungarian agri-food exports: increasing volatility by 10% results in a 4% increase in agri-food exports. The positive effect of exchange rate volatility on agricultural trade is consistent with the findings of McKenzie and Brooks (1997).

The mass variables of gravity model $\ln GDP_{jt}$ and $\ln POP_{jt}$ have the expected positive sign, but only the first variable is significant. This implies that a higher value of GDP per capita of 10% in the export destination country (j) increases Hungarian agri-food export by 3%. The classical trade resistance variable of gravity equation $\ln DIST_{ij}$ has the expected negative sign and is significant at the 1% level: A distance increase of 10% results in a 14% decrease in exports to these export destination countries. The border dummy ($D_{1,BOR}$) is significant and its positive sign indicates that Hungarian agri-food exports are increasing in the relation of countries which have a common frontier with the analysed country. However the qualitative trade resistance variables ($D_{2,EU}$ and $D_{3,CEFTA}$) are not significant.

Conclusions

This article has investigated whether exchange rate volatility has negatively affected the Hungarian agricultural exports. We constructed a balanced panel of Hungarian agri-food exports to 81 export destination countries for the period 1999-2008. This gave a fairly large panel dataset to which we applied the gravity model specification, which has numerous advantages over cross-sectional studies that have typically been used to highlight the impact of exchange rate volatility on bilateral trade flows. Exchange rate volatility is captured by a moving standard deviation of the first differences in the exchange rate over the forty-eight months nominal average exchange rate of year t and the prior three years.

The estimations of the gravity equation indicate that the signs of significant parameters are according to our expectations. The signs of parameters for the variables of population and income (GDP) of export destination countries are positive, while distance is negative. As well as exchange rate volatility has positive effects on Hungarian agri-food exports.

The policy implications of the positive effect of exchange rate volatility on Hungarian agri-food trade are connected to the process of joining to the euro zone and to the attitude of agri-food products trading firms. As the exchange rate volatility has a positive effect on trade with Hungarian agri-food products, the agricultural holdings and firms operating in the food industry are interested in prolonging the process of joining Hungary to the euro zone, introducing euro as late as possible. At the same time, trading firms with Hungarian agri-food products seems to cover their risks which arise from currency volatility using the opportunities offered by the forward and futures markets.

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Annex 1

Agri-food export destination countries from Hungary

Albania	Iceland	Peru
Algeria	Iran	Poland
Argentina	Ireland	Portugal
Armenia	Israel	Republic of Korea
Australia	Italy	Romania
Austria	Japan	Russia
Azerbaijan	Jordan	Saudi Arabia
Belarus	Kazakhstan	Senegal
Belgium	Kenya	Singapore
Bosnia and Herzegovina	Kuwait	Slovakia
Brazil	Kyrgyz Republic	Slovenia
Bulgaria	Latvia	South Africa
Canada	Lebanon	Spain
Chile	Libyan Arab Jamahiriya	Sweden
China	Lithuania	Switzerland
Croatia	Luxemburg	Syrian Arab Republic
Cyprus	Macedonia, FY	Taiwan
Czech Republic	Malaysia	Tajikistan
Denmark	Malta	Thailand
Egypt	Mexico	Tunisia
Estonia	Moldova	Turkey
Finland	Mongolia	Ukraine
France	Morocco	United Arab Emirates
Georgia	Netherlands	United Kingdom
Germany	New Zeeland	United States
Greece	Norway	Uzbekistan
Hong Kong	Pakistan	Venezuela

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Parametric farm performance and efficiency methodology: Stochastic Frontier Analysis

Bakucs L., Zoltán[1]

Abstract

There is a continuously growing literature on the agricultural transformation in Central and Eastern European countries (see some surveys in *Brooks and Nash* 2002; *Rozelle and Swinnen* 2004). The research has focused on various aspects of transition, including land reform, farm restructuring, price and trade liberalisation, but even though Farm Accountancy Data Network (FADN) data are now available for some years, there are only a few studies (e.g. *Bakucs et al.* 2010, *Fogarasi and Latruffe,* 2007, *Baráth et al.,* 2009) focusing on Hungarian farm performance. The objective of this paper is to shed light on some methodological issues that are needed to study Hungarian farm performance. Here we consider one aspect of farm performance, namely technical efficiency. This measure refers to whether farmers are capable of using existing technology to its full potential by producing the most possible from a given set of production factor quantities.

Keywords

farm technical efficiency, Stochastic Frontier Analysis, methodology

Stochastic Frontier Analysis (SFA)

Technical efficiency can be measured using parametric or non-parametric approaches. The latter (e.g. Data Envelopment Analysis, DEA) have however severe shortcomings such as the sensitivity of the results to outliers and the potential bias in the results due to the exclusion of potentially more efficient firms. To circumvent this problem, researchers have resorted to various methods such as the bootstrapping technique (e.g. *Brümmer*, 2001). Another drawback of the non-parametric methods is that they do not account for random noise. Within the parametric approaches, the Stochastic Frontier Analysis (SFA) is commonly used. *Aigner at al.* [1977] and *Meeusen and Van den Broeck* [1977] have simultaneously yet independently developed the use of SFA in efficiency analysis.

The main idea is to decompose the error term of the production function into two components, one pure random term (v_i) accounting for measurement errors and effects which cannot be influenced by the firm such as weather, trade issues and access to materials, and a non-negative one, measuring the technical inefficiency, i.e. the systematic departures from the frontier (u_i):

$$Y_i = f(x_i)\exp(v_i - u_i) \tag{1}$$

or, equivalently:

$$\ln(Y)_i = \beta x_i + (v_i - u_i) \tag{2}$$

where Y_i is the output of the i^{th} firm, x_i a (k+1) vector of inputs used in the production, $f(\cdot)$ the production function, u_i and v_i the error terms explained above, and finally, β a (k+1) column vector of parameters to be estimated. The output orientated technical efficiency, (TE) is actually the ratio between the observed output of firm i to the frontier, i.e. the maximum possible output using the same input mix x_i (*Battese*, 1992, Figure 1).

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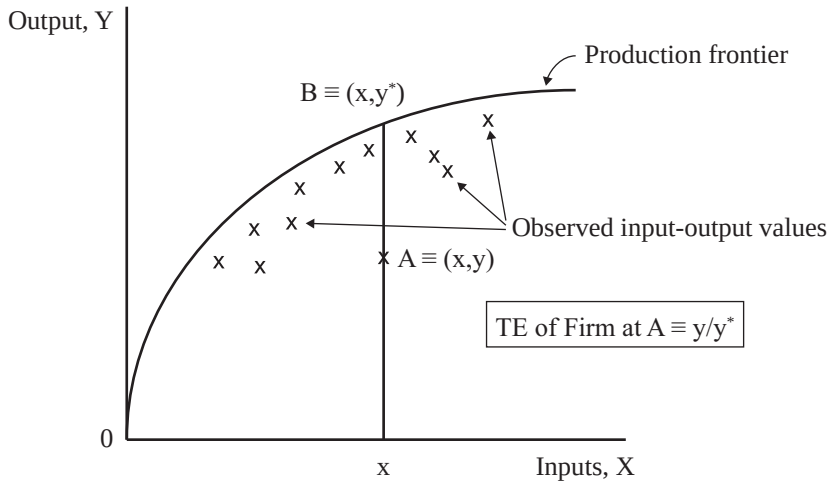

Figure 1: Technical efficiency of farms
Source: Battese (1992), p. 187

Arithmetically, technical efficiency is equivalent to:

$$TE_i = \frac{Y_i}{Y_i^*} = \frac{\exp(x_i\beta + v_i - u_i)}{\exp(x_i\beta + v_i)} = \exp(-u_i), 0 \leq TE_i \leq 1 \quad (3)$$

Contrary to the non-parametric DEA approach, where all production technical efficiency score are located on, or below the frontier, in SFA they are allowed to be above the frontier if the random error *v* is larger than the non-negative *u* (Figure 2).

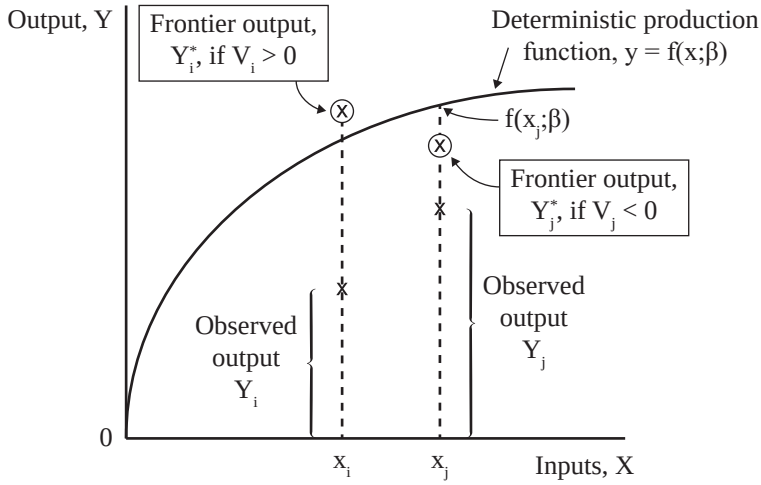

Figure 2: Stochastic frontier model
Source: Battese (1992), p. 191.

Applying SFA methods requires distributional and functional form assumptions. Firstly, because only the $w_i = v_i - u_i$ error term can be observed, one needs to have specific assumptions about the distribution of the composing error terms. The random term v_i is usually assumed to be identi-

cally and independently distributed drawn from the normal distribution, $N(0,\sigma_v^2)$, independent of u_i. There are a number of possible assumptions regarding the distribution of the non-negative error term u_i associated with technical inefficiency. However most often it is considered to be identically distributed as a half normal random variable, $N^+(0,\sigma_u^2)$ or a normal variable truncated from below zero, $N^+(\mu,\sigma_u^2)$.

Secondly, being a parametric approach, it is necessary to specify the underlying functional form of the Data Generating Process, DGP[2]. There are a number of possible functional form specifications available, however most studies employ either Cobb-Douglas (CD):

$$f(x_i) = e^{\beta_0}\prod_{k=1}^{K} x_{ik}^{\beta_k} \tag{4}$$

or TRANSLOG (TL) specification:

$$\ln f(x_i) = \sum_{k=1}^{K}\beta_k \ln x_{ik} + \frac{1}{2}\sum_{k=1}^{K}\sum_{j=1}^{K}\beta_{kj}\ln x_{ik}\ln x_{jk} \tag{5}$$

Because the two models are nested, it is possible to test the correct functional form by a Likelihood Ratio, LR test. The TL is the more flexible functional form, whilst the CD restricts the elasticities of substitution to 1, thus being more restricted but easier to estimate and interpret. The model could be estimated either with Corrected Ordinary Least Squares (COLS) or Maximum Likelihood (ML). With the availability of computer software, the estimation by ML became less computationally demanding and the ML estimator was found to be significantly better than COLS.

Extensions of the basic SFA model

Incorporating time effects

With panel data, TE can be chosen to be time invariant, or to vary systematically with time. To incorporate time effects, *Battese and Coelli* [1992] define the non-negative error term as an exponential function of time:

$$u_{it} = \exp[(-\eta(t-T))]u_i \tag{6}$$

where t is the actual period, T the final period and η a parameter to be estimated. TE either increases ($\eta > 0$), decreases ($\eta < 0$) or it is constant over time, i.e. invariant ($\eta = 0$). LR tests can be applied to test the inclusion of time in the model.

Determinants of technical inefficiency scores

Since TE is allowed to vary, the question arises, what determines the changes of TE scores? Early studies applied a two-stage estimation procedure, firstly determining the inefficiency scores and then, in a second stage, regressing TE scores upon a number of firm specific variables assumed to explain changes in inefficiency scores. Some authors however showed that conflicting assumptions are needed for the two different estimation stages. In the first stage, the error term representing inefficiency effects is assumed to be independently and identically distributed whilst in the second stage they are assumed to be function of firm specific variables explaining inefficiency, i.e. they are not independently distributed (*Curtiss*, 2002). *Battese and Coelli* [1995] proposed a one stage procedure where firm specific variables are used to explain the predicted inefficiencies within the

[2] Within the econometric literature there are a number of possible interpretations of the DGP. Here we refer to the true, but unknown model generating the data that is approximated by a 'best available' functional form.

SFA model. The explanatory variables are related to the firm specific mean μ of the non-negative error term u_i:

$$\mu_i = \sum_j \delta_j z_{ij} \tag{7}$$

where μ_i is the i^{th} firm-specific mean of the non-negative error term; δ_j are parameters to be estimated, and z_{ij} are i^{th} firm-specific explanatory variables.

The heteroscedastic SFA model

Using cross-section or panel data may often lead to heteroscedasticity in the residuals. With heteroscedastic residuals, OLS estimates remain unbiased but no longer efficient. In frontier models, however, the consequences of heteroscedasticity are much more severe as the frontier changes when the dispersion increases. *Caudill et al.* [1995] introduced a model which incorporates heteroscedasticity into the estimation. That is done by modelling the relationship between the variables responsible for heteroscedasticity and the distribution parameter σ_u:

$$\sigma_{ui} = \exp\left(\sum_j x_{ij}\rho_j\right) \tag{8}$$

where x_{ij} are the j^{th} input of the i^{th} farm, assumed to be responsible for heteroscedasticity, and ρ_j a parameter to be estimated.

Within the SFA approach it is possible to test whether any form of stochastic frontier production function is required or the OLS estimation is appropriate using a LR test. Using the parameterisation of *Battese and Cora* [1977], we define γ, the share of deviation from the frontier that is due to inefficiency:

$$\gamma = \frac{\sigma_u^2}{\sigma_v^2 + \sigma_u^2} \tag{9}$$

where σ_v^2 is the variance of the v and σ_u^2 the variance of the u error term.

It should be noted, however, that the test statistic has a 'mixed' chi square distribution, with critical values tabulated in *Kodde and Palm* [1996].

Some applications of SFA methods

Most efficiency and productivity studies focused on three main groups of issues when explaining the sources of inefficiency: farm owner/manager characteristics, farm type and size, and finally the effect of various subsidies. Here we focus on the literature applying the SFA methodology and studying the latter two issues.

The impact of optimal farm size and structure upon the technical efficiency of farms

The optimal farm structure as well as the optimal farm size has long been in the focus of agricultural economics debates. The issues seem to be even more controversial in transitional newly acceded European Union (EU) economies where (in most cases) political-social and economic changes in the early 1990s were followed by the dismantling of socialist agricultural farm structures (de-collectivisation and the breaking up of socialist state agricultural enterprises) and the emergence of various new, mostly family farm based structures. *Gorton and Davidova* [2004] reviewed the efficiency studies focusing on Central and Eastern European Countries (CEEC). Of the studies employ-

ing the SFA methodology, *Curtiss* [2002] found that, on average, in the Czech Republic wheat and rapeseed farms larger than 150 ha perform better, then smaller ones, or farms specialised on other field crops. *Munroe* [2001] found that in Poland, farms smaller than 15 ha are less efficient, whilst for Slovakia, *Morisson* [2000] analysed seven commodities and concluded that there is a positive relationship between the scale of production and efficiency scores. In addition, *Curtiss* [2002] found evidence of higher technical efficiency of individual farming in sugar beet production, but lower in wheat production, compared to corporate farming. *Latruffe et al.* [2004] reinforced Munroe's results for Poland and found that for both crop and livestock farms the size-efficiency relationship is positive, meaning large farms are more efficient. More recently, *Alvarez and Arias* [2004] using data from a group of 196 dairy farms in Northern Spain found a significant positive relationship between technical efficiency and size.

The impact of agricultural subsidies upon the technical efficiency of farms

As it has often been shown in agriculture, public support reduces farmers' effort, implying greater waste of resources and thus further distance from the efficient frontier. This may be even more appropriate when considering decoupled payments since these government transfers are not linked to output. Thus if income supports are mainly through decoupled transfers, higher production does not imply bigger premia. This in turn may reduce incentives to produce close to the possible frontier resulting in increased inefficiencies (*Serra et al.,* 2008).

Serra et al. [2006] elaborated a theoretical framework that allows for both output and input price uncertainty and incorporates risk attitudes of economic agents. The theoretical framework and empirical analysis revealed that in a non-risk neutral scenario decoupling will cause farms with decreasing absolute risk aversion, DARA (increasing absolute risk aversion, IARA) to increase (decrease) input use if the input is risk increasing. If, however, the input is risk decreasing then the impacts of decoupled government transfers are inconclusive. *Bakucs et al.* [2010] investigated the determinants of the technical efficiency of Hungarian farms using Hungarian FADN data for the 2001-2005 period, the crucial phase of adjustment and first years of membership of the EU. The results showed that accession to the EU has reversed the pre-accession trend of decreasing efficiency. Increased competitiveness, opening of new market opportunities or access to better inputs may be reasons for this. The investigation of the determinants of technical efficiency has made it possible to characterise the most efficient farms in Hungary over the period studied: these were companies located in the favourable region of Western Hungary, with a non specialised and labour intensive production system. This, along with the large production elasticity of labour (0.319), suggests labour scarcity in Hungarian agriculture 10-15 years after the transition. The direct effect of agricultural support policies on farm production and efficiency was also investigated in the paper. Accession to the EU was found to only slightly enhance technological change and production, contrary to what was expected from accession, but to improve farms' efficiency. However, the other side of the coin about EU membership is that public subsidies received by farmers in the frame of the Common Agricultural Policy (CAP) have a negative influence on their technical efficiency. This effect was found here to be even stronger in periods where subsidies were higher (2005 c.f. 2004).

Latruffe et al. [2008], using non-parametric methods, investigated the relationship between CAP direct payments and managerial efficiency of French crop and beef farms, and found significantly negative correlationfor crop farms and a significantly positive one for beef farms. They concluded that the type of payments also matter, since Less Favoured Area and area-based payments decrease crop farms' efficiency, whilst agri-environmental and headage payments increase beef farms' efficiency scores.

Serra et al. [2008] revisited the issue of the relationship between technical efficiency and decoupling. Using an additive SFA approach as opposed to the Stochastic Frontier Production Function used in *Serra et al.* [2006], they have shown that since technical inefficiencies are positively related to output variability and negatively to production mean, a decoupling process affecting the input use will also have an impact upon technical inefficiencies. Using empirical farm level data from Kansas the paper found that an increase in decoupled transfers will induce an increase (decrease) in DARA (IARA)[3] farms' technical inefficiency if the given input is risk decreasing. With risk increasing inputs, however, the effect of decoupling upon technical inefficiencies can be either positive or negative, somehow contradicting previous studies that mostly concluded that government transfers are farm inefficiency increasing.

Software packages

There are a large number of computer software packages appropriate for estimating the technical efficiency of farms. Most often the LIMDEP (www.limdep.hu), NLOGIT (www.limdep.com), STATA (www.stata.com), and TSP commercial software packages or programs written in Ox, SAS, Gauss program languages are used for SFA estimations. There are however some freely downloadable programs that are appropriate for SFA analysis. *Coelli* [1996] developed the program Frontier (www.uq.edu.au/economics/cepa) and Mark Steel of the Warwick University has the WinBUGS software for SFA estimations available at the http://www2.warwick.ac.uk/fac/sci/statistics/staff/academic/steel/steel_homepage/software.

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[3] Decreasing Absolute Risk Aversion and Increasing Absolute Risk Aversion respectively.

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Local sustainability in Hungary – an analysis of the factors that determine the low number of LA21 strategies

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Abstract

The concept of sustainable development is currently one of the most important concepts in the world. The implementation of the global idea is in the hands of local communities. The success of LA21 initiatives largely depends on two important factors: the bottom-up initiatives of the community based on voluntary participation and the support from the national government. In the case of Hungary we examine central government initiatives to date, as well as the factors that determine the success of bottom-up initiatives. As an illustration we present some of the findings of a survey we conducted in the micro-region of Gyöngyös.

Keywords

sustainable development, local agenda, social participation, national government

Introduction

In recent decades it became clear that the environmental polluting and energy wasting life-style of mankind leads to the degradation of natural resources and to an ecological catastrophe in the long term, so nowadays much more emphasis is put on sustainability and environmental friend-liness. Sustainable development strategies are prepared at every level of government, at the local, regional, national and international level, and, as Kuti and Szabó explain: "nowadays a new form of macro level planning is sustainable development strategies" (Kuti – Szabó, 2003:1).

Even though the idea of sustainable development has been known for decades, and it has become an expression used in everyday life, the concept is still unclear: as it is used in a wide range of contexts there are a number of definitions and interpretations available. According to Daly (1991) it is not a problem as the debate about sustainability has led to the consensus that it is a mistake both morally and economically to see the world as a business enterprise. He also thinks that the elaboration of the idea of sustainability reflects society's recognition that it is a necessity to stop the chase for growth. Even though there are a number of interpretations, it is very difficult to give a concrete definition of sustainability (Magda – Bozsik, 2010). The complexity of the phenomenon can be demonstrated by the interpretation given by Csete (2005), who states that sustainability is a way of life, thinking, production and consumption which embraces all dimensions of human existence: the relationship to natural resources, economy and society.

Since the notion was elaborated, several interpretations of sustainability have emerged. The most important ones are weak and strong sustainability, and also anthropocentric and ecocentric approaches. The main difference between these interpretations is how they evaluate the rearrange-ments between the different types of capital (natural, human and technical capital) supported by technical development, and inside natural capital. While the conditions of *weak sustainability* allow rearrangements between the different forms of capital, in the case of *strong sustainability* the ele-ments of the different sub-systems cannot be interchanged. The aggregate value of natural resources cannot decrease with time. According to the *anthropocentric approach* mankind and nature can be

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separated, humans have command over nature, thus environmental limits can be neglected. According to the *ecocentric approach* mankind is an elemental part of nature and can only exist in harmony with nature, thus it has to pay great attention to the carrying capacity of the environment and must not overstep it, that is to say this approach does not allow interchanges among natural capital either.

The circumstances in which the idea was elaborated, and the environmental problems and disasters which occur more and more often nowadays, suggest that the interpretations which allow natural values to be changed for manmade values are not appropriate. It is becoming apparent that the destruction of the environment has led to changes which endanger the life circumstances of future generations and the future of our planet as well. It means that environmental interests must have priority over economic and social ones in almost every case, as we do not know what the irreversible level of environmental damage is, and neither do we know which environmental elements future generations will prioritise. Bearing this in mind, global environmental problems can only be handled with the principle of precaution, and still we can only hope that we have not reached the level of environmental damage which is irreversible. The principle of precaution is particularly important in case of those resources which are scarce. It means that such resources should come to the fore which are capable of reducing shortages, ones that are unlimited on the human timescale (Magda, 2010).

The objectives of the research

Sustainable development aims to affect the future of mankind by reforming the relationship between economy, society and the environment, an aim which can only be reached with the active participation of the community. For this reason, Agenda 21 requires local and national authorities to prepare sustainable development strategies and to pay great attention to involving the community. It is essential to handle economic and social issues together with their environmental effects, to identify the problems and to work out possible solutions in accordance with the efforts of the community, and to choose and implement the most appropriate ones.

According to the *Treaty of Amsterdam*, sustainable development is a prominent area and also the overall aim of the European Union (EU), so the European Committee undertook the task of the propagation and distribution of the idea of Local Agenda 21 as one of the elements of the *Rio Agreements* (UNCED, 1992). In 1994 with the participation of several European municipalities the *Aalborg Charter* was concluded which commits the signatories to the Local Agenda 21 process and to the elaboration of long-term action plans aiming at sustainability. The *European Sustainable Cities and Towns Campaign* which was established together with the *Aalborg Charter* aims to build up networks between signatory municipalities and between existing networks of municipalities and to extend the number of participants of the Charter (CEC, 2006:40). However, there are only a few signatories to the Charter from Central and Eastern Europe, four of which are from Hungary. The situation is not very encouraging in the field of local sustainability in Hungary. Although there are initiatives that can be described as ones that were prepared in the spirit of local sustainable development, there are only a few municipalities which have working, formalised sustainability strategies (e.g. Szécsény Város Önkormányzata, 2010; Rév8 Józsefvárosi Rehabilitációs és Városfejlesztési Zrt., 2010).

One of the most important messages of sustainability is that the consultative process between the local government and the community can have far reaching consequences which can influence the municipality's life for a long time. In our paper we explore the inhibitive factors bearing this

duality in mind, as the lack of top-down initiatives together with the low number and the low support of bottom-up approaches have led to this unflattering image for Hungary. With the help of national documents and relevant literature we analyse the factors that describe the commitment of national governments: the role of the national sustainable development strategy and its possible effects, legal constraints that bind local governments to deal with sustainability, financial resources which are available for the implementation of initiatives related to local sustainability, and available guides and case studies.

In the case of local communities we examine the role of local governments and citizens, and the role of some other possible stakeholders such as the media. We illustrate our findings with some of the results of the questionnaire survey we made among local governments and citizens in the micro region of Gyöngyös. In a mainly rural area like this the topics of rural development and sustainable development are largely related and can only be interpreted together (Magda et al., 2009). The intent of our survey was the examination of the potential for local sustainability. The questionnaire concentrated on the following topics:

- The weight of economic, social and environmental factors in the life of the municipalities, the ranking of problems connected with these factors.
- The existence of the documents which could serve as a basis of local sustainability strategies.
- The extent to which the resident population can be mobilised, local citizens' role in the preparation of documents that influence the life of the municipality, and the extent of co-operation between the local government and the population.
- Initiatives related to sustainability at the municipalities, the opportunities and constraints of preparing local sustainability strategies,

In the first part of the questionnaire we gave information about the aim of the research and ensured respondents about confidential handling of the data they provide. We asked all local governments in the micro region to fill in one questionnaire, and 60% of them, (15 local governments), returned the completed questionnaire. We also received 184 evaluateable community questionnaires. We also aim to show in our paper how the inhibitive factors can be reduced.

The importance and aspects of local agendas

Local sustainability strategies are crucial preconditions of sustainable development. The *Declaration of Rio* states that „environmental issues are best handled with participation of all concerned citizens, at the relevant level" (UNCED, 1992:2). In accordance with it *Chapter 28* of *Agenda 21*, which is also known as *Local Agenda 21* (LA21), states that local communities play an important role in the implementation of sustainability as they are aware of the area's circumstances and requires local authorities to „undertake a consultative process with their populations and achieve a consensus on "a Local Agenda 21" for the community". It goes on to say „Through consultation and consensus-building, local authorities would learn from citizens and from local, civic, community, business and industrial organisations and acquire the information needed for formulating the best strategies. The process of consultation would increase household awareness of sustainable development issues. Local authority programmes, policies, laws and regulations to achieve Agenda 21 objectives would be assessed and modified, based on local programmes adopted" (UNCED, 1992:285).

In short, when preparing a local sustainable development strategy the general aim is to work out and implement programmes with the active participation of local governments and the active

support of the community which are based on the principle of sustainable development (Szlávik − Pusztai, 2001). by examining countries which are successful in the implementation of local sustainability we can see that the distribution of power between the national and the local level and the appropriate relationship between the different levels are important elements. The success of LA21 initiatives depends on two important factors, one is the bottom-up initiatives of the community based on voluntary participation and the other is the high level of support from the national government.

The role and tasks of central government

The commitment of central government to sustainability issues is essential as it determines the local level's attitude to local sustainability. The role taken by central government can be of different sizes. In many cases the success of local sustainability strategies is based on the high level of support from central government in the form of campaigns, financial support and the coordination of the process. Beside these it is necessary to alter the legal background: such laws are needed which support the process of local sustainability and it is also essential to allocate financial instruments for local communities to formulate and implement a new type of sustainability programme.

Some authors (e.g. Lafferty – Coenen, 2001) share the opinion that national governments have to deal with the local sustainability process but they must not strive to lead the process as it can lead to the dominance of national priorities over local ones, which can make the local community become uninterested and local initiatives lose impetus. It means that central government must be cautious about local sustainability: it has to support it but must not force local communities to act as it wishes them to do. Its role can best be described as a facilitator; it has to convince communities that the local sustainable development strategy serves the interests of the community, it has to provide information in the form of brochures and guides, which enable local communities to initiate local processes and to elaborate independent initiatives. It also has to provide financial instruments for implementing these initiatives. The best way is when top-down ideas and bottom-up initiatives are also present, and with a strategy acceptable for both sides communities manage to implement the elements in it.

Governments across Europe are aware that they have responsibility for the issues of sustainability. Their main tasks are the following (Lafferty – Coenen, 2001:277):

- Setting up an administrative focal point for coordination and information dissemination;
- Producing manuals, guidelines, books and training opportunities;
- Providing funding for research and pilot studies;
- Providing direct funding for promoting LA21 initiatives.

It is worth examining what steps the central government of Hungary has taken in these areas, and whether it intend(ed) to play the initiative role or just let, but not help, local initiatives emerge. Earlier, contrary to European trends, the Hungarian government did not show significant interest in the topics of sustainable development, although it tried to meet the expectations of the EU. However, in the last few years the process of sustainability has gathered momentum. In June 2007 the *Hungarian National Sustainable Development Strategy* (MKK, 2007) was prepared, in February 2008 the *National Climate Change Strategy* (MKO, 2008), and in October 2008 after almost a year of preparatory work the *National Council for Sustainable Development* was founded, the aim of which is to foster the implementation of sustainable development in Hungary. The Council also works for the propagation of local sustainability; in the course of 2010 it asked eight municipalities to prepare their own local agenda as a pilot project.

Administrative focal point

An administrative focal point for coordination and information dissemination, where not only experts but also politicians at the highest level are present, has been set up: the task belongs to the Prime Minister's Office. Local sustainable development strategies can emerge under the auspices of the national sustainability document, and financial resources available for local sustainability derive from governmental organisations such as ministries, and ministerial or inter-ministerial committees. One of the most important tasks of the national governing body is the preparation of the national sustainable development strategy. The demand for it was officially drawn up by *Government Decision 2064/2004.* (MKK, 2004) in March 2004. The most important characteristics of a sustainable development strategy are the holistic system approach, objectives that bring in new ideas, long enough time horizon and interpretation as a learning process (Gáthy et al., 2006). The final version of the strategy was worked out taking these characteristics in view in June 2007 (MKK, 2007). The strategy specified 11 priorities in three areas.

The national strategy acknowledges the importance of local sustainability strategies but it *does not provide guidance to local communities*. The priorities and action plans of the national strategy can serve as a point of reference when making local strategies, but it does not dispose of the legal background and the financial conditions of strategy making. It stresses that it is important to make local strategies, but it does not give reasons to this statement and does not indicate the primary aims of strategy making.

Legal background and funding

By creating the legal background of local sustainability strategies communities get some guidance about the requirements which derive from national initiatives and the rights and opportunities provided by them.

In Hungary after the change of regimes, the old laws which deal with the protection of the environment were gradually replaced by new ones. The most important requirement of the new laws was that they should harmonise with acquis of the EU. The most important of these from the point of view of our research is *Law 53/1995. on the protection of the environment* (MKO, 1995). One of the aims of the Law is the elaboration of the harmonious relationship of mankind and the environment, the high level, aligned protection of the environment, its elements and processes, and ensuring sustainable development. It also laid down the tasks of local governments connected to environmental protection. As a legal act which defines the tasks of local governments related to sustainability has not been worked out yet – current laws of the country only state that local governments can make local sustainability strategies (Government Decision 2064/2004) (MKK, 2004), but no financial resources are allocated for this task, – this law is the one which provides the most exact list of tasks about sustainability.

The question of financing is also essential. As local governments are underfinanced across Europe and the resources are bound by law, central government programmes can provide resources for preparing and implementing local sustainability strategies, for starting pilot projects and for the recognition of efforts in the form of applications and prizes. Although the application tenders of the *New Hungary Development Plan* (KEOP, TÁMOP, KÖZOP, GOP) pay attention to the harmonious, sustainable development of the environment, the economy and society, and contain several elements of sustainability as well as some flagship projects (e. g. „clear town – green countryside" programme), which can be connected to sustainability, we do not have information about starting pilot projects or applications and awards which aim for local sustainability.

Guides and case studies

Another major task of central governments is the propagation of the process of local sustainability. We can find good examples for spreading the concept of sustainability, for making informative guides for the population and stakeholders of local sustainability in several countries of Europe: a number of books, guides, manuals and case studies are published, conferences and courses are organised for experts and interested stakeholders. It is highly important as the control of the process is the task of well-trained experts. The training of these experts is realised at professional conferences. These meetings allow networks of participants to be established which can make the exchange of experience and consultation possible.

In Hungary the situation in this field is not encouraging. A few guides and manuals were published, but beside these, only a few books and case studies, publications in scientific journals (e.g. Csete – Török, 2008; Vásárhelyi, 2003), some diploma works (e.g. Dankó, 2006) and PhD theses (e.g. Csete, 2009) deal with this topic. International literature is not or only indirectly available in Hungarian, which makes the stream of news harder. It also means that international trends and initiatives reach Hungary rather late. The number of conferences and trainings dealing with local sustainability is also very small.

The training of experts is a vital area, but the process of sustainability can only be successful if a great proportion of the local community supports it. Local governments – as the leaders of this process – must strive to involve the community in the process of decision making in as great a number as possible so that decisions would not reflect the preferences of a small group of people. Although papers are presented at several conferences in this topic, they only reach a small audience. So it is a common task for central and local governments to propagate the notion of sustainability for the community. It is central government's task to ensure that the population is informed about the idea and the priorities of sustainability, and it is up to local governments to inform the people about local problems and opportunities. The media can play a major role in this process, mainly public service national and local television – as beside the Internet they are the population's main source of information – and national and local newspapers. Local governments' own publications can also be the mediators of the topic.

Tasks at the local level

Although the ideas and initiatives of national government in the field of local sustainability are important factors, *Local Agenda 21 is traditionally based on the participatory methods of the local community*, through the initiatives of the population local solutions are worked out to solve the global problems related to sustainability. Initiatives based on social participation are of great importance with respect to local sustainability, as the implementation of *Local Agenda 21* does not have a strict course put down in a standard, there is only an algorithm of implementation, which may largely differ according to the nature, the circumstances of the region and the timing of implementation (Szlávik, 2002).

The success of local sustainability strategies relies heavily on the participatory methods and initiative skills of the local level. Participatory methods ensure that the aims indicated in the strategy reflect the priorities of the public, while initiative skills help to establish innovative solutions for local problems. Communities choose a purposeful (goal-oriented) value-oriented action when considering the future development of their municipality (Hudecková – Pitterling, 2009:597). It is a requirement that local agendas should be worked out at the local level based on the consultative participation of the population.

Participatory methods are the condition of the bottom-up approach. There are many aims which can unite people and make them form different groups. Sustainable development is a complex idea, no wonder that several organisations are interested in sustainability, more precisely the future of the local community, the formation of the economy, society and the environment. These organisations are the motive powers of local sustainability. They work out concepts in their professional area which can be the basis of the sustainability strategy for the community. As democratic traditions are strong and social capital is high in many countries of Europe, there are several organisations for which the formation of the future and the environment is important. For this reason individuals are willing to take part in working out and implementing a sustainability strategy sacrificing their free time. These initiatives which are based on participation methods in the community put local sustainable development strategies in motion (Szlávik, 2002).

A minimal level of welfare is necessary in the society so that it could concentrate on working out solutions for global environmental problems. This economic security is missing in Hungary and this creates unfavourable conditions for the emergence of sustainability. Social tendencies are also unfavourable. In the economy there are only a small number of initiatives which point towards sustainability (support for more sustainable production methods, incentives for using alternative types of fuel etc.). Impoverishment of the population and the decay of people's health are the most serious contingencies for society. Environmental problems occur more and more often for example in the form of extreme weather conditions (such as the flooding across Central Europe in June 2010) Due to the restrictive economic policy the situation is not probable to improve, but a further decay can be expected.

Lafferty and Coenen (2001:278) listed five aspects which are necessary for the success of bottom-up initiatives. They are the following:

- an active and politically mobilised population;
- interested and motivated civil servants;
- local politicians with a particular concern for environmental issues;
- positive international contacts and networks;
- existing environment and development initiatives.

Social participation

Regarding the active and politically mobilised population the question is how much local communities are sensitive to environmental problems, how much action they are willing to take against them and whether their initiative, skill and social capital are enough to handle environmental problems on their own. In case of strong democracies people are pleased to take part in defining the objectives of the community, which means that the efficiency of decision making and the quality of governance improve. Due to the political system before the change of regimes, democratic traditions in Hungary are still weaker than in Western Europe. In Hungary, where people got used to the fact that decisions were made above them by central government, it cannot be expected that the community has an opinion about and position on an abstract idea like sustainability. *The society lacks social capital, which is the basis of bottom-up approaches*, and as a consequence communities are unable to affect decision making significantly. While in other countries strategies are made with the participation of several organisations (such as environmental groups, trade unions, local media, universities and research institutes), and the initiatives derive from these, in Hungary there are fewer civil organisations in general, and in particular ones that are interested in and willing to work for sustainable development. The number of volunteers is not enough either. Altogether it means that civil

organisations have not yet managed to become a force which could influence common thinking.

Csath (2002) refers to the analysis of the Swiss *Institute for Management Development* (IMD) about social capital, in which Hungary belonged to the countries which were at the bottom of the list in all four categories – social cohesion, quality of life, business ethics and social responsibility. The reasons *Csath* gives are the following:

- The dramatic change caused by the change of regimes;
- Unclear privatisation affairs;
- The query of the neutrality of jurisdiction;
- The survival of the previous relationship networks;
- Old-new chains of relationships;
- The emergence of mafia groups;
- Distrust towards political parties.

The statements in the study are still true even today, so it is not surprising that there is no real progress considering social capital, the initiative skill of the community and bottom-up approaches.

Regarding the active and politically mobilised population, it is worrying that it seems that people are interested in social problems only if they are affected by them personally. Similar things can be said about environmental problems; the difference is that people are less willing to work against them. There are some events (e.g. floods, Paks, cyanide poisoning on the river Tisza) which evoke public interest and indignation, but by now they have only temporarily allowed environmental issues to come to the fore. Maybe the toxic sludge catastrophe near Ajka in 2010 will reveal the importance of taking environmental aspects into account.

According to Kerekes (2007) the number of green party politicians indicates the priorities of society about the environment. At the first five Parliamentary elections since the change of regimes in Hungary in 1990, no green political parties managed to get at least 5% of the votes and thus get into the Parliament. Environmental protection was not an important issue in party politics and the values of the parties represent the values of society. In the parliamentary elections in the spring of 2010 neither environmental protection, nor sustainable development was mentioned as a main area of interest in the communication materials of the major parties. The appearance of the party LMP (Politics Can Be Different) on the political scene and its declared goals can bring in changes in this respect.

Another inhibitive factor is the lack of information. In the order of values of the society environmental issues fall behind, the reason of which is the lack of information. The media plays a huge role in influencing this order by introducing the essence of the vision of sustainable development. In Hungary problems concerning the environment – although their presence in the media is getting stronger – do not attract the attention of the media, environmental issues only manage to get into the media when there are sensational or scandalous events (such as the cyanide pollution on the river Tisza or German waste near Kecskemét). After public interest in these events decreases, there are no environmental reports for a long while, even though there are still a lot of environmental problems (Baják – Kuti, 2006). An example for this is the toxic sludge catastrophe near Ajka, which – because of its implications – may not allow public interest to be diverted from environmental risks. That makes the stronger presence of sustainability – its principles and values – in the media desirable, with special emphasis on the role of individuals and local communities. It is the only way to make people aware of the fact that even though sustainable development is a global notion, its implementation is in the hands of local communities.

To introduce the notion of sustainability to the public it must be shown how local solutions contribute to the improvement of global environmental issues, as well as that it does not require impossible efforts and financial sacrifice from citizens, but with a little attention to the environment significant improvement can be reached. In the micro-region of Gyöngyös we found that the most important role of the community is providing information, participation in decision-making and in the implementation of decisions. While all local governments say that the community takes part in the municipalities' life in some way, 12% of the citizens' questionnaires contain the answer 'the community does not take part in the municipalities' life' (Figure 1), which makes us believe that there are some social groups that local governments did not manage to involve.

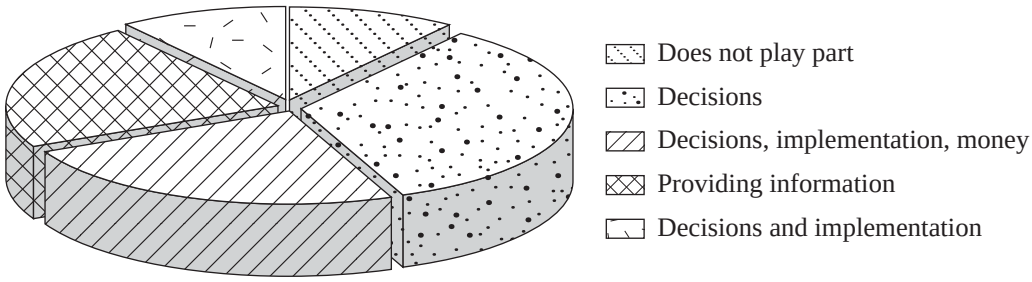

Figure 1: The role of the community in the life of the examined municipalities
Source: our own composition

Civil servants and politicians

Local governments (especially small ones) also have to tackle with the lack of expertise. Although they employ environmental experts, the number of civil servants who deal with environmental topics is low. Beside the required activity they hardly have time for their own initiatives, one of which for example the support of the process of sustainability could be. As a consequence, environmental programmes and development plans are prepared with the help of external experts (e.g. consultant companies), so the priorities of these documents are only partially in accordance with the real priorities of the community. These strategies contain several elements which are inadequate for people to adapt to.

In many cases local politics is an instrument of party politics, politicians sometimes support issues which are against the interests of the local community, although in affairs that affect the life of the community it seems to be easier for politically counter-interested parties to make a compromise – especially if the affair becomes the centre of the community's interest. Politicians are usually quite positive about environmental issues – it is not easy to explain a decision against environmental interests. In Hungary green parties do not have loyal voters, so their candidates only rarely manage to get into local government bodies. In a country like Hungary, where the number of local initiatives is minimal and almost all of the strategies emerge by the commitment of the mayor, the personal involvement of the mayor – as Szlávik (2002) describes seems inevitable.

About ¾ of the examined municipalities in the micro-region of Gyöngyös would have difficulties preparing a local sustainable development strategy on their own; they would have to enlist the services of external experts (Figure 2).

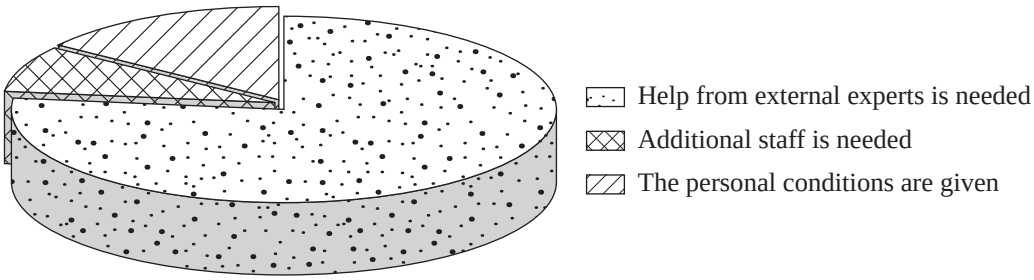

Figure 2: Personal conditions of local sustainability at the examined municipalities' local governments

Source: our own composition

Among the local governments that do not want to hire external experts, there are some who would have to hire additional staff to be able to perform this task. It means that the proportion of local governments which possess the personal competences to prepare their own sustainable development strategy is only 14%. It demonstrates that the lack of expertise is a major inhibitive factor of local sustainability for smaller municipalities.

International contacts and networks

Even though local governments have several cultural, economic etc. relationships with other municipalities, these relationships are not connected to sustainability, so the exchange of experience is not the aim of them. Only a small number of Hungarian municipalities take part in the work of networks related to sustainability. It is characteristic that among the signatories (more than 2700) to the *Aalborg Charter*, which is an important document of local sustainability, there are only four Hungarian municipalities, Aba, Kecskemét, Monor and Nagykanizsa (The Aalborg Commitments Secretariat, 2010). It is a small number if we take into account that there are 3152 municipalities and 174 administrative micro regions in Hungary.

The lack of national commitment has a bad influence on municipality leaders, who underestimate the importance of the topic. It can be connected with the lack of information, most Hungarian municipalities are not aware of the local aspect of sustainability, nor of the initiatives in this field, and thus do not take part in networking. As there are only a few manuals, guides and case studies about sustainability, the lack of interest from local governments and the default of local strategies can be experienced.

Taking part in such networks usually has a financial side, municipalities which take part in them have to pay an annual membership fee, which is – knowing the financial background of Hun-

garian municipalities – also against being a member. All Hungarian municipalities which are members of such networks either had a special aim (mostly they expected financial support) or there are some leaders or prestigious people at the municipality who are committed to sustainability, which made them undertake the requirements of the membership. As a result of all this there is only a small number of local governments which have been connected to the concept of sustainable development.

It is a positive fact that many municipalities have relationships with foreign municipalities who could take part in such networks or initiatives and can serve as a role model for Hungarian municipalities in this respect. Although the examined local governments of the micro-region of Gyöngyös have claimed for and won a lot of financial resources provided by application tenders of the EU, among the declared goals of which sustainable development can be found (e.g. the applications of Dél-Mátra 11 Leader+ Action Group, City Towards EU Compliance Award of the EU won by the municipality of Gyöngyös in 2001), none of the examined municipalities takes part in the work of international networks or initiatives the primary aim of which is related to sustainability.

Existing documents

Existing development plans of municipalities can be used when working out a local agenda for the community. It is a positive fact that most local governments in Hungary have already worked out documents which could be used when formulating a local agenda. Since 1995 local governments are legally bound to make environmental programmes, and if they fail to perform this task they lose a small proportion of financial resources. Beside environmental programmes, economic and municipal development plans and waste management plans are common. Some municipalities possess traffic plans and health programmes as well. The initiatives related to sustainability which can be found in these documents are quite important, as they can form the basis of a future formalised sustainable development strategy.

In the micro-region of Gyöngyös we examined what proportion of local governments has documents which are related to sustainability (Figure 3). While about half of the municipalities have a vision type document, only 20% of them have an action plan which defines how this vision should be put into practice. *It means that municipalities are aware of their goals and targets but they do not know how to reach them.* The existence of action plans is quite important as the mobilisation of the community can be implied by them.

Development plans, environmental protection programmes, waste management plans and environmental reports are found at the municipalities in almost the same proportion: about half of the municipalities have worked out one. The only type of plan which is an exception is traffic management plan. It is easy to understand if we mention that the examined municipalities are rather small ones and no major road crosses them except for one, which is the seat of the small region, and because of the closeness of the motorway the traffic in the municipalities is not very high.

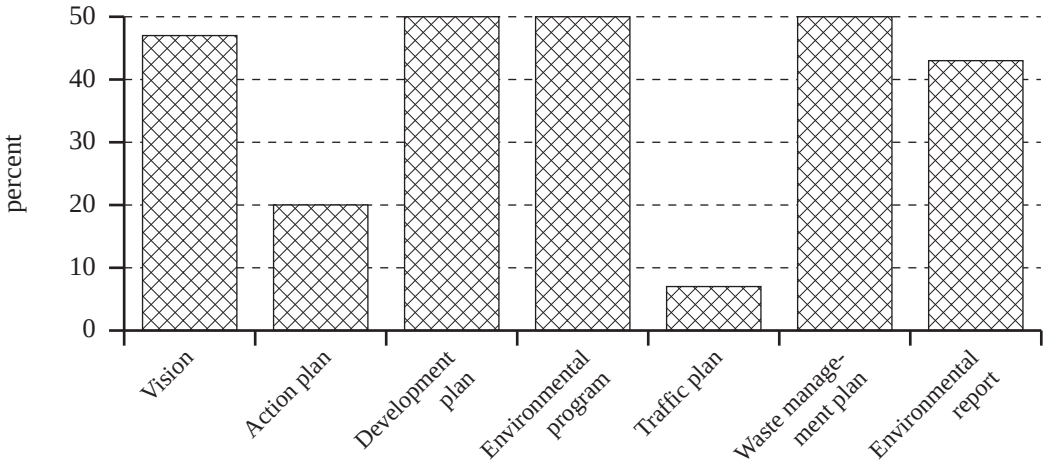

Figure 3: Existing documents of the examined municipalities (our own composition)

Conclusions

Firstly we can say that local sustainable development is not treated according to its importance in Hungary. Although the slogans of (local) sustainable development have partly been built into central government materials, as there is no international pressure and there is no social pressure for local sustainable development strategies, the issue has been reduced in priority. The national sustainable development strategy was elaborated late, the legal background of local sustainability is not set and no financial resources are provided directly for that. There are only a few manuals, guides and case studies about local sustainable development.

Secondly, community leaders are not committed to sustainability. Many municipalities have documents which could form the basis of a local sustainable development strategy, but as the number of environmental experts employed by local governments is small, external experts are needed.

Thirdly, democratic traditions are weak in Hungary and social capital does not reach the level which is necessary for bottom-up initiatives. People are difficult to mobilise. There are few civil organisations and environmental groups are weak. Environmental interests usually fall behind economic ones.

Taking all this into account it is not surprising that there are only a few local governments where some leaders or prestigious citizens are committed to sustainability which have initiatives related to sustainability.

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