Prevalence of the application of integrated pest control and integrated production techniques in fruit (apple) production in Hungary

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SUMMARY FINDINGS, CONCLUSIONS, RECOMMENDATIONS

The introduction of integrated crop protection and integrated fruit (apple) production technologies in commercial production and its development into a marketing strategy are indispensable if the risks relating to chemical residues are to be mitigated. In the framework of the 6th Network of Excellence programme we reviewed the conditions of the introduction of the technologies and the role of retail chains in seven countries. The methods used in the study included questionnaire survey and the conducting and evaluating of semi-structured expert interviews. The components of consumer behaviour were studied on a sample of 328 customers (of a hypermarket and a supermarket), in expert interviews with employees of two retail chains in charge of purchasing goods, with 6 fruit (apple) suppliers (3 wholesalers and 3 POs), as well as 11 fruit growers. Domestic and international experience was compared and evaluated in the course of the research.

USE OF CROP PROTECTION CHEMICALS AND ITS IMPACTS

No accurate statistics are available concerning the amounts and value of the crop protection chemicals used in fruit production in Hungary. According to *Pálmai (2005)* the amount of crop protection chemicals (insecticides, fungicides and herbicides) used in Hungary varied between 7.8-10 kg/ha during the period between 1975 and 1990 and it was 10 kg/ha in 1990. The quantity of chemicals used dropped dramatically between 1990 and 2001, to 2.1 kg/ha. One important consideration from the aspect of evaluating the decrease in the quantities of chemicals used is that the crop protection technology and the range of the chemicals used changed significantly during the period concerned (the quantity required to be used per hectare diminished). The fundamental changes in the Hungarian agricultural sector, in ownership structure and in the structure of production, along with the constant shortage of farmers' income also contributed to the decrease of the amounts of chemicals used. On the basis of the average figures for 1991-1995 and for 2004-2008 the value of crop protection chemicals used increased to 501.3%. Within this overall increase the amount spent on fungicides, insecticides, herbicides and other crop protection chemicals increased to 610.9%, 566.3%, 426.9% and 1018.8%, respectively. The bulk of the increase resulted from the increase in the prices of chemicals. The relative percentages of the amounts spent on the different categories of chemicals also changed significantly, as the ratio of herbicides decreased, while that of fungicides, insecticides and other chemicals increased. The volume index of chemical use (*CSO, 2006*) dropped to 95.5% by 2006 in comparison to 1990, reflecting that the quantity of chemicals used remained practically unchanged. Over time, the quantity of chemicals used can be plotted on a U-shaped curve, with the lowest in 1997 when the volume index was below even as low as 40%.

Only indirect data (*from the CSO*) are available concerning chemicals used in fruit production are available with regard to the size and proportion of land where chemicals were applied (by economic organisations). The average fruit growing area managed by economic organisations – as a percentage of the period between 2005 and 2007 – was 26.975 hectares, 74.5% of which was treated with insecticides and acaricides, 78.2% was treated with fungicides and bactericides, 48.9% with herbicides, 2% with soil disinfectants and 14.8% was subject to treatment by other crop protection chemicals. Accordingly, the quantity of crop protection chemicals used in agriculture as a whole and in fruit production in particular, has not increased but rather stagnated at the 1990 level during the recent two decades.

A more accurate picture can be formed of the risks of the use of crop protection chemicals from data originating from official checks of fresh fruits and vegetables (*Vásárhelyi, 2009*). The proportions of the samples below and over the limit values showed a different trend before and after Hungary's EU accession. The proportion of samples containing crop protection chemical residues over the limit value and those of chemicals not permitted increased from the 2.4% observed in 1998 to 12.8% by 2002 and then it dropped to 1.6% by 2006. The proportion of samples containing chemicals below the permitted level decreased from 50.8% in 1998 to 27% in 2002 and than it went up to 41.9% by 2006. The corresponding ratios in imported fruits and vegetables were as follows: the proportion of samples containing chemicals over the limit value and those containing prohibited chemicals was 0.6% in 1998, 0.5% in 2002 and 3.4% in 2006. The ratios of imported samples containing chemical residues below the respective limit values were 46.4%, 5.2% and 71.6% in 1998, 2002 and 2006, respectively. On the whole, at the end of the period under review domestic produce fared better than did imported produce in terms of both chemical residues over and those below the relevant limit values. No chemical residues were found in 58.1% of the domestic tested samples, in contrast to the mere 27.1% in imported fruits and vegetables.

Intensive, industrialised farming entailed production in monoculture which lead to the proliferation of pests, weeds and diseases as a consequence of which chemical crop protection became a dominant element among the farming techniques. The most important among the first pesticides that came to be widely applied – as early as in the 1940s – was DDT, along with other related substances, one of the most notorious persistent (slowly degrading) organic pollutant (POP). Attention was first drawn to problems entailed by slowly decomposing substances and to the consequences of this property was drawn by *Carson (1962)* who pointed out that such slowly degrading compounds accumulate in certain living tissues (bioaccumulation) and its amounts build up along the food chain (biomagnification). These mechanisms of action entail risks to human health and to the natural environment (*Székács – Darvas, 2009*) by affecting employees working with chemicals, along with food consumers (through contaminating soil, drinking water and foodstuffs) as well as the flora and fauna (resistance building up, and bio-diversity declining). *Székács – Darvas (2009)* reported that the previously used DDT had and the current weed control practices applied in the production of maize and cereals are having the worst impacts, causing soil contamination. Some of the chemicals in use (atrazine and triazine) are washed into the soil and, dissolved in groundwater, behave like slowly degrading compounds for lack of oxygen. *Székács – Darvas (2009)* found, in their research conducted between 2006 and 2008, DDT/DDE residues in 50% of the tested soil samples, atrazine (herbicide used to be applied in maize, no longer permitted) in 20-30%, lindane (active agent prohibited in 2000) in 5-15% and trifluraline in 10-40% of the samples. Some of the chemicals applied by farmers end up in surface waters and in groundwater. Research conducted by *Székács – Darvas* between 1994 and 2000 identified chemical residues, primarily atrazine and acetochlor (weed killers for maize) and diazinone in 5-50% of the tested surface water samples. Some 60% of the samples tested between 2000 and 2004 contained active agents in detectable quantities. According to tests on raw drinking water in 1998 the atrazine, diazinone and prometryne contamination of the samples exceeded the maximum residue limit (MRL) set by the European Union (*Kárpáti et al., 1998*). Part of the active agent residues (soil, water, food) is detoxified in and is excreted from live organisms, but part of them accumulate, primarily in the fat tissues, in the mammary glands and in the bone marrow (*Darvas, 2006*). Chemical residues accumulated in the mammary glands are excreted from the body in the mother's milk. OETI (National Institute for Food and Nutrition Science) studies (*Griff et al., 2007*) show that samples of mothers' milk still contain significant amounts of DDT. These substances have adverse impacts on wildlife, particularly among peak predators (as proven by the substantial decrease in the number of predatory birds during the 70s and 80s). In mammals, including humans, chemical residues may cause DNA deformations. *Székács – Darvas (2009)* reported that as many as 9 mutagenic active agents were still available in the market in Hungary in 2009. Another major human health risk lies in the carcinogenic impact of these substances (*Ames et al., 1973*). Those handling crop protection chemicals (those working in facilities in which such chemicals are stored, those mixing the chemicals for spraying, those not following the rules on spraying) are most exposed to the risk entailed by the carcinogenic effects of such substances. Other human health risks include teratogenic effects (resulting in distortions such as cleft palate, cleft lip, open spine; *Darvas, 2006*), sex hormone (oestrogen, testosterone) disorders (*Colborn et al., 1996*), other health risks and weakened immune system, such as allergy (*Institóris – Dési, 2006*), as well as postnatal health risks, e.g. the frequency of premature births and infant diseases (*Repetto – Baliga, 1996*).

THE BACKGROUND AND METHODS OF THE RESEARCH

The research project took place in the framework of the No. 6 Network of Excellence frame programme and the European Network for Durable Exploitation of Crop Protection Strategies programme (No. 3.5 sub-programme: Societal Assessment of Current and Novel Low Input Crop Protection Strategies), between 2007 and 2010. Possibilities of integrated crop protection and integrated production in apple production were studied in the framework of the sub-programme with the involvement of six countries (Switzerland, France, the Netherlands, the United Kingdom, Hungary and Poland). Five main elements affecting the spreading of integrated production were studied in the framework of the sub-programme public politics, research and consultancy (advisory) services, farmers' cooperation, the development of marketing strategies and the role and impacts of civil society organisations (Table 1). The Marketing Institute studied the impacts of the development of marketing strategies and those of retail chains playing a dominant role in the supply chain.

The following methods were used in our studies:

• Face to face questionnaire-based consumer behaviour surveys (in 1 hypermarket and in 1 supermarket):

➢ 161 customers interviewed in hypermarket;

➢ 167 customers interviewed in supermarket.

• Semi-structured expert interviews with retail and wholesale procurement employee:

➢ Expert interviews with employees of 2 retail chains in charge of fruit and vegetable procurement (1 international hypermarket chain and 1 domestic supermarket chain);

➢ Semi-structured interviews with representatives of 6 undertakings participating in the distribution of apples, supplying the two retail chains (3 wholesalers of fruits and vegetables and 3 producers' sales organisations (POs)).

Table 1

Impacts of factors affecting the spreading of integrated apple production in the participating countries

	Apple CH	Apple F	Apple NL	UK
The role of the procedure	Strong: ecological regulations for direct payments	It is likely to grow stronger on the national and local level (e.g. in the case of catchment areas)	Pesticide action plan 1991 and 2001	UK Pesticide strategy 2006
Involvement of research	Strong in the first phase	In experiment sites (research projects in IP fruit production)	Strong in the preparation of the pesticide action plan, thereafter: weakening	Strong in the Pesticide Safety Directorate
Collective dynamics among farmers	Strong, particularly in the initial stages	Market driven (producers' marketing groups)	Market driven (cooperatives) + study groups	-
Integration in marketing strategy	Not successful	Supermarket schemes	MRL requirements on the part of retail trade	Supermarket schemes
Civil society involvement	Strong: the community's responsibility for agriculture and the environment	Low, except for CSA schemes	Owing to MRL activities and NGOs it is on the increase towards supermarkets	On the increase (PAN activities)

Source: Lamine et al., 2009

- Semi-structured interviews with 11 fruit and vegetable farms.

➢ Of the 11 fruit producing farms (of over 20 hectares used for fruit production) 5 units were limited liability companies (Kft.-s), 3 family farms, 2 cooperatives and 1 private shareholding company (Zrt.).

➢ The sample included units operating in every fruit growing regions: North Great Plain, North Hungary, South Great Plain, West Transdanubia and Central Hungary.

➢ The average apple growing area (productive and unproductive) was 52.2 hectares (varying between 10 hectares and 120 hectares).

➢ Most producers have long years of agricultural experience and with secondary or tertiary qualifications.

➢ Every fruit growing farm had at least one full-time or part-time employee with tertiary qualification in crop protection.

➢ Half of the fruit growing farms were established before 1996, the other half were established thereafter.

➢ 6 farms were established in the course of the 'compensation process', 4 units were established by transforming socialist cooperatives and one was founded after the privatisation of a socialist state farm.

The following main findings and conclusions were drawn from the interviews.

The main findings and conclusions drawn from the interviews conducted with retailers and wholesalers of fruits and vegetables and with the POs participating in the distribution of apples:

Those drawn from interviews conducted with retail chains.

Fresh fruits and vegetables account for 2-3% of the sales of both forms of retailers however, there are major differences in terms of the width and depth of the available product ranges. In the hypermarket a total of 250 different fruit product, including 30 different apple 'stock keeping unit's' were available, while the corresponding figures in the supermarket were 75 and 12, respectively. Neither of the retail chains had retail brand of apples and producer branding was not typically applied either.

Most of the apples sold by the hypermarket originated from conventional intensive production, with some eco-apples as a niche market product (less than 1%). The supermarket chain sold only apples produced by the conventional intensive technique. No specific marking or branding of apples from integrated production was observed in either retail chain (though there must have been at least some apple originating from such technologies in their respective product ranges).

Both retail chains were selling a similar number and range of varieties: in the hypermarket the main varieties were Idared, Golden Delicious, Starking, Granny Smith, while in the supermarket chain they were Idared, Jonagold, Golden Delicious, Starking and Summered. The proportion of imported apples differed significantly in the two chains, with 10-12% imported apples in the hypermarket chain (primarily Granny Smith) and 2-3% in the supermarket chain. These figures apply only to direct imports but no accurate data were available concerning indirect import (through wholesalers).

Both retail chains rely on multiple suppliers: the hypermarket chain suppliers deliver predominantly to a central warehouse, in the case of the supermarket chain (multiple regions) deliveries are made to the region's C+C stores or directly to the shops. The hypermarket chain is supplied by an average of 5-8 suppliers, while in the case of the supermarket chain there are some 2-3 suppliers per region (a total of 16-18). Relationship with suppliers is arranged predominantly on the basis of annual frame contracts.

Neither of the retail chains prescribes regulations concerning integrated apple production for its suppliers. Other branded apples are not typically sold either. Neither chain is planning to start selling branded apples from integrated production or to introduce such a supplier quality and safety management system. In selecting suppliers and in determining the quality requirements to be met both retail chins apply and require compliance with the provisions contained in the *Codex Alimentarius Hungaricus* concerning apples, i.e. they apply no additional requirements or special quality assurance systems. The requirements to be met by suppliers apply – besides those pertaining to quality – primarily to quantity, the range of different varieties, terms of delivery and payment as well as packaging. In the case of the hypermarket chain there is a higher minimum quantity requirement owing to deliveries to be made to the central warehouse, while in the supermarket chain smaller suppliers are also accepted.

The quality of the apples delivered to the retail chains is checked primarily by way of a visual inspection in the case of both forms of chains. Chemical residue testing is carried out for the most part by the suppliers, the wholesalers, the POs and the large producer farms. Official tests are also carried out but those are performed on an ex-post basis and primarily for the purpose of sanctioning if necessary.

The main findings and conclusions drawn from the interviews conducted with the supplier producer organisations (Pos).

Most of the apple supplier POs were producer organisations accredited temporarily or permanently between 2000 and 2003.Their average annual sales revenue amounted to HUF 2.75 billion but their sizes varied between wide extremes (0.25–7.4 billion HUF/year). Apples accounted for an average of 6.8% of their total sales revenue, varying between 4.8% and 70%. The number of apple growers (own members and the major non-member suppliers) varied between 25 and 90 farms (28 on an average).

The average refrigerated storage capacity of the POs concerned was 1800 tonnes partly ULO capacities, partly refrigerated storage facilities with temperature controlled storage space. Every PO had its Global-GAP (2005-2009) quality assurance system in place. The POs were selling a relatively broad range of apple varieties, the most important ones included: Idared, Jonagold, Jonathan and Golden Delicious, supplemented by smaller quantities of Mutsu, Gala, Granny Smith, Breaburn and Golden Reiders apples.

The role of the sales channels: Only one PO was exporting apples directly (Romania/Auchan) and indirectly (Germany, Scandinavia) in significant quantities. The most important domestic sales channels included the following retail chains: Tesco, Cora, Auchan, Spar, Match, Lidl, Penny, Profi, CBA, Coop Hungary and Reál Hungária. One PO was selling apples in larger amounts directly, primarily through what is known as 'pick it yourself' (15-20%).

Only one PO was engaged in material apple branding activities: its export brand name is HAVITA, in the domestic market its name is *Demecser Alma*. It is authorised to use the Excellent Hungarian Food (apples) trade mark. The POs have adequate knowledge of integrated apple production, one of them played something of a pioneering role in introducing this technology in Hungary. None of the POs have made attempts to develop branding and marking activities relating to 'integrated apples'.

The key findings and conclusions drawn from interviews with apple growers:

The main changes that have occurred in apple production technologies are summed up below.

Many apple growers planted apple trees in relatively large areas between 1996 and

2000. The predominant shape was cordon (4.0 x 1.5 m) or slim spindle (4 x 3 m). New plantations used only low growth, primarily M9 and M26 stocks. In new plantations the growers used predominantly varieties that are less sensitive to diseases, Jonathan has been practically dropped from the range of varieties used. The main varieties planted by growers included: Idared, Jonagold, Gala, Granny Smith, Mutsu and Fuji. All of the new plantations are fully equipped with drip irrigation technologies, while in some of the older plantations conventional irrigation was also still in use.

The majority of the apple farms in the sample (with the exception of two units) have refrigerated storage capacities, partly with controlled temperature storage space, partly based on the ULO technology. Most (72.9%) of the apple farms have machinery and technology for sorting and packaging the produce.

All of the farms comprised in the sample had adopted the integrated crop protection and/or integrated apple growing technologies. Some of them had been using such technologies ever since 1996. Later on they continued integrated apple production in the framework of the Agricultural and Rural Development Operative Programme (ARDOP) (2004-2009).

Description of the crop protection technologies applied in apple production.

The process of the spreading of what is referred to as integrated pest control or the integrated apple production technology is comprised of two main phases. An integrated crop protection research programme was conducted by the Fruit Production Research Institute of Újfehértó between 1992 and 1994 in the framework of an international cooperation programme. According to the interviewees state subsidies played a dominant role in spreading the technology. In the first phase, from 1996 on plantations suitable for integrated production were provided an extra subsidy (of 5%) in the system of subsidies for new plantations. In the framework of the agricultural environmental management target programme of the ARDOP the farms that had adopted integrated apple production technologies were provided with an extra amount in the form of area payment (99 000 HUF/ha).

The representatives of the apple farms comprised in the sample stated unanimously that neither retail chains and fruit and vegetable wholesalers, nor the POs played any role in the spreading of integrated apple production. The process was not significantly affected by the behaviour of those purchasing apples or of consumers, or by the impacts of their behaviour either. On the whole, the spreading of the integrated apple production technologies was a predominantly supply side process, driven by a subsidy-oriented push strategy.

The apple producers comprised in the sample said that the risks of chemical use are rarely discussed by stakeholders in public forums, some debates have taken place in the press and in the electronic media primarily about chemical contaminations exceeding the applicable limits that have been identified in the course of tests carried out by the authorities. Scientific exchanges and debates of the topic are also rare and, according to the interviews, it is usually fully neglected in official forums and technical/professional conferences. The majority of the interviewees had information on the natural, environmental, human health (consumers and agricultural workers) risks entailed by chemical use. They held that some 15-20% of fruit producers may be considered to be interested enough in and to have information of adequate depth concerning the topic.

The apple producers were members of the *Apple Product Council* (which has dissolved in the meantime) and of *Fruitweb* (Hungarian Organisation and Product council of Vegetables and Fruits), but they considered that the role played by these organisations in spreading the integrated apple production technology to be hardly more than marginal.

All of the apple producers were dissatisfied with the domestic advisory/consultancy system, including crop protection advisory/consultancy. They also argued that this was the reason for the fact that nearly a third of the trees planted between 1996 and 2000 have had to be culled and that a relatively high proportion of the farms (20%, according to the interviews) have had change the shapes of their apple trees. They rated the roles played by research institutions and universities in the framework of crop protection consultancy and the chamber of agriculture performing an advisory function to be 'negligible'. Companies engaged in distributing chemicals carried out the most intensive crop protection advisory activities but farmers do not consider these to be unbiased. The only apple producers that were relatively satisfied with the advisory services they had been provided with were those that had foreign (2 Austrian, 1 Dutch and 1 Italian) advisors in the framework of crop protection advisory services. The role played by the Crop Protection and Soil Health Stations was also considered to have been deteriorating since they have been assigned a primarily official controlling function.

They considered the operation of the meteorology stations and the crop protection forecasts to be crucial for integrated apple production, enabling the application of pest-specific crop protection solutions adapted to the plantations. A total of 63.6% of the apple farms had their own meteorology stations. The system of crop protection forecasts was considered to be relatively poor.

The representatives of the apple producing farms considered the following to be among the main problems of integrated apple production: the range of permitted chemicals is being narrowed without regard to domestic features of production (varieties, climate, technologies), shortcomings in crop protection forecasts, the risks of infection in neglected fruit growing areas, growing weather-induced risks, growing resistance in pests, chemicals' quality problems and high chemical prices. The following crop protection-related problems were mentioned most frequently: the difficulties of protection against apple scab (*Venturia inaequalis*) fire blight (*Erwinia amylovora*), mites and codling moth (*Cydia pomonella). Apple farms in different production regions are facing substantially different sets of problems in crop protection.*

The interviewed representatives of apple farms considered that the quantity of crop protection chemicals used in Hungary is some 25-30% lower than the quantities used by apple producers in the main apple producing countries in West Europe. Some 35.4% of producers considered that during the past 10 years they managed to reduce the amounts of chemicals used, while 63.6 of the respondents considered that the amount of chemicals used either stagnated or increased somewhat. The saw or see primarily the following possibilities for reducing the quantities of chemicals used: continued improvement of the spraying technologies (up-to-date machinery), development of the crop protection forecasting system, spreading pest/disease-specific crop protection approaches, improving the knowledge of apple growers (training, extension training) and considerable improvements in the advisory services. A total of 45.5% of the farms (mainly the larger apple growing farms) themselves had their produce tested for chemical residues after harvest.

Despite the fact that the domestic retail chains do not require that producers should have special quality assurance systems, 54.5% of the apple producers had private Eurep-GAP/Global-GAP quality assurance systems. They consider the accreditation of the Global-GAP quality assurance system to be too expensive and they recognise that it is of importance for exporters (1 farm even decided not to have its accreditation renewed). The other apple producers (45.5%) had HACCP or ISO-9001 quality certification systems.

The roles of the sales channels and the channel relationships in apple sales.

The apple growing farms participating in the interviews used the produce for the following purposes: processing (owing to its apple production experiments one farm had a high – 40-50% – proportion of apples fit for processing only), selling on the local market ('pick it yourself', local retailers) 8-10%, retail chains 10-15%, wholesalers and POs 50-60%. 27.3% of the producers sell their produce only to wholesalers, 9.1% of them only to POs. The proportion of apples sold directly to retail chains is diminishing. The most important retail chains include: Metro, Cora, Match, Lidl, Coop Hungary and Reál Hungária. Only 36.4% of the apple growing farms are PO members, but only two of them sell the largest part of their produce through the POs. The apple growers that do not have their own storage, sorting and packaging capacities sell their produce in bulk (usually in large plastic containers).

The interviewees made no mention of any technical/professional training or advisory activities (concerning production, crop protection or post harvest technologies) on the part of the main buyers (wholesalers, retail chains and the POs).

The relationships with fruit and vegetable retailers and wholesalers are usually organised in the forms of oral agreements for the given season, concrete transactions and orders arte laid out in writing. The quality parameters applying to apples are based predominantly on the norms contained for apples in the Codex Alimentarius Hungaricus. Little information flows from buyers to producers and this applies to both market and to technical/professional information. The monitoring system is functioning for the most part in a paper-based form.

The apple growers comprised in the sample tended to have a negative view of the POs, using these as a sales channel only to a minor extent. They said that the POs are more important for smaller apple producer units without their own storage, sorting and packaging capacities. The views formed of the POs were heavily affected by the fact that they failed to live up to the expectations for strengthening the in the producers' bargaining position against retail chains. This was, to a large extent, a consequence of the POs' poor marketing activities and shortage of experts. As a combined result of the previous situation and the weight of the grey and black economy in the market of fresh fruits and vegetables during recent years the POs have been offering deteriorating price and payment conditions for members and suppliers.

To sum up the conclusions drawn from the interviews.

Public policies and agricultural policy have played a major role in the introduction and spreading integrated apple production technologies. The integrated fruit production research activities performed by the Fruit Production Research Institute of Újfehértó between 1992 and 1994 in the framework of an international cooperation programme. According to the interviews the Crop Protection Department of the then Ministry of Agriculture and the positive attitude and international experience of the Crop Protection and Soil Health Service played a major role in disseminating information concerning the technology. The key roles in the spreading of the technology was played by the system of subsidies for new apple plantations (+5%), and the operational subsidies under the ARDOP. By contrast, state organisations played no positive and initiative roles in creating the effective conditions and requisites for the efficient implementation of the technology.

The role played by research and advisory services in the introduction and effective application of the technology was rated very poor by the interviewees. Apart for research between 1992 and 1994 crop protection research projects had to be executed with very small budgets, thus they could not provide adequate support to apple producers' technological adaptation. The interviewees held that the (production and crop protection) advisory background had been extremely weak so it could not provide adequate assistance to the spreading of the technology. No advisory services can be operated effectively without an adequate research background.

Mention should be made of the role played by the more innovative apple producers, who started to build up the technological requisites for integrated apple production during the period when subsidies were given to new plantations. From among the larger apple producing farms the ones with more resources for development and ample financial resources had access to the plantation subsidies and later on to the operational subsidies for integrated apple production. The majority of the farms that had adopted integrated apple production technologies had better than the average human resources (agronomists and crop protection engineers with tertiary qualifications). In medium-sized and small farms, without the necessary human resources integrated apple production technologies cannot be introduced without effective state assistance (in the form of relevant research activities, training, extension training, advisory services).

The farms applying the integrated apple production technology could not convert their technological advantage into competitive advantage in the domestic or in the export markets. The farms that had participated in the first research programme tried to develop a marketing strategy for apples from integrated production. The Agricultural Marketing Centre provided even financial assistance to the Guaranteed Healthy Apples Programme and the trade mark programme. The initial sales attempts quickly failed. The many reasons for the failure included the organisational uncertainties caused by the parallel processes of compensation, privatisation and cooperative transformations, the lack of such strategies and demand on the part of the international retail chains which entered and spread in the domestic market at that time, along with the lack of financial and marketing resources. The last decade saw only some feeble attempts at developing and implementing such marketing programmes, again primarily for the lack of cooperation among producers and the shortage of their financial assets.

The interviewees said that civil society organisations played little role and showed little signs of intent to participate in spreading integrated apple production technologies. The trade/professional organisations failed to pay adequate attention to this area and the environmental and consumer protection groups also failed to play any major role. The press and the electronic media made the main contributions to the process predominantly by exaggerating crop protection risks but that debate did not take place in scientific forums.

Significant differences were found between the practices applied in European countries (United Kingdom, France, the Netherlands and Switzerland) and those applied in Hungary. The National Rural Development Plan's ARDOP programme played a major role in the launching of the integrated crop protection and integrated fruit production programmes in Hungary. The process has been driven primarily by producers laying emphasis on technology development, while market demand has played only a marginal role. Research and advisory services have also made very little contribution to triggering the processes and to the implementation of development, which caused serious efficiency problems as well. Civil society organisations and producer organisations have not been playing significant roles so far either. Corporate (producer) branding attempts in connection with integrated crop production have been occasional so far and most of them have failed. So far the attitude of domestic and international retail chains has not encouraged the spreading of the new technologies. On the whole, the spreading of integrated crop protection and integrated crop production technologies in Hungary is fundamentally production oriented and has taken place mostly on the basis of a push strategy comprising development programmes and aid schemes.

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