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POSSIBILITIES TO REDUCE ENVIRONMENTAL HAZARDS WITH SPECIAL RESPECT TO PESTICIDE USE

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THE reduction of the load on environment is one of the most important challenges for the economy. Farms are required both to be economical and meet the social expectations to reduce chemical use. We have examined the processes on the basis of European and Hungarian data. During the research, we were seeking the answers to the questions: what alternatives may farmers choose, what is the impact of pesticide ban or reduction of their size, and activities. We have stated that chemical free farming is able to provide the same level of profit in case of favorable market conditions, increased subsidies, and precision farming may play also an important role.

Key Words: Load on Environment, Farming Strategies, Operability.

Introduction

Starting from the middle of the 20th Century, the replacement of natural and human resources (labour) in the agriculture with industrial means and expenses has been extremely accelerated in the so-called "mechanization and chemicalisation" process. The new technologies and farming systems were based on intensive industrial means and input use. The impetus of this process was the aim to increase average yield. This objective is justified and necessary up to a certain level, because the subsistence and food supply of the growing population on Earth cannot be imagined without modern varieties and certain new technologies for improving labour efficiency.

Objectives

The objective of this paper was to summarize the main risk elements of chemical use in plant production regarding to chemical use and to evaluate the economic consequences of alternative technologies at the same time. The main focus was the use of fertilizers and pesticides, to determine the level of chemical use in Hungary comparing it to European data.

Based on Hungarian data earlier we examined the changes in calculated profits caused by changes in chemical use, its impact on the viable farming size, and production structure. We intended to develop a LP model which made it possible to examine the farm level profits while modeling the production structure (simulation). In our model we also sought answer to the question of what output reduction is acceptable to maintain the farm level gross margin while reducing the costs of chemicals at the level of plant production compared to conventional farming. This assumption is based on the fact that farmers would like to know if they can sustain the former level of profits before changing farming strategies, and what circumstances are required.

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Material and Methods

Based on international and domestic literature we summarized the economical aspects of sustainability, the possible farming strategies of reducing chemical use and environmental hazards and investigated the intensitiy of agriculture – plant production – in Hungary. To understand the special – dichotomy – role of plant protection, first it is necessary to deal a little bit with the production functions.

The role of plant protection could be considered as not only a resource of plant production, but mainly it decreases the uncertainty – risk – of harmful organisms, it promotes the effectiveness of other resources (like fertilizers, species, irrigation etc.) Finally it could insure the expected yield – other way – the profit.

$$Y=f(x_1,\dots,x_n;x_{n+1},\dots,x_k;x_{k+1},\dots,x_m)$$

The value of the decision variable (x_1, x_2,...,x_n) could be chosen by the decision maker (fertilizer, seed, some kind of pesticides). The value of predetermined variables (x_{n+1}, x_{n+2},...,x_k) is known when we make the decision, but we do not modify them, the decision maker should comply with them (water capacity of soil). The uncertain variables are unknown during the decision (x_{k+1} x_{k+2},...x_m), could not be changed (the dynamism of predetermined variables, degradation of harmful organisms, parameters of weather) the negative effect on yield – on the profitability of production – is lower when we could decrease the role of uncertain variables. This reflects in the frequent preventive treatments.

If we got use the threshold value to make a decision on plant protection and we choose the possible alternatives by an economical decision criterion we have to calculate its effects on farm level. [Takács-György, 2005]

Sustainability

The new paradigm of agricultural research and development is based on the interaction of three factors: ecological sustainability, equal chances together with economic efficiency, and the mutual assistance of governmental and non-governmental sectors in order to improve the performance and profitability of farming systems. This paradigm was the basis of the sustainable agriculture of the 1990s and the decades after.

Today the main requirement on farming is that it should be economical and environmentally sound, adapted to ecological and economic conditions. It is an objective all over the world to implement farming that is sustainable in the long term. The concept of sustainable farming has more definitions.

The principle is the environmental adaptation, which means that the land is used for the most suitable purposes, with the most suitable intensity which can be implemented without any damage. Sustainable land and forest farming, production-servicing activity means that the economic aim is in harmony with the regeneration of natural resources and assimilation ability of loaded environment. The farmer uses quality materials, means and technologies which do not damage natural resources, the farmer himself and the end-product consumers. The reduced chemical use, modern techniques and technologies result in high quality. [Jørgensen, 2000; Bongiovanni and Lowengerg-DeBoer, 2004]

The protection of natural resources and food safety presumes and enforces each other in sustainable agricultural and rural development. Efficient farm production in environmentally less vulnerable areas with good agro-ecological conditions should involve resource-saving, professional and controlled production technologies which help to achieve the basic objectives of environmentally safe agricultural farming.

More important task is to find the appropriate degree of intensity and form of farming regarding environment. The balance between profitability, environmental protection and social requirements should be found. The environment needs the conservation and improvement of natural resources and surroundings, while economy requires the efficient supply of material sources. As regards society, equal rights should be ensured and maintained.

Environmental Risks in Crop Production

A lot of risk factors should be considered in crop production which significantly affect the quantity and quality of yield and the realisable income. Basic risk elements are the production risks including natural factors (weather, insects and pests). This group of risks can be evaluated differently in each production technology. Traditional farming has quite a few (chemical) means to eliminate pests-insects, while chemical-free farming gives priority to prevention and indirect elements. [Brethour – Weersink, 2001; Ørum et al., 2002]

In addition to farming risks, the market risks cannot be neglected especially due to the uncertainty of market prices (resource and product prices).

The role and effect of technological risk is smaller compared to the above, still it can be significant. The risks of not complying with production technology should also be mentioned, such as risks on environment, fertilizing, irrigation and soil cultivation.

Load on Environment

In order to ensure the safety of food supply, the intensity of agricultural production has been increased all over the world in the late 20th century, partly because of the economic race, partly to meet the demands of growing population [Láng, 2003.] Large-scale farming broke with former traditions and experiences and moved to a uniformed, well-mechanised and chemical-oriented production. Technological changes were made in order to meet the demands. Mass production required the use of more and more chemicals (fertilizers and pesticides) and the development, "industrialization" of agriculture was permanent. During this period, the fertilizer use sky-rocketed in Hungary, then gradually decreased from the middle of the 1980s (Figure 1). In the same period, a slow increase could be seen in Hungary by today.

In international comparison it can be stated that both Hungarian fertilizer use is low, acceptable regarding environmental load, because in the early 2000s the NPK use per one hectare of field and plantation was 60-70 kg, while OECD average was above 110 kg/ha or even higher in some countries (Belgium, Ireland). (Table 1)

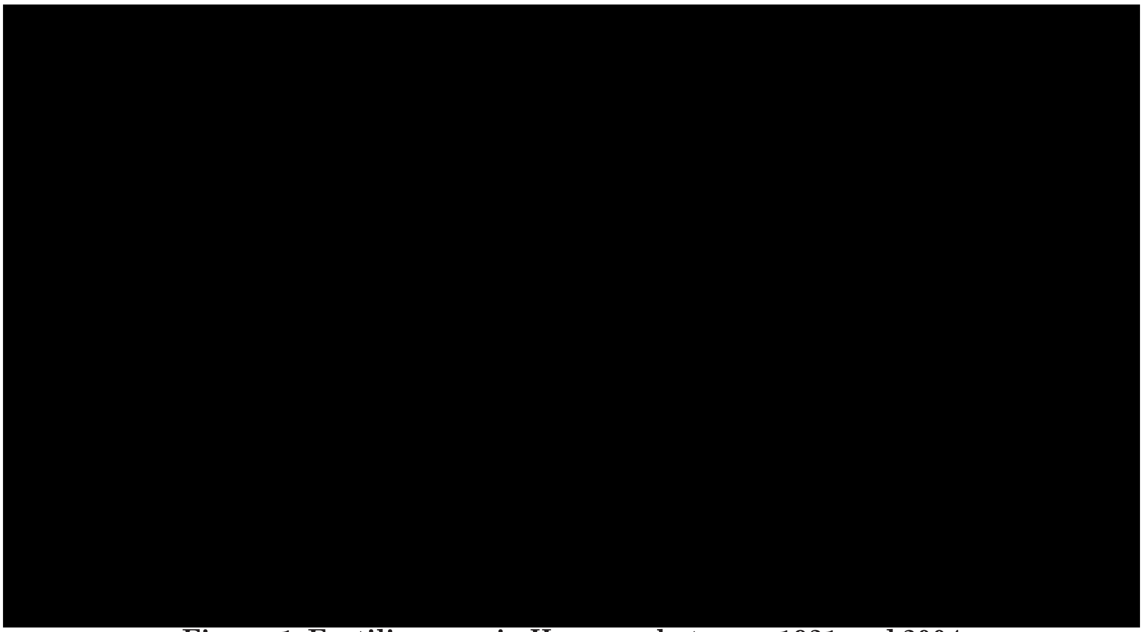

Figure 1: Fertilizer use in Hungary between 1931 and 2004.

Source: Year-Books of KSH (HCSO), Budapest, 2005. p.171.

Table 1: NPK-Fertilizer use per one hectare of Field and Plantation (kg/ha)

Countries/Year	1980	1990	1995	2000	2001
Australia	25,8	24,3	40,3	45,0	48,7
Canada	48,1	50,1	62,4	59,4	58,1
Hungary	262,4	128,6	73,2	86,8	67,3
Mexico	50,5	69,4	47,1	67,1	68,5
Slovakia	387,1	308,5	66,9	75,0	76,1
Portugal	82,4	88,8	84,1	88,6	92,2
Poland	231,3	146,2	103,8	109,5	107,8
USA	112,7	99,0	108,8	105,1	110,7
OECD	129,2	116,8	114,2	111,2	112,7
Germany	412,6	269,9	233,9	228,2	217,3
Japan	332,5	350,6	325,7	300,7	280,3
Belgium	596,5	494,2	354,4	328,1	337,2
Ireland	552,3	893,3	822,0	555,5	531,0
New-Zealand	1024,7	832,8	1513,5	1562,9	1665,1

Source: Environmental Indices of OECD Countries, 2004, KSH, Budapest. 2005. p.85

The reduction of health and environmental risks of pesticide-use and the development of sustainable pesticide use strategy is a highlighted area of EU Action Program 6 (Thematic Strategy on the Sustainable Use of Pesticides).

In Hungary, the chemical crop protection has been decreasing from the middle of the 1980s, primarily due to economic, secondarily to environmental reasons, and thirdly to the development of manufacturing and technology, because the same effect can be reached with smaller doses. Pesticide use was the highest in 1985, when 26.316 ton of chemicals was sprayed in order to protect the crop cultures. In the years following the social transition, the pesticide sales dropped and stayed on a low level with small fluctuations.

In the first half of 1990s, the total pesticide use fell, then the following years it stagnated with small fluctuations. Between 1995 and 2003 the total quantity per hectare (was between 0,9-1,4 [KSH, 2004.] In 2001, the quantity of applied pesticide was only the fourth of the quantity observed in the base year (6430 ton in 1985). The chemical agent quantity per hectare of agricultural land was the third of the level in 1985 in case of herbicides, and even less, 18-20 % in case of fungicides and pesticides.

The Hungarian pesticide use is very favourable regarding the load on environment compared to EU-15 average, because these values are a lot lower than the EU average in the last few years. (Table 2)

Large-scale agricultural production has resulted large-scale environmental damages, especially because of the excessive fertilizer and pesticide use. While the animal husbandry pollutes the environment with liquid manure and chemicals, the air pollution and soil compression of heavy machinery damages the environment, too. The wash-out of unnecessary nitrogen and phosphor fertilizer causes water pollution, the excessive or inappropriate dosage of crop protection chemicals, regulators and other fruit forcing agents are very dangerous for human health and certain varieties of agro-ecosystem. The pesticide residues were analysed in the food and fodder and caused further human and animal health problems. [Bulla, 1993]

Table 2: Fertilizer and Pesticide use in International Comparison

	Total area thousand sq. km.		Major protected areas[2] % of total area		Nitrogenous fertilisers use tonnes per sq. km. of agricultural land		Pesticides use tonnes per sq. km. of agricultural land	
Australia	7 713		18,5	b	0,2		0,01	
Austria	84		28,0		3,5		0,09	
Belgium	31		3,4		10,8	d	0,69	
Canada	9 971		8,7		2,7		0,06	
Czech Republic	79		15,8		6,8		0,10	
Denmark	43	a	11,1	a	7,6		0,11	
Finland	338		9,1		6,0		0,06	
France	549		13,3		7,5		0,27	
Germany	357		31,5		10,5		0,17	
Greece	132		5,2		3,0		0,14	
Hungary	93		8,9		6,2		0,14	
Iceland	103		9,5		0,5		0,00	
Ireland	70		1,2		8,1		0,05	
Italy	301		19,0		6,0		0,58	
Japan	378		17,0		8,8		1,24	
Korea	99		7,1		18,9		1,20	
Luxembourg	3		17,1		10,8	d	0,33	
Mexico	1 958		9,2		1,1		0,04	
Netherlands	42		18,9		14,6		0,410	
New Zealand	270		32,4		2,1		0,02	
Norway	324		6,4	c	9,6		0,08	
Poland	313		29,0		4,5		0,06	
Portugal	92		8,5		2,6		0,40	
Slovak Republic	49		25,2		3,6		0,16	
Spain	506		9,5		3,6		0,14	
Sweden	450		9,5		6,0		0,05	
Switzerland	41		28,7		3,5		0,10	
Turkey	779		4,3		3,1		0,06	
United Kingdom	245		30,1		6,8		0,20	e
United States	9 629		25,1		2,6		0,08	
G7	21 430		17,1		3,4		0,12	
OECD Europe	5 024		13,7		5,6		0,17	
EU-15	3 242		15,1		6,4		0,23	
OECD Total	35 042		16,4		2,2		0,07	

1. Figures for the latest available year; they include provisional figures and Secretariat estimates; varying definitions can limit the comparability across countries.

2. IUCN management categories I-VI and protected areas without IUCN category assignment, a. Greenland excluded, b. Great Barrier Reef Marine Park included, c. Svalbard, Jan Mayen and Bouvet islands excluded, d. Belgium and Luxembourg, e. Great Britain, f. England and Wales, g. Partial totals.

Sources: OECD Environmental Data, Compendium 2004; Environment at a Glance: OECD Environmental Indicators, 2005, StatLink: http://dx.doi.org/10.1787/278828771536, OECD in Figures - 2005 edition - ISBN 9264013059

The increased large-scale agricultural production has been polluting the environment. In 1972, the UN World Conference on Environmental Protection held in Stockholm tried to focus on the problem and put "ecological development" in the limelight for the participating countries. The use of chemical products has led to the excessive pollution of environment, changed climatic conditions and caused greenhouse effect.

Researchers have revealed that chemicals can be serious risk elements in diseases (allergy, asthma, cutaneous diseases, cancer) and weaken the effect of antibiotics against illnesses. Mankind, therefore, has great responsibility in careful application of chemicals. The Sustainable Development Strategy approved by the European Union in 2001, aimed to achieve by 2020 that only those chemicals can be produced and used which impose no serious threat to human health and natural environment. The US Food and Drug Administration estimates that the citizens of developed countries consume about 2.5 kg chemicals per year with food.

Consumers in welfare states want to have quality and safe food which is produced with minimum pollution, not imposing serious load on environment.

Soil Structure

Among environmental risks of crop production, the deterioration of soil structure should also be mentioned. It is caused by one-sided soil cultivation and lack of crop rotation. Damages by water and wind erosion are also on the list of risks. The present study does not cover these in detail.

Possibilities of reducing chemical use

One of the basic tasks of sustainable agriculture is to find and apply those technologies and processes under given ecological and social conditions which enable the maintenance of environment together with economic production. This should be the principle of farming strategies for each farm. That's why it is necessary to examine the economic effects of transition on farm level, branch level and national economy level. In recent years, many developed countries has started to research the economic consequences of pesticide use reduction, both regarding methods and implementation. On the principle of economy, the research tries to find answer for optimum chemical use, reducing the load on environment and human sphere (considering also those trends which totally reject artificial chemical use). [Takácsné; 2006]

Crop Production Technologies and Short-long Term Objectives

The selection of crop production technologies is basically determined by the short and long term objectives and company strategies. When the technologies are examined, the changes of short and long term objectives and their consequences should be measured. The short term objective, that is profit maximization, can be reached with conventional, chemical-based technology, because artificial materials can help to achieve significant yield increase in no time. Alternative possibilities, however, should also be analysed, because short term profit maximization can be against the long term, balanced and sustainable farming. As against conventional technologies, here the target to reach, in addition to profit, is the production of healthy basic and end-products, sustainable farming, the protection of environment and reduction of causeless load on environment. [Mawapanga and Debertin, 1996]

There are some farming technologies and processes which can be alternatives to large-scale crop production systems based on extensive use of chemicals. The objective of these processes is to approach the production to natural systems, to use less artificial chemicals – or totally ban the chemical use – and produce healthy and high-quality raw materials and food.

Implementation of technologies based on reduced chemical use resulted new trends in addition to conventional farming, such as

- reduction of pesticide use in general, one way of which is the use of chemicals with lasting and curative effect, thus less treatment is needed during vegetation. The reduction of agent doses also help to cut the quantity of chemicals sprayed on given area unit;

- chemical-free trends (banning the use of artificial chemicals), that is organic farming, and the total ban on chemical use for the sake of environmental safety. The area involved in ecological farming and the number of farms engaged in organic production has been constantly increasing in Hungary and in the world, too. In 2005, the area of land involved in organic production was 30.6 million hectares in the world and additional 62 million hectare was registrated for wild plant collection. In 2005, ecological production was carried oout on 6.9 million hectares in Europe that means 190000 organic farms. Out of them 6.3 million hectare and 160000 farms are within the European Union. The share of organic land from agricultural land is 3.9%. Italy has the biggest organic area and the most organic farmers, from 2004 to 2005 the ecolands in Europe grew by 510000 hectares (+8.0%), out of this the ecoland in EU grew by 490000 ha, that is by 8.5% [Willer and Yussefi, 2007]. In Hungary, the ecological farming started to develop dynamically from the middle of the 1980s until 2004, then a break came. In 2005, the area involved in organic farming was 122615 hectares following a 6000 hectare decrease, and the number of organic farms was 1353. These trends could help to reduce artificial chemical use all over the world, but it must be taken into consideration that how to produce the necessary food for all the habitants of the world. On the other side not only cases could be more effective and profitable the organic farming comparing with the conventional production. It depends on the market situation, on the exsitance of price-surplus.
- the introduction of integrated crop production systems (Integrated Pesticide Management), which can reduce the load on environment by using only the justified quantity of pesticides [Polgár, 1999];
- precision farming, which enables targeted agent spraying by spot treatment in addition to (or in place of) reducing chemicals, so it results in rational chemical use. The rational crop protection can serve the value production, production of common goods, conservation of biodiversity, and the protection of nature and the earth. This requires, however, the development of technical background (additional investment), and the maintenance of the available one, which means extra costs and cannot be automatically included in sales price. Precision fertilising has already proved its cost efficiency, while the cost reducing effect of precision crop protection has not been thoroughly analysed by researchers yet. By decreasing the number and area of treatments and selecting the dosage according to soil features, the quantity of agent sprayed can be further reduced. [Székely and Kovács, 2006; Takácsné, 2006].

Economic Effects (consequences) of Reducing Chemical use or Chemical-free Farming

There are quite a few consequences of changing the production process. Part of them can be quantified and measured, while other part cannot be defined numerically (sustainability, environmental protection, almost natural farming, etc.)

In order to explore the economic deviations of farming processes, first the changes of expenses and, as the consequence, the changes of costs have been considered. Significant difference between traditional and ecological farming is that the use of fertilizers and pesticides is not allowed in ecological farming. The soil nutrient supply should be solved with organic manure or other organic material instead of fertilizers. Crops should also be protected against pests and insects in ecological farming, but not with chemical agents.

In conventional farming, most of the material costs goes for fertilizers and crop protection chemicals. By eliminating chemicals, 20-25% of costs can be spared, but the yield change is uncertain when artificial nutrient supply and chemical crop protection is eliminated. During the intensification of agriculture the chemicals were used for yield increase, while today they are used for increasing crop safety and to prevent yield drops.

When input is changed, the yield values are changed, too. References state that 60-70% of traditional yield results can be reached with chemical-free farming. The yield losses due to chemical ban can be significantly different in the branches. [Kis, 2005]

Examining the wholesale prices, it can be seen that higher prices can be achieved with chemical-free production than conventional one. The question of premium price, however, is very complex, because there can be great differences by each product, year and area. It is true all over the world that part of the products of organic farming cannot be sold as „organic product"; they must be sold in conventional markets [Schramek – Schnaut, 2004; Offermann – Nieberg, 2000].

According to a research made in Switzerland and Norvegia, the premium price could be as high as 50-200% in late 1990s [Offermann – Nieberg, 2000.]. The 2002 data of the Central Statistical Office in Hungary (KSH) explicitly show the remarkable price differences between products made with different technologies. As regards cereals, the premium price was the greatest – almost twofold and 1,7-fold average premium – for the ecologically produced winter wheat and maize, while the price of oil crops – bio soy-bean and bio rape – was significantly (by 40%) higher than the conventional product prices [KSH, 2004]. The prices, however, have dropped very much due to the increasing competition and globalized markets. It also indicates the process of market saturation and the dynamics of demand-supply changes. The research on premium price, farm size, and demand-supply relations explore the outcomes of ecological farming in economic sense. [Takács, 2006]

The subsidies offered can be different for each form of farming or production. Comparing the subsidies, it is obvious that the subsidy of organic production can be higher by 90-125% than the grants for conventional production. The objective of this extra support is to cover the consequences of transformed farming and to motivate the farmer to sustain environmentally-friendly production processes and to produce healthy products.

The above mentioned yield changes and the differences of production and sales prices affect the results and profitability of branches. A comprehensive farm research in Germany (BMELF, 1991) revealed higher family income in ecological farms by about 12%. Schönberger examined the profitability of ecological farming in Hungarian farms and pointed out that the income per hectare in bio-sunflower branch was higher by 16% than the income of traditional large-scale production. The final result of research by Offermann – Nieberg (2000) was +/- 20% as the obtainable profit of organic farming compared to that of conventional farming.

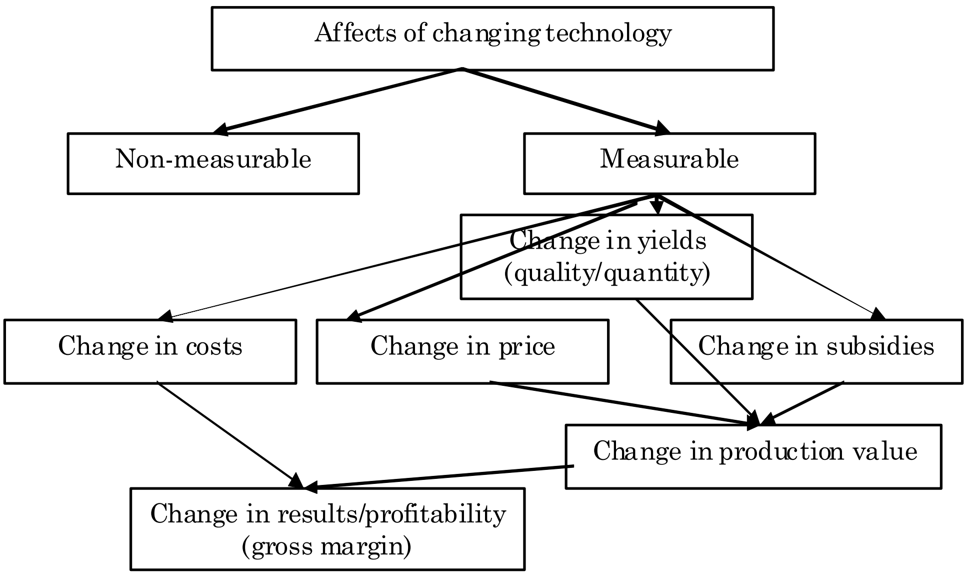

Figure 2: Effects of Changing Technology

Source: Kis, 2006.

Precision Farming

Precision farming is the land-specific regulation of all the crop production inputs (fertilizers, pesticides, lime, crop protection chemicals, sowing seed, etc.) in order to reduce losses, increase profit and conserve the quality of environment. [Kalmár, 2000]. According to Yule and Crooks (1996), the point in precision farming is that the natural inputs can be calculated exactly according to the local conditions. Therefore the profitability of production improves and the unnecessary overdosage can be avoided.

The objective of precision crop protection treatments is to apply the optimum pesticide combination and dose in the justified places. Precision crop production and crop protection enables the development of rational and reasonable chemical use. Therefore not the chemical use alone is reduced, but the "unnecessary" chemical spraying can be decreased and, at the same time, the profit of the farm can be increased [Takácsné, 2003]. When evaluating the outcomes, however, it should be considered that parallel with cost saving, some plots should be walked around and treated more times than in case of

Table 3: Economical Comparision of Alternative Strategies of Chemical Reduction

	Reduced Crop Protection Chemical Use	**Chemical-free Production**	**Precision Farming**
Obtainable yield	almost same as conventional	15-35%	almost same as conventional
Production costs	almost same as conventional	80-110% of conventional	higher due to extra investment
(Extra) Investment Need	none	none	significant
Sales price	same as conventional	possible to realize premium (0-30%)	same as conventional
Subsidy	same as conventional	special target support in addition to conventional	special target support in addition to conventional
Profitability	almost same as conventional	higher than conventional in case of premium price and subsidies	depending on the size; *in smaller farms* it is less than conventional due to the big investment need; in middle-size farms it is the same as conventional; *in bigger farms* it is higher than in case of conventional farming
Weed control	Based on herbicides	Physical, biological and agrotechnical means	Based on herbicides according to local/area (plot) features
Crop protection	Based on pesticides	Physical, biological and agrotechnical means	Based on pesticides according to local/area (plot) features
Nutrient supply	Based on fertilizers	Use of manure and organic materials	Based on fertilizers according to local/are (plot) features
Soil cultivation	Based on rotation and ploughing	Minimum soil cultivation ploughing	Based on rotation and

Source: Takács-György and Kis, 2007.

traditional farming, or only more expensive agents can help depending on the spreading of pests. Thus in some cases, precision crop protection – with the same yield level – can impose extra costs for the farm. On farm level, the extra costs (investment) of transition to precision farming are cleared under fixed conditions. On the basis of modelling, 250 ha field crop production is the smallest size, although based on own equipment, this alternative can be employed as a strategy by the middle and large-scale farms [Székely et al., 2000; Csete et al., 2002]. Another solution can be if some supplier or a machinery co-operative, or a machinery ring helps to build up the technical conditions. Today the spreading of precision farming is hampered partly by the relatively small farm sizes, partly by the lack of capital and the low profitability of field crop production. [Takács, 2003a; Takács, 2003b]

Conclusions

Both the ecological and the economic aspect of sustainability should appear at the same time in agriculture. The increasing environmental consciousness can be tracked in the spreading of environmentally friendly technologies, decreasing and rationalization of fertilizer and crop protection chemical use in agricultural production.

On farm level, the reduced or totally eliminated chemical use will result significant changes in profitability. If there is no premium sales price over against the different input size and structure under the same production technology, then the reduction or ban of chemical use will result that

– the input need, the obtainable yield level and the profitability of branches will change,
– the interval, which enables to make positive gross margin, is narrowed in each crop culture,
– it will increase the production threshold and gross margin – viable – size of branches. Since agricultural farms usually manage fixed production sizes, their lands – and farming size – cannot be increased or only with difficulties, the necessity of extending the size of farms is urging, and the land concentration is escalating;
– the risk of production and the inflexibility of farms is increasing, therefore drops in chemical use cannot be realised automatically. The farming alternatives should be analysed and the appropriate strategy should be applied in each case;

There is, however, a consequence beyond the farm limits, which should be considered. The reduced chemical use will result positive externality at the level of national economy, because it will reduce the quantity of chemicals loaded on environment, and the damages in human and animal health.

Table 3 shows the evaluation of alternative technologies according to main points of view and the comparison with conventional farming.

Only those alternatives will be feasible strategies for farms which enable them to manage their farms and remain viable with the given size, equipment, production structure and level – including possible subsidies, too. In addition to this, chemical-free production has a lot of good effects which cannot be quantified or expressed in money. Consider that this way of farming strengthens the multifunctional role of agriculture. It is an important factor in environmental protection, reduction of environmental pollution and close-to-nature farming. It contributes to the maintenance of biodiversity and increasing of food safety.

Therefore the question of sustainability is becoming into the foreground as an alternative meeting the requirements of our age. Upon the evaluation of different farming strategies, the conditions – capital, size, equipment, skills and determination – should determine the appropriate alternative for the given farm. Under given conditions, the changes in the profitability of farming must also be analysed.

The base principle for the sustainable agriculture, is to continue farming in the natural environment in such way that with the applied farming method we can reduce the emission of – the unnecessary and harmful- chemicals, but in the same breath will ensure the farms long term viability and achieve income, beside this the environment should be kept and maintained such as part of the social function of living.

The precision farming is a such technology, that allows the soil- ecosystem –plant –engineering combination of scaling to apply the chemicals at the parcel level, and optimalize these at a known level of production cost, yield and price. The development of agricultural technical improvement allows the use of the newest technologies in a wide range. From the farm economy point of view the viability means along with the adaptation of the process the invested cost will return as part of the income revenue, so there will be such amount of income for the farm that will assure the return of the invested capital, it means, it will provide the simple economical reproduction. However, the conversion to the new technology will cost extra investment, that possibly not every farm can provide from economical-, or from other consideration. Despite the use of precision agriculture can provide a more rational use of fertility, and also provide reduction of pesticide use, realistically we can not expect that this will be used on the total arable area in a foreseeable future. For the requirement by this technology both in number of farms and in size of the cultivated area only a few farms can meet the expectations. In those countries where the small farm structure is characteristic it must be found those alternative cooperation forms among farmers that colud help to spread this new technology. Although the uptake is prevented, because the most of the farms can not achieve the right berak even size that will allow return of the needed extra investment, also often no expertise are available for the sufficient adoption of the technology. In the latter case, any initiative which may be organized in the level of production (machine rings) or from the service provider's side (like IKR Production Development and Commercial Corporation in Hungary) can help to promote a wide-scale use of the precision plant production. In Hungary, with the IKR instruments, and experts, over 10,000 hectares are using precision fertility treatment, and for the use of precision pesticide application steps has been initiated already, and it is under way. If one takes into account the role or possible future role of this technology in the environmental pollution, should be considered the support of the development of this design, that will allow to achieve the compliance with the requirements for the agricultural pesticide reduction, also the loss of income from the extra expenses would be compensated by the achieved income on the production level.

The conversion to precision farming has a more important role in the pesticide application reduction. In this case the spot treatments will result in actual material saving, as the experiences show, the ratio of those areas that can be omitted from pesticide treatment can reach 30-70%. Also, savings can be achieved in the dose of herbicide, if the application taking place with the knowledge/awareness of the soil qualities, of course, within the manufacturer’s specified interval. In case of an optimistic scenario the pesticide savings can reach 30 thousand tons. Taking into account the role of agricultural production as part of food security, this creates an important quantity, while we are evaluating the complex results of the precision technology.

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