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## **Foreword**

### **Tradition and Innovation – International Scientific Conference of (Agricultural) Economists Szent István University, Gödöllő, 3-4 December, 2007**

Tradition and Innovation – International Scientific Conference was held on December 3-6, 2007, in the frames of the anniversary programme series organized by the School of Economics and Social Sciences of the Szent István University. The aim of the conference was to celebrate the 50th anniversary of introduction of agricultural economist training in Gödöllő, and the 20th anniversary of the School of Economics and Social Sciences, which was founded in 1987.

The articles published in the special edition of Bulletin 2008 of the Szent István University were selected from the 143 presentations held in 17 sections of the conference and 30 presentations held at the poster section. The presentations give a very good review of questions of national and international agricultural economics, rural development, sustainability and competitiveness, as well as the main fields of sales, innovation, knowledge management and finance. The chairmen of the sections were Hungarian and foreign researchers of high reputation. The conference was a worthy sequel of conference series started at the School of Economics and Social Sciences in the 1990s.

## **Előszó**

### **Tradíció és Innováció – Nemzetközi Tudományos (Agrár)közgazdász Konferencia Szent István Egyetem, Gödöllő, 2007. december 3-4.**

2007. december 3-6. között a Szent István Egyetem Gazdaság- és Társadalomtudományi Kara (SZIE GTK) által szervezett jubileumi rendezvénysorozat keretében került megrendezésre a Tradíció és Innováció – Nemzetközi Tudományos Konferencia, amelynek célja volt, hogy méltón megünnepelje a gödöllői agrárközgazdász képzés fél évszázada történet elindítását, s ugyanakkor a Gazdaság- és Társadalomtudományi Kar 1987-ben történt megalapításának 20. évfordulóját.

A Szent István Egyetem által kiadott Bulletin 2008 évi különszámában megjelentetett cikkek a konferencián 17 szekcióban elhangzott 143 előadásból, illetve a poszter szekcióban bemutatott 30 előadásból kerültek kiválasztásra. Az előadások jó áttekintést adtak a hazai és nemzetközi agrárközgazdaság, vidékfejlesztés, a fenntarthatóság és versenyképesség kérdései mellett az értékesítés, innováció, tudásmenedzsment, pénzügy fontosabb területeiről is. Az egyes szekciók elnöki tisztjét elismert hazai és külföldi kutatók töltötték be. A konferencia a Gazdaság- és Társadalomtudományi Karon az 1990-es években elkezdett konferencia sorozat méltó folytatása volt.

Dr. László Villányi  
Dean / dékán



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## **DYNAMICS OF CHANGES IN AGRICULTURAL LAND USE ARISING FROM CLIMATE, POLICY AND SOCIO-ECONOMIC PRESSURES IN EUROPE**

**FEKETE-FARKAS, MARIA – SINGH, MAHESH KUMAR –  
ROUNSEVELL, MARK – AUDSLEY, ERIC**

### **Abstract**

This article analyses the mechanism behind the changes in agricultural land use arising from climate variables, agricultural policies and socio-economic pressures. The study presented here has undertaken an integrated methodology in the estimation of future land use change in Europe. The scenarios constructed in this study include estimates not only of changes in the climate baseline, but also of possible future changes in socio-economics. The overall aim of the study was to raise the awareness of policy makers about the vulnerability of the European rural economy and agro-ecosystems based on economic and environmental considerations in term of both their sensitivity and capacity to adapt to change.

**Keywords:** climate change, agricultural land use, socio-economics, policy

### **Introduction**

Land use change, the physical change in land cover caused by human activities such as agriculture, is a common phenomenon associated with population growth, market development, technical and institutional innovation, and related rural development policy. Changes in land use can have various consequences on economic growth, the level and distribution of income, and on natural resources such as biodiversity, ecosystems, water, and soils. Land use change leads to change in—and is influenced by—socio-economic indicators such as agricultural productivity, wealth, and human capital. A better understanding of the complex interactions of these changes over time can enable decision makers at various policy levels to design and implement regionally adapted policy interventions which stimulate benefits and counteract negative consequences of land use change by considering the trade-offs among economic, environmental, and social objectives in the process of sustainable rural development. Socioeconomic impact assessment has tended to focusing on quantitative characterization of key drivers and to ignore a narrative description of a scenario, “storyline”, highlighting the main characteristics, dynamics and relations between key driving forces (IPCC, 2001).

As the world has become more affected, changing patterns of land use have raised the interest of the public, the policy makers and scientists in different fields. This information could provide policy makers with ideas on how to adapt to these changes. The aspect of this paper is the construction of coherent future scenarios of the drivers of agricultural land use change in Europe (Rounsevell et al., 2002a,b, 2004, Várallyay et al., 2007.).

When farmers decide what and how to produce, they face different resource constraints arising from differences in geographic and climate conditions, type of soil, location, physical and financial size of farms, current production pattern or mode of land ownership. These factors cause differences in the rate of adapting to changes, which in turn depend on the time horizon of a study (Fekete-Farkas and Audsley, 1997).

The factors influencing the farmers' decision making are included in a conceptual model (Fig.1)

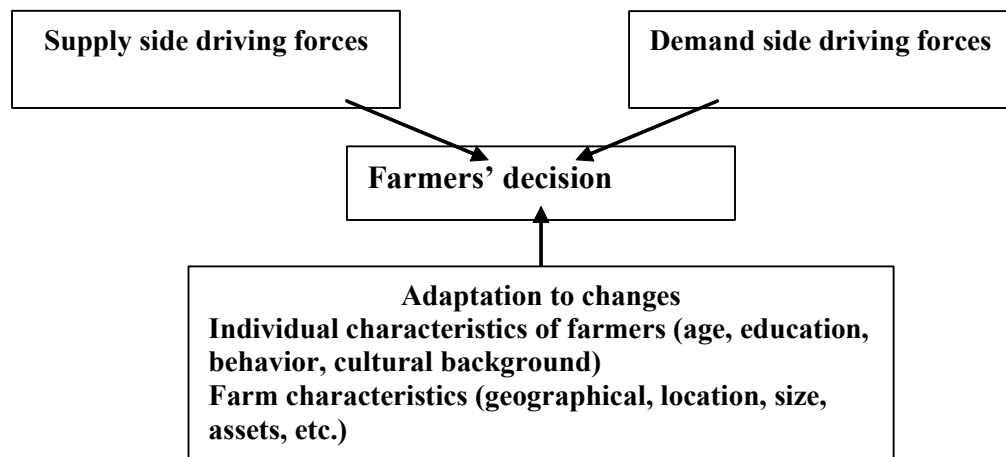


Figure 1 Factors influencing the farmers' decision making

The expected climate changes will alter regional agricultural systems with consequences for economic and social welfare. The specifics of the impact will depend on how the effects of climate translate into the factors that determine the competitiveness or viability of the agricultural system.

A brief summary of the interactions between climate changes and agriculture are as follows (Abildtrup and Gylling 2001):

- Land use change has been identified as a major driving force for global climate change through the emission of greenhouse gases, related to the intense use of natural resources;
- Climate change may influence the socio-economic context of farmers, for example through changes in the physical yields of crops and livestock production; in the performance of farmers (profit, gross margin or total utility); in the optimal farming system (changes in rural production mix and pattern and in allocation of production factors); in income distribution; in the function of rural areas and in heritage and life style.

The agricultural land-use change is not only caused by increasing food demand due to population growth, but also by changes in food preferences and lifestyles which are driven by economic growth, modernization and urbanization. Agriculture is a special type of activity which guarantees qualitative and quantitative food security and being multifunctional in nature, occupying a large area, and being important for employment especially in Central and Eastern European Countries (CEECs), it contributes to economic, social and ecological equilibrium. If people have a clear understanding of the links between choices and consequences, they are more likely to make informed and sustainable choices.

### Methodology and results

Future trend in the factors determined the land use is full of uncertainties. In such context prediction of socio-economic trends and environment changing in space and time are clearly impossible. Given these constraints, an alternative technique for the exploration of uncertain futures is the application of scenarios.

Different definition exists for term scenario. For the International Panel on Climate Change (IPCC) a scenario is defined as “a coherent internationally consistent and plausible description of a possible future state of the world” (IPCC, 1994).

Figure 1. shows a schematic illustration of methodology. The methodology and scenarios have been developed by research team of ACCELERATES and have amplified to Central and Eastern European as well. The construction of the agricultural sector model scenarios was based on pair wise comparison approach to obtain quantitative judgement from verbal comparative judgements of expert (Rounsevell et al. 2002, Giupponi and Rosato 2002, Kramphorst 2002, Fekete-Farkas et al, 2003, Fekete-Farkas et al. 2005, Al).

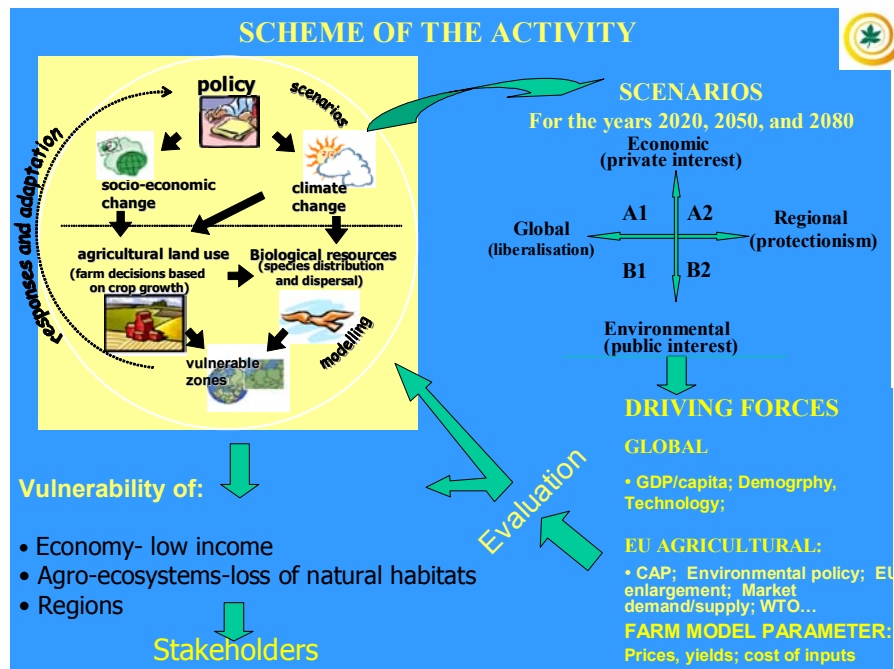


Figure 2 Methodology of development of socio-economic scenarios  
Sources: Fekete Farkas et al, 2005

Steps of development of socio-economic model:

- Identify and describe the global scenarios to simulate (SRES);
- Identify and evaluate the Global Driving Forces (GDF);
- Describe the impact of GDF on agricultural sector;
- Identify and evaluate the Agricultural Sector Driving Forces (ASDF)
- Evaluate the impact of ASDF on the Agricultural Model Parameters over time and space.
- Interpretation of the results of land use model

## Scenarios

In our research, the four SRES marker scenarios were selected each of which is described by a narrative storyline representing plausible demographic, social, economic, technological, and environmental development alternatives: A1, World Market, A2, Regional Enterprise; B1, Global Sustainability; B2, Local Stewardship.

The two-digit code of the four families locates them in a four-quadrant chart. The vertical axis represents a distinction between a more economical future development, driven by private and short-term interest (A) versus a sustainable, more environmentally oriented (B) future. The horizontal axis represents a range between more globally (1) versus more regionally oriented

developments (2). They reflect the type and principle of governance as globalization and liberalization (1) or regionalism, localization and protectionism (2).

The storylines represent different social and economic values as well. Development in storylines A1, A2 - where people are primarily concerned with material well-being, driven by private, and short term interest and on the contrary B1, B2 driven by mainly public and long term interest achieving balance between economic, social and environment objectives. The SRES storylines do not describe explicitly the decision-making structure, institutions and type of government, but the ACCELERATES project should take them into consideration due to their historical importance and substantial differences between EU-15 and CEECs.

### Global drivers

The global driving forces are based on the scenario storylines described in the Special Report on Emission Scenarios (SRES) (Nakicenovic et al., 2000). Based on these storylines the key global drivers shaping the future development in land use were identified as follows: population growth, economic growth, technological innovation and deployment, policy and pattern of governance, market: supply/demand, power and institutions, resources competition, social values: equity and environmental concern.

Figure 2. shows some results for OECD and Eastern European country based on SRES scenarios.

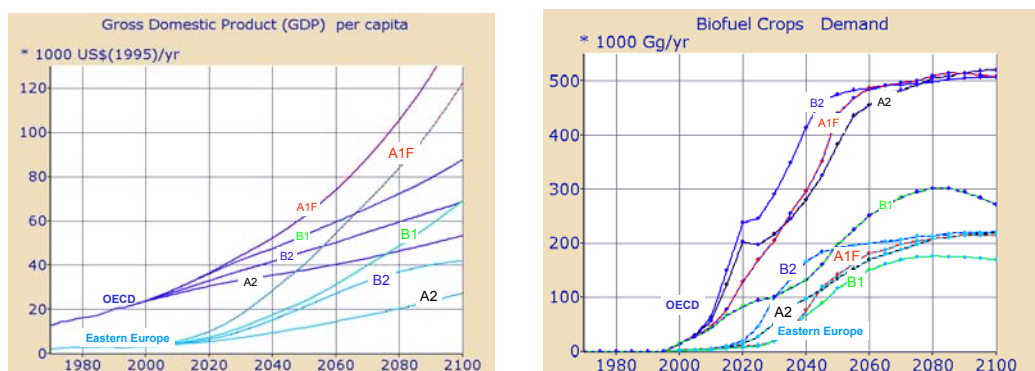


Figure 3 some results based on IPCC SRES scenarios

### European drivers

The European perspective identified specific regional concern and priorities in relation to global scene and based on current situation. Importance and intensity of these driving forces are different by scenarios, time horizon, or by countries, and the final outcomes result willingness and ability of people to change.

The European perspective identified specific regional concerns and priorities in relation to the global scene and based on the current situation. The importance and intensity of these driving forces are different between scenarios, time horizon, or by countries, and the final outcomes result from willingness and ability of people to change.

The key drivers shaping future agricultural land use were identified (Fekete-Farkas et al., 2003): geographical situation (including market accession), demography (population growth, density; population breakdown: by age and urban-rural; migration: international flow; from

urban to rural; from rural to urban), economy and policy (GDP/capita; growth of the national economy; changes of income level and distribution; world market situation: demand/supply, prices; domestic demand for agri-food production; technological innovation and deployment; food quality regulation, food safety; role of WTO; role of Foreign Direct Investment (FDI); pattern of market chain; development of infrastructure; energy demand; EU enlargement), agricultural policy (national; Common Agricultural Policy (CAP): price support, intervention, direct payments, rural development, environment protection), environment policy and regulation (national; international agreements (Kyoto, etc.); public awareness), other sector and social policies (because of finance, of education, social benefit, sources of alternative income, support of S&M enterprises), land market regulation (ownership, leasing), resource competition (land, water), farm structure (size and legal form), personal characteristics of farmers (education, age).

Taking into consideration that the European agriculture is not homogenous, the local, sector experts or stakeholders have selected the drivers, which are considered to be the main drivers for changing in the examined region.

The various historical backgrounds make differences between the dominant driving forces, their importance in the European Union and in the members of EU from Central European countries. In the EU-15 the CAP market intervention, WTO agreement, the CAP second pillar, the environmental policy, the resources competition (including the demand of land for biofuel production), the world market situation were selected as the main drivers of change in future land use. In the new members the land market regulation, the development of infrastructure, the rate of rural unemployment and alternative income possibility and structural change in food chain were also mentioned as the main driver of shaping future pathway of agricultural development for the shorter run to 2020. The based conclusion here is that the various historical backgrounds create differences between the dominant driving forces and their importance in the European Union compared to the Central European countries. The year 2020 is considered a transition year, i.e. the scenarios include mechanisms on how to get to the future. While in the scenarios 2020 the policy and market drivers are dominated, in scenarios of 2050 and 2100 the technical development, growth and breakdown of population, and environmental issues are more concerned to be as main driving forces.

Qualitative values of driving force came from the experts' opinions that have been collected by asking them questions, and having the Saaty scale as a reference for their answers (Abildtrup et al, 2006).

### **CEECs – storylines**

To understand the differences between the main drivers we need to know more about the differences between the Western and Central and Eastern European countries.

- Europe does not have a homogeneous pattern of wealth and economic development. Western and Northern Europe have some of the highest standard of living in term of GDP per capita, life expectancy, level of healthcare and education, or other common criteria of development. The standard of living in Southern Europe (Portugal, Greece, and Spain) is lower, but the gap is narrowing. Central Europe can be characterized with high level of income inequalities. GDP per capita ranges from close to US \$ 40,000 per annum in Switzerland and Luxembourg to less than US \$ 1,000 in Albania and Macedonia. Central and Eastern European Countries in GDP per capita account about 10 to 70% of EU-15 average. Lower level of GDP/capita means that they have less monetary sources for co-financing required by EU regulation for rural development projects. As a consequence,

labor cost varies significantly as well. An important factor in context with the future demand is that because of the low level of personal income in the CEECs people spend much higher portion of their income (25-60%) on food and per-capita consumption is quite low in comparative term.

- Europe has a highest population density of all continents. The average population density in EU 15 is 116 inhabitants /km<sup>2</sup>. In the CEECs the average population density is less comparing with its level in EU-15 average. The demographic trends would not indicate large changes in population. Due to low fertility rate the aging of people is unfavorable the share of population over the active age expected to increase in the next future. These factors may influence not just on the pattern of consumption but may have important effects on unemployment rate, land ownership and farm size because of the increasing average age of landowners.
- The share of rural people is about 20% of total in current EU countries. The central and Eastern Europe is not so strongly urbanized; more than 40% of population lives in rural areas. The breakdown of the rural population by age is unfavorable due to rural urban migration before the transition. Central and Eastern European Countries (CEEC) are characterized by large areas, which are threatened to a relatively small extent by urbanization and transport.
- Structure of economy differs widely, role of agriculture in the economy much higher in CEECs comparing to EU average. Share of agriculture in GDP and in employment are illustrated in Fig. 4.

Share of agriculture in employment and GVA, 2005 (%)

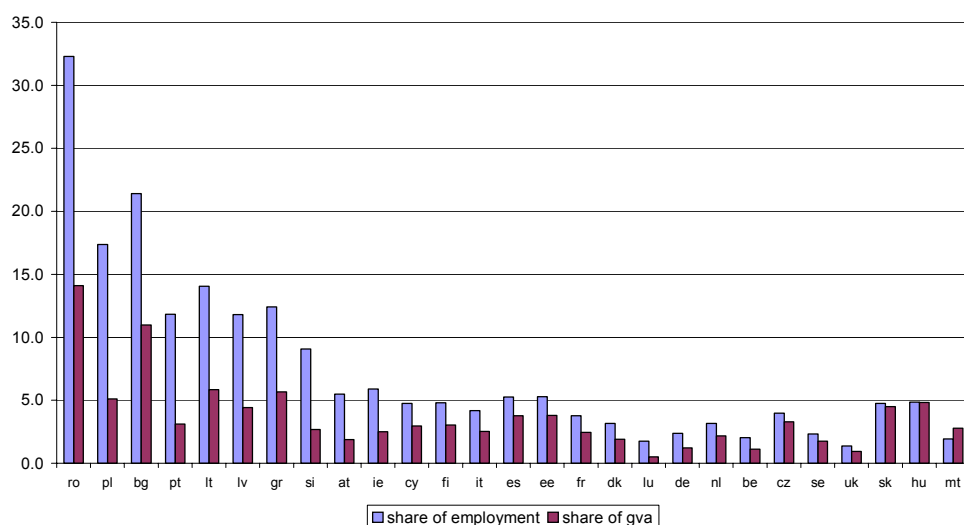


Figure 4. Differences between EU-15 and CEECs

Source: EUROSTAT, 2005

- Radical political and economical changes which occurred in the Central and Eastern European Countries at the beginning of the 90s led to a sharp economic decline and originated the formation of new agricultural policy and a new agricultural structure built on private ownership. However the average size is much larger in old members of EU than new members but the new members often have dualistic farm structure. Data of Table 3 provide more information about the farm structure in CEECs. When we try to evaluate the level and impacts of fragmentation of land use we need to consider the crop structure as well. The higher share of arable and especially cereal production makes the fragmentation problem more serious. Land fragmentation i.e. non contiguous landholdings

can cause significant level of production loss due to high supervision cost and increased time requirement. In many countries especially in Poland and Romania the subsistence farms service as a social net, providing supports for unemployed families.

Table 1: Dualistic farm structure in CEE countries

Country	Year	Share of UAA used by family farms/household plots (%)	Average size of family farms (ha)	Average size of private and state-owned holdings (ha)
Slovenia	2001	94	6	290
Poland	1996	82	7	426
Romania	1997	67	3	2 491
Hungary	2000	55	9	312
Czech Rep.	2001	27	28	1 035
Bulgaria	1999	26	1	519
Slovakia	2000	23	4	1 399

Source: EAA, 2004

- The land fragmentation with the demographic issue and lack of capital can be mentioned as the main reason of productivity gap between CEECs and old countries of EU (Table 2).

Table 2 Comparison of agro-economic factors

Country	AE	AL	AE / 100 ha	GVA / AE	GVA / GAP	GAP / AL
Bulgaria	795	6,2	12,8	2 256	289	479
Czech Republic.	267	4,3	4,8	3 501	217	671
Hungary	279	6,2	4,5	7 011	315	728
Poland	2 926	18,2	16,1	1 770	285	656
Romania	4 342	14,8	29,3	1 187	348	649
Slovakia	180	2,4	7,5	2 661	200	602
CEECs	9 478	59,9	15,8	1 784	282	-
EU-15	6 891	136,4	5,0	20 968	1 059	1 931

Source: National Development Plan of Hungary (2003)

Notes: AE = Agricultural employment (million capita); AL = Agricultural lands (million ha); GVA = Gross Value Added of agriculture (million EUR); GAP = Gross Agricultural Production (million EUR)

- Due to the transition crises in the agriculture the production became more extensive; and lower use of pesticides and fertilizers increased the yield gap between CEECs and EU-15. (Fig. 5 a, b) However it was also resulting higher associated biodiversity as a positive effect of transformation (Zellei, 2003).

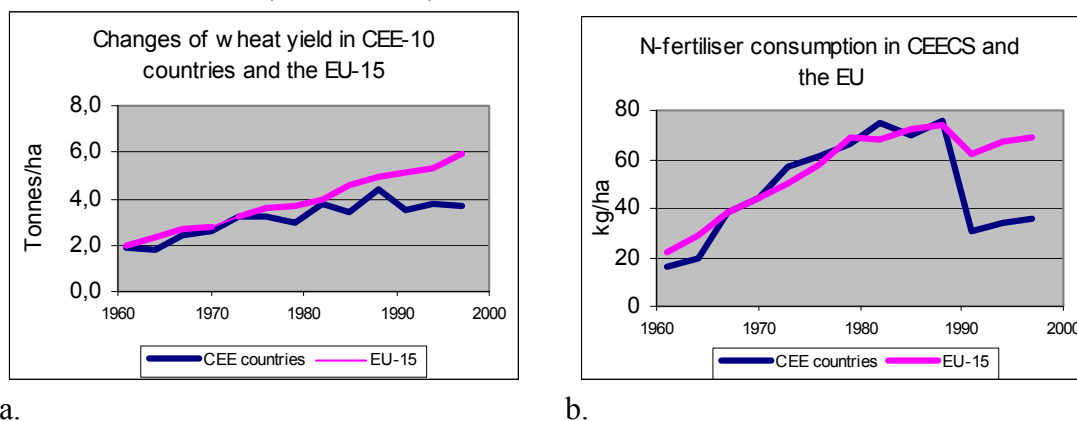


Figure 5 Extensification of Agriculture in CEECs

Source: EAA, 2004



- Lower level of subsidy according to The Copenhagen Agreement and less resources for co-financed programs because of the lower level of GDP/capita destroy the future competitiveness of agriculture not just on the European market but on the world market as well.
- In the CEECs the land market and land market regulation was mentioned as one the main drivers of future land use change. e can mention as common feature in these countries that land market does not function properly. The reasons of this - beside of official restriction - can be find both on demand and supply side of the market. The unclear property rights, the low price of farmland, high unemployment rate and lack of alternative income possibilities, in the uncertain and low income, landlords' sentimental value to their family land, expectation of increasing subsidy and price of land after the EU accession, the low productivity in the agriculture, uncertainties in the agricultural policy can be mentioned as the main constraint for well functioning land market (Fekete-Farkas et al., 2007.)

### **Modeling of land use change**

The final step of the project is to take the results as input parameters into the farm model, which was built for the proposal of regional and local application in order to define the vulnerability of European regions (Dobo et al., 2006) The crop growth model estimated potential crop yield based on information on physical environment, i.e. soil, water, plant and nutrient characteristics. The farm based decision model applied in the project then determines the agricultural land use, cropping, labor and machinery that optimize long term profit. This model takes into account long-term risk aversion and other environment constrains.

The main effects of both climate and socioeconomics were in the margin of Europe. The results suggest a significant decline in arable area but the rate of this change much depend on scenario assumption and location. The principal cause of this reduction is the assumption about the role of technological development which can be compensated by increasing biofuel production and increasing demand of food consumption according to increasing income and number of population especially in developing countries. All scenarios tend to increase the level of European production, through a combination of the fertilizing effect of CO<sub>2</sub>, new technology and new area becoming suitable. The major climate trends are quite clearly the northward march of arable farming, but there is also an increase in the same regions in the viability of grassland farming. In the future if arable agriculture becomes more profitable (e.g. because of increasing world market price), there will be pressure to change, which might be not good for the environment. There is some reduction in the profitability in the southern areas. The decline of agricultural area is less for environmental scenarios, where the declining agricultural area counterbalanced by policy mechanisms that seek to limit the use of chemicals.

### **Conclusion**

Our analysis showed that the changes in land use depend on the climate scenario applied. Furthermore, differences in the socio-economic condition also had significant impacts on land use. This indicates that, on the one hand, it is not possible to design policies that anticipate certain climate induced land use changes, but that policies should be adjusted continuously to adapt to climate change. On the other hand, land use is sensitive to markets for agricultural inputs and outputs, technology, and policies and these changes may in many cases have more significant impacts on land use than climate change.

This indicate that, on one hand, it is not possible to design policies that anticipate certain climate induced land use changes, but that policies should be adjusted continuously to adapt to climate change. On the other hand, land use is sensitive to markets for agricultural inputs and outputs, technology, and policies and these changes may in many cases have more significant impacts on land use than climate change. The vulnerability assessment in combination with the scenario analysis involving stakeholders may help the future formulation of agricultural policies including CAP, meeting more public concern and less transition cost. The inclusion of climate change impact in the design and implementation of European, national and local, development initiatives can reduce vulnerability of farm sector and rural economy. Results show that Central and Eastern European countries are likely to have considerable more difficulty adapting to climate due to many factors not just the policy. The conclusion for current policy is that future development of CAP in two aspect, mitigation and adaptation of climate is needed. Climate change present a problem of decision-making under condition of deep uncertainty, as a consequence of it future development of crop insurance policy to cope with increasing production risk is necessary.

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