Land use changes in the EU: Policy and macro impact analysis

Vplyv SPP a makroekonomického vývoja na užívanie poľnohospodárskej pôdy v EÚ

P. Ciaian

Katholieke Universiteit Leuven, LICOS – Centre for Institutions and Economic Performance, Leuven, Belgium
Slovak University of Agriculture, Nitra, Slovak Republic

Abstract: This paper analyses the impact of the Common Agricultural Policy (CAP) and macroeconomy on land use changes in the EU. Three scenarios are simulated up to 2030: baseline, macro scenario and policy scenario. Simulation results indicate that GDP leads to a stronger effect on land use changes than the CAP. Stronger changes in land use are observed at the crop disaggregated level than at the aggregated level for the total agricultural area, arable land, grassland and permanent crops.

Key words: agricultural policy, land use, policy simulations

Abstrakt: Článok sa zaoberá dopadom Spoločnej poľnohospodárskej politiky (SPP) a makroekonomického vývoja na užívanie pôdy v Európskej únie. Projekcie do roku 2030 sa uskutočnili pomocou dynamického modelu parciálnej rovnováhy. Hodnotili sa tri scenáre: východiskový scenár, makro scenár a scenár zmeny SPP. Výsledky ukazujú, že rast ekonomiky má silnejší vplyv na zmeny v užívaní pôdy než SPP. Väčšie zmeny sú na úrovni jednotlivých komodít než na agregátnej úrovni pre celkovú poľnohospodársku pôdu, ornú pôdu, trvalé lúky a pasienky, a trvalé porasty.

Kľúčové slová: poľnohospodárska politika, užívanie pôdy, simulácie scenárov

This paper uses the agricultural LUMOCAP model to analyze the impact of agricultural polices and macroeconomy on land use changes in the EU. The model is a dynamic, multi-product, supply model of the EU agriculture. The model covers all agricultural area. The overall design of the model focuses a particular attention to the potential influence of agricultural policy on the land use changes. The model covers all major first pillar policies as well as rural development policies.

The objective of the paper is to analyze how the macro changes and changes in agricultural policies affect land use changes in the EU. The simulation results are provided up to 2030 for three scenarios: baseline, macro scenario, and policy scenario. The baseline scenario assumes continuation of the past policies, the macro scenario assumes that from 2009 on, the GDP growth is higher by 50% relative to the baseline scenario, and the policy scenario assumes that direct payments, intervention prices, rural development payments, and quotas are cut by 50% in relative to the baseline.

THE MODEL

The agricultural model structure of the LUMOCAP model applied in this paper contains features of the AGLINK model of the OECD and of the AGMEMOD model (OECD 2004; Chantreuil et al. 2005; Erjavec, Donnellan 2005; AGMEMOD 2006). The model incorporates all the major CAP instruments from the market measures (Pillar 1) and from the rural development policies (Pillar 2). Domestic prices are endogenous and are represented by the relationships that link them to the world market prices. World prices are exogenous in the model. Prices in the NMS are assumed to converge to the EU price levels after the EU accession. The main source of world prices used in the model is the OECD.

The basic structure of the model is provided in Table 1. The model contains four levels which represent the farm land allocation decision process. At level 1, a decision is made on the amount of land allocated to agricultural activities, on the amount of the abandoned land, and on the amount of land transferred to non-agricultural uses. At level 2, land allocation is made among three main sectors: arable land, permanent grassland, and permanent crops. Each of these three sectors is further split in more specific sub-sectors at the level 3. At level 4, there is only a land allocation decision for cereal-oilseeds area. Farms decide about the split of land to cereals, oilseeds and set-aside.

In order to take account of the differences in polices applied among the different members of the EU, three separate agricultural models were constructed:
1. EU-15: It includes 15 old member states,
2. NMS-10: It includes 10 New Member States which joined the EU in 2004 (the Czech Republic, Cyprus, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, and Slovenia),
3. NMS-2: It includes 2 New Member States which joined the EU in 2007 (Bulgaria and Romania).

The three regional submodels follow the general structure of the model presented in Table 1. The three submodels are interlinked mainly through prices. Prices of the New Member States (NMS) are assumed to converge to the EU-15 price level after the accession.

The model covers all agricultural area and all major crop and animal sectors of the agricultural economy. The following crop sectors are included: cereals, oilseed, rice, potatoes, sugar beet, tobacco, vegetables, fodder from arable land, other arable land, wine, olives, fruit crops, and other permanent crops. Additionally, the set-aside area is modeled. To take account of the competition for resources between agricultural economy and non-agricultural economy, the agricultural land loss to urban areas and the abandoned land are also modeled (Table 1). The animal sectors cover beef, dairy, sheep and pigs.

The model incorporates all the major CAP instruments from the market measures (Pillar 1) and from the rural development policies (Pillar 2). The policies are exogenously introduced into the model. The modelling approach assumes that the intervention prices affect the EU prices. Coupled direct payments are assumed to affect per hectare (or per animal) returns, while the decoupled payments and rural development payments are assumed to affect only the land allocation between agricultural use and non-agricultural use.

Table 1. General model structure

Level 1	Level 2	Level 3	Level 4
Agricultural land loss to urban areas			
Abandoned land			
Usable agricultural area (UAA)	arable land	cereals-oilseed area	cereals
			oilseeds
			set-aside
		rice	
		potatoes	
		sugar beet	
		tobacco	
		vegetables	
		fodder from arable land	
		other arable land	
	permanent grassland		
	land under permanent crops	wine	
		olives	
		fruit crops (excluding wine and olives)	
		other permanent crops	

Land allocation

Rational farms behave so as to maximise their profits given as follows:

Max Π [*p, w, y, e, T, P*],

where *p* is a vector of output prices, *w* is a vector of input prices, *z* is a vector of fixed factors (that are farm owned or operated on a long-term contractual basis, e.g. land, family labour, capital), *e* is a vector of environmental characteristics of land (soil quality, topography, climate, etc.), *T* is technology (e.g. farm practices), and *P* are agricultural policies. Variables *p*, *w*, *e*, *T* and *P* are exogenous to the farm. Farms decide about the production of agricultural outputs that affect their profits, i.e. market outputs. They will choose the production structure and allocation of this production to available land such as to maximise profits taking into consideration the variables *p*, *w*, *e*, *T* and *P* (Just, Antle 1990).

The solution to the farm maximization problem is land allocation to specific crops which depends on returns, input costs, policies, land type, technology, land suitability and other factors.

Following this stylized model, the land allocation at each farm's decision level of the LUMOCAP approach (as provided in Table 1) to a specific land use category is based on a set of linear equations; with one equation determining the area for one land use category. Dependent variables are represented in hectares (at level 1) or as area shares of the higher level of the total area (at levels 2 to 4). The main explanatory variables which determine the land allocation between crops are own returns, returns of competing crops, policy variables, animal stocks, and macrovariables.

Yields, slaughter weights and total production

A general specification of the yield (slaughter weights) equation is the function of real price and trend. Trend is an exogenous variable and is used as a proxy to measure technological development. There is expected a positive impact of prices on yields and slaughter weights. Prices change marginal profits of outputs. Higher prices give an incentive to farmers to increase production because of a higher profitability. Farmers are motivated to use more inputs for crops with higher prices in order to obtain higher yields and hence a higher production. In the case of low prices, there is an incentive to use less input and hence to reduce yields. There are few studies that estimate yield price elasticities. At the same time, the findings are mixed. For example, Choi and Helmberger (1993) find that maize, wheat and soybean yields in the US respond positively to the increase in the expected output prices, but the effect is small, especially for wheat. On the other hand, Menz and Pardey (1983) find an insignificant maize yield elasticity in the US.

Yields are used in the model to calculate the per hectare returns (price times yield plus the coupled direct payments) while slaughter weights are used to calculate animal returns (price times slaughter weight plus coupled direct payments). The total production for a specific crop is obtained by multiplying the crop area with the yield.

Price formation

For each regional submodel (EU-15, NMS-10, and NMS-2), one representative price is used for each crop or for each animal sector. The representative price is taken from the most important market within the EU (for example French wheat price is used as the representative price for wheat in the EU-15 submodel, while Hungarian wheat price is used as the representative price for wheat in the NMS-10 submodel).

The EU market prices are endogenously determined in the model. Each price included in the model includes one equation where price is the dependent variable and the independent variables are world prices and market intervention policies (e.g. intervention price). This modeling of prices implies that they are not determined from the market-clearing conditions. Rather the development of prices is based on the assumption of world price developments and on the assumptions of the EU intervention policies. The main source of world prices used in the model is the OECD's AGLINK model. To conduct the different policy scenario simulations, other models, such as the FAPRI, GTAP or CAPRI, can be also used as a source for world prices.

With the EU accession of the NMS, their agricultural economies became part of the common EU agricultural market. The pre-accession trade berries were removed, while the CAP market interventions were introduced in the NMS. To take these effects into account, prices in the NMS are assumed to converge to the EU price levels after the EU accession.

Model estimation and calibration

To fill the model with the required coefficients, three main approaches were applied: (1) econometric estimation; (2) calibration; and (3) coefficients taken

Table 2. Standard errors for land allocation equations (1996–2004)

	EU-15	NMS-10	NMS-2
Usable agricultural area (UAA)	1.0	6.1	0.9
Permanent grassland	2.3	4.6	2.2
Arable land	1.3	8.4	2.3
Land under permanent crops	4.5	28.3	7.5
Arable crop area equations			
Cereals-oilseeds area	1.7	2.3	2.7
Rice area	6.2	21.2	38.3
Potato area	3.7	26.9	5.8
Sugar beet area	2.8	12.3	40.2
Vegetable area	2.4	9.0	10.5
Fodder from arable land area	1.9	13.7	24.0
Tobacco area	5.6	18.2	15.8
Permanent crop area equations			
Vineyards area	2.3	21.7	4.9
Olive area	10.4	15.0	
Fruit crop area	2.5	14.4	15.4
Average	3.5	14.4	13.1

from economic literature. The econometric estimation was used to obtain the coefficients for yield, slaughter weight, price, and animal stock equations. The main problem faced when estimating was short time series especially for estimating the land allocation equations. For this reason, to obtain coefficients for land allocation equations, the combination of estimation, calibration, and economic literature approach was applied. Table 2 reports standard errors for the land allocation equations for period 1996–2004. The EU-15 land allocation equations have smaller standard errors than land allocation equations of the NMS. The main explanatory variables which drive the land use changes are own returns, returns of competing crops, policy variables, animal stocks, and macrovariables. The land allocation equations do not incorporate institutional changes implemented in the NMS. The NMS implemented wide ranging reforms from the early 1990s on with the aim to replace planned economy with market institutions and later on with the aim to join the EU. These reforms are an important factor that significantly affected farm decision making in the NMS besides agricultural polices and market returns.

The main data sources were the EUROSTAT and the European Commission. Other sources were the FAOSTAT, the OECD, and the UN, which supplemented the missing data from the EUROSTAT and from the European Commission.

SCENARIOS

There scenarios are simulated in this paper:

1. *Baseline scenario*: Continuation of past polices. The EU-15 countries introduce the 2003 reform in 2005–2007 and are assumed to apply the reform up to 2030. In the NMS, it is assumed that the 2003 reform is introduced in 2009.
2. *Macro scenario*: From 2009 on, the GDP growth is assumed to be higher by 50% relative to the baseline scenario. Agricultural policies are assumed to be the same as in the baseline scenario.
3. *Policy scenario*: Direct payments, intervention prices, rural development payments, and quotas are cut by 50% relative to the baseline. Macroeconomic variables are assumed to be the same as in the baseline scenario.

SIMULATION RESULTS

Trends in land use and the baseline scenario simulation results

The total utilized agricultural area including fallow land was around 140 million hectares in the EU-15 in 2004. More than 50% of the UAA was arable area, followed by grassland (more than 30%), and permanent crops (less than 10%) (Figure 1). In the NMS-10, there was around 35 million hectares of the UAA including fallow land in 2004. The share of arable area in the UAA in the NMS-10 is higher than in the EU-15 (more than 70% of the UAA), while the share of grassland and permanent crops is around 25% and 3%, respectively (Figure 2). In the NMS-2, there was around 20 million hectares of the UAA including fallow land in 2004. The share of arable land, grassland, and permanent crops in the UAA is around 62%, 33%, and 4%, respectively (Figure 3).

The UAA declined continuously from the early 1970s in the EU-15. It declined by around 10% in 2004 relative to 1972. A substantial decline in the UAA took place during the 1990s, during the introduction of the 1992 CAP reform which cut intervention prices and thus reduced land profitability in agricultural use relative to land profitability in non-agricultural use. After 2000, the UAA remained fairly stable in the EU-15. The UAA decline was mainly driven by the reduction of grassland. Grassland declined by more than 20%, followed by permanent crops, by more than 15%. Farms first reduced less productive land such as grassland. The more productive arable area remained fairly constant since 1972 in the EU-15, around 80 million hectares (Figure 1).

The NMS (especially the NMS-10) show a higher dynamism in land use development than the EU-15. In the NMS-10, the UAA declined by more than 15%

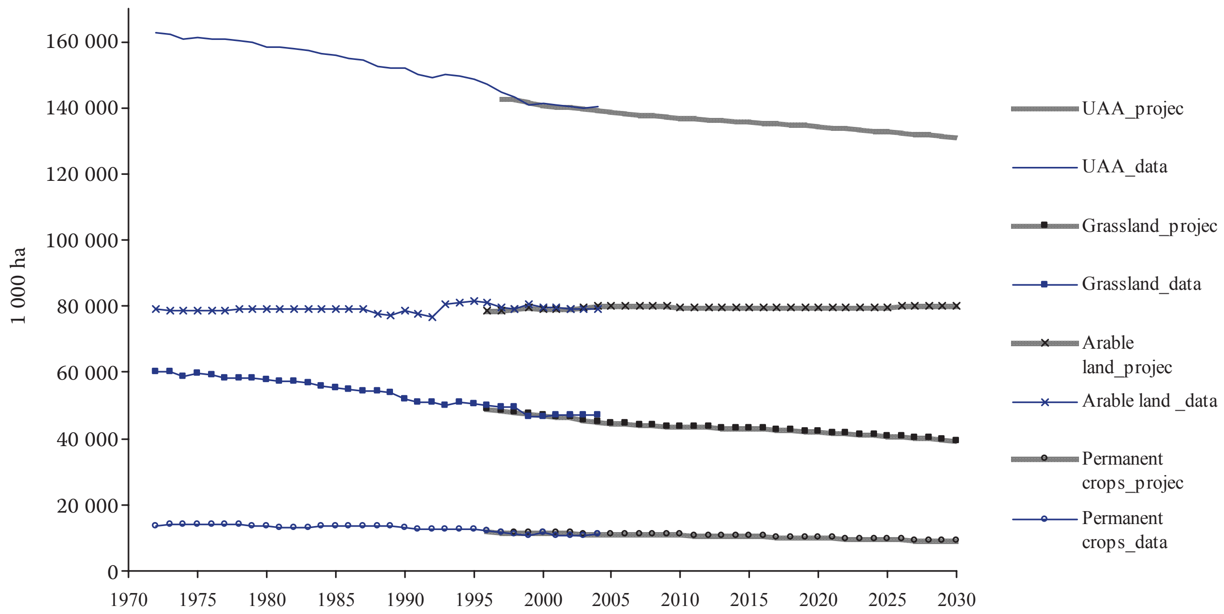

Figure 1. Development of UAA, arable land, grassland, and permanent crop area use in EU-15, 1972–2030 – *baseline scenario*

Note: UAA also includes fallow land

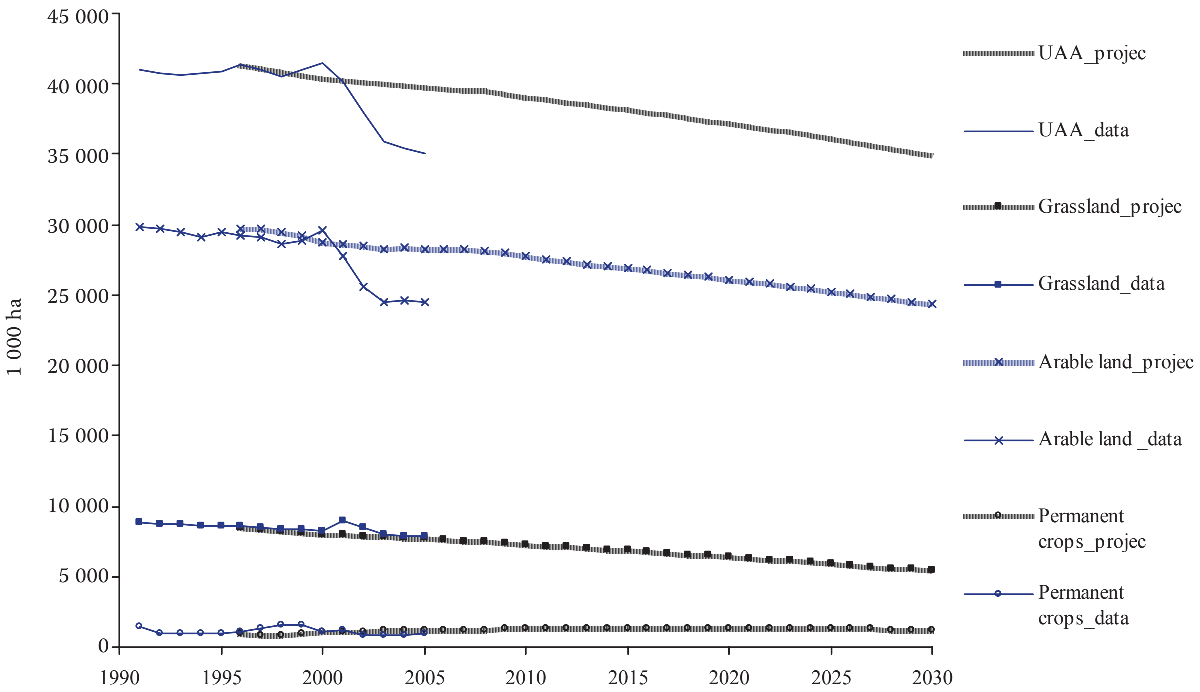

Figure 2. Development of UAA, arable land, grassland, and permanent crop area use in NMS-10, 1991–2030 – *baseline scenario*

Note: UAA also includes fallow land

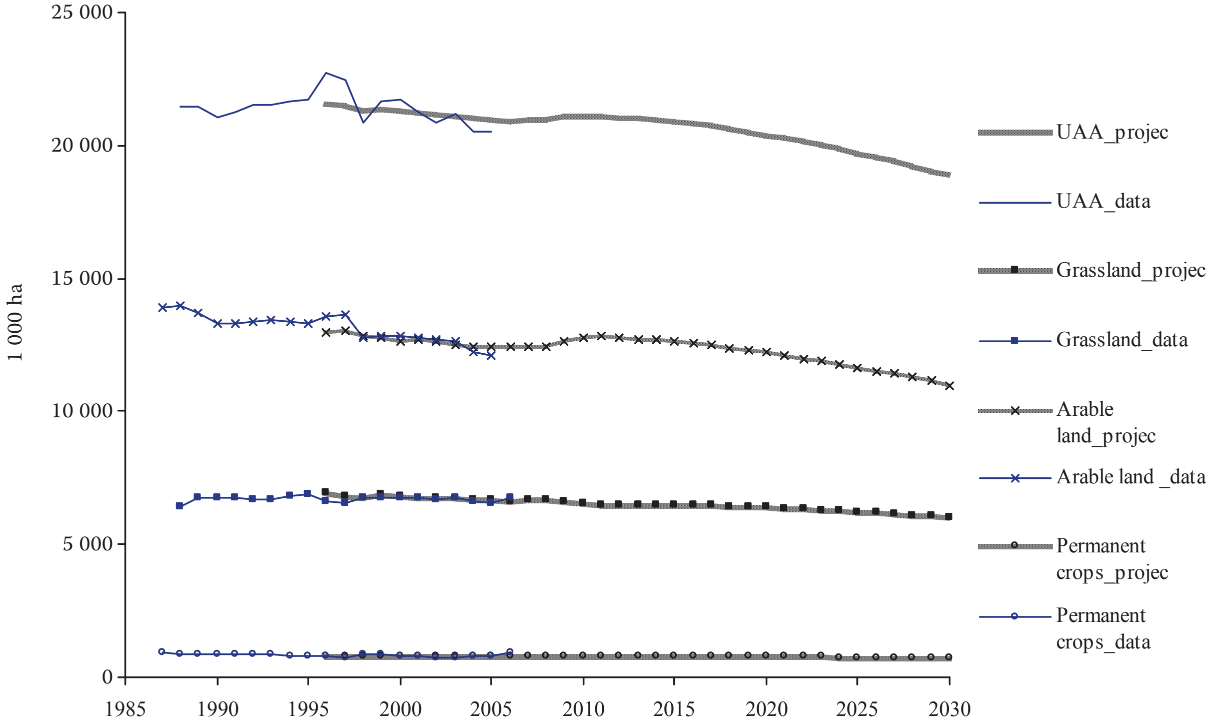

Figure 3. Development of the UAA, arable land, grassland, and permanent crop area use in NMS-2, 1987–2030 – *baseline scenario*

Note: UAA also includes fallow land

Table 3. UAA, arable land, grassland, and permanent crop area projections (2004 = 100) – *baseline scenario*

	2004	2007	2010	2015	2020	2025	2030
Usable agricultural area (UAA)							
EU-15	100	99	99	98	97	96	94
NMS-10	100	99	98	94	91	87	83
NMS-2	100	100	100	99	96	93	88
Total	100	99	99	97	96	94	92
Permanent grassland							
EU-15	100	98	97	96	94	91	88
NMS-10	100	97	94	88	82	76	70
NMS-2	100	99	97	96	95	92	89
Total	100	98	96	95	92	89	85
Arable land							
EU-15	100	100	100	99	100	100	100
NMS-10	100	100	98	95	92	89	86
NMS-2	100	100	102	101	97	93	88
Total	100	100	100	98	98	97	96
Land under permanent crops							
EU-15	100	99	98	94	90	85	81
NMS-10	100	107	114	117	115	112	107
NMS-2	100	99	102	100	97	93	88
Total	100	100	100	97	92	88	84

in 2004 compared to the 1991 level, and by 5% in the NMS-2. The most of the UAA reduction in the NMS-10 took place after 2000. Permanent crops declined the most (by around 39% and by 7% in the NMS-10 and the NMS-2, respectively), followed by arable land (18% and 8% in the NMS-10 and the NMS-2, respectively), and grassland (10% and 3% in the NMS-10 and the NMS-2, respectively) (Figure 1). These trends are driven by the high economic growth in many NMS and due to the excessive share of arable land in the UAA in the NMS due to the pre-1989 police who turned large grassland areas into arable land.

The simulation results indicate that the UAA will continue to decline reaching 94% of the 2004 level in 2030 in the EU-15. A more dramatic decline in the UAA is expected in the NMS due to a higher GDP growth. In 2030, the UAA drops to 83% and to 88% of the 2004 level in the NMS-10 and the NMS-2, respectively (Table 3 and Figures 1–3).

The permanent crop area and grassland drive the decline of the UAA in the EU-15. The permanent crop area and grassland decline proportionally more than the UAA, while arable land remains unchanged. This trend confirms the observed past trend where the least productive land leaves the agricultural sector in larger proportions. Due to the significantly higher permanent crop prices in the EU than in the NMS-10, the negative trend of the permanent crop area in the NMS-10 is reverted after the EU accession. The permanent crop area increases in

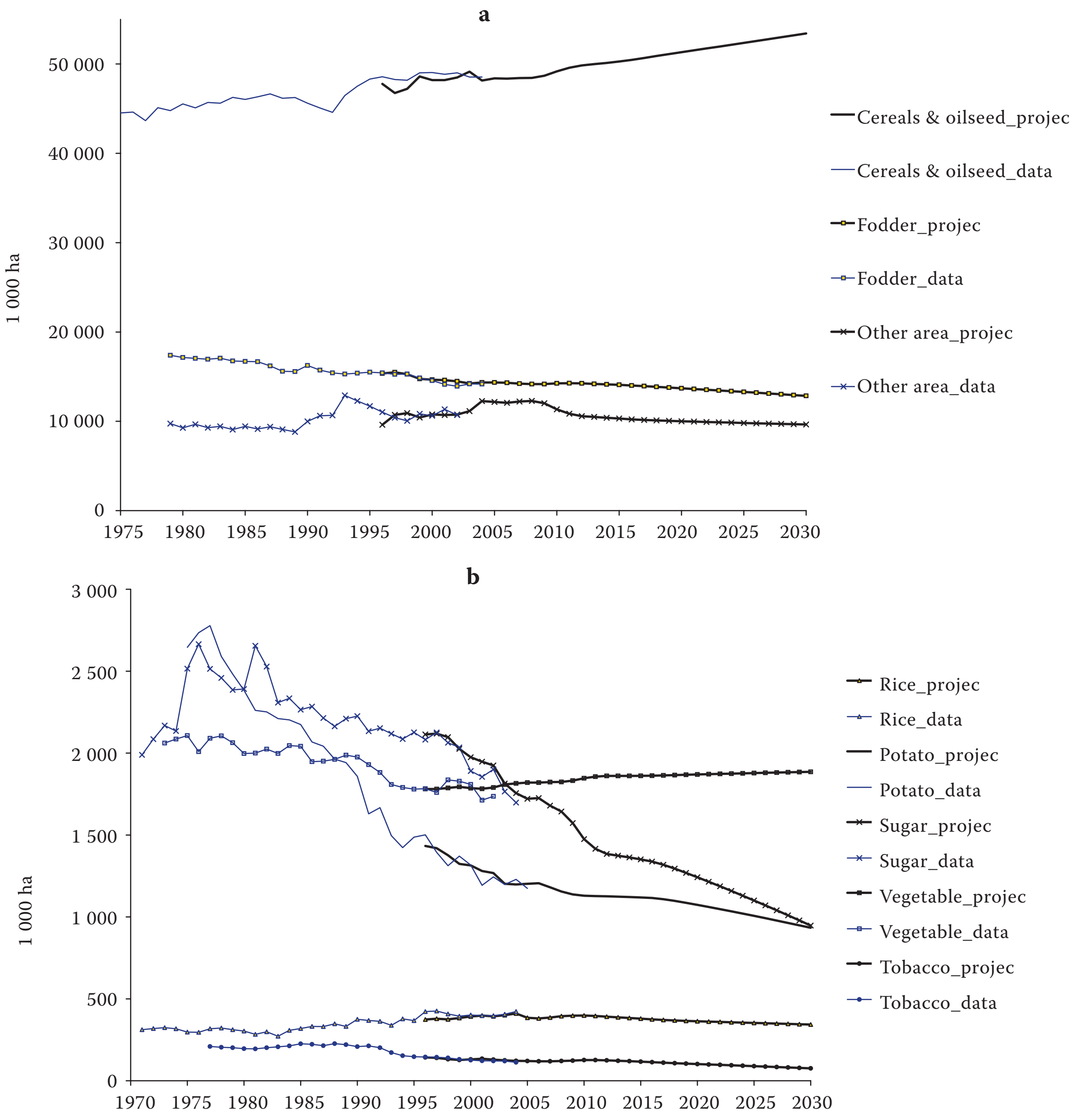

Figure 4. Development of the arable crop area use in the EU-15, 1975–2030 – *baseline scenario*

2030 relative to 2004 level in the NMS-10. The arable area and especially grassland area decline in the NMS-10. In the NMS-2, arable area, grassland, and permanent crop area are projected to decline by approximately the same rate as the UAA (12%) (Table 3 and Figures 1–3).

Table 4. Arable crop area projections (2004 = 100) – *baseline scenario*

	2004	2007	2010	2015	2020	2025	2030
Cereals-oilseeds area							
EU-15	100	101	102	104	107	109	111
NMS-10	100	99	100	101	100	98	96
NMS-2	100	96	101	100	97	93	89
Total	100	100	101	103	104	104	105
Rice area							
EU-15	100	94	97	92	88	86	84
NMS-10	100	100	98	95	92	89	86
NMS-2	100	100	103	101	98	94	88
Total	100	94	97	92	89	86	84
Potato area							
EU-15	100	99	94	93	90	84	78
NMS-10	100	54	54	57	57	58	58
NMS-2	100	100	84	84	82	79	75
Total	100	77	73	74	73	71	68
Sugar beet area							
EU-15	100	96	84	77	71	63	54
NMS-10	100	99	93	86	82	79	75
NMS-2	100	257	549	487	503	505	499
Total	100	98	91	84	79	72	64
Vegetable area							
EU-15	100	100	102	103	103	103	104
NMS-10	100	104	116	119	116	113	110
NMS-2	100	96	120	120	116	110	103
Total	100	100	107	108	107	106	105
Fodder from arable land area							
EU-15	100	99	99	98	95	93	90
NMS-10	100	58	70	78	77	77	79
NMS-2	100	110	142	144	134	122	109
Total	100	94	98	98	95	92	89
Other arable land							
EU-15	100	100	92	84	82	80	79
NMS-10	100	135	116	94	83	73	63
NMS-2	100	122	62	54	53	49	46
Total	100	111	98	85	81	76	72
Tobacco area							
EU-15	100	98	104	96	84	73	62
NMS-10	100	100	98	95	92	89	86
NMS-2	100	100	103	101	98	94	88
Total	100	99	103	97	88	80	71

Arable crop area projections

The disaggregated projections at crop level indicate a large variation in the development of land use changes among arable crops. In the EU-15, the area of most arable crops is expected to decline in 2030 relative to 2004. The exception is the cereal and oilseed area and the vegetable area which are projected to increase. The most dramatic decline is expected for the sugar beet and tobacco area due to the policy reforms and due to the less favorable development in returns relative to other crops, followed by the potato and rice area (Table 4 and Figure 4).

In the NMS, the total arable area declines in 2030 relative to 2004, while in the EU-15, the area stays unchanged (Table 3). This is because of a stronger non-agricultural demand for land resources in the NMS due to the high expected GDP growth. This decline in the arable area drives the decline of most of the arable crop areas in the NMS. However, the area for more protected crops decreases less (e.g. cereals and oilseeds), while the area for some crops increases (vegetables and sugar beet in the NMS-2). The vegetable area increases because farmers receive significantly higher prices after the accession. For similar reasons, as well as due to the low base level,

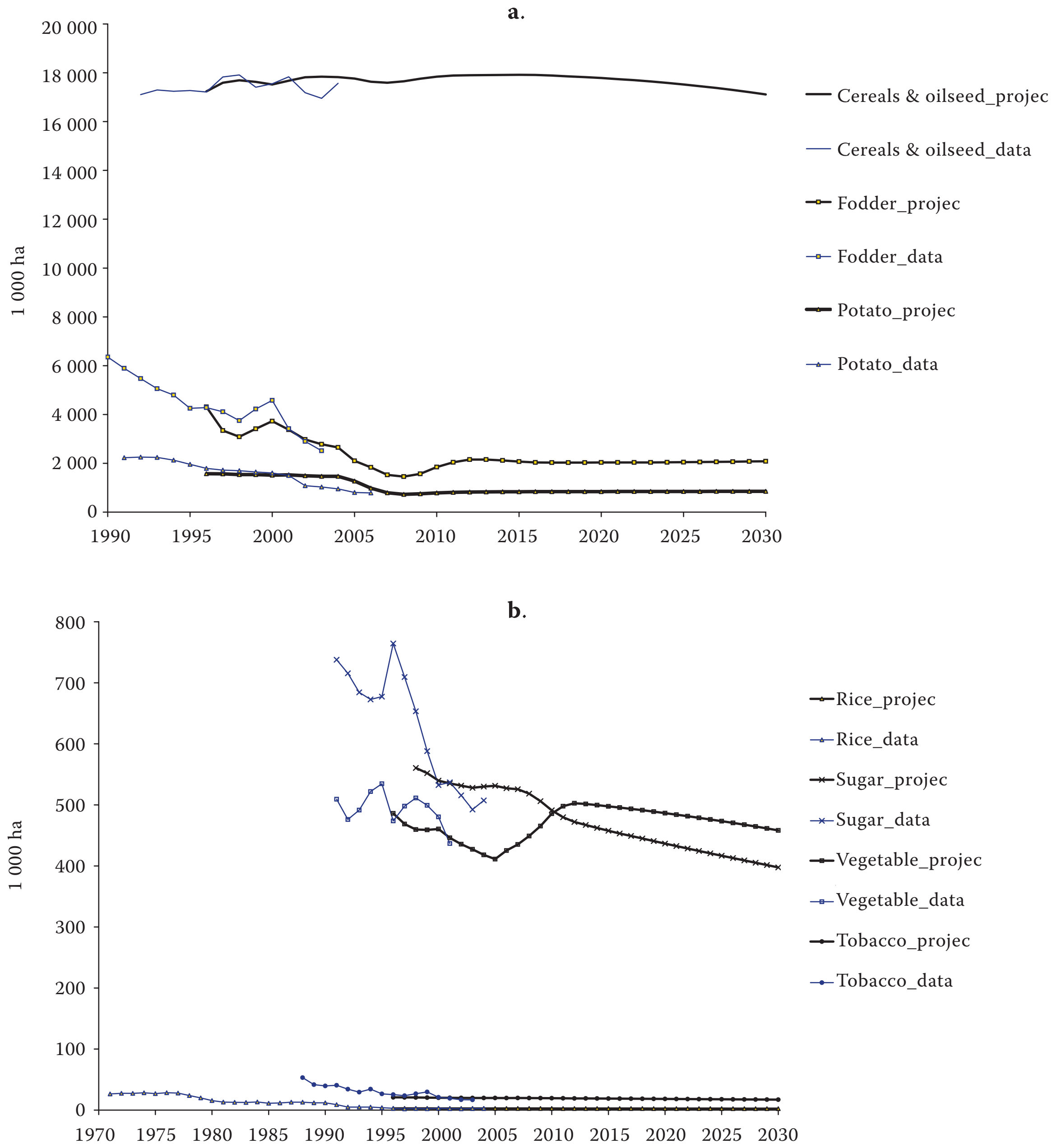

Figure 5. Development of the arable crop area use in the NMS-10, 1990–2030 – *baseline scenario*

the sugar beet area experiences a high increase in the NMS-2 in 2030 relative to 2004 (Table 4 and Figures 5 and 6).

Permanent crop area projections

The vineyard, olive, and fruit area decline in the EU-15 in 3030 relative to 2004. On one side, this is driven by the policy reforms implemented in these sectors as well as due to the external factors (e.g. non-agricultural demand for land resources) causing the reduction in the overall UAA which farmers implement by reducing the permanent crop area together with grassland (Table 5). In the NMS, the projected area of vineyards, olives, and fruits declines less than in the EU-15. Prices of permanent crops in the NMS develop more favorably after the accession than the arable crop prices. This is especially the case of the fruit crop area which increases in the NMS-10 in 2030 relative to 2004, while for the NMS-2, a slight decline is predicted. The vineyard and olive area declines in the NMS, but by less than in the EU-15 (Figures 7–9).

Macro scenario simulation results

This section provides the land use projections for the *macro scenario*. This scenario assumes that

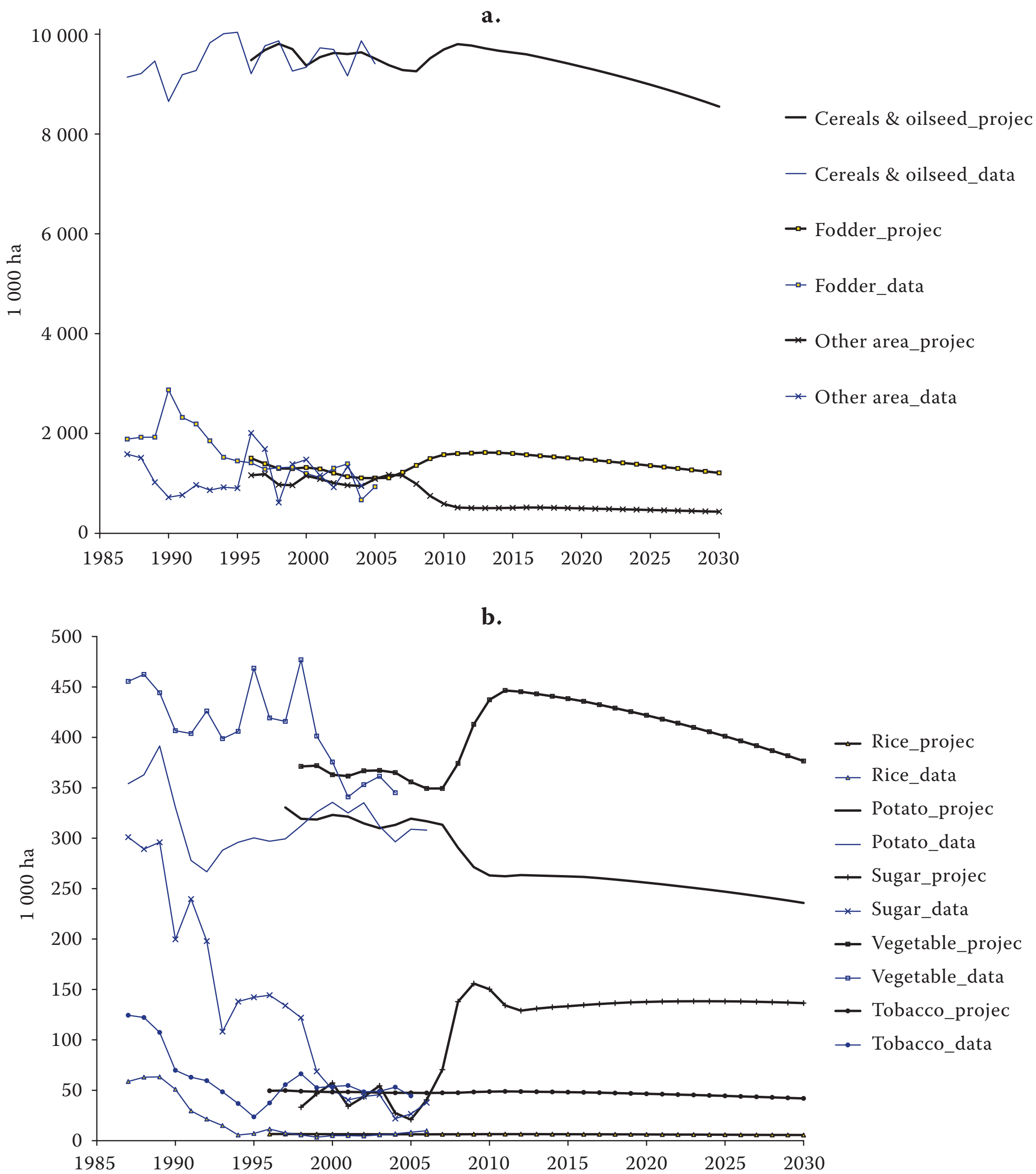

Figure 6. Development of the arable crop area use in the NMS-2, 1987–2030 – *baseline scenario*

from 2009 on, the GDP growth in the EU-15 and the NMS is higher by 50% relative to the *baseline scenario* GDP growth. The simulation results are reported in Table 6. The table shows percentage change in land use relative to the baseline scenario simulation results.

The GDP growth is expected to have a significant impact on the land use changes. Higher growth rates

Table 5. Permanent crop area projections (2004 = 100) – *baseline scenario*

	2004	2007	2010	2015	2020	2025	2030
Vineyards area							
EU-15	100	99	99	95	91	88	84
NMS-10	100	95	99	101	99	96	92
NMS-2	100	97	98	96	93	89	85
Total	100	99	99	95	92	88	84
Olive area							
EU-15	100	97	94	88	81	75	69
NMS-10	100	105	110	109	104	99	93
NMS-2	–	–	–	–	–	–	–
Total	100	97	94	88	81	75	69
Fruit crop area							
EU-15	100	99	98	94	89	85	80
NMS-10	100	114	123	125	122	118	112
NMS-2	100	108	118	115	110	105	99
Total	100	102	104	101	97	92	87
Other permanent crop area							
EU-15	100	103	107	110	109	108	106
NMS-10	100	99	106	110	110	108	106
NMS-2	100	93	90	90	89	87	84
Total	100	102	105	108	107	106	104

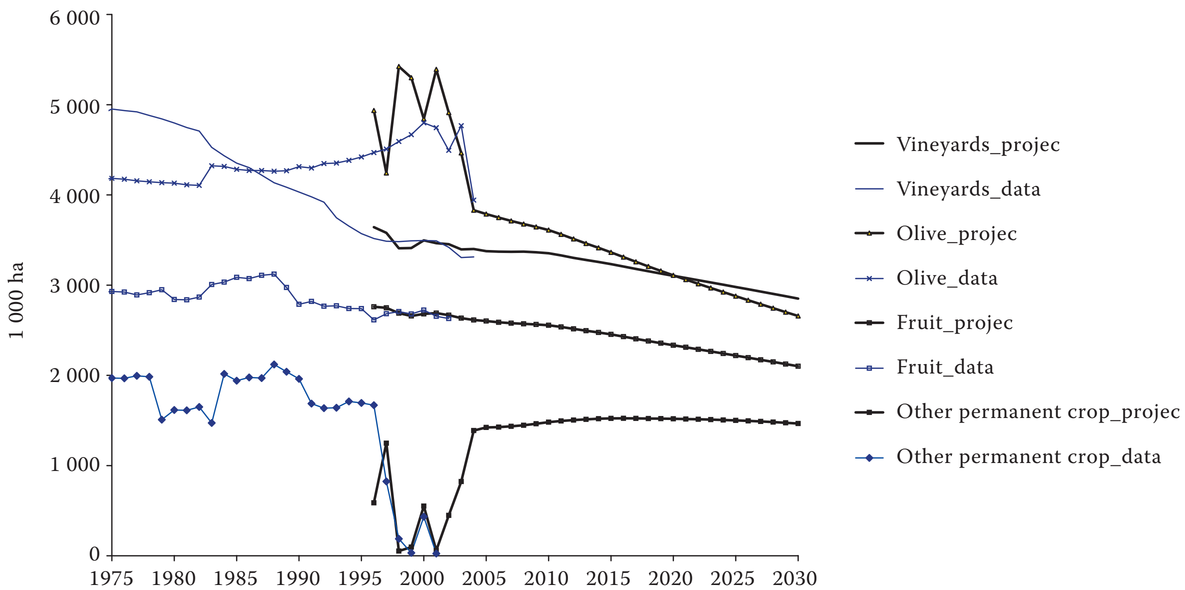

Figure 7. Development of the permanent crop area use in the EU-15, 1975–2030 – *baseline scenario*

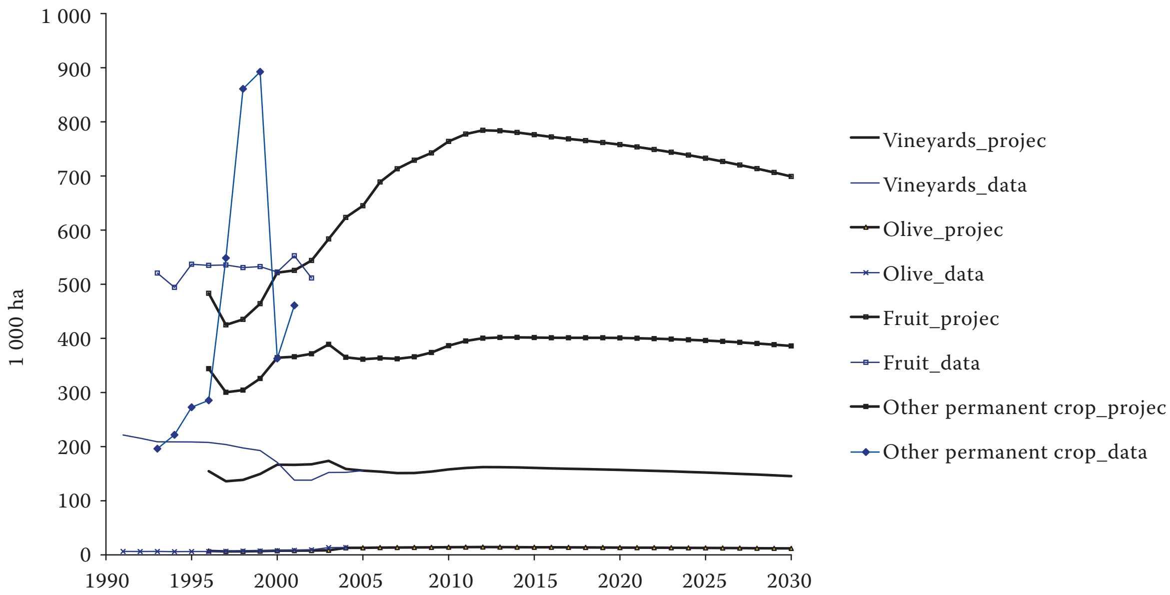

Figure 8. Development of the permanent crop area use in the NMS-10, 1991–2030 – *baseline scenario*

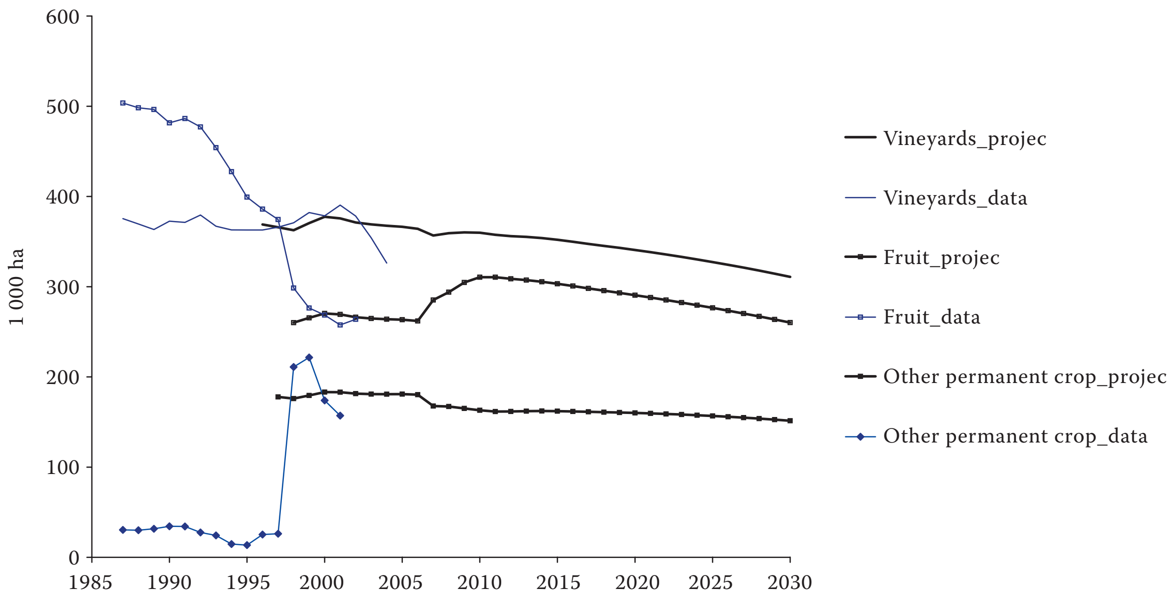

Figure 9. Development of the permanent crop area use in the NMS-2, 1987–2030 – *baseline scenario*

in the NMS than in the EU-15 lead to a stronger reduction in the UAA in the NMS than in the EU-15. Relative to the baseline, the UAA declines by 3%, 11% and 15% in 2030 in the EU-15, the NMS-10 and the NMS-2, respectively. The most of the UAA decline is expected to be transposed by farmers on the permanent crop area and especially the grassland area reduction. Farmers are expected to be motivated to reduce the arable land less due to a higher profitability of arable land, especially relative to grassland (Table 6).

Policy scenario simulation results

This section provides the land use projections for the *policy* scenario. This scenario assumes that from 2009 on, intervention prices, direct payments and quotas are cut by 50% relative to the baseline scenario. The simulation results are reported in Table 6. The tables show the percentage change in land use relative to the baseline scenario simulation results.

The reduction in agricultural support reduces the profitability of land in agriculture relative to the pro-

Table 6. UAA, arable land, grassland, and permanent crop area projections (baseline = 100) – *macro scenario* and *policy scenario*

		2004	2010	2015	2020	2025	2030
Usable agricultural area (UAA)							
EU-15	*macro scenario*	0	–0.2	–0.7	–1.4	–2.2	–3.2
	policy scenario	0	–0.4	–0.5	–0.5	–0.5	–0.5
NMS-10	*macro scenario*	0	–0.4	–1.8	–3.7	–6.7	–11.1
	policy scenario	0	–0.9	–1.4	–1.4	–1.4	–1.4
NMS-2	*macro scenario*	0	–1.2	–2.9	–5.2	–9.0	–15.1
	policy scenario	0	–1.4	–2.4	–2.4	–2.4	–2.3
Total	*macro scenario*	0	–0.4	–1.2	–2.2	–3.7	–5.8
	policy scenario	0	–0.6	–0.9	–0.9	–0.9	–0.8
Permanent grassland							
EU-15	*macro scenario*	0	–0.3	–1.1	–2.1	–3.3	–4.8
	policy scenario	0	–1.3	–1.4	–1.3	–1.4	–1.4
NMS-10	*macro scenario*	0	–1.0	–3.7	–7.8	–13.7	–22.3
	policy scenario	0	–0.5	–1.1	–1.0	–1.0	–1.0
NMS-2	*macro scenario*	0	–1.3	–3.0	–5.4	–9.1	–15.2
	policy scenario	0	–1.0	–1.0	–0.7	–0.6	–0.6
Total	*macro scenario*	0	–0.5	–1.6	–3.1	–5.1	–7.9
	policy scenario	0	–1.2	–1.3	–1.2	–1.2	–1.2
Arable land							
EU-15	*macro scenario*	0	–0.1	–0.5	–1.0	–1.7	–2.5
	policy scenario	0	–0.4	–0.6	–0.6	–0.6	–0.6
NMS-10	*macro scenario*	0	–0.3	–1.2	–2.6	–4.9	–8.5
	policy scenario	0	–1.4	–2.2	–2.2	–2.2	–2.2
NMS-2	*macro scenario*	0	–1.1	–2.8	–5.1	–8.9	–15.0
	policy scenario	0	–1.6	–3.3	–3.4	–3.4	–3.4
Total	*macro scenario*	0	–0.3	–0.9	–1.8	–3.1	–4.9
	policy scenario	0	–0.8	–1.2	–1.3	–1.2	–1.2
Land under permanent crops							
EU-15	*macro scenario*	0	–0.2	–0.8	–1.5	–2.4	–3.5
	policy scenario	0	3.2	3.8	4.0	4.1	4.2
NMS-10	*macro scenario*	0	–0.7	–2.6	–5.3	–9.3	–15.1
	policy scenario	0	7.3	13.0	13.2	12.8	12.3
NMS-2	*macro scenario*	0	–1.3	–2.9	–5.2	–8.9	–14.8
	policy scenario	0	–1.0	–1.2	–1.0	–0.9	–0.8
Total	*macro scenario*	0	–0.3	–1.1	–2.2	–3.6	–5.5
	policy scenario	0	3.3	4.4	4.7	4.7	4.8

fitability of land in alternative uses. The projections reported in Table 6 indicate that the UAA decreases more in the NMS than in the EU-15, specifically by 0.5%, 1.4%, and 2.3% in the EU-15, the NMS-10, and the NMS-2, respectively. This is driven by the combination of three factors. First, the share of arable sector is bigger in the NMS than in the EU-15. The arable sector is one of the most protected sectors under the CAP alongside the livestock sector and with the reduction in overall agricultural support, the arable sector is expected to decrease the most causing a larger effect on the UAA in the NMS than in the EU-15. Second, coupling of direct payments is higher in the NMS which results in a higher reduction of the crop area when the coupled payments are reduced. Third, due to the stronger expected outflow of recourses to other sectors of the economy in the NMS than in the EU-15, there is expected a higher relative decline in agricultural income. The results in Table 6 indicate that compared to baseline scenario, the arable area will decline by 0.6%, 2.2%, and 3.4% in the EU-15, the NMS-10, and the NMS-2, respectively. Table 7 reports the results for the specific crop area with a high variation among crops in the land use changes.

Grassland is expected to decline by 1.4%, 1%, and 0.6% in the EU-15, the NMS-10, and the NMS-2,

Table 7. Arable crop area projections (baseline = 100) – *policy scenario*

	2004	2010	2015	2020	2025	2030
Cereals-oilseeds area						
EU-15	0	–1	0	–1	–1	–1
NMS-10	0	0	–1	–1	–1	–1
NMS-2	0	–1	–2	–2	–2	–2
Total	0	–1	–1	–1	–1	–1
Rice area						
EU-15	0	2	5	6	6	6
NMS-10	0	–1	–2	–2	–2	–2
NMS-2	0	–2	–3	–3	–3	–3
Total	0	2	5	5	6	6
Potato area						
EU-15	0	–6	–7	–7	–8	–8
NMS-10	0	3	7	6	6	5
NMS-2	0	1	1	1	1	0
Total	0	–2	–1	–1	–1	–2
Sugar beet area						
EU-15	0	–12	–18	–19	–21	–24
NMS-10	0	–3	–5	–5	–5	–5
NMS-2	0	–10	–14	–9	–8	–7
Total	0	–10	–15	–15	–16	–17
Vegetable area						
EU-15	0	0	1	1	1	1
NMS-10	0	3	5	5	5	4
NMS-2	0	–1	–3	–3	–3	–3
Total	0	1	1	1	1	1
Fodder from arable land area						
EU-15	0	0	0	0	0	0
NMS-10	0	20	39	39	36	33
NMS-2	0	–12	–19	–19	–18	–18
Total	0	1	3	3	3	3
Other arable land						
EU-15	0	3	0	0	1	1
NMS-10	0	–12	–26	–28	–30	–31
NMS-2	0	12	22	20	19	18
Total	0	–1	–7	–7	–7	–6
Tobacco area						
EU-15	0	4	9	10	12	13
NMS-10	0	–1	–2	–2	–2	–2
NMS-2	0	–2	–3	–3	–3	–3
Total	0	2	5	5	6	6

Table 8. Permanent crop area projections (baseline = 100) – *policy scenario*

	2004	2010	2015	2020	2025	2030
Vineyards area						
EU-15	0	4	5	5	5	5
NMS-10	0	11	17	17	16	16
NMS-2	0	0	0	0	0	0
Total	0	4	5	5	5	5
Olive area						
EU-15	0	–14	–12	–11	–10	–9
NMS-10	0	–10	–4	–3	–2	–1
NMS-2	–	–	–	–	–	–
Total	0	–14	–12	–11	–10	–9
Fruit crop area						
EU-15	0	3	4	4	4	4
NMS-10	0	5	11	11	11	11
NMS-2	0	–4	–4	–4	–4	–3
Total	0	3	5	5	5	5
Other permanent crop area						
EU-15	0	42	36	32	28	26
NMS-10	0	11	16	16	15	15
NMS-2	0	3	2	2	2	2
Total	0	33	29	26	24	22

respectively (Table 6). In contrast to the arable area and grassland, the permanent crop area increases in the EU-15 and the NMS-10, while in the NMS-2, it slightly declines (Table 6). Table 8 reports the disaggregated simulation results for permanent crops. Because of the cut in the wine abandonment premium, the vineyard area increases relative to the baseline scenario. At the same time, the less protected fruit crops increase in the EU-15 and the NMS-10. On the other hand, the olive area is expected to decline due to a higher decrease in the relative returns.

CONCLUSIONS

This paper provided simulation results up to 2030 for three scenarios: the baseline, macro scenario and policy scenario. In the baseline scenario, the UAA is expected to decline, but more strongly in the NMS than in the EU-15 due to the higher expected GDP growth rate. The most of the decline in the UAA is coming from grassland followed by the permanent crop area and arable land. Farms first reduce the less productive land such as grassland as a response to the economic growth.

The simulation results for the macro scenario and the policy scenario indicate that the GDP growth leads to a stronger effect on land use changes than the CAP. A higher GDP growth by 50% relative to the baseline growth leads to a higher decrease in the UAA and stronger changes among the different land use categories than the policy scenario which assumes the reduction in the policy support by 50% relative to the baseline. These results indicate that structural changes in economy are stronger drivers of the aggregate land use changes in agriculture than agricultural support. On the other hand, agricultural policy is more important in affecting the allocation of agricultural area among different crops.

In this paper, the simulations were provided up to 2030. However, one should caution the simplistic interpretation of such a long-run trends. The aim of the paper was to provide long-run trends in the land use in the EU reflecting past developments. Most of the forecasts are estimated based on the past trends and therefore they are subject to future structural changes that could not be captured in the estimations.

Acknowledgment

This research was undertaken with support from the European Union sixth Framework Research Programme. The content of the publication is the sole responsibility of the authors and it in no way represents the views of the Commission or its services.

REFERENCES

AGMEMOD (2006). Impact Analysis of the CAP Reform on Main Agricultural Commodities. Report 4, Baseline and Scenario Results of Country and EU 25/27 Aggregate Models, AGMEMOD Partnership.

Chantreuil F., Levert F., Hanrahan K. (2005): The Luxembourg Agreement Reform of the CAP: An Analysis using the AGMEMOD Composite Model. In: 89th EAAE Seminar, Parma, Italy. February 3–5, 2005.

Choi J.S., Helmberger P.G. (1993): How sensitive are crop yields to price changes and farm programs? Journal of Agricultural and Applied Economics, *25*: 237–244.

Erjavec E., Donnellan T. (2005): Development of the AG-MEMOD Country Level Agricultural Policy Analysis Tool in the New Members States of EU. In: 89th EAAE Seminar, Parma, Italy. February 3–5, 2005.

Gohin A. (2004): Assessing the 2003 CAP Reform: Sensitivity to the Decoupling of Agenda 2000 Direct Payments. TRADEAG Working Paper 06/04.

Just R.E., Antle J.M. (1990): Interactions between agricultural and environmental policies: A conceptual framework. American Journal of Agricultural Economics, *80*: 197–202.

Menz K.M., Pardey P. (1983): Technology and U. S, corn yields: plateaus and price responsiveness. American Journal of Agricultural Economics, *65*: 558-562.

OECD (2004). Analysis of the 2003 CAP Reform. OECD, Paris.

Arrived on 9th June 2007

Contact address:

Pavel Ciaian, LICOS – Centre for Institutions and Economic Performance, Katholieke Universiteit Leuven, Deberiotstraat 34, B-3000 Leuven, Belgium
e-mail: pavel.ciaian@econ.kuleuven.be; www: http://www.ciaian.szm.sk;