



# Implementation of the CAP Policy Options with the Land Use Modelling Platform

**A first indicator-based analysis**

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## A first indicator-based analysis

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# Executive Summary

## **Background**

In November 2010, the European Commission launched the revision of the Common Agricultural Policy (CAP) with the Communication “The CAP towards 2020”<sup>1</sup>, based on the outcome of a wide public debate (initiated in April 2010). This document identifies the challenges that should be addressed in the forthcoming years, and in line with the “Europe 2020 Strategy” defines as main objectives of the reform i) *Viable food production*; ii) *Sustainable management of natural resources and climate action*; and iii) *Balanced territorial development*. In order to accomplish these aims, three policy options are outlined: the “Adjustment”, the “Integration” and the “Re-Focus”. These options differ mainly in the weight that is given to a specific objective and present diverse ways to achieve these objectives.

In this context, and in the framework of the impact assessment procedure, the Institute for Environment and Sustainability of the European Commission Joint Research Centre (JRC-IES) was requested by DG Environment (DG ENV)<sup>2</sup> to assess a range of environmental impacts resulting from the implementation of different policy settings foreseen under the CAP reform, focusing on the greening component of Direct Payments, as defined in the Integration policy option.

Therefore, a range of environmental impacts of the CAP reform are presented and assessed within this report. The work is based on a modelling approach that translates socio-economic driven land use projections for the year 2020.

## **The methodology**

The results presented here are derived from the application of the Land Use Modelling Platform (LUMP), developed by the JRC-IES to support the exploration of future policies and the impact assessments of

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<sup>1</sup> COM(2010) 672 final: Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions “*The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future*”.

<sup>2</sup> This work was developed in the scope of an Administrative Agreement between JRC and DG ENV - *Support for improving land-use modelling for informing environmental policy making* (AA N. 070307/2010/555750/F1 JRC Ref. N. 31656-2010 NFP ISP).

alternative implementation measures. The core component of this platform is the land use model *EUClueScanner* (EUCS100), developed in collaboration with DG ENV.

LUMP integrates diverse and specialized models and data into a coherent workflow. For this assessment, the profiles of the current CAP scenario and the Integration policy option are quantified within the LUMP through three modules: i) the amount of land claimed per land-use type (derived from external models); ii) a set of rules to allocate this requested land; and iii) the computation of indicators to facilitate the analysis of results.

The amount of land claimed is computed based upon regional and global parameters. These parameters are derived from dedicated external models for a range of issues such as demography, agriculture, regional economy, climate change. All contribute to the definition of the requirements for land use/cover transformations. The forecasted amount of land required for the agricultural sector is computed using the projection for 2020 from the “Common Agricultural Policy Regionalised Impact Modelling System” (CAPRI)<sup>3</sup> in a special configuration for farm level policy analysis (CAPRI-FARM). The scenario from this CAPRI-FARM configuration is a direct payment scenario with flat rate premiums at Member State level. The amount of land claimed for built-up areas for the 2020 forecast is based on future population estimations from DG ECFIN/Eurostat (EUROPOP 2008).

The spatial allocation of land use is determined within EUCS100 by a set of locally influencing factors which together define the suitability of each land parcel for each land use type. These factors include accessibility, policy-driven restrictions and biophysical properties such as topography, soil characteristics and crop suitability maps (provided by the JRC-IES AGRI4CAST Action). A spatially refined Corine Land Cover (CLC) map for the year 2006 is used as the initial year for the simulations.

As a final step, a set of indicators is computed in order to give an overview of the impacts of the reform proposals on the European territory. These indicators are designed to highlight spatially varying impacts of the assessed policy options, thus enabling an evaluation of the impacts of the new CAP within a geographical context which is comparable to that of the reform itself. Additional indicators can be computed, covering other environmental issues, such as water quality, in order to gain a deeper insight into the regional impacts of CAP.

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<sup>3</sup> CAPRI is an economic model developed by the University of Bonn with the aim of providing sound scientific support to policy makers regarding the CAP.

A baseline scenario and a policy alternative are defined and implemented in the LUMP resulting in two different simulated land use/cover maps for year 2020:

- the *Status Quo* scenario represents the current socio-economic and environmental trends with existing policy provision maintained (business-as-usual scenario);
- the *Integration* policy option builds on the present policy provisions but it encompasses a specific set of greening measures.

The Status Quo is considered to be the reference scenario to which the impacts of the Integration policy option are compared. For the Integration policy option, the following specific greening measures were implemented as part of the assessment:

- ecological focus area,
- maintenance of permanent pastures,
- separate payment for Natura 2000 areas.

The implementation of these policy settings in the EUCS100 model were based in assumptions that are briefly exposed in Box I.

## Box I: Main assumptions used in this study

### Common/shared assumptions for both scenarios

- Future land claims for arable land and pasture were derived from the CAPRI-FARM 2020 scenario with the assumption of national-flat rates.
- Future land claims for urban land were derived from Eurostat data (EUROPOP2008), based on a single convergence scenario, whereby demographic structural differences between EU countries are assumed to fade out by 2150.
- Land use change from forest or semi-natural vegetation to agricultural land is only allowed outside protected areas (i.e. Natura 2000).
- Land use change from agricultural land to urban or industrial land is only allowed outside protected areas (i.e. Natura 2000).
- Abandoned land is driven by economic factors, i.e. emerges as a result of the decline in agricultural claims, and thus its definition does not take directly into consideration any other variable related with economic or demographic conditions (e.g. holdings with low income or proportion of farmers close to retiring age).

### Status Quo scenario

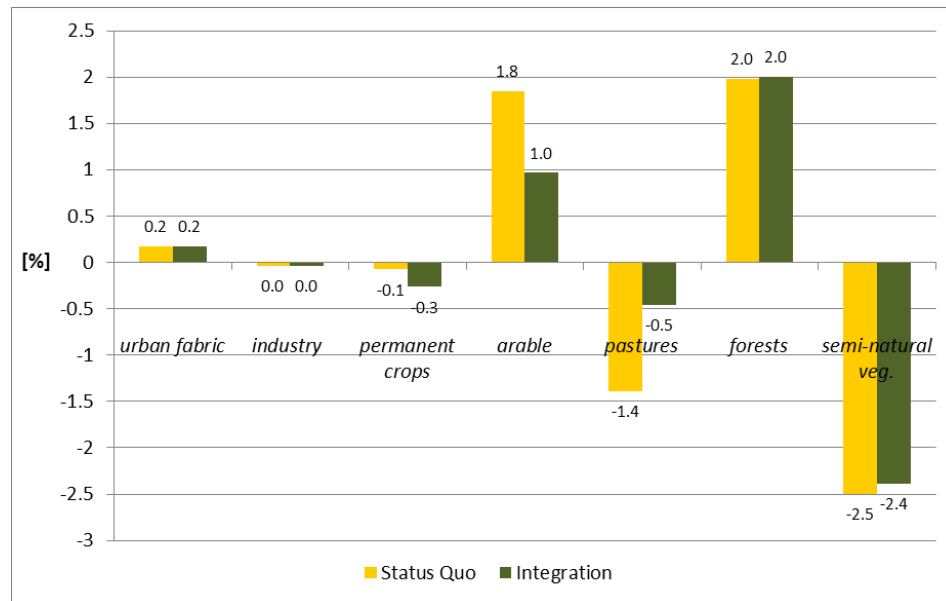
- Land use change to arable land and permanent crops is encouraged in Less Favoured Areas (art.18 and 20) and discouraged in environmental sensitive areas: a 50m strip width along water courses in currently designated Nitrate Vulnerable Zones; and in erosion sensitive areas (where erosion is between 20 and 50 ton/ha/year and higher than 50 ton/ha/year).

### Integration policy option

- As in Status Quo, land use change to arable land and permanent crops is encouraged in Less Favoured Areas (art.18 and 20) and discouraged in environmental sensitive areas: a 50m strip width along water courses in currently designated Nitrate Vulnerable Zones; and in erosion sensitive areas (where erosion is between 20 and 50 ton/ha/year and higher than 50 ton/ha/year), however due to the emphasis that is given to the sustainable management of natural resources, these conditions are combined with a slightly higher degree of discouragement in this policy option.
- Maintenance of agricultural land is encouraged in Natura 2000 areas currently cropped and in the High Nature Value Farmland.
- Maintenance of pasture/grassland that has not been in rotation for at least 5 years in its current status is enhanced.
- The occurrence of Semi-natural vegetation is encouraged in a 50m strip width along water courses within current Nitrates Vulnerable Zones.
- Agricultural abandonment is enhanced in a 50m strip width along water courses.

## The results

The overall (EU27) changes in land use/cover (2006-2020) are presented in Figure I.



**Figure I: Net change (%) in EU27 from 2006 to 2020, per land use/cover**

For EU27, both simulations estimate an increase of arable land (higher in Status Quo) and a slight decrease of permanent crops and pastures. For pastures the reduction is less significant in the Integration policy option due to the greening measure ‘maintenance of permanent pastures’. This difference is particularly evident in Ireland, Greece and Romania. Forest increases in both simulations (especially in Sweden, Finland, Portugal and Czech Republic), while semi-natural vegetation decreases (mainly in Sweden, Finland, Estonia and Bulgaria). The decline of semi-natural vegetation and the growth of forest in Sweden and Finland are partly due to the natural succession process.

To assess the impact of the projected changes in land use/cover in 2020, a set of indicators are generated by linking the changes with specialized thematic models. A number of quantitative conclusions can be drawn from analysing these indicators:

### 1. Distribution of agricultural land use categories

The shares of the three types of agricultural land uses (arable, permanent crops and pasture) are consistent in all countries between the two simulations for 2020, except for the United Kingdom

where the share of pastures is significantly higher under the Status Quo scenario and for Ireland, where the share of pastures is significantly higher under the Integration policy option. Although there is an overall increase of arable land in the EU27 under both simulations for 2020, this trend is not consistent among all Member States: an overall decrease was forecasted for the Czech Republic, Denmark, Poland, Portugal, Slovenia and Sweden. There is a slight overall decrease in permanent crops in the EU27 under both Status Quo scenario and Integration policy option for 2020, especially in Spain.

## 2. Land cover change

The expansion of agricultural land at the expense of semi-natural vegetation is, in general, higher under the Integration policy than the Status Quo scenario. The difference is particularly relevant in Greece, Slovakia and Cyprus, whereas Ireland, Sweden and Finland manifest a higher conversion from semi-natural areas to agricultural land under the Status Quo scenario than under the Integration policy option.

The loss of forest due to the expansion of agriculture is particularly pronounced in Latvia, Estonia and Lithuania, especially under the Integration policy option. This same pattern of change is also evident in the vicinity of Natura2000 sites.

While there is an overall increase in arable land, there is also abandonment of some agricultural areas. In the EU27, this change is less than 1% and is slightly more pronounced in Slovenia (6% in Status Quo, 3% in Integration policy) and Ireland (around 2% for both model runs). The Integration policy option results in a high value of abandonment in riparian areas (25% in the Integration and 2% in the Status Quo), due to the greening measure ecological focus area, which promotes the establishment of buffer strips along water courses. In the scope of this project, riparian areas were considered as a 50m strip width (both sides) along water courses.

## 3. Agricultural land converted to artificial surfaces

At EU27 level, the loss of agricultural land due to urbanisation is less than 0.35% for the Status Quo scenario and for the Integration policy option. This process is more intense (higher than 1%) in Cyprus (especially under the Status Quo scenario), but also in Ireland, the Netherlands and the United Kingdom for the Status Quo and the Integration. Similar trends, as those previously described for EU27, are found around Natura2000 sites (in a 500m buffer zone), where agricultural loss to

urbanization is higher than 1% only in Ireland, Netherlands and Cyprus (in this case only under Status Quo).

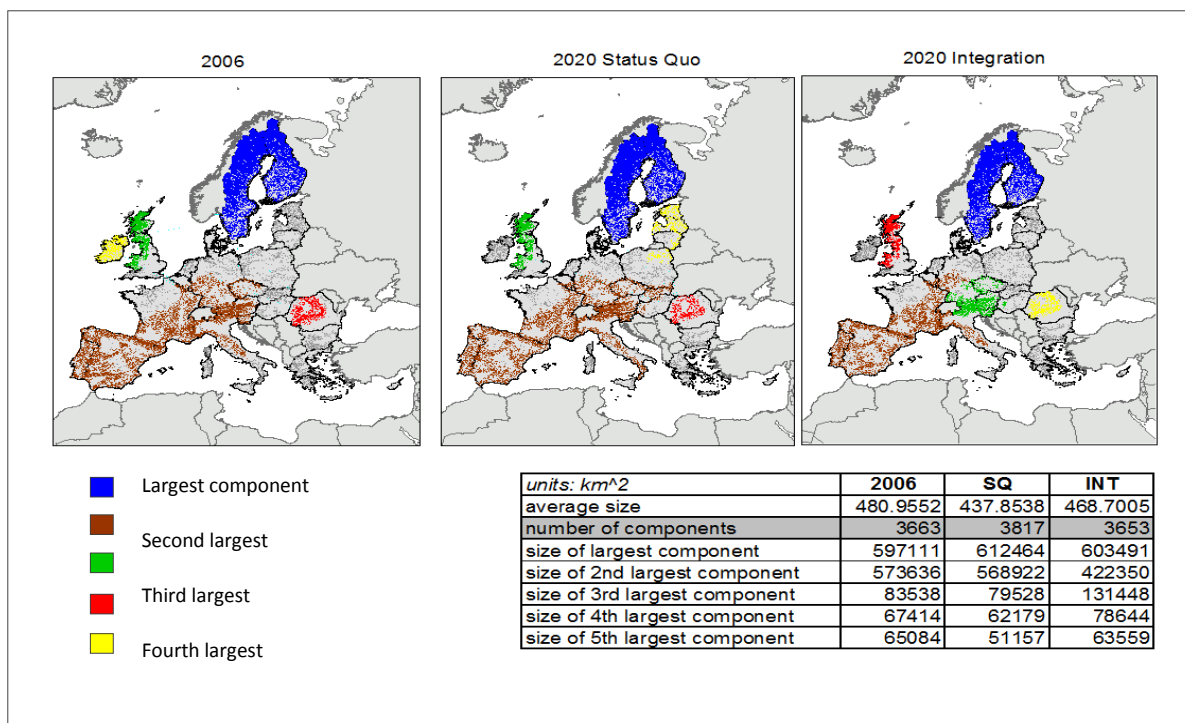
#### 4. Conservation of natural areas

In the vicinity of Natura2000 sites, the loss of semi-natural vegetation to agricultural land in 2020 varies considerably between Member States, with notable loss in Estonia, Greece and Spain for both runs, and Latvia for the Integration policy option.

In buffer zones along rivers the expansion of agricultural land over semi-natural vegetation is less intensive under the Integration policy option than under the Status Quo scenario for all countries with the exception of Austria, Germany, Poland, Slovakia and the United Kingdom.

#### 5. Conservation and connectivity of Green Infrastructure

The net amount of Green Infrastructure increases under the Integration policy option with respect to the Status Quo scenario. However, whereas there is a gain in the number of connecting elements within Green Infrastructure under the Integration policy option, there is a net loss of number of compact core natural areas referred to as *nodes*. Two per cent of core natural areas are infringed upon by agriculture in the Integration policy option. On the contrary, this trend of loss of core natural areas is not seen within the Natura 2000 sites. The majority of this network of protected areas (54%) manifests an improvement of core natural areas. In the Integration policy option, according to the results of this modelling exercise, some natural areas which are key to Green Infrastructure components are ruptured. **This result emphasizes the importance of targeting the support through localising areas to be beneficiaries of greening, as opposed to just increasing the quantity of natural areas *ad hoc*.**



**Figure II: The five largest components are shown for the 2006 Green Infrastructure map and the 2020 output for Status Quo and Integration**

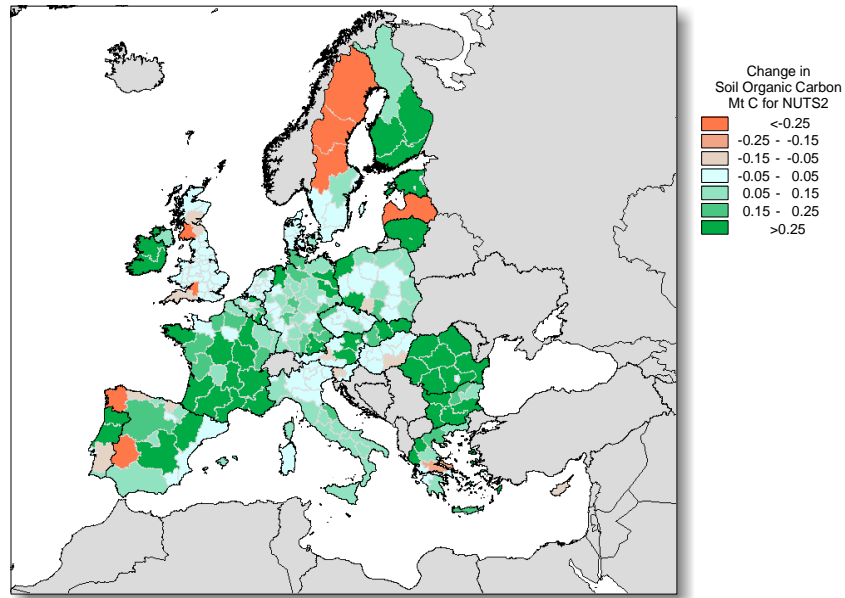
#### 6. Homogeneous agricultural areas

Important from a biodiversity perspective is the level of homogeneity of agricultural regions, likely to reflect more intensive agriculture. The results show that areas with a ‘pure core’ agricultural pattern become more heterogeneous in the Integration policy option (hence more favourable to biodiversity), with only two exceptions (Estonia and Latvia). Only a very small percentage of Natura 2000 polygons worsen under the Integration policy option (5.14%) whereas 22.14% improve (72.72% do not show any changes).

#### 7. Soil Organic Carbon stocks

The estimated changes in soil organic carbon (SOC) stocks have been found to be very responsive to evaluating the differences in land use change. For both the Status Quo scenario and the Integration policy option, a loss of SOC-stocks for EU27 is modelled, showing a loss more than twice as high under the Status Quo scenario than those estimated for the Integration policy option.

The losses in SOC-stocks are not evenly spread across the area of the EU27 and also divergent trends between the regions of a single country were modelled. The estimated changes in SOC from Status Quo to Integration policy option over 10 years and aggregated at NUTS2 are presented in Figure III.



**Figure III: Estimated Changes in Soil Organic Carbon from Status Quo scenario to Integration policy option over 10 Years (NUTS2)**

In conclusion, these simulations have shown that the greening options implemented under the Integration policy option produce an overall impact that can be measured with a set of land use/cover based indicators. In general terms, the modelled greening options reduce the pressure on naturally vegetated areas and on environmentally sensitive sites. When comparing the results obtained for the two simulations, the Integration policy option points towards a lower level of environmental impact as compared to the Status Quo scenario globally at the EU27 level. However, several indicators also show pronounced regional differences and local developments, which do not follow the national or European trends.

The method developed and the tools applied within this project have been proven to provide highly relevant results to evaluate the potential impact of measures affecting land use/cover change. The Land Use Modelling Platform has been found highly adaptable to model even complex scenarios and an expert instrument to support further evaluation of European agricultural policies. In fact, the possibility

to evaluate geographically differentiated impacts is one of the key assets of the methodology since it allows to assess EU policy proposals from a wide continental perspective as well as from a more detailed regional viewpoint. This is essential for policies such as the CAP where local characteristics (related to biophysical features and management practice) are the main elements to be considered when evaluating their impacts. Furthermore, the combination of an economically driven schema (as projected by CAPRI) with a high resolution biophysical analysis (as deduced by LUMP) allows the quantification of phenomena otherwise not possible. In the wider perspective of the impact assessment procedure within the European Commission, the proposed methodology adds essential quantitative and qualitative elements, in particular because of its multi-sectoral approach.

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**Abstract**

This report presents the results of a study aiming to assess the environmental impact of two alternative scenarios for the new Common Agricultural Policy, evaluated by using the features of the Land Use Modelling Platform (LUMP). The first scenario set the baseline conditions in form of the Status Quo; the second was a policy alternative, Integration. The scenarios set the framework for the economic drivers as analysed by CAPRI, which the LUMP integrates to produce detailed and geographically specific projections of changes in land use/cover between 2006 and 2020. The changes in land use/cover were then evaluated for their impact on various environmental sectors by comparing their effect on a set of relevant indicators of environmental conditions.

The simulations have shown that the greening options expressed under the Integration policy option produce an overall impact that can be measured with a set of land use/cover based indicators. In general terms, the greening options reduce the pressure on naturally vegetated areas and on environmentally sensitive sites.

This modelling approach has proven to be applicable for the evaluation of the new CAP scenario and the implementation of policy options, in the frame of the overall objectives of the reform. Due to the characteristics of the modelling framework, the set of computed indicators shows the differentiation of the impacts at national and regional levels, allowing the assessment of the impacts of the new CAP in the proper geographical context.

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