

CROSS-COMPLIANCE ASSESSMENT TOOL

**Policy-oriented research:
Scientific support to policies SSP**

Specific Targeted Research Project (STREP)

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Glossary of terms and acronyms

CC	Cross Compliance
CCAT	Cross Compliance Assessment tool. It is the acronym of the project and also the name of the integrated assessment tool (CCATool) delivered by the project.
CAP	Common Agricultural Policy
EU legislation	Part of the EU legislation associated to the cross compliance system on environment, food safety, animal health and welfare
GAEC	Good Agricultural and Environmental Condition
LSU	Livestock Unit
NVZ	Nitrate Vulnerable Zone
“per se”compliance	Compliance with cross compliance standards without taking any action at any time, farmers comply automatically. This is also why for many standards there does not exist a 0 compliance level (e.g. nitrogen gifts below 170 kg/N/ha in NVZ are quite common)
SMR	Statutory management requirement.
SFP	Single Farm Payment or direct payment, which is largely decoupled from production.
UAA	Utilised Agricultural Area

Executive summary

The CCAT tool

A tool has been developed, which allows for an integral assessment of compliance with the standards that are part of EU cross compliance policy. The CCATool enables integral assessment of the impacts of standards, which are part of cross compliance, for different input data and under different scenario assumptions. Although a baseline and a number of pre-selected scenarios are defined, the tool is flexible in that it allows the user to make his own choices with respect to a large set of key parameters, among which there are: compliance rates, cost estimates for becoming compliant with sub-obligations of standards per region, per farm type, implementation of CC measures etc. Impacts, as evaluated by specific indicators, are measured for various impact fields. The effects assessed in the CCAT project relate to agricultural markets, producer's income, land use, soil, water, air, climate, biodiversity and landscapes, as well as animal and public health.

Main results

As regards the results, effects of additional compliance (gap-closure between baseline and 100% compliance) were found to be limited as the best-estimates of baseline compliance are already high (average at 90% for most CC standards). However, clear regional differences were found. Another finding was that overall effects of cross compliance standards (measured as percentage changes in field specific indicators) tend to be larger in economic rather than in environmental and biodiversity terms. Again clear regional diversity is seen. This also applies to the potential effectiveness of CC standards on biodiversity and landscape but generally it is very positive. Regional variation in the latter occurs due to large differences in implementation at national and regional levels (both for EU legislation and GAECs). This effectiveness is assessed on the basis of the formulated obligations in the regional legislations (legal texts) which have obtained a score. Total effectiveness is then expressed as the average of scores per group of GAEC and or EU legislation obligations.

As to the economic effects the overall conclusion is that costs for becoming compliant with CC standards are only partly compensated for by market effects. However, the total costs are limited, especially when concentrating on the costs for additional compliance i.e. the costs that still have to be made between baseline compliance, i.e. the level of compliance when CC was introduced, to reach the 100% compliance rate. Divergent economic effects occur in crop and animal sectors: In the crops sector the production and prices remain rather constant under influence of CC standards. In the animal sectors there is a general production decrease and a price increase. This generally leads to small but regionally diverse changes resulting in both intensification and extensification of livestock and land use.

As to the environmental effects, assuming gap closure, in most regions limited declines in agricultural emissions were observed. However, a selection of regions experienced some very limited but negative environmental externalities such as loss in soil carbon in regions in Poland and Southern Portugal, ammonia emission increases in Poland, Bulgaria, Romania and Alpes-Méditerranée. However, these increases are relative and since the baseline situation refers to very small levels a relative change can be rather large.

Specific conclusions on environmental impacts

Impacts of CC standards related to the Nitrates Directive show that:

- Impacts are highest on N leaching/runoff, while there is also a small positive effect on NH₃ emissions, N₂O emissions and carbon sequestration.
- Except for balanced N fertilization, the impacts are limited (<5%) on N leaching and N concentrations in surface waters and very limited (<2%) for N emissions. A strict balanced N fertilization to be applied in a wider number of regions has the largest potential to further reduce N leaching and NH₃ emissions and enhance GHG mitigation
- The difference between baseline and zero compliance (what did we gain?) is considerably larger than between full compliance and baseline (what can still be gained?). This is because the level of compliance with the Nitrate Directive was already very high in most regions when CC was implemented.

The GAEC standards show significant reductions in erosion and to a lesser extent increases in soil carbon stocks and reductions in N fluxes.

The impacts of CC standards are regionally diverse. In most regions, there are declines in agricultural emissions and increases in soil carbon. However, a selection of regions experience negative environmental externalities.

Specific conclusions as regards to biodiversity and landscape impacts

Intensity changes due to CC are in general quite small, although its effect on biodiversity will vary depending on regional characteristics such as share of HNV farland and the assemblage of wild species present in the region.

However some general trends emerge:

- Livestock intensity: An extensification trend is seen in Scandinavian and Eastern European countries and North Western Iberian Peninsula regions versus intensification in Central European Countries and Mediterranean regions (except Italy).
- Land use intensity: An extensification trend is seen in Mediterranean, Scandinavian and Eastern countries versus intensification in Central European countries.

Specific conclusions as regards to potential effectiveness assessment

- The method, although an experiment and including both intended and unintended effects of CC measures, seems useful to explore patterns of potential effectiveness of CC measures on biodiversity and landscape across the EU.
- In general, positive effects are found, although quite variable in magnitude among EU Legislations and GAECs. No negative effects are foreseen.
- Results are now expressed as an average score per region to correct for differences in the number of GAEC and EU legislation measures implemented in every region. In a next assessment this approach could be further improved by weighting the score according to

the share of regional UAA, of Natura 2000 and the assemblage of wild species present to obtain a more precise assessment.

Recommendations with respect to the use of the CCAT-assessment tool

Based on the obtained results and improved insights gained with respect to the trade-offs between standards and impacts at different levels of compliance, the following recommendations can be given:

- To optimally exploit the potential of the CCATool for assessing the impacts of standards that are part of the EU's cross compliance policy, it still remains crucial to improve the information on compliance rates with standards and also, although to a lesser extent, on the costs of compliance.
- The main aim of the CCAT project was to generate a tool for an integrative assessment of the standards that are part of the EU's cross-compliance policy. The CCAT tool provides an extensive overview of the impacts of (minimum) standards for several impact fields. Rather than using the tool for impact assessment of such standards, it would also be very interesting and feasible to use the tool in such a way as to study which standards are needed in order to achieve certain impacts (which may be public goods, or specific rural services, including climate change issues).
- The CCAT tool is also useful for understanding which public services are most efficient both from an economic and environmental perspective. It helps to identify those measures with limited costs and high environmental externalities and also measures with high costs and low environmental externalities.
- More and/or stricter measures (e.g. balanced fertilization) can further enhance GHG and N-leaching mitigation as long as they do not involve significantly higher cost levels. Otherwise contrary effect may be sorted through production increase response.

Potential extensions and limitations of the CCAT-tool

Whereas the CCAT tool has been developed with a focus on the EU legislation associated to the cross compliance system, it has a wider potential applicability. As such it can be useful to evaluate some of the new challenges addressed in the 2008 Health Check of the CAP. Although the CCAT tool integrates a wide number of aspects, and is to our knowledge the best integral evaluation framework of its kind that is currently available, it also has a number of limitations. Some selected potential extensions and limitations are:

- The CCAT tool could also provide integrated assessment support in a wider context than only Cross Compliance. The CCAT tool can easily be adapted to assess:
 - Climate policy options (climate proof GAECs)
 - Public services and their potential effects
 - Land use changes induced by bioenergy targets
- The CCAT project did not assess the permanent grassland obligation, or considers the effects on extensive grassland categories and HNV farmland, due to limitations in the models and data. This could be addressed in a follow-up by extending the approach with an improved grassland module incorporated in CAPRI and extensive data collection and land use modelling.

- Moreover, biodiversity is not assessed directly, but only through pressure indicators related to biodiversity, which reflects the state-of-the-art in biodiversity assessments, but further spatial analysis and case studies could provide better insight into real impacts
- Input data on which basis the present assessments are done could always be improved which will also improve the output. Up-dates of input data can however be easily implemented.

1 Introduction

1.1 Focus and scope of assessment

The main objective of CCAT was to do an EU wide regional assessment of the impacts of important parts of EU legislation on environment, animal welfare and public health. Since agriculture is the focus of this study, the EU legislation considered is the one associated to the Cross Compliance (CC) system because this system makes a link between this legislation and the CAP payments. Cross Compliance is an extra mechanism to stimulate farmers to adjust behaviour in a desired direction. Measures include monitoring, inspection and punishment in the form of reduction of CAP payments (see Box 1.1 for more information). Consequently the wording "EU legislation" will be used further in this document for identifying the relevant EU legislation which is also included in the scope of cross compliance.

Box 1.1 Background to cross compliance

The 2003 Mid-Term Review (MTR) of the Common Agricultural Policy (CAP) introduced a number of adjustments to agricultural support. One of the most substantive changes was the introduction of a system of decoupled payments per farm (Single Farm Payment (SFP)) in combination with a (compulsory) cross compliance (CC) instrument (EC-Regulation 1782/2003). The latter refers to a system in which the CAP payments are made conditional on farmers meeting Statutory Management Requirements (SMRs) and Good Agricultural and Environmental Conditions (GAEC). Together with the greater decoupling of support payments and the rural development Second Pillar that were introduced in 2003, cross compliance intrinsically sought to promote sustainable agriculture. At the same time, it should help to justify the payments for farmers to society. Moreover, its scope was extended from its original environmental focus to a much wider range of public concerns, each of which was already covered by EU legislation, e.g. animal welfare, food safety, and maintaining agricultural land in a good agricultural and environmental condition (GAEC). More specifically CC could positively contribute to integrate in the CAP areas of EU legislation that could help to ensure that the positive environmental and safety benefits of agricultural management of the land are achieved. Detailed rules for the implementation of cross compliance are set down in Regulation (EC) No 796/2004 and were recently further adjusted (Regulation (EC) No 1122/-2009). The first CC SMRs were implemented in the EU 15 and Malta and Slovenia as from 2005 onwards. They relate to environment, public and animal health, and the identification and registration of animals. In 2006 and 2007 additional SMRs followed related to food safety (public health) and notification of diseases and animal welfare. For the new member states (excluding Romania and Bulgaria) the first SMRs were only introduced into the scope of cross compliance in 2009. In 2009 the CC instrument was further adjusted (Regulation EC No 73/2009)¹. At this moment 18 SMRs are included in the CC package. The implementation of GAEC standards was done in 2005 in both old and new member states. GAEC standards are defined at Member State level and have been newly introduced as part of the CC package. Roughly, in 2008 there were 11 standards relating to the protection of soils and maintenance of habitats and agricultural land. In addition, each

¹ Council Regulation (EC) no. 73/2009 of 19 January 2009. *Official Journal of the European Union*, L 30/16. <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:030:0016:0099:EN:PDF>

Member State must ensure that the area of permanent pasture is maintained at the same magnitude as in 2003 (2004-2005-2007 for the new MS). The latter clause was also newly introduced with CC and aims at avoiding the abandonment of land and associated environmental degradation. Abandonment of land was feared as a potential by-effect of the introduced decoupling, which delinked support from production activities. As such the GAEC standards are aimed to ensure that the positive environmental benefits of agricultural management of the land are achieved. In CCAT the impact assessments focus on the GAEC standards related to soil protection and minimum levels of maintenance. The majority of Member States have implemented standards for most GAEC issues. The implemented standards vary from very basic, simple and already required or satisfy more complex and new issues. The approach to GAEC standards in countries and regions has been further analysed in this project (see Section 2.2). Given the aim of implementing GAEC standards taking into account the specific characteristics of regions in terms of soil and climatic conditions, existing farming systems, land use, crop rotation, farming practices and farming structures, standards defined may vary between Member States.

Within the CCAT project a tool is developed, the CCATool, that enables the assessment of impacts of EU legislation and GAEC measures included in CC. It enables assessments to be repeated with new and improved input data and under different scenario assumptions.

The effects assessed in the CCAT project relate to agricultural markets, producer's income, land use, soil, water, air, climate, biodiversity and landscapes, as well as animal and public health.

1.1.1 Approach to assessing impacts of EU legislation, vocabulary and explanation of terms

Before the methodological approach, models and tools are presented that were developed in the CCAT project, it is first necessary to explain how impact assessments were linked to the implementation of EU legislation on environment, animal welfare and public health and what the scope of the study was.

Part of these impacts will have a private character and affect the regulated party. Examples are the cost a farmer has to make to comply with the standard. Standards might also generate private benefits (e.g. an increased organic matter content of the soil might improve soil fertility, increase yields and thus increase farmer's revenues) or private disadvantages (e.g. generate a yield and/or income loss). Alongside these there are also other impacts, having a public or/and non-commodity character. Often these are related to the policy aims associated with the standards (e.g. preserved habitat quality, minimum levels of animal welfare, ensured food safety, traceable animals, etc.).

From the above reasoning and the distinction between standards and enforcement of standards a number of conclusions can be drawn with respect to impacts, cost and benefits attributed to respect of EU legislation in the CCAT project:

- 1) Impacts associated with satisfying an EU legislation should be attributed the standard itself (or enforcement mechanisms in general) rather than to CC;
- 2) Derived from this it follows that cost associated with satisfying an EU legislation should be attributed to this standard and not to CC;
- 3) Similarly benefits following from keeping up to EU legislation standards should be contributed to these standards rather than to CC;

- 4) A main benefit of CC as an enforcement mechanism is an improvement of the degree of compliance²;
- 5) The main costs of CC are related to possibly additional inspection and monitoring by public administrations. However these administrations should normally use the inspection and monitoring systems stemming from the EU legislation. Therefore CC is assumed to not entail supplementary costs. Furthermore, possible costs made by public administration however remain outside the scope of the project. Costs for the farmers in terms of record keeping, registration, etc. are normally directly related to EU legislation and therefore, unless explicitly stated to be otherwise, not attributable to CC.
- 6) Since the GAECs are newly introduced EU standards and considered as being a part of the CC, both the cost associated with complying to these standards, as well as all the benefits following from these can be assessed;
- 7) By definition new or additional costs from EU legislation can only arise as far as standards are newly introduced and not refer or replace pre-existing legislation or farm practices either at Community or national level. Although the GAECs do not contain pre-existing legislation at EU level, they refer mostly to a normal farm practise or at least partly to pre-existing legislation at individual Member State level. As a consequence, only a limited part of the GAECs is likely to lead to additional cost and/or benefits.

In terms of impact assessment, the primary focus in CCAT is on EU legislation standards. As such there is no direct link to CC because EU legislation applies independently. The link is rather an indirect one, since only the EU legislation is considered that is associated to the cross compliance system.

- 8) The GAECs are considered to be a part of EU legislation and their impacts can thus be directly assessed. However, although the GAECs do not contain pre-existing legislation at EU level, they partly refer to pre-existing legislation at national or individual member state level. This implies that only a limited part of the GAECs, depending on the specific region we are focussing on, is likely to lead to additional cost and/or benefits. In the estimation of the baseline compliance level estimations attempts were made to take this into account (see under Chapter 2).
- 9) There is an indirect effect: cross compliance might improve the degree of compliance to EU legislation because it acts as leverage through higher awareness raising of farmers to these requirements. As far as this is the case the changes in impacts that are caused by this increased degree of compliance can be said to be cross compliance-induced. This project will therefore especially focus on identifying compliance levels with SMR and GEAC standards since 2005 and assessing the impacts at different levels of compliance with standards (see also chapter 2 about scenarios).

² Cross-compliance is evaluated here within the context of its role to create a leverage to compliance with standards. When seen in a wider policy perspective there might be other benefits, such as the legitimization (and justification) of 'decoupled' direct payments to farmers, the flexibility it opens to rely more on a responsive regulation approach. It also provides the EC with an extra instrument to stimulate Member States to properly implement and control common regulations (Jongeneel and Brouwer, 2007). These wider issues are beyond the scope of this research. However, they are important from a political economy perspective and it is good to be aware of them when assessing the implementation, application and deliberation of future adjustments of the CC instrument.

Degree and costs of compliance: explanation and use of terms

What is assessed is the impact of EU legislation implemented for environment, animal welfare and public health in the different EU regions. The starting point of this impact assessment is the following:

- 1) The implementation specifications as specified in legal text at regional or national level (and if not available the EU regulation text was used). A total of 2680 national implementing EU legislation standards and 590 national GAECs were analysed and used as the starting point for the CCAT assessments (see also Chapter 2).
- 2) The level of compliance with EU legislation and GAEC standards. Depending on the scenarios assessed, different levels of compliance with standards are used. These compliance levels refer to the proportion of farms and/or agricultural area and/or livestock population that is compliant with a standard. These levels may range between 0 and 100% compliance depending on the scenario that is assessed (see Chapter 2).
- 3) The cost of compliance made by the farmer in order to become compliant with an EU legislation and/or GAEC standard. How these costs were estimated, expressed and linked to the compliance level scenarios is further explained in Chapter 2.

With respect to the compliance with EU legislation and levels of compliance it is important to realize the following:

- Compliance with a regulation or standard, implies compliance with all the applicable standards in the legislation. In this project EU legislation and GAECs are decomposed into sub-requirements or measures, and also compliance estimates are ‘disaggregated’ or downscaled at the level of measures.
- Farmers can be compliant with a standard or with a standard-specific measure for various reasons. First they can be compliant with the legislation because even without taking any action at any time, they are already legally compliant with the legislation (in this project we label this as ‘*per se* compliance’). One reason could be that a farmer is not affected by a standard (e.g. a farmer outside a Nitrate Vulnerable Zone is not affected by a Nitrate Directive-measure). Another reason could be that a farmer is affected, but is already satisfying a specific measure (e.g. an extensive or organic farmers are already in line with the maximum manure application measure of the Nitrate Directive). It is important to realize that "*per se*" levels of compliance might be zero but may also be far above of what is required by the standard. Overall it is clear however that standards that require specific management actions are not necessarily part of the common farming practices and are more likely to show low compliance rates and also low "*per se*" levels of compliance. An example of low "*per se*" compliance applies to the animal registration obligation directives as animal registration and ear tagging require active response of a farmer. Also note that "*per se*" rates of compliance will vary over regions, amongst others depending on the composition of the farm population (structural farm types) and the measures considered.
- Regarding the specification of scenarios and compliance levels, it should be realized that when a scenario of “zero compliance” is run, actually the rate of compliance will be much higher as the reference farmers population includes many groups that are already complying or that do not fall within the target group (e.g. for which additional enforcement is needed). The realized relevant rate of compliance will be the "*per se*" rate of compliance (which will often be above-zero as is discussed above).

- Costs of compliance are used to capture the costs of complying with a certain measure or standard (see Box 1.2). Note that costs of compliance are attributed to compliance with EU legislation standards, not to CC as such³.

Box 1.2 Types of costs

Two important costs concepts are distinguished. First “additional costs” (ACC) of compliance refer to the costs associated with achieving a compliance level beyond the estimated baseline or 2005 reference level and the level of compliance as specified in a specific scenario. So additional costs of compliance exclude the costs associated to realize the baseline level (i.e. costs related to efforts made to comply with standards dating from before 2005). Note that the “additional costs” will be scenario specific, because whereas the baseline level stays the same, the target level will be scenario specific (e.g. full compliance). The upperbound of the additional costs of compliance is the cost associated with improving the level of compliance from the base line level towards full compliance (100% compliance rate). Second, “total costs of compliance” refer to the costs of compliance, associated with increasing compliance from the baseline level till the compliance level as specified in a specific scenario plus the costs associated with improving compliance from the "per se" compliance level till the compliance level as specified in the baseline. Since these latter costs mainly refers to costs and/or decisions that have already been made in the past these are labelled as RCC (already in the past realized costs of compliance. Note that $TCC = RCC + ACC$, or in other words: the difference between "additional costs" and "total costs" of compliance is thus equal to the costs of compliance associated with bridging the gap between "per se" compliance and the compliance level as specified in the base line.

1.1.2 EU legislation and GAEC standards and impact fields

The CCAT tool includes impact assessments for a number of EU legislation and GAEC standards in relation to all impact fields that could be assessed with the tools, data and knowledge available in the project (See Table 1.1). Cost estimates were made for EU legislation and GAEC sub-requirements or measures. The costs were the main input for the economic assessments with the CAPRI model. CAPRI then calculates effects on markets, farmers’ income and also on land use (cropping shares) and livestock population size and composition. Since the cropping shares and livestock numbers are then taken as input for further assessments with the environmental models and for the post-model knowledge based assessments of impacts on land use, biodiversity and landscape, practically all impact fields are covered. The only impact fields not assessed EU wide relate to animal welfare and public health. These fields were only assessed in a more profound way in an Austrian case study and some initial EU-wide extrapolations were made from this for a limited number of indicators.

³ In a strict sense there are some costs that can be attributed to EU legislation. Take as an example the costs farmers face in terms of doing some record keeping and spending time with monitoring and inspection operations. Moreover, there are administrative costs at the side of the public sector associated with operating the EU legislation, which are beyond the scope of this project, which rather focuses at the primary agricultural sector.

Table 1.1 Scope and assessments in relation to standards and impacts fields in CCAT

<i>EU legislation and GAECs</i>	Final tool	
	<i>Assessment level</i>	<i>Impact field</i>
SMRs		
Nitrates Directive	NUTS2, HSMU and grid (1*1km) for selection of regions and indicators	MWABLSL_U
Wild birds Directive	NUTS2	MLB
Habitats Directive	NUTS2	MLB
Sewage Sludge Directive	NUTS2	MSLBL_U
Ground Water Directive	NUTS2	MSLBL_U
Animal Registration Directive	NUTS2, case study Austria	All**
Bovine, Ovine and CAPRine Animal Registration Regulation	NUTS2, case study Austria	All**
Plant Protection Product Directive	NUTS2, case study Austria	All **
Hormones Directive	Case study Austria*, NUTS0	A_WP*
Food Law Regulation	Case study Austria*, NUTS0	A_WP*
Regulation (EC) 999/2001 on prevention, control and eradication transmissible spongiform encephalopathies	Case study Austria*	A_WP*
Foot-and-Mouth Disease Regulation	Case study Austria*	A_WP*
Calves directive	NUTS0, Case study Austria*	A_WP*
Pigs Directive	NUTS0, Case study Austria*	A_WP*
Animal welfare Directive	NUTS0, Case study Austria*	A_WP*
Regulations on the hygiene of foodstuffs and food of animal origin	Case study Austria*, NUTS0	A_WP*
Regulation on requirements for feed hygiene	Case study Austria*, NUTS0	A_WP*
GAECs		
Soil erosion-minimum coverage	NUTS2, HSMU and grid (1*1km) for selection of regions and indicators	MWASBLL_U**
Soil erosion-minimum land management	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**
Soil erosion-retain terraces	NUTS2	MWASBLL_U**
Soil organic matter-standards for crop rotation	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**
Soil organic matter-appropriate stubble management	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**
Soil organic matter-appropriate machinery use	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**

Minimum level of maintenance-minimum livestock stocking density and appropriate regimes	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**
Minimum level of maintenance-Protection of permanent grassland	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**
Minimum level of maintenance-retention of landscape features	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**
Minimum level of maintenance-Avoiding the encroachment of unwanted vegetation	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**
Minimum level of maintenance-Maintenance of olive groves	NUTS2, HSMU for selection of regions and indicators	MWASBLL_U**

M=market & producer income; W=water quality; A=air and climate; B=biodiversity; L=landscape; S=soil quality; A_W=animal welfare, P=public health, L_U=land use.

* Still to be decided. If good cost estimates can be made for all EU regions, CAPRI can make assessment of Market, producer income and land use effects. This can then be used as input for further MITERRA and knowledge based assessments for all other impact fields.

** Many impact fields are only assessed indirectly: CAPRI makes an assessment of impacts on cropping shares and livestock numbers and these are used as input for further assessment in MITERRA and knowledge based assessments for all environmental, land use, landscape and biodiversity impacts.

Except for the animal welfare and public health, assessments are delivered at the NUTS2 level and cover the whole EU-27 (see Table 1.1). However, some environmental assessments performed by DNDC and EPIC models present results at a more spatially detailed level which is the homogenous Spatial mapping Unit (HSMU) level and a 1* 1 grid level respectively. For further explanation of this, see next section and Chapters 2 and 3 of this deliverable.

1.2 Structure of this report

In this chapter a description was given of the policy context, the scope of the study and the use of terms.

In Chapter 2 a description is given of the modelling tools, knowledge and data used for the assessments.

In chapter 3 first a more detailed description is given of how the scenarios for de assessment are defined in terms of implementation of EU legislation and GAEC standards, compliance levels and costs of compliance. After this an explanation is given of the way scenarios are translated into model input for the assessment of impacts.

In Chapter 4 the results of the assessments are presented for all impact fields; starting with the economic effects, followed by the effects on environment, biodiversity and landscape and ending with the effects on animal welfare.

Chapter 5 presents the CCATool and gives an overview of the contents and the way the end user interacts with the tool.

The concluding chapter 6 gives an overview of the main findings and the recommendations derived from the project for policy and for follow-up research.

2 Methodology, models and data

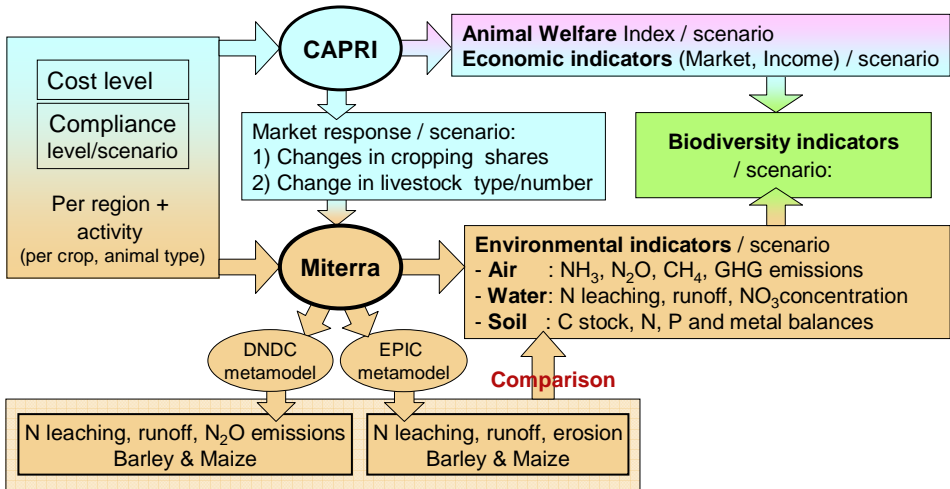
2.1 Methodology and models

The analytical tool of CCAT enables the assessment of the integrated impacts of EU legislation standards given different levels of compliance and specific national and regional implementations and conditions. EU legislation standards may have effects in a direct and an indirect way. The models, knowledge and data used to assess (part of) these effects are described here.

There are four types of assessment approaches included in CCAT:

- 1) A modelling-based assessment to estimate impacts on farmers' income and markets, land use and livestock patterns and the environment (water, air, soil)
- 2) A post-model assessment taking output of CAPRI and MITERRA and translate this further into pressure indicators for biodiversity in terms of changes in intensity and habitat quality.
- 3) A qualitative approach involving the allocation of a potential effectiveness score for biodiversity and landscape preservation to an EU legislation and GAEC standard. This allocation is based on the legal text at national and regional levels and should be seen as an inventory focussing on a so-called positive by-product of EU legislation standards.
- 4) A qualitative approach to estimating the contribution of the implementation of the EU legislation standards on animal health. Contrary to the above assessments, this approach has been implemented only at the scale of a case study and some limited extrapolations were made to the EU wide scale.

Figure 2.1 Models in CCAT



2.1.1 Models in CCAT

The backbone of the CCAT tool is made up by the CAPRI and MITERRA models. Additional models which were used to do limited environmental assessments at a more detailed scale were the EPIC and DNDC models. A more detailed description of the two core models CAPRI and MITERRA is given in Box 2.1 and 2.2 and a rough explanation of how the models were used in the CCAT assessment is given underneath. For a detailed description of the modelled approaches we refer to other CCAT reports⁴.

A key starting point of the integrated assessment of the EU legislation standards in CCAT is the integration of the models CAPRI and MITERRA. The procedure for this integration ensures that:

1. the behavioural consistency of both models is maintained
2. that the strong points of each of the models remain exploited e.g. CAPRI in explaining the behaviour of farmers with respect to input-output decisions as a response to market signals; MITERRA in explaining nutrient, phosphate, metal and carbon balances as a function of manure applications, animal activities, crop allocation and soil and groundwater table conditions.

The economic model, CAPRI, models farmers' response to EU legislation and translates these in economic indicators on producer's income, prices, quantities supplied and demanded (market impacts) and also in changes in land use and livestock patterns. It simulates how the relative cost to become compliant with EU legislation and GAEC standards, estimated in a pre-modelling step outside CAPRI, lead to changes in cropping patterns (land use), shifts in animal herd numbers and composition and eventual output quantities which may lead to changes in income and agricultural markets (an assumption should be fixed: no change for the economical situation) . Costs determine farmers' response and these responses may also involve changes in land use and livestock population numbers and composition. This is why economic effects and responses are the starting point of the operationalisation of not only the economic but also the environmental impact assessments. An important outcome of the economic assessment is therefore input for the assessment of effect indicators for environment, land use, landscape and biodiversity.

However, it is also possible that certain EU legislation standards lead to changes in practices first e.g. changes in fertiliser inputs which are quantified first by Miterra. These changes in fertiliser inputs have an effect on production costs which are fed back to the CAPRI model.

Beside the modelled response by CAPRI on land use and livestock patterns the direct impacts of implementing certain EU legislation and GAEC standards on farming practices also need to be taken into account to model the environmental effects. Therefore both CAPRI indicators

⁴ De Vries et al. (2008), Development and application methodology of environmental impact tool to evaluate cross compliance measures. CCAT Deliverable 4.2.1.

Van der Velde et al. (2009), Derivation of EPIC meta-models to evaluate the impact of cross compliance measures on leaching and runoff of nitrogen and soil erosion at European scale. CCAT Deliverable 4.2.3.1.

Follardor et al. (2009), Derivation of DNDC meta-model to evaluate the impact of cross compliance measures on leaching and emissions of nitrogen at European scale. CCAT Deliverable 4.2.3.2.

Heckelei et al. (2008), Report on the design and development of the economic impact generator of CC. CCAT Deliverable 4.1.1.

Jongeneel et al. (2008), Report describing the operationalisation of the first selection of indicators into impacts of Cross Compliance for the implementation in the first prototype of the analytical tool. CCAT Deliverable 2.3.

Jongeneel et al. (2009), Report describing the operationalisation of the second selection of indicators into impacts of Cross Compliance and the implementation in the final analytical tool. CCAT Deliverable 2.6/2.7.

on land use and livestock patterns and the changes in farm management practices are the input for the environmental MITERRA model. Especially in relation to the changes in practices a translation is required in factors (measures) which can be assessed by the model.

Box 2.1 CAPRI model

The CAPRI (Common Agricultural Policy Regional Impact) model is an agricultural sector economic model covering the EU-27, Norway and Western Balkans based on non-linear regional programming models consistently linked with a global agricultural trade model (Britz, 2008). Its principal aim is to analyse impacts of changes in EU (or international) agricultural policies and markets on European agriculture and global agricultural markets, mostly at the medium term (8-10 years ahead).

The supply module consists of independent aggregate non-linear programming models representing activities of all farmers at regional or farm type level captured by the Economic Accounts for Agriculture (EAA). The programming models follow a hybrid approach, as they combine a Leontief-technology for variable costs covering a low and high yield variant for the different production activities with a non-linear cost function which captures among others the effects of labour and capital on farmers' decisions. The non-linear cost function allows for perfect calibration of the models and a smooth simulation response as is plausible for observations on aggregate behaviour. The models capture in considerable detail the current premiums paid under CAP and a module with feeding activities covering nutrient requirements of animals. Main constraints outside the feed block are arable and grassland, set-aside obligations and milk quotas. Prices are exogenous in the supply module and provided by the market module.

The module for marketable agricultural outputs is a spatial, non-stochastic global multi-commodity model for about 40 primary and processed agricultural products, covering about 40 countries or country blocks in 18 trading blocks. Bi-lateral trade flows and attached prices are modelled based on the Armington assumptions (Armington, 1969). The behavioural functions for supply, feed, processing and human consumption apply flexible functional forms where calibration algorithms ensure compliance with micro-economic theory. The parameters are synthetic, i.e. to a large extent taken from the literature, other modelling systems or own expert assessments. Policy instruments cover Product Support Equivalents and Consumer Support Equivalents (PSE/CSE) from the OECD, (bi-lateral) tariffs, the Tariff Rate Quota (TRQ) mechanism and, for the EU, intervention stocks and subsidized exports. This module allows for market analysis at global, EU and national scale, including a full assessment of price effects in all regions as a consequence to changes in exogenous inputs (e.g. policy shifts).

The supply model OF CAPRI is based on positive mathematical programming:

$$\max_{x_j \geq 0} z = \sum_{j=1}^n (r_j - c_j) x_j - \sum_j x_j \left(\alpha_j + \frac{1}{2} \sum_k (\beta_{jk} x_k) \right)$$

$$s.t. \sum_{j=1}^n a_{ij} x_j \leq b_i \quad [\lambda_i]$$

j activities

r revenue

c variable cost

x production level

a input coefficients

b resource availability

α and β parameter from calibration

λ dual value of constraints

We assume that EU legislation standards only influence variable cost, i.e. some additional cost c^* calculated in the scenario preparation tool enter the objective function.

$$\max_{x_j \geq 0} z = \sum_{j=1}^n (r_j - c_j - c_j^*) x_j - \sum_j x_j \left(\alpha_j + \frac{1}{2} \sum_k (\beta_{jk} x_k) \right)$$

$$s.t. \sum_{j=1}^n a_{ij} x_j \leq b_i \quad [\lambda_i]$$

* additional variable cost (CC measures)

As a consequence of introducing additional cost the optimal production level and hence the supply of agricultural goods will change. Following the market model determines demand and prices based on changed supply. This again alters the revenues in the supply part. Iterative solutions of market and supply models finally lead to equilibrium.

The ‘Common Agricultural Policy Regional Impact’ (CAPRI) model was built by the Institute for Food and Resources Economics (ILR, according to its German acronym) of Bonn University, at the end of the ‘90-ties. Since 1999 (first operational version), its development is founded on an open network approach, engaging many users and researchers, with Bonn-ILR acting as the clearinghouse. Information about the CAPRI network, related projects and publications can be found in the CAPRI web site: www.CAPRI-model.org.

As regards the economic indicators the CAPRI part of the CCAT tool is able to provide the necessary information, without the need to adjust the model (except for adding some derived calculation rules). The challenge is to feed the model with accurate data on cost levels, reflecting the additional cost of satisfying EU legislation standards multiplied with the share of farms, farmland and/or farm animals that is compliant. A pre-model calculation tool has been developed which supplies information to the models on regional implementation of standards and compliance and cost levels. The pre-model calculation tool is fed by collected and further processed data on compliance levels as is further described in Chapter 2.

The link between CAPRI and MITERRA is crucial. First MITERRA calculates changes in fertilizer and animal manure application, due to cross-compliance standards. These changes are input to CAPRI, which uses this information amongst other to estimate the percentage cost increases in the pre-model calculation tool. CAPRI then calculates the economic effects and also the new equilibrium situation in terms of animal numbers and in crop area per crop type per compliance scenario. This information on the change in livestock type, livestock numbers and cropping patterns are then new input into MITERRA. Based on the implemented measures, MITERRA calculates the emissions to air, water, soil and excretion rates taking account of local bio-physical endowment. Based on this, CAPRI determines changes in fertilizer applications (mineral and manure) per crop. Further CAPRI simulates effects of cost implications, which lead to a change in livestock type and livestock numbers and also on the change in cropping patterns. All these changes are fed to MITERRA.

In a post-model assessment the absolute and relative differences per indicator are calculated for all scenarios and compared. An overview of all indicators produced by the different models and thus the CCAT tool are presented in Annex 1.

Box 2.2 MITERRA model

MITERRA is a deterministic and static N cycling model which calculates greenhouse gas and nitrogen emissions on an annual basis, using emission factors and leaching fractions. The MITERRA model was developed to assess the effects and interactions of policies and measures in agriculture on N losses on a regional level (NUTS-2) in the EU-27 (Velthof et al., 2009). MITERRA is partly based on the existing models CAPRI and GAINS. The GAINS model (<http://gains.iiasa.ac.at/gains/>) estimates current and future gaseous N and C emissions from agriculture (and other sectors) in Europe (Klimont and Brink, 2004). MITERRA was supplemented with an N leaching module, a soil carbon module and a measures module. The input data consists of activity data (e.g. from Eurostat and FAO), spatial biophysical data, and emission factors. The model includes measures to mitigate GHG and NH₃ emissions and NO₃ leaching.

The main input data for MITERRA are crop areas and animal number. Crop areas are directly derived from CAPRI. Animal numbers are derived at national level from GAINS and distributed over the NUTS-2 regions according to CAPRI data. Input by mineral fertilizer is derived from national fertilizer consumption rates, obtained from FAO, and is distributed over crops using weighing factors, based on the calculated crop N demand. Excretion is calculated as the number of animals times the excretion per animal, based on GAINS animal categories and excretion factors. The manure is distributed over different crop groups with different application rates. For ammonia (NH₃) the emission factors from GAINS are used and for nitrous oxide (N₂O) and methane (CH₄) the emission factors from the IPCC 2006 guidelines are used. MITERRA has its own approach for leaching and surface runoff. Leaching fractions are determined based on texture, land use, precipitation surplus, organic carbon content, temperature and rooting depth. Surface runoff fractions are calculated based on slope, land use, precipitation surplus, soil texture and soil depth (Velthof et al., 2009). Soil carbon stocks are calculated using the approach of the IPCC 2006 guidelines with assigned stock change factors for each crop.

Beside assessments made by the 2 key models, environmental effects are also assessed by the DNDC and EPIC models. These models are however not part of the main model chain and only the results of the assessments were included in the final CCAT tool. This means that for the DNDC and EPIC assessments:

- 1) There is no link to the CAPRI output
- 2) They do not take the scenarios on implementation, compliance and cost levels into account but only assume maximum implementation of certain standards⁵
- 3) The results only apply to a theoretical situation in which the arable land is covered by a limited number of crops such as maize and barley.
- 4) The assessments are done at a very detailed spatial level. For EPIC this are grid cells of 10 by 10 km and for DNDC the Homogeneous Spatial Mapping Unit.
- 5) The results of the assessments are available in the CCAT tool as mapped output presented at the levels of Nuts 2 regions.
- 6) The results of both models have been compared to the MITERRA assessment results for sensitivity analysis.

For further details on the EPIC and DNDC assessment approaches and results we refer to the Box 2.3 underneath and different CCAT deliverables⁶ and the CCAT tool.

Box 2.3 EPIC and DNDC models

The **EPIC** model is a soil/crop model composed of several simulation components for weather, hydrology, nutrient cycling, pesticide fate, tillage, crop growth, soil erosion, crop and soil management and economics. The model was originally focused on the effect of soil erosion on productivity, but is now an integrated field scale crop-soil model especially well-suited to evaluate crop growth, irrigation requirements (including an option for auto-irrigation), nutrient uptake and cycling, and erosion. It is composed of several simulation components for weather, hydrology, nutrient cycling, pesticide fate, tillage, crop growth, soil erosion, crop and soil management and economics (Williams, 1995). It predicts the effects of management decisions on soil, water, nutrient, and pesticide movements and their combined impact on soil loss, water quality, and crop yields for areas with homogeneous soils and management.

The **DNDC** model (Denitrification-Decomposition) is a process-oriented computer simulation model of soil carbon and nitrogen biogeochemistry (Li, 2000; Li et al., 2006). It is a mechanistic detailed model, originally developed for use at the field level and further developed for the use at regional scale. DNDC is a multi-ecosystem

⁵ Standards assessed by DNDC include: Maximum manure application (SMR2), growing winter crops (SMR8), minimum coverage arable land (GAEC3) and tillage methods (GAEC4). Standards assessed by EPIC include: growing winter crops (SMR8), and tillage methods (GAEC4).

⁶ Van der Velde et al. (2009), Derivation of EPIC meta-models to evaluate the impact of cross compliance measures on leaching and runoff of nitrogen and soil erosion at European scale. CCAT Deliverable 4.2.3.1.

Follardor et al. (2009), Derivation of DNDC meta-model to evaluate the impact of cross compliance measures on on leaching and emissions of nitrogen at European scale. CCAT Deliverable 4.2.3.2.

Jongeneel et al. (2009), Report describing the operationalisation of the second selection of indicators into impacts of Cross Compliance and the implementation in the final analytical tool. CCAT Deliverable 2.6/2.7.

model designed for assessing the emissions of N₂O, CH₄, and NH₃ from the soil into the atmosphere and the stock changes of organic carbon in the soil profile on the basis of mechanistic process-understanding. The model consists of two components. The first component, consisting of the soil climate, crop growth and decomposition sub-models, predicts soil temperature, moisture, pH, redox potential and substrate concentration profiles driven by ecological drivers (e.g., climate, soil, vegetation and anthropogenic activity). The second component, consisting of the nitrification, denitrification and fermentation sub-models, predicts greenhouse gas emissions from the soil (CO₂, N₂O, CH₄), the dynamics in soil carbon pools and NH₃ fluxes based on the modelled soil environmental factors.

Both the EPIC and DNDC models make their assessments at a detailed spatial scale (grids or homogeneous spatial units) which are much smaller than administrative boundaries.

2.1.2 Post-model assessments for estimating pressure indicators for biodiversity

For the assessment of the impacts on biodiversity the output data from CAPRI on land use and livestock and from Miterra on emissions is important, since these predict changes in land use intensity and quality of habitats. In this post-model assessment two groups of pressure indicators for biodiversity were developed:

- 1) Share in intensive and extensive land use and livestock categories
- 2) Level of nitrogen deposition in the air and of nitrogen concentration in surface water above the critical load level

1) Calculation of changes in land use and livestock intensity

Agricultural intensification is one of the main drivers of biodiversity loss in the European agricultural habitats and loss of landscape features and diversity. In this sense, the interpretation of changes in the value of the land use and livestock indicators will be based on the idea that the higher the share of extensive land uses and extensive livestock densities, the better for biodiversity and landscape⁷.

The input data for this assessment comes from the CAPRI Coco database, which specifies 35 different land use categories and 10 different livestock categories and their average management practices (artificial fertilisers, agro-chemicals and N-manure input levels, concentrate and maize feeding, stocking densities) and the CAPRI model output for the scenarios of different compliance levels. CAPRI assesses the response of farmers in relation to EU legislation standards and translates this response in a new equilibrium situation in relation to cropping area shares and livestock type and number shares per Nuts 2 region. In a

⁷ For the scientific underpinning and a more detailed description of the approach see:

Oñate, J. et al. (2008), Design and development of land use change, landscape and biodiversity impact generator as a component of the CCAT analytical tool, prototype 1. CCAT Deliverable 4.3.1.

Jongeneel et al. (2009), Report describing the operationalisation of the second selection of indicators into impacts of Cross Compliance and the implementation in the final analytical tool. CCAT Deliverable 2.6/2.7.

post-model assessment the absolute and relative differences are calculated for all scenarios with respect to the 0% compliance scenario.

Land use intensity:

The crop intensity per region is calculated categorizing the main crops in an intensive, medium or extensive group according to 4 intensity indices (Nmanure, Nmineral, Crop Protection Products Spending and Yield). Data per crop on these indices are obtained from the Capri-Coco database for 2004. To calculate the final intensity of land use per region the crops are categorized in an intensive or an extensive group according to a combined score on the 3 input related intensity indices. The areas of all intensive and all extensive crops are then added-up and related to the total UAA in the region to calculate the final aggregate indicators.

To assess which part of the crops and their related area in a region is intensive or extensive, the following steps were taken:

- Selection of crops to be included in the assessment: apple, pears and peaches, barley, citrus, durum wheat, grass and grazings, fodder maize, grain maize, set aside non food production, oats, other cereals, other fodder on arable land, olives, padi rice, potatoes, pulses, rape seed, other root crops, rye and muslin, soya beans, sugar beet, sunflower, soft wheat, table olives, table grapes, and table wine.
- Classification of crops per region according to the 4 crop intensity indices and to the combined index.

Livestock intensity

The livestock intensity per region is calculated by categorizing each livestock type (pigs, poultry, dairy cows, other cattle, sheep and goats) in an intensive or extensive group and adding up the total intensive and the total extensive livestock units (LU).

Pigs and poultry are categorized automatically in an intensive class. For the categorization of the grazing animal types a more complex calculation scheme is followed based on a combination of 2 intensity indices:

1) The estimation of the intensive and extensive livestock share is based on both stocking density information and feeding levels of concentrate/high protein feeding. These intensity indicators were used to classify the grazing livestock types such as dairy, beef, sheep and goat as they can be managed either in an intensive or extensive way. Their classification in intensive and extensive is based on either regional specific thresholds or related to EU average score on the intensity sub-indicators.

2) There are however livestock types which can always be considered intensively managed, such as pigs and poultry. Therefore figures of LU of these groups have been added directly to the “intensive pool”.

Calculation in changes in intensity

Changes in intensity between crops and livestock because of changes in the implementation of EU legislation are not caused by changes in the intensity indices according to which crops and LU have been categorized in an intensive and extensive pool, but only by the changes in cropping patterns and area for which CAPRI calculates changes. These changes come from modeling the different EU legislation implementation scenarios.

2) Calculation of habitats quality in terms of changes in nitrogen deposition and concentration

Most studies on the effects of excessive nitrogen on biodiversity have been developed in terrestrial ecosystems, mainly considering plant species and soil biodiversity, and in aquatic ecosystems. N deposition has clearly increased in many natural and semi-natural ecosystems across the EU (Bobbink, 2008), often on undisturbed ecosystems naturally adapted to very low N inputs and N availability (Nordin et al., 2009) where additional N inputs can cause substantial changes in biogeochemistry and species composition (Sutton et al., 2009). N deposition causes loss of sensitive species by favouring a few nitrogen tolerant species over less tolerant ones. These effects are likely to be quite important in Natura 2000 sites, particularly in Special Protection Areas due to its proximity to agricultural sources (Bealey et al., 2009). Eutrophication causes many negative effects on the aquatic ecosystem too, including impacts on biodiversity (for extensive review see Carpenter et al., 1998; Smith and Schindler, 2009).

Two indicators are therefore developed in a post model assessment of Miterra output runs:

- 1) total N deposition (KgN) that exceeds the critical load levels per region for sensitive habitats and species
- 2) N concentration in surface water expressed in level of exceedance of the critical load above which aquatic organisms are negatively affected

N deposition that exceeds critical load

The indicator developed expresses the total N deposition (KgN) that exceeds the critical load levels per region. The assessment of changes in the total N deposition (with baseline data for the year 2005 based on EMEP) is done by:

- Keeping the total NO_x deposition constant
- Changing the total NH_x deposition by the percentage change in NH₃ emission assessed by MITERRA. This approach assumes that a change in NH_x emission is reflected by the same change in NH_x deposition within a NUTS2 region. It will become more reliable when the NUTS2 region is larger.
- Comparing present N loads with critical N loads for the baseline year 2005 situation after including CC measures. The concept of critical N load has especially been developed in order to set targets for emission reduction policy. The critical load information used for this assessment consists of a spatial database (CCE, 2007) in which per 50×50 km square with various percentile values for the critical N load (CLN) are provided. We used the 5, 10 and 50 percentile values, indicating the percentage of the area covered with (semi) natural ecosystems for which the critical N load is exceeded, e.g. when the current deposition is equal to the 5% critical load level which implies that at this level 95% of the habitats are unaffected by NH_x emissions.

N concentration above critical load level for aquatic organisms

Firstly the changes in the area exceeding critical N concentrations in surface water are calculated by assessing the *N concentration in total runoff* (both surface runoff and interflow) to surface water and comparing it to critical limits. *N concentration in total runoff* is

calculated by adding the N flux by both surface runoff and interflow and dividing it by the sum of the related water fluxes. This concentration level is further corrected by two factors:

- 1) An immobilisation factor for N-up-take in the water by sediments, water plants, etc.
- 2) A weighting factor enabling to take into account the relative contribution of agricultural deposition of N as compared to N-deposition by woodlands and other natural areas to surface water. The weighting is done according to relative surfaces of the different land categories.

The approach assumes that the N concentration in runoff to surface water is comparable to the N concentration in surface water.

The resulting indicator shows the level of exceedance of the critical load set at 1.5 mg/L caused by different implementation levels of EU legislation.

2.1.3 Qualitative approach to assessing the potential effectiveness of EU legislation obligations on biodiversity and landscape

EU legislation and GAEC standards prescribe certain practices that positively (either directly or indirectly) target species or important landscape features and/or habitats. These effects may be intended or unintended. In the latter case they can be seen as a positive by-product for the preservation of biodiversity and landscape. Examples could be GAEC standards enhancing the preservation of landscape features (such as hedges and terraces), permanent grassland, olive groves, minimal soil cover etc.. As to the EU legislation it is clear that the standards on the Birds and Habitats Directives will have positive influence on biodiversity, but since there are differences in the way they are implemented at national and regional level the potential effectiveness is also likely to range. For the assessment of impacts of EU legislation standards on landscape and biodiversity a potential effectiveness indicator is developed including both unintended and intended potential effects. This approach was introduced in the CCAT project as an experiment and a new way of analyzing EU legislation standards in relation to biodiversity and landscape conservation. The effectiveness scores are based on the interpretation of the legal implementation specifications of EU legislation standards in the different regions/countries. The interpretation is rated as is further specified underneath and the indicator calculation procedures have been integrated into the CCAT analytical framework. Results were mapped at regional scale (NUTS 2) per scenario.

The effectiveness of standards for biodiversity and landscape is estimated through adding a score on the (legal) implementation specifications of the different EU legislation and GAECs at the level of specified sub-requirements or measures per standard. This intrinsic potential effectiveness is scored in the following way:

Identification and qualitative assessment of the potential effectiveness of each obligation.		
BD	L	Obligation characteristics
3	0	Obligations containing elements directly targeting the maintenance or survival of animal or plant species, and habitats listed in the Directives.
2	2	Obligations containing elements affecting habitat structure and landscape structural elements
1	1	Obligations containing elements affecting non-structural characteristics of the habitat for species (i.e. pollution, erosion, water abstraction)

2	1	Other management prescriptions, e.g. stocking regimes, stubble management or time limits for harvesting, packaging, or grubbing of hedges.
1	0	Other management prescriptions, e.g. minimum height of cut or restrictions on treated seeds.
0	0	Obligations without effects on biodiversity and landscape.
00	00	Obligations which effects cannot be assessed.
X	X	Obligations not in force

Once the scoring was done a final aggregated and average score per EU legislation or GAEC or for a group of these was calculated in the CCAT tool. The grouping into an aggregate score is potentially misleading, since there are regions which have a much higher number of GAEC standards implemented because of specific regional characteristics. These regions are likely to have a much higher aggregate potential effectiveness score than regions with a low number of GAECs implemented. Moreover, an SMR including a high number of measures (e.g. the Nitrate Directive, with 9 distinguished sub-requirements or measures) may for that reason get a stronger weight than an SMR consisting only of a few measures (e.g. Habitat Directive)⁸. To underpin this also average scores are calculated per region. For the interpretation of the potential effectiveness scores one should take both the aggregate and the average score into account. Beside this, it is also very important to realise that with the potential effectiveness approach CC standards are assessed both in terms of intended and also unintended policy outcomes. The advantage is however, that comparisons between regions can be made easily since the results were the result of a consistent and generically applied methodology and are all mapped at the Nuts 2 level. Interestingly, many differences were found in the (average) effectiveness scores between regions for the same CC standards and also measures.

2.1.4 Assessment of animal welfare impacts

In the field of animal welfare and public health there is very limited EU wide data available on which basis reliable assessments can be done on the status let alone the impacts of EU legislation standards. Therefore, the decision was made to conduct a field study in Austria to survey the relevant indicators on-farm. Additional to the assessment of farm indicators, the field study provides important insights into the farmer's perspective of implementation of specific EU legislation standards in the field of animal welfare and public health and his/her motivations to (not) comply.

In the field study interviews and direct observations to fill-out CC check lists were used to collect information. In total 65 farms in different parts of Austria were visited. Key indices that were specified with the collected data were the level of compliance with relevant animal welfare and human health standards, the Austrian "Animal Needs Index (ANI) 35L" and the EFSA zoonosis indicators.

Principally the farms that were assessed in Austria could be divided into two groups: farms that comply with the EU legislation obligations and those that do not. For the shares of farms that comply, potential minimum Animal Needs Indexes (ANIs) were calculated depending on

⁸ Whereas currently within this project no alternative weighting schemes are analysed, the methodology easily allows for this.

their level of certification and the production conditions the farmer has to comply with.⁹ Whereas organic farmers e.g. have to comply with special housing system requirements, conventional non-certified farmers only have to comply with the national regulations that in most cases include all EU legislation standards in the field of animal welfare. We assume that all minimum requirements were applied and from that we calculated minimum ANI scores on the specific production obligations of the EU organic standard or in case of non-certified farms on the national standards. Furthermore, since the minimum ANI scores for conventional non-certified farms and those certified under the EU organic standard show in dependence on the animal type and weight, in case of pigs the group size and in case of cattle the type of housing system (tie stalls or loose housings) significantly diverging values, the evaluations were based on constellations involving 5 different animal types aligned to weight classes, emanating from specific assumptions given under section 3.4 of this report.

The minimum ANIs that were calculated on the basis of “full compliance” with legislative standards were in the following compared with the arithmetic averages of on-farm measured ANI results of the Austrian field study. From comparison estimations of the risks of non-compliance with the individual EU obligations could be derived.

These ANIs could then be applied to similar farm-type animal group combinations in other EU countries. This extrapolation to other EU countries not only took account of the farm types distinguished in the Austrian case, but took also into account the specific national interpretations of EU legislation standards, as well as shares of organic livestock farming. It resulted in estimations of minimum ANIs and compliance levels at Nuts 0 level. These levels were used as the levels for the baseline compliance scenario and the related ANI score. From this baseline level situation and the related arithmetic average of the on-farm ANI score, the ANI scores in the alternative compliance scenarios (0%, 25%, 50%, 75%, 100%) could also be derived.

A similar extrapolation approach is also intended to be used for the EFSA zoonosis indicators calculated for the different Austrian farms. This however did not fit within the time schedule of the project and was not included in the CCAT tool and results.

More detailed information of the animal welfare approach can be found in different CCAT deliverables¹⁰ as well as in section 4.4 of this report.

2.2 Data sources used

Beside additional data on implementation of EU legislation standards and implementation levels collected within this project, the data sources used in the quantitative assessments (modelling) were derived from the already existing databases belonging to the core models used in this project. Since links have already been established between CAPRI-MITERRA and also DNDC, the input data used by the models has also already been made consistent.

⁹ From now on, the term ANI always refers to the most recent version of the indicator framework, i.e. the ANI 35L.

¹⁰ Annen, D. (2008), Report on how to develop the indicators of impacts of CC on food safety, animal welfare and health, CCAT Deliverable 4.4.1

Jongeneel et al. (2009), Report describing the operationalisation of the second selection of indicators into impacts of Cross Compliance and the implementation in the final analytical tool. CCAT Deliverable 2.6/2.7.

The main database used for the CAPRI modeling is the CoCo database. It is built of 3 main data sources:

- (1) the SPEL-EU data base as a consistent national frame for farm and market balances, activity levels (hectares of crops and animal herd sizes), unit value prices and the Economic Accounts for Agriculture
- (2) the REGIO domain of EUROSTAT as the main source for regional activity levels and physical output, and
- (3) data supplied from different national sources, to fill gaps or correct errors in

REGIO and to supply data not comprised in it, mainly data on political instruments.

CoCo was developed at the University of Bonn and the database is currently available at JRC-IPTS (AGRILIFE⁵ Unit) and provides a comprehensive picture of the agricultural sector for the EU27 Member States plus the Balkans. The main data sources for the construction of CoCo are presented in Table 2.1. CoCo is fairly detailed and also includes algorithms for data consistency and completeness. The database is up-dated every 2 years. For further information see: [http://www.CAPRI-model.org/docs/CAPRI_documentation.pdf#search="COCO"](http://www.CAPRI-model.org/docs/CAPRI_documentation.pdf#search=)

Table 2.1 Overview of data contained in the CoCo database

Data items	Source
Activity levels	Land use statistics, herd size statistics, slaughtering statistics, statistics on import and export of live animals
Production	Farm and market balance statistics, crop production statistics, slaughtering statistics, statistics on import and export of live animals
Farm and market balance positions	Farm and market balance statistics
Sectoral revenues and costs	Economic Accounts for Agriculture (EAA)
Prices	Derived from production and EAA
Output coefficients	Derived from production and activity levels, engineering knowledge
Input coefficients	Different type of estimators, engineering functions
Activity specific income indicators	Derived from input and output coefficients and prices
Policy data	Various sources (Official Journal of the EU)

Source: Eurostat (<http://epp.eurostat.ec.eu.int>), several bio-physical econometric studies and European Commission (http://publications.eu.int/general/oj_en.html).

Many data contained in the CoCo database are also used by MITERRA and DNDC, especially in relation to land use and livestock. In addition to these statistical data, which need to be consistent between all models, several spatial data sources were used. An overview of the main data variables used in MITERRA and DNDC are given in Table 2.2 underneath.

Table 2.2 Major input data for MITERRA Europe and DNDC

Indicator	Needed inputs	Unit
General for N balance	Application rates and types of: - fertilizers - animal manure Yields of harvested crops	kg /ha/yr ton/ha/yr ton/ha/yr
Nitrogen balance	N ₂ fixation Atmospheric N deposition N contents in fertilizers, animal manure, biosolids and crops	kg N/ha/yr kg N/ha/yr mg N/kg
NH ₃ emission	NH ₃ emission factors/parameters	Depends on model (e.g. % of N excreted)
N ₂ O emission	N ₂ O emission factors/parameters	Depends on model (e.g. % of N excreted)
Nitrogen leaching ¹	N leaching fraction	Depends on model (e.g. % of N applied)
Nitrogen runoff ²	N runoff fraction	Depends on model (e.g. % of N applied)
Carbon balance	C/N ratios in animal manure and biosolids (sewage sludge, compost etc)	-
CH ₄ emission	CH ₄ emission factors per animal category	kg CH ₄ /ha/yr

In addition, there are also several climatic and soil data required in both MITERRA and DNDC. As for the soil data the European soil database from JRC is used (http://eusoils.jrc.ec.europa.eu/ESDB_Archive/ESDB/).

3 Scenarios

3.1 Introduction

In order to assess impacts of EU legislation and GAEC standards it is clear that this requires insight into the way these standards are implemented at regional levels, the compliance levels with standards as well as the costs of compliance. These three aspects are likely to vary with regional heterogeneity. For the assessments in CCAT scenarios are developed in which varying levels of compliance with standards and differences in implementations are specified. One main scenario is the baseline which refers to the implementation and compliance level situation level just before EU legislation starts to have its impact which is just before 2005; the first year of implementation of For the old member states (MS) for all GAECs this is the year 2005. In this chapter it is explained how estimates at regional level were made of the implementation of standards, related compliance and costs of compliance in different scenario situations and how these were translated into model input.

3.2 Implementation of EU obligations

The implementation of the EU legislation into national or regional legislation should in principle be uniform in all member states. This is not true for all Directives and Regulation. Most of them offer variation in the way MS have to implement them to take into account local needs and challenges (e.g. zoning for the Nitrates Directive) Nevertheless, the results of former projects¹¹ show, that the translation of this EU legislation into national and/or regional legislation happened in a quite diverse way. For the translation of GAECs into national and regional legislation the member states had a level of freedom than for the implementation. The GAEC standards to be developed had to be in accordance with the issues indicated in Annex IV of the regulation, but could be adapted to the special climatic and structural conditions in the member states. This resulted in a quite different implementation of the GAEC standards (at the level of sub-requirements or measures) in the member states which is a crucial starting point for the assessment of the impact of these.

To ensure a regionalised assessment of the effects of EU legislation standards it is crucial to have information on national and regional implementations. For this purpose an EU-27 database was developed in CCAT in which implementation specifications are categorized per EU legislation and GAEC. For the development of this database use was made of the information that was already gathered in other projects, as well as from original own work. In the CIFAS project (Schramek et al., 2007) a lot of information on SMRs and GAECs was already collected in a central database and characterised according to so-called 'short names'. In CCAT the CIFAS methodology was further adapted to the needs of the CCAT project and the database was further supplemented with new data from especially new MS and additional EU legislation and GAECs.

¹¹ Cross Compliance Project (Jongeneel et al, 2007), CIFAS and Cross Compliance Network

The methodology developed to include the national and regional implementation information into the database required the interpretation of legal texts and translation of these in codes (see Table 3.1). These codes synthesise the detailed standards in the different MS/Regions on the basis of their similarities and are needed to enable the impact assessment. They are developed taking into account that they should clearly refer to the topic of the EU legislation (e.g. for Groundwater Directive related requirements and similarly Sewage, Nitrates, Birds, Habitat Directives), with the objective to capture some criteria of the EU standard (e.g.: Nitrates – N limits per hectare; Birds – closed season for hunting; Habitat – prohibited farming practices etc.).

The coding was prepared for three specific objectives:

- Supporting the translation of EU legislation / GAECs to specific (management) practices and thereby providing a basis for estimating costs of compliance which can then be used as input for the models (e.g. CAPRI, Miterra, DNDC and EPIC)
- Representing ‘national diversity’ in EU as a manageable set of categories enabling the mapping and comparison of implementations
- Characterising the national standards (from the perspective of potential impacts on landscape and biodiversity) in order to add a potential effectiveness score to the standards.

Table 3.1 Codes included per EU legislation and GAEC

EU legislation:	GAECs:
EU legislation -ID	GAEC-ID
Related directive or regulation	GAEC issue
The measure (= grouped obligations)	GAEC standard
Specification of measure	Sensitive area
Sensitive area	Most detailed Nuts level, Region ID
Animal type	
Most detailed Nuts level, Region ID	

Although the EU legislation for new MS are not included in the final coding database of CCAT (see Table 3.2) the number of different EU legislation measures and specifications and GAEC standards identified is still very high. The CCAT coding database now includes:

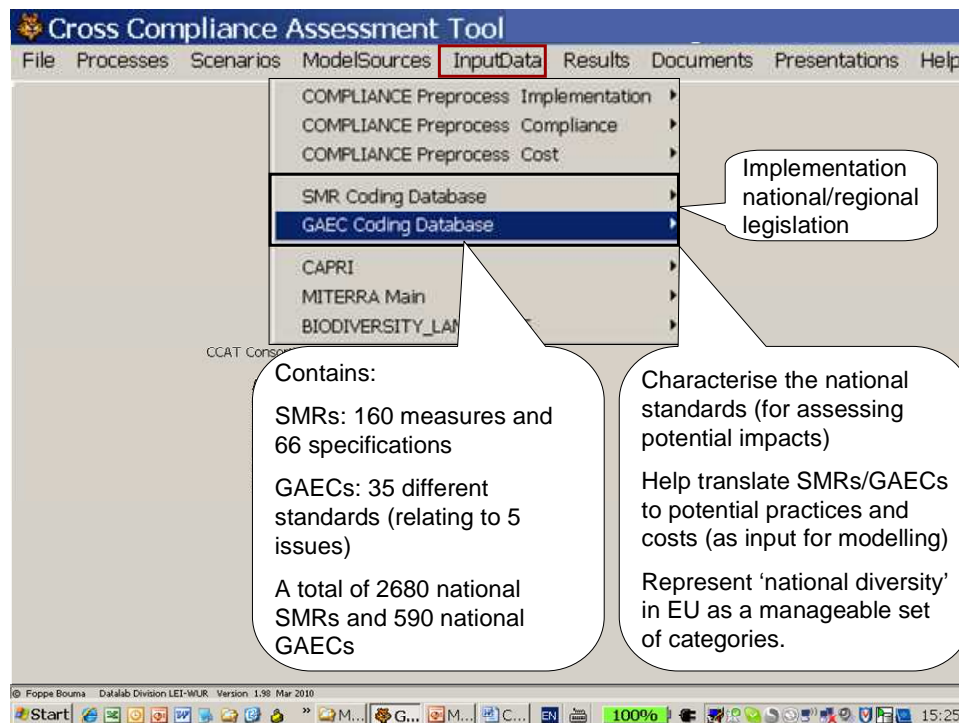
- For EU legislation: 160 different measures and 66 specifications
- For GAECs: 35 different standards (relating to 5 issues)
- Based on the total of 2680 national EU legislation and 590 national GAECs (for an overview of countries and EU legislation included see Table 3.2)

Table 3.2 Overview of national EU legislation and GAECs included in coding database

	Name of directive / regulation	Available data in CCAT
01	Conservation of wild birds	Old MS + SI
02	Protection of groundwater against pollution	Old MS + SI
03	Use of sewage sludge in agriculture	Old MS + SI
04	Nitrate Directive	Old MS + SI
05	Conservation of flora and fauna	Old MS + SI
06	Identification and registration of animals	Old MS + SI
07	Framework for identification and registration of animals	Old MS + SI
08	Identification and registration of bovine animals, labelling of beef (products)	Old MS + SI
08a	Animal identification and registration – sheep and goats	Old MS + SI
09	Restrictions on use of plant protection products	Old MS + SI
10	Restrictions on use of substances with hormonal, thyrostatic action	Old MS + SI
11	Food law	Old MS + SI
12	Prevention and control of TSEs	Old MS + SI
13	Control of Foot and Mouth Disease	Old MS + SI
14	Control of certain animal diseases	Old MS + SI
15	Control of Bluetongue	Old MS + SI
16	Protection of calves	IE, NL, IT, DE, AT, FR + ES
17	Protection of pigs	
18	Protection of animals kept for farming purposes	
19	Hygiene of foodstuffs	
GAECs	All	Old + new MS

The full coding database for both EU legislation and GAECs is available in the CCAT tool as is illustrated by the underneath screen dump of the CCAT tool.

Figure 3.1 Overview of coding databases in CCAT tool



In the CCAT tool the use of different scenarios enables impact assessments with variations in implementation situations. The main scenarios assume a baseline implementation of SMR and GAEC standards as specified in the coding database discussed here and thus following the national and regional specific legal text specifications. However, there are also scenarios available in the CCAT tool which take the EU directive text as a starting point and assume implementation of all standards even those that are not obligatory. This is further discussed in Section 3.5.

3.3 Compliance levels

The degree of compliance is crucial information for the impact assessment of EU legislation standards on the different impact fields. Degrees of compliance should not only be expressed in terms of farms but also in terms of agricultural area and animal population compliant and non-compliant. The determination of the rates of actual compliance is not straightforward however for various reasons.

First, there is a general lack of data. Only limited information about compliance is currently publically available. Examples of recent EU wide studies that provide compliance estimates for the year 2005 are the CCAT project and the study by the Alliance Environment (2007) prepared for DG-Agriculture.

Second, as far as data are available they provide rough figures which only give an average compliance rate for the total EU legislation and not for the more detailed measure level. While it is exactly this detailed level which is used for the impact assessment as this links directly to the farm management. Furthermore the way the compliance rate is applied to an EU regulation is unclear and nearly always it precludes decomposition of 'overall' or aggregated compliance rate into compliance rates associated with specific requirements.

Third, the available data usually specify the number of breaches detected but these are difficult to generalize to compliance rates for the whole farm population, since they are conditional on risk sampling, and information about risk sampling is not accessible.

Fourth, when information is available it is often available at Member State level (Nuts 0), but not at lower regional levels (Nuts 2 or Nuts 3).

Fifth, if data are available they refer to one moment and it can be expected that compliance rates change in time, after all this is what is aimed at with EU legislation. Data on compliance are therefore needed for different moments in time.

Sixth, when a certain degree of non compliance is detected, often information is lacking about how serious the violation of the standard is. For example if a farm is non-compliant with respect to the Identification and Registration Directive it might not be clear how many of the animals are not-identifiable. But for the costs of compliance not only information about the degree of compliance, but in principle also about the seriousness of non-compliance would be necessary.

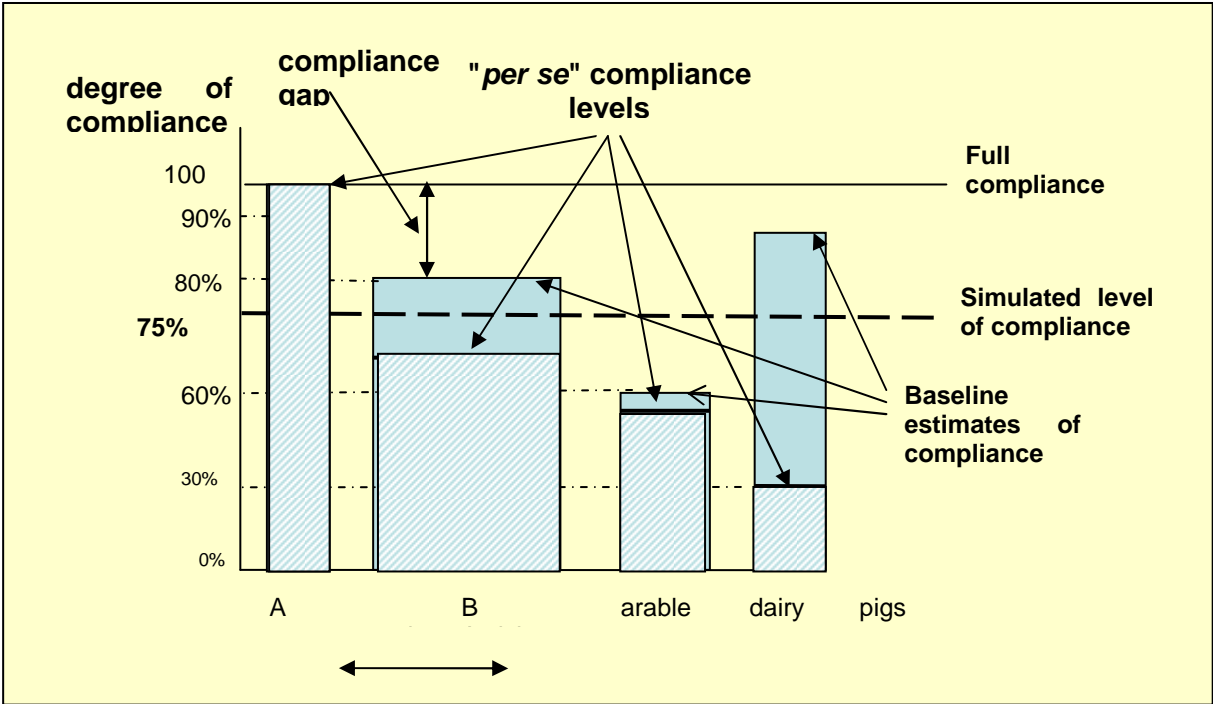
The lack of information, complications and complexity described above precluded an explicit consideration on compliance with standards. In addition insight into the dynamic pattern of compliance rates is also required. For example, if in the past there already is a trend to increase compliance, it would be wrong to attribute an observed increase in compliance after implementation of CAP reform fully to this measure. Although serious efforts were made on gathering information on compliance rates it turned out to be impossible to do a proper empirical validation on compliance rates. Fortunately, this did not hamper the development of the CCAT tool as such. The tool can be filled with any compliance rate per selected EU legislation standards (at sub requirement level) which is then used to simulate the impacts.

In CCAT it was therefore decided to work with 6 scenario situations with varying levels of compliance:

- 0) Baseline compliance (2005-2009, depending on EU legislation and EU country): estimated level in the first year of implementation of a EU legislation or GAEC which differs per Nuts 2 region and standard.
- 1) 50% gap closure: halve way between baseline and 100% compliance
- 2) 0% compliance: "*per se*" voluntary level, 0% = minimum level, but is often higher because of "*per se*" compliance
- 3) 50% compliance: 50% = minimum level
- 4) 75% compliance: 75% = minimum level
- 5) 100% compliance: full compliance

Figure 3.2 illustrates how the different compliance rates in the 6 scenarios should be interpreted. The Figure shows total farm populations of a region and groups sectoral farm types in a region. These differ in magnitude (see thickness of bar) and in the baseline levels of compliance (see top-level of bar). For example the baseline level of compliance of region A is estimated at 90%, that of region B 80%, and so on. Alongside the baseline estimate, for which an explanation of how it was derived is discussed underneath, a second estimate was made for each region indicating the level of compliance without any of the considered standards imposed in an obligatory way (see the fat horizontal lines in the bars). This level can be interpreted as a "*per se*" level of compliance. This latter level might be zero, but will for most standards be much higher than zero.

Figure 3.2 Compliance levels and scenario simulation



The highest horizontal line in Figure 3.2 indicates full compliance. Note that Region B has a compliance gap of 20%. Scenario 1) assumes 50% gap closure. For region B this would imply that the compliance gap of 20% has to be reduced by 10 percentage points (B's compliance rate is increased by 10 percentage points from 80% to 90%). The other scenarios all impose a minimum level of compliance. For example, the dotted horizontal line, indicating a compliance level of 75% illustrates how running scenario 4) would work out. Scenario 4) imposes a (minimum) level of compliance of 75%. Note that regions A and B already exceed this compliance level because of the high level of "per se" compliance. As a consequence, we don't expect any adjustments in these two regions. In contrast, regions C and D with baseline compliance levels of 60% and 30% respectively, are clearly below the 75% criterion associated with scenario 4). In these regions adjustments have to be made in such a way that they also achieve the 75% compliance level. Note simulating scenario 4) does not exclude that some regions might have higher rates of compliance than 75%, but no region is allowed to have a lower rate. As a consequence, the regional impacts can be rather different, even though a similar minimum level of compliance is specified for all regions.

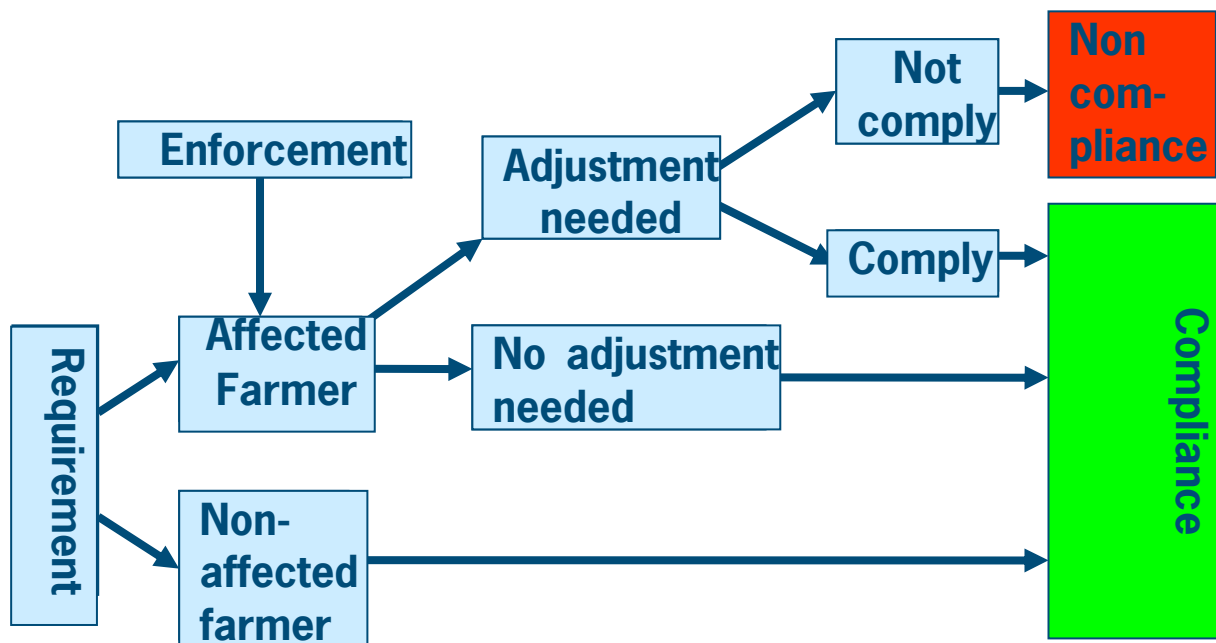
One of the scenarios refers to the baseline compliance situation. Data on this level of compliance are most difficult to derive for the reasons discussed above. In CCAT best estimates have been made of this level at Nuts 2 for EU 27. The methodology for this estimation is discussed underneath followed by the methodology to estimate the 0 or "per se" level compliance situation. All other compliance levels used in the other compliance scenarios do not need further explanation as their specification follows automatically ones the "per se" and/or baseline compliance situation is specified.

Estimating the baseline compliance level

Getting good information on the baseline compliance level is very complicated as already discussed above. Best estimates of compliance levels were therefore made at a disaggregated regional level (Nuts 2) in terms of farm, livestock and land use shares compliant and non-compliant. How this was done is briefly described in the following. For a more detailed description we refer however to other CCAT deliverables¹².

EU legislation standards are aimed at directing farmer's behaviour in such a way that certain (minimum) standards are respected. A farmer has the option to either comply or not comply. In the latter case (s) he faces the risk to be detected as a non-compliant. If this is the case, as a consequence of infringement procedure of EU legislation, a farmer can get a fine. In addition as a consequence of the cross-compliance punishment scheme, part of the direct payments might be withdrawn (depending on the significance of the violation). Figure 3.3 provides a more refined scheme of the link between a regulatory requirement and compliance.

Figure 3.3 Link between regulatory requirements and compliance response by the farmer



The basic idea is to classify farmers with respect to their likelihood to comply. A regulation may or may not affect a farmer. For example, animal welfare regulations will not affect a specialized arable farm, which has no animals. If a farm is affected by the regulation there are two possibilities.

1. The farm structure and/or management is already well adapted to the regulation and no adjustment is needed. In that case the farm already complies, without having to make any further compliance costs.
2. A farmer may need to make adjustments in his behaviour and maybe in the farm facilities in order to comply with the requirement. Here the farmer has to choose between making or not making these adjustments. If he does not he will be non-compliant (and subject to sanctions).

¹² Jongeneel et al. (2009), Estimating compliance levels and costs of compliance. CCAT Deliverable 3.2.3.

Already by characterizing farms in being affected or non-affected by a standard may help to get more insight into the compliance issue. Furthermore, if data are available which could help to identify which part of the affected farms is likely to need to make adjustments, this further informs about which part of the farming population is most likely to have lower levels of compliance. They can be seen as a risk group. As Figure 3.3 shows, there are three categories of farms which need to be identified for estimating the compliance situation of a farm population in a region: non-affected farms, affected farms but likely to already following the EU standards, and affected farms which need to take action in such a way as to become compliant. Here the non-affected farms can be said to be compliant by definition. With respect to the affected farms, useful indicator variables may be available which help to identify the groups most likely to have higher levels of non-compliant farms. For, example, a dairy farm located in a nitrate vulnerable zone area, is clearly to be considered an affected farm in terms of the Nitrate Directive. However, if its stocking density is below a the norm that leads to a 170 kg organic manure per hectare as specified in the sub standard of the Nitrate Directive, this farm is unlikely to have problems with compliance. Existing data sources provide the possibility to estimate per sectoral farm group the average nitrate balance (e.g. number of livestock per type, excretion factors, cropping areas). Based on this information a grouping of farm type groups could be made per region in high risk and low risk farms and related livestock population. The data collected on breaches in other projects and in CCAT could then be used and combined with the high risk group, as this is likely the group in which most of the breaches can be expected.

In order to come to an estimation of baseline compliance levels per region for the different requirements included in EU legislation standards the following approach existing of different steps was followed:

- 1) obtain a best-estimate of the compliance rate and the number of breaches at Member State level, preferably measured at requirement level rather than at the encompassing EU legislation or GAEC level. This information was obtained from different already performed studies¹³ as discussed above and additional data collection in some case study countries/regions.
- 2) Identify which farms which are affected and at low and high risk of not being compliant. This is done through an analysis of the characteristics of farms, preferably per individual farm or farm group (NOT at the level of the total farm population) at regional level. Such information was obtained from the Farm structure survey (FSS) data, Coco database, FADN data in which information is available per sectoral farm group, but also spatial databases specifying e.g. boundaries of Nitrate Vulnerable Zone (NVZ), land use and land cover classes (CLC), digital elevation model for slope information etc.). This analysis helps to define the categories of affected and non-affected farms. Moreover, within the affected category indicators are searched to estimate which part of the affected farms is likely to make adjustments (e.g. farming practice, create provisions for handling manure, etc.) in order to become compliant and which part is at highest risk of not becoming compliant.
- 3) Link the non-compliance rate or the reported number of breaches at Member State level to the farm activity characteristics at regional level in order to obtain best-estimates of compliance at regional level. Here the following logic is followed:
 - Farms which are not affected by a regulation (e.g. because they are located outside a NVZ) can reasonably be assumed to comply with or satisfy the standard.

¹³ Cross Compliance Project (Jongeneel et al, 2007), Study on Cross Compliance for DG-Agri (Alliance Environment, 2007)

- Farms which are affected but have identifiable characteristics (for example a below 170 kg N per hectare excretion) and therefore unlikely to be in need to adjust their farming practice or farm facilities, may also be assumed to fully comply.
- Based on these estimates a region-specific lower bound compliance rate can be estimated. This can be made in terms of the number of farms, hectares and animals out of their respective totals.
- Farms which are affected and likely to make changes in farming practices, provisions, investments, etc. have a choice either to comply or not comply. Here we assume that this group will only partially comply with the requirements, where the rate of compliance is based on the member state level estimates. Here the latter are translated/transformed into compliance rates at the level of this group (cf. risk-based sampling).
- Combining the information of the three distinguished categories (not affected, affected but change/adjustment not likely to be necessary, affected and required to make changes) a best estimate of the actual level of compliance is made.

Estimating the 0% ("*per se*") compliance level

A 0% compliance rate cannot easily be translated in a compliance and non-compliance share for all EU legislation and GAECs as in many cases farmers already comply with certain obligations without needing to take any additional action (or were not really affected, for example because of their free choice for a non-intensive production system). Moreover, when standards are pre-existing and enforced for already some time, this will affect the current degree of compliance and create an initial degree of compliance which is far beyond zero. Most likely it is therefore simply impossible to enforce a zero degree of compliance as no data are available on such a theoretical situation. This problem was particularly valid for the Nitrate Directive. With this obligation a part of the farm population will be automatically compliant without needing to take any specific action or make any additional costs. This applies to farms that have a nitrate surplus lower than the maximum of 170 kg nitrate per hectare and/or to farms not located in a Nitrate Vulnerable Zone (NVZ). The assessment of impacts should therefore not relate to the whole farming population, but only to that part of the population that is located in a NVZ and that has to actively do something to become compliant. A similar method to estimate the "*per se*" compliance level was developed for all EU legislation standards. A full explanation of this method is discussed in Deliverable 3.2.3.

3.4 Cost of Compliance

Costs, that have to be covered in case of adoptions of management/production, are declared for each specific measure or standard. Costs are assigned to a production activity (1 ha of crops or 1 head of animals) per year. The costs can be either a fixed amount per unit or be related to characteristics of this production activity in the CAPRI data base. For example the costs for ear tags of bovine animals are assumed to be a fixed amount per head. The maximum manure application (often 170kgN/ha) depends on the N excretion of animals, which also depends on the feed composition. CAPRI calculates the N excretion rates for each animal type and region. Hence the additional costs of manure transport are linked to the N excretion for each animal type and region. Money valued positive (by-) effects of the measures can be subtracted from costs. Costs can be zero when the positive effects fully compensate the costs. Investment costs are converted to an annuity per year. When 100% "per se" compliance of farmers can be assumed, costs do not have to be declared. In Figure 3.4 a screen dump is shown of (part of) cost database included in the CCAT tool.

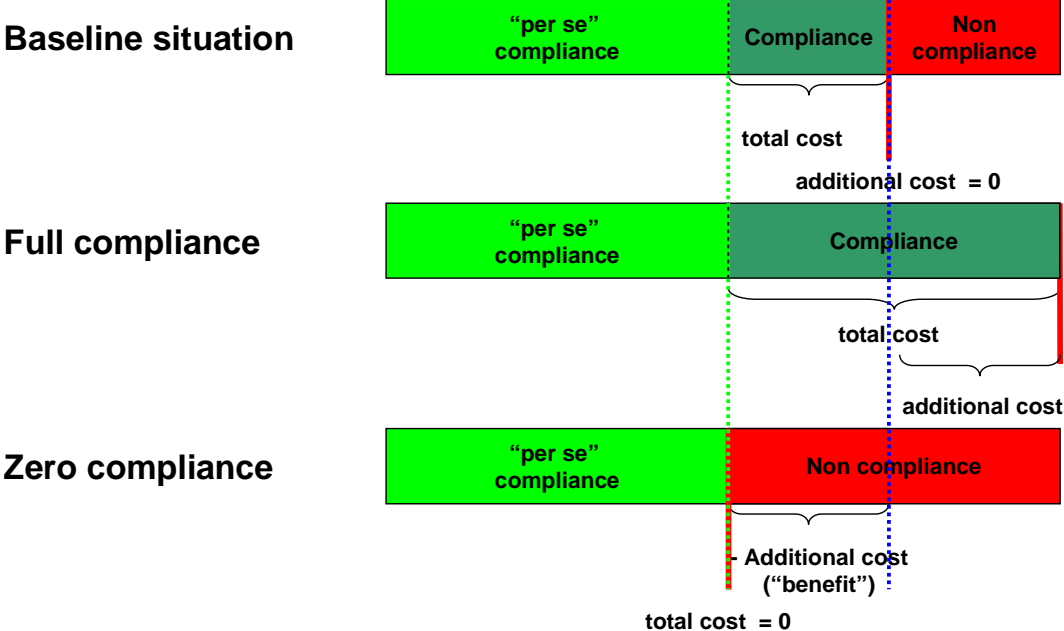
Figure 3.4 Screen dump of CCATool showing explanation of costs related to CC standards and the costs estimation.

Cross Compliance Assessment Tool				
File Processes Scenarios ModelSources InputData Results Documents Presentations Help				
1	A	B	U	V
1	MEASCODE		VALUE	
2	Regulation		cost calculation	
3	Text	Code	cost conversion factor	explanation and motivation
4	real number use "eps" for real "0"			
14	Maximum manure N application standard of 170 kg N per ha (except where a derogation applies) (in Nitrate vulnerable zones) Art. 5 +	ME0404	0.41	transport of manure for 25km, cost 10ct per t*km, scaled to kg manure (-> /6 -> 6kg N per ton of manure)
15	Limitation to fertilizer application on steeply sloping grounds Art 5 + Art 4 + Annex IIA	ME0405	0	we assume no additional cost since application of fertilizer is not generally forbidde, wouls apply to all crops receiving fertilizer (not SEFA). Requires to some extend improved application technique which are covered by ME0407
16	Prevention of leaching to water courses, riparian zones, buffer zones Art 5 + Art 4 + Annex IIA	ME0406	0.005	in many coutries reduced intensity of farming next to water. effects total output of arable crops > related cost are the loss in production output decreases by 0.5% (1% of area effectet, 50% decline in yield)
17	Appropriate fertilizer and manure application techniques, including split application of N	ME0407	0.06	Cost for manure application 4€/m3 -> increases by 10% -> convert to kg N (/6) is assigned to
18	Appropriate fertilizer and manure application techniques, including split application of N	ME0407	0.01	Cost for mineralapplication 10ct/kg -> increases by 10% -> 1ct
19	Growing winter crops (maintain vegetation cover during rainy periods) Art 5 + Art 4 + Annex IIB	ME0408	.50	cost for additional tilliung and seed: 100 EUR (ad hoc)
	Land use management, including the use of crop rotation systems and the proportion of	ME0409	0	benefits of improving soil: 50 EUR (ad hoc) assign cost to groups of crops which are we assume 0 cost since most farms anyway have a rotation custom

The CAPRI model combines the declared costs, with the "per se" compliance, baseline and scenario compliance rates. Conceptually we have to differentiate total cost and additional cost (compared to the baseline). The CAPRI model is designed for countervailing scenario analysis based on additional costs (see Figure 3.5) In the baseline situation already farmers cover significant (total) costs, but the additional costs are zero (by definition). The effects of these costs are already displayed in the observed production data. By simulating compliance above the baseline level (e.g. 100% compliance), additional costs occur. In case of low

compliance rates, additional costs can be negative (= benefits). "Per se" complying farmers do not have to cover costs at all (see Figure 3.5).

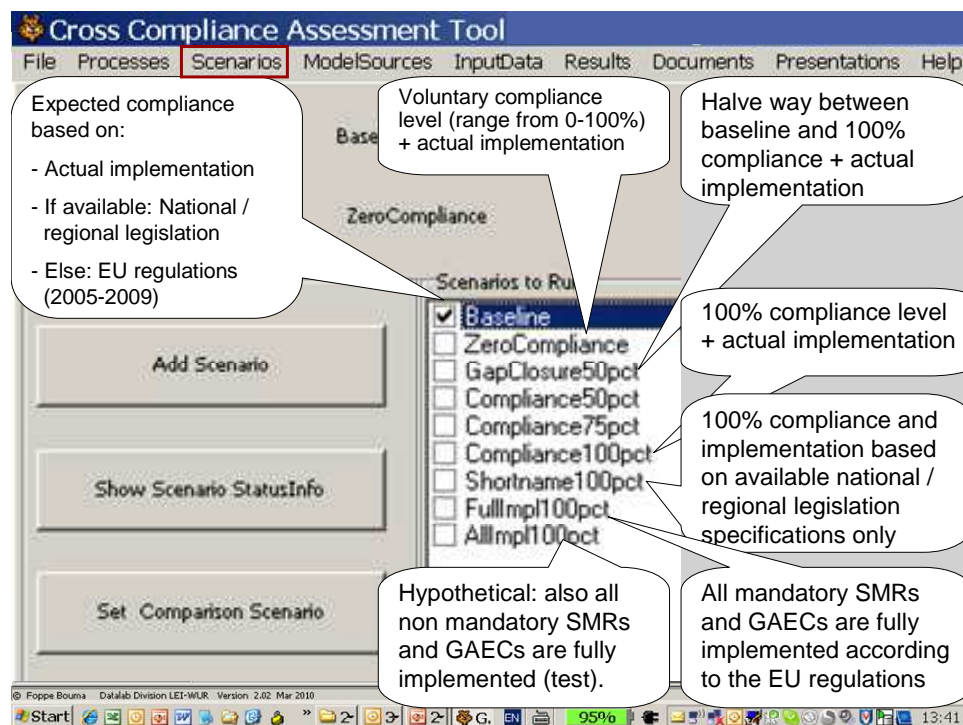
Figure 3.5 Costs levels under different compliance levels and scenarios



3.5 Translation of scenario specifications into model input: pre-process

Beside the six scenarios as defined Section 3.5 on compliance levels there are also three other scenarios included in the CCAT tool with varying implementation situations for the standards. In Figure 3.6 an overview and short explanation is given of the present scenarios included in the CCAT tool.

Figure 3.6 Overview of 9 scenarios included in the CCAT tool



As for the 6 different compliance scenarios it is assumed that all EU legislation standards are implemented according to the national and regional level legal text specifications. So national implementations overrule the EU-regulation text, unless the national specifications are not available in the coding database. The reason for this could be either that the MS is lagging behind with implementation of certain standards or no access to the legal text was obtained and the information is thus missing. This applies to all SMRs that should have been implemented as from 2009 in most of the new MS (see Table 1.1 and Table 2.2). For these MS in case of SMR standards the EU regulation text is followed instead of the CCAT coding table specifications.

As for the other 3 scenarios with varying implementation the following situations are captured:

- Shortname100 %: Assumes 100% compliance with standards specified only in national and regional legal text. So the assessment is purely based on the coding table specifications. The results of this scenario will not be different from the compliance scenario of 100% in the case of GAECs as these are based on national legal text available for all EU27 and of SMRs for old MS+ Malta and Slovenia. The other MS are missing.

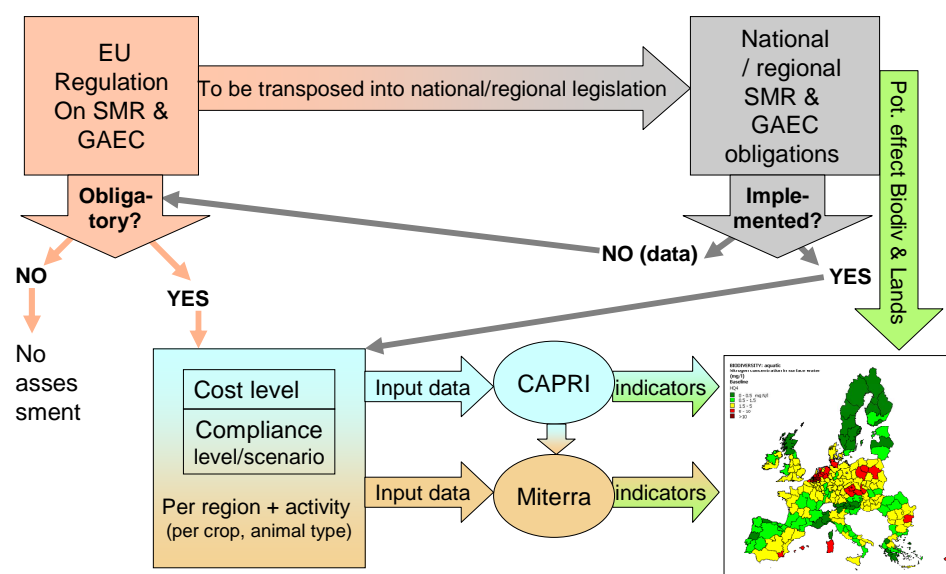
- Full implementation100%: Assumes 100% compliance in combination with an implementation situation following purely the EU regulation specifications.
- All implemented100%: The is a purely hypothetical situation assuming 100% compliance of all EU legislation and GAECs including those that are non-mandatory based on EU regulation specifications.

The implementation implies that measures are assigned to the Nuts2 regions for which they are applicable and they are parameterized in terms of changes of model parameters and/or model inputs. The degree of compliance implies the fraction of the area or of the livestock (per type) of a Nuts2 region for which the measure is applicable. Based on the selected scenario and degree of compliance, the changes in fertilizer and manure use in %-change as compared to the baseline year will be derived for all Nuts 2 regions and disaggregated at specific activity levels. These results will be used in the CAPRI_Pre-Processor that calculates all the additional costs related to the applied measures. How this pre-process exactly works is explained underneath.

CCAT pre-process

The pre-model calculation step is crucial for linking scenario information to the impact assessment (see Figure 3.7).

Figure 3.7 Schematic overview of CCAT pre-process, translation into model input and output and indicators



In the pre-model the following parameters are specified and linked to the per unit (hectare/animal) activities used in CAPRI and MITERRA:

1. Implementation: depending on the scenario specifications and the availability of information in the coding database the pre-model ensures that either the national and regional implementation specifications are used or the EU regulation specifications.
2. Level of compliance. Depending on the scenario the pre-model calculation ensures that the right compliance level is used and allocated to the production factors (hectares/livestock). This aspect is very complicated as this process involves the

allocation of the national per standard average compliance levels to regional production factors.

3. Additional cost expressed per production factor needed for reaching a compliance status (comparing non compliance / full compliance)
4. Share of ("*per se*") compliance in reference situation (without CC measures) with respect to production level
5. Production level of activity

All the input parameters are differentiated by region, farm type, measure and activity. As it was impossible to get all data at the most detailed level, data gaps were filled with values from a higher aggregated level. The hierarchy shown in Table 3.3 was followed for this.

Table 3.3 Level of aggregation for data input

	Level of aggregation				
	High				Low
Region	EU27	EU15/EU12	Member state	Nuts1	Nuts2
Farm type	All farms	Specific farm type			
EU legislation standards	Specific GAEC and EU legislation standards	Specific sub-requirements or measures			
Activity	All activities	agricultural area / animals	Arable land / grassland / animals	specific activities	

The allocation of the compliance level and the "*per se*" compliance level (under 2 and 4) to the activity levels at the most detailed regional level is done following the steps already discussed in Section 3.3. Overall it involves the following information and calculation steps:

- Identification of farms, related livestock and hectares affected. This is specified per Nuts region for every standard and sub-requirement. It should relate to specific farm parameters which are included in the CCAT pre-process database.
- Identification of risk groups and groups that comply already. These groups are part of the affected farm group (and the related livestock and hectares). This is specified per Nuts region for every standard and sub-requirement and uses specific farm characteristics for which data are included in the CCAT pre-process database. Examples of such data relate to characteristics like land use, nitrogen balance, location within an area with certain characteristics like slope, LFA status, NVZ status, etc.
- Link the non-compliance rate or the reported number of breaches at member state level to the affected farms and particularly the high risk farms. The logic for doing this is to assume that farms that are not affected can reasonably be

assumed to comply with the standard. Farms which are affected but are not in the risk group are also assumed to be fully compliant. Farms which are in the high risk group are likely to make changes in farming practices, provisions, investments, etc. but have a choice either to comply or not comply. Here we assume that this group will only partially comply with the requirements, where the rate of compliance is based on the member state level estimates. Here the latter are translated/transformed into compliance rates at the level of this group (cf. risk-based sampling). Combining the information of the three distinguished categories (not affected, affected but change/adjustment not likely to be necessary, affected and required to make changes) a weighted average compliance is calculated.

As to the allocation of costs the pre-process module contains a huge database in which per standard and related measure cost levels are specified. The identification of these costs and the procedure to link these to activity levels was explained in the former section already.

4 Results

4.1 Income and production effects

Due to increasing globalisation and decreasing barriers of trade agricultural production in Europe has to compete globally. Minimal production standards in Europe are generally known to be more restrictive than those of the most notable competitors (e.g. Brasil, Argentina, USA etc.; see Jongeneel et al, 2009). Since compliance with minimal standards might increase costs of production, the competitiveness of European producers on world markets might potentially be threatened. The CAPRI model is designed to simulate and investigate the consequences of increasing production cost within a context of competitive markets. At the same time minimal production standards might lead to positive externalities which are valuable by society.

CAPRI simulation results reveal that increasing production costs are almost not honoured by market effects. Given a fixed and constant utilizable agricultural area (UAA), the cropping pattern is mainly driven by the relative competitiveness of crops rather than absolute production cost. Generally one would assume that additional cost lead to decreasing production. However, several obligations address specifically maintenance of fallow land, making “not producing” less attractive as well. Although simulation results seem to be quite sensitive, model results suggest no major affects in the supply of crops. Hence producer prices are rather stable and additional cost are not compensated. In the animal production adoption processes are different. The animal herds decline notably when production cost increase. Following increasing producer prices compensate almost the additional cost for the remaining production. Nonetheless the agricultural sector loses income since fewer animals are kept.

All results show that market effects will not honour the positive externalities of minimal production standards sufficiently. Hence compensation of farmers by direct income transfer is generally justified.

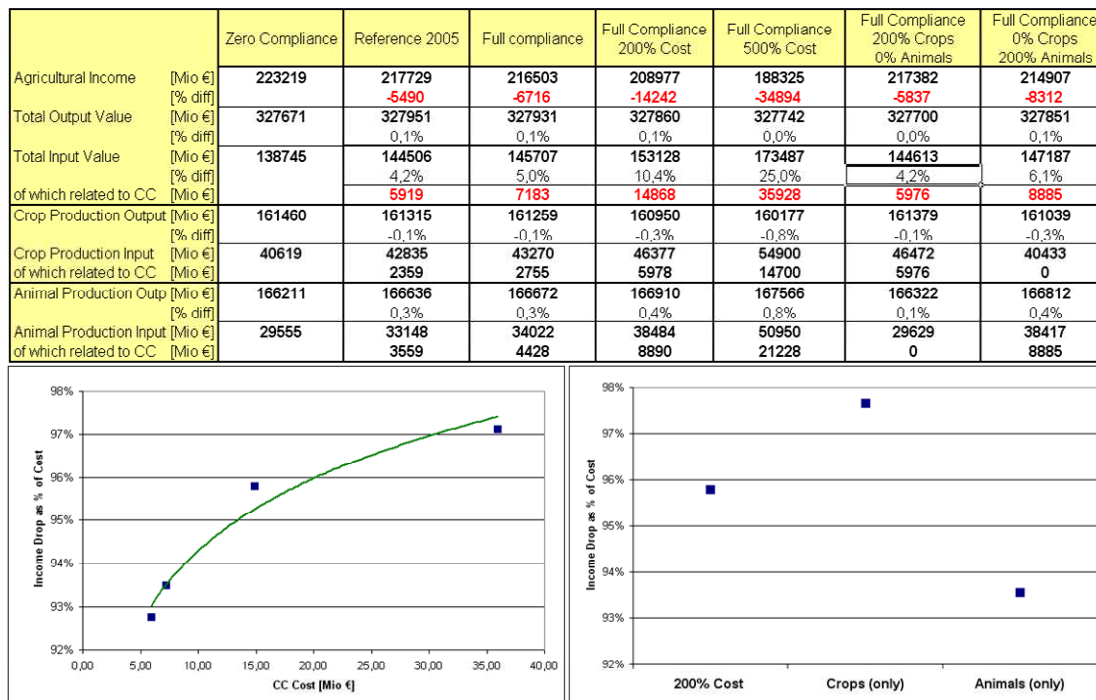
In the next subsection the effects on income in the agricultural sector will be presented. Subsequently effects on crops production and animal husbandry will be analysed separately in more detail.

4.1.1 Agricultural Income

Figure 4.1 visualizes the (aggregate) income effects of the European agricultural sector under different scenarios. Comparisons are made to the situation where no minimal standards are implemented (called “Zero Compliance”). Other scenarios considered are the baseline scenario “Reference 2005” (which reflects the best-estimate of compliance to standards made by the project consortium at the moment EU legislation was introduced) and the “Full Compliance” scenario. The tool also allows for assessing several other pre-defined scenarios (see discussion in previous sections), whereas the CCATool also allows the user to define his/her own scenario. In order to summarize results and focus on main impacts, here only a limited subset of the analysed and potential scenarios is discussed. To provide some further insight into the sensitivity of the results with respect to the cost of compliance-estimates used in this study a few sensitivity analysis results (with extreme cost estimates) are presented.

Figure 4.1 provides information of agricultural income in EU 27 for different compliance scenarios. Because income or profits are derived from revenues and costs, also these are presented. Moreover, agriculture is disaggregated into a crop and an animal subsector. As Figure 4.1 shows, the impact of compliance with EU legislation standards associated with moving from a “zero compliance” (or “*per se*” compliance level) to the 2005 baseline level (“Reference 2005”), is €5.49 billion. Moving from the “Reference 2005” level (which roughly reflects best-estimate of the achieved level of compliance without yet having the leverage effect of EU legislation, to “Full compliance” (100% compliance with all considered EU legislation standards) will induce further costs, because apparently the level of compliance in the “Reference 2005”-run is lower than 100%. Figure 4.1 shows that the total costs of compliance associated with achieving “Full compliance” for EU agriculture are €6.7 billion. From this the additional costs of compliance (i.e. the costs associated with moving from the reference 2005 level to 100% compliance) can be easily derived as being €1.226 billion. Conditional on the assumption that the best-estimates of level of compliance with standards made for the baseline (“Reference 2005”) are right, it could be stated that this €1.226 billion provides an upper bound estimate of the costs of compliance (i.e. the costs of compliance associated with the ideal case that from 2005 on all farmers would be effectively induced to fully comply with all analysed EU legislation standards). From this it can be deduced that more than 80% of the costs associated with respect to compliance with standards have already been made before 2005.

Figure 4.1 Impacts of different degrees of compliance with standards on income, revenues and costs for EU agriculture (source: CCAT-tool)



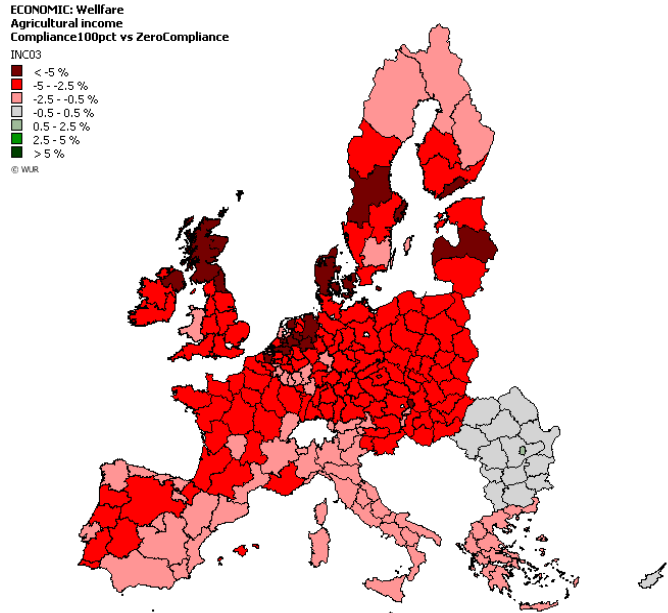
The decline in agricultural income varies in a small band between -2% and -7% depending on the scenario assumptions compared with the zero (or “*per se*”) compliance level. As can be seen when looking to revenues (output value) and costs (input value), the impact on income comes from two sides. On the one hand there is an increase in costs associated with compliance with standards. This (direct) effect clearly dominates the picture. For example, the negative impact on income associated with moving from “Zero compliance” to “Full compliance” of €6.72 billion appears to be due to an increase of costs of compliance with

standards of €7.18 billion. However, there are some (secondary) effects which make that the final impact on income is less negative. These secondary effects may on the one hand come from adjustments in the input factors (the model guarantees this input mix is continuously optimized in order to minimize the costs, e.g. the diet of animals is optimized depending on the prices of fodder components changing during simulations) and on the other hand from changes in revenues. With respect to revenues two impacts play a role. The costs of compliance may make a production activity less profitable and for that reason lead to a reduction in the amount supplied (negative volume change). However, a reduction in supply, even though very small, is likely to increase the scarcity of the product supplied by agriculture, which will be reflected in a (slight) increase in the product price (positive price effect). As Figure 4.1 shows, the net revenue-effect of compliance with standards is positive, although the order of magnitude is rather minor.

From Figure 4.1 it also becomes clear that the impacts on crop and animal subsectors are different. Generally speaking, about 40% of the costs of compliance are associated with the crop sector, whereas 60% is originating from the animal sector. As such animal production has higher costs of compliance, i.e. is more negatively affected by having to comply with the EU legislation standards, than the crop sector. As regards, the indirect effect (impact on revenues) the crop and animal sectors differ. In the animal sector the net effect on revenues associated with (increased) compliance with standards is positive, while in the crop sector this is slightly negative (holds irrespective which scenario is considered). As such the revenue effect partly compensates for the unequal effect of costs of compliance. Note also that as a result of the increase in the output value of animal products and the decrease in the value of crops by chance the overall output value stays to be rather invariant.

Since in the “Reference 2005” scenario the level of compliance is according to our best-estimates already high (i.e. minor violations of the minimal standards) the impacts of increasing the rates of compliance beyond this level, whatever the sanctioning (or incentive) mechanism used, will be limited. On the one hand this is due to the (on average) limited improvements in compliance that still have to be achieved, while on the other hand (on average) the costs of compliance associated with compliance to standards are relatively low. Whereas the Cross Compliance scheme provides additional incentives to farmers to follow exactly the standards, the impact on income at sectoral level induced by this will be limited.

Figure 4.2 Agricultural income effect



Whereas Figure 4.2 presented the impacts on income of various compliance scenarios at a highly aggregated way, the impacts may significantly vary over regions (i.e. some regions compliance to a specific measure or standard may have a positive net income effect, whereas other regions may face a negative net income effect). As denoted before, in case of “Full compliance” the farm incomes in EU agriculture decrease on average by 3% as compared to situation without implementation

of minimal standards (“Zero compliance”). Figure 4.2 visualizes the spatial heterogeneity of income losses. Bulgaria, Romania, Italy, Greece Southern France, parts of Spain and the North of Finland and Sweden are faced minor decreases in income, while Belgium, Netherlands, Denmark and North Western parts of Germany are most seriously affected.

4.1.2 Crop production

When production cost increase it is generally assumed that production goes down. However, when farmers decide on the allocation of their (fixed amount of) land to different crops it is relative profitability that is important. If all crops are effected in such a way that the relative profitability would not change, costs of compliance with standards would not affect the optimal crop mix. In this case the additional cost would result in lower land rents rather than adaptations of the production program.

The CAPRI model decides on the allocation of land to about 40 production activities plus fallow land subject to a fixed UAA. As long as the land rent is positive the UAA will be exhausted. Since fallow land is generally eligible for Pillar 1 payments higher than the maintenance cost, a minimum land rent is guaranteed. Consequently, additional costs related to EU legislation influencing the profitability of crops differently change the land allocation, whereas the total UAA will be exhausted. When some activities decrease in acreage, others have to increase. Only if the UAA would decrease, e.g. when agricultural land is converted to forest, overall decreasing crop production would be possible. However, non-agricultural land (e.g. forest land) is not included in CAPRI and cannot be included in the simulation.

As Table 4.1 shows production of cereals increases relative to oilseeds and potatoes, although in general changes are minor. Impacts on revenue are counteracting impacts on production (for reasons discussed above). The explanation for this phenomenon is signalled in the “Additional costs” column of Table 1, which shows that the per hectare additional costs of compliance for cereals are lower than for oilseeds, and even lower than the costs associated with the preservation of fallow land (no cropping). The relative expansion of cereal production will lead to a (small) increase of EU exports of cereals. As such this shows that the impact of having to comply with standards, because it might affect different activities in a different way, may for some specific activities (e.g. cereals production) even lead to an increase in its production (even while at a global scale increased costs of compliance tend to have a negative impact on competitiveness).

Table 4.1: Effects on selected crops (comparison of “Full compliance” with “Zero compliance”)

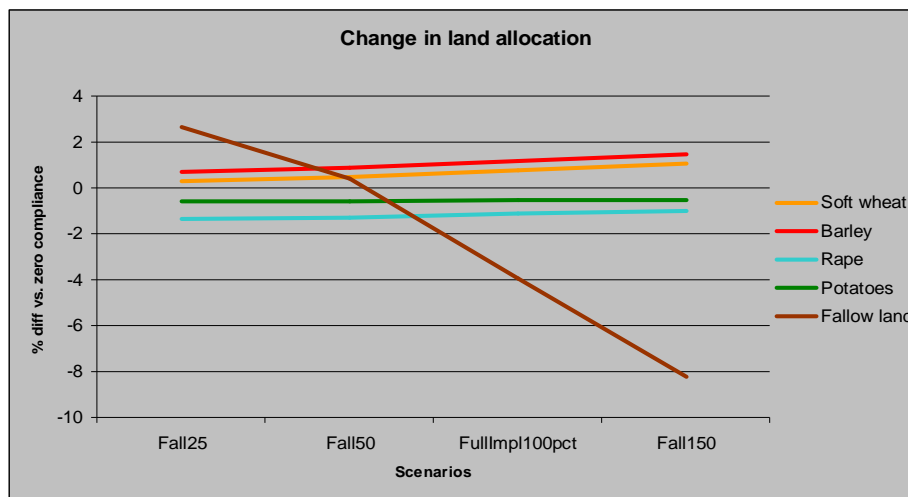
	Production [1000 ha or heads]	Revenue [€ / ha or head]	Additional Cost [€ / ha or head]	Price € per ton]	Supply [Mio tion]	Demand [Mio tion]	Net Trade [Mio tion]
Soft wheat	22501 0,40%	589,24 -3,03	13,9	98,62 -0,44%	127961 1118	121780 1032	6030 86
Barley	14044 0,93%	451,67 -3,66	13,2	98,62 -0,62%	61235 887	57908 822	3327 64
Rape seed	4586 -1,13%	667,06 2,25	29,1	200,16 0,37%	14194 -288	14154 -286	29 -1
Potatoes	2306 -0,45%	3362,24 13,42	46,7	122,65 0,37%	62272 -584	56572 -530	5701 -54
Fallow Land	12294 -1,87%		23,2				

In order to avoid land abandonment GAEC standards enforce minimal maintenance of fallow land. As can be seen from Table 4.1, in our calculations the per hectare costs of compliance related to fallow land are higher than those for soft wheat and barley. The additional cost calculated in CCAT try to account for additional expenditures but also potential savings or

benefits and the actual farmers' behaviour. In the case of fallow land additional costs are high compared to cereals. This is because maintenance of land, that is intended to be taken out of production, has probably minor positive benefits nor is in line with farmers "per se" behaviour. Due to this significant additional costs fallow land is predicted to decrease, but results are highly volatile as discussed later.

Cereal areas increase although producer prices go down. The additional supply is then mainly processed to biofuels. In the model cropping cereals is still the best land-use choice since it has rather low additional cost connected and processing demand is rather price elastic, i.e. additional production can be used for conversion into biofuels without introducing major price drops. Potatoes are mainly used for human consumption where demand is rather inelastic. Following the slight drop in production leads to price changes covering partially the additional production cost.

Figure 4.3 Sensitivity analysis of change in land allocation with respect to changes in costs of compliance with fallow land



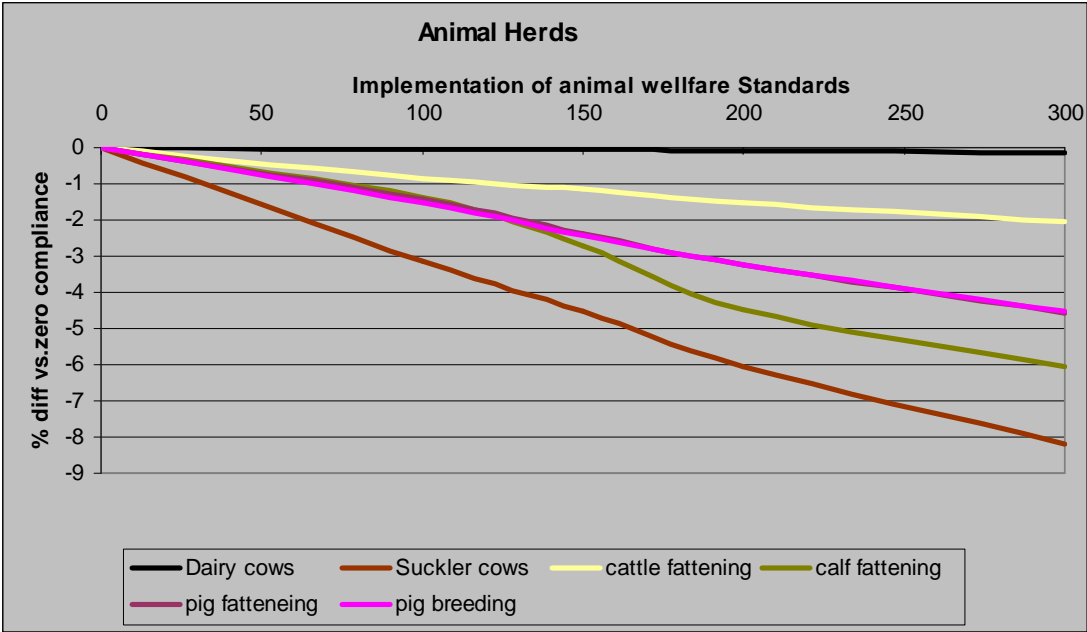
Since additional costs are generally assumed to cause a decline in production or activity levels, the decrease of fallow land area is a counterintuitive result. In order to test the sensitivity of model results we varied the cost related to fallow land. As is shown in Figure 4.3 this variation has significant influence on the fallow land area. However, since the fallow land area is relatively small the changes are still small as compared to shifts in other crops. This reveals that it is difficult to exactly predict what the impacts of compliance with GAEC-standards on fallow land are. The actual developments in the next years should be observed carefully since according to our results a decrease of ecological valuable fallow land is definitely possible. Decreasing tendencies will mainly be observed in regions where additional costs of cereal production are low (usually where use of pesticides and fertilizer is low). The simulation results also depend on historical development of fallow land which is highly volatile in some counties (e.g. Poland).

4.1.3 Animal production

As regards animal production, the implementation of minimum standards tends to lower the number of animals. The actual standards lead to a reduction in herds up to 3%. Dairy cows herds are almost stable, since our simulations refer to the base year 2005 when milk quotas

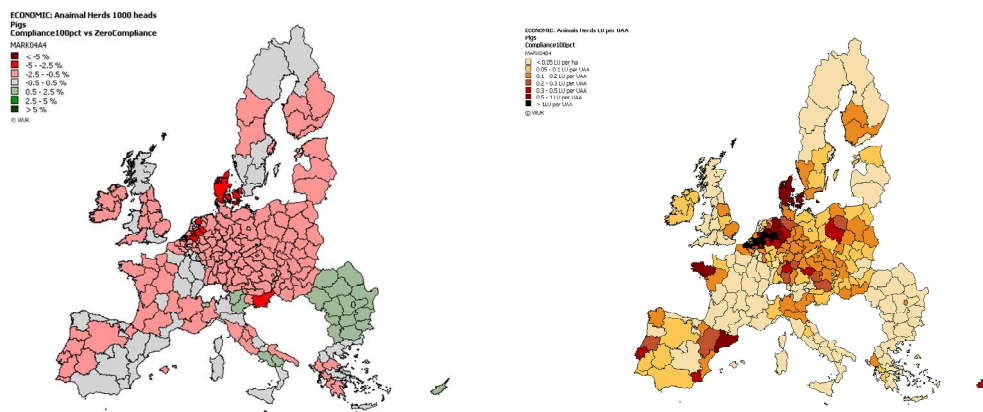
were binding. Quota rents are lowered due to additional cost, but remain positive in general. Following the milk production is rather unchanged. If the analysis was done for a future situation without quotas, adjustments in the dairy sector would be visible, but still small compared to other animal categories, since additional cost are relative small compared to overall production cost. Suckler cow herds decrease significantly. All other animal categories decline in a range of 1%- 2%. Animal welfare standards account for about half of the cost related to animal production. In order to test the sensitivity of changes in animal herds, we varied the cost related to animal welfare. This could be interpreted as a stricter implementation of measures. Hence, double costs is interpreted as a situation where standards are twice as strict as actually (this scenario is referred to as ‘implementation 200%’ in the following). If the cost of compliance with animal welfare standards would increase by factor 3, the decline of animal herds could be up to 8%.

Figure 4.4 Implementation of animal welfare standards and animal herd stocks (at varying costs of compliance levels (0%-300%))



The decline of animal herds is more pronounced in regions where the livestock density is high. Figure 4.5 shows the example of pigs where most significant drops are visible in the rather intensive livestock production regions of The Netherlands and Denmark.

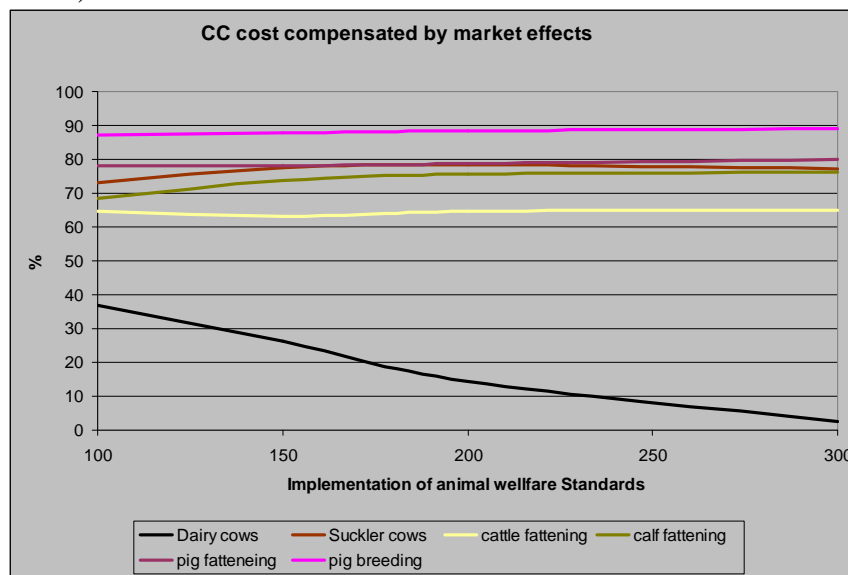
Figure 4.5 Absolute and stocking density changes for pig herds



The decrease in animal numbers has mainly positive effects on the economic conditions of the remaining farms. So some regions gain in terms of animal stocks whereas others lose. Especially regulations with respect to manure disposal impose significant costs in regions where animal density is high, while they can be zero in other regions. Hence production tends to move from intensive to extensive regions. As such this signals that compliance with standards may not only have a potential impact on the EU's external competitiveness, but also on the internal (i.e. change the relative activity levels between regions).

Further analysis of the results show that as regards the animal sectors producer prices and young animal prices increase, while feed tends to become less expensive since land rents¹⁴ and demand for feed goes down. These effects partially compensate for additional cost. Figure 4.6 shows that (except for dairy cows) on average between 65% and 90% of the additional cost are compensated by adaptation of prices.

Figure 4.6 Costs for EU legislation standards as percentage of price adaptations (market effect)



¹⁴ The CAPRI model assumes that there is no market for roughage. Hence costs for fodder produced on farm are determined by value of land, variable input cost and depreciation of equipment. The land rent declines, as described in section 4.1.2.

4.2 Environmental effects

Environmental indicators and cross compliance measures

Environmental indicators evaluated by the CCAT tool include

- Soil: N balance, P balance and metal (Cd, Cr, Cu, Ni, Pb, Zn and Hg) balance and soil carbon stock.
- Air: NH₃ emission and critical N load exceedance in view of N impacts on biodiversity (in view of biodiversity effects) and emission of the greenhouse gasses N₂O and CH₄ emission (and their sum in terms of global warming potential, entitled total GHG emission)
- Water: N leaching, N runoff, NO₃ concentration groundwater, N concentration in surface water (in view of biodiversity effects)

The EU legislation/GAECs and proxy CCAT measures included are:

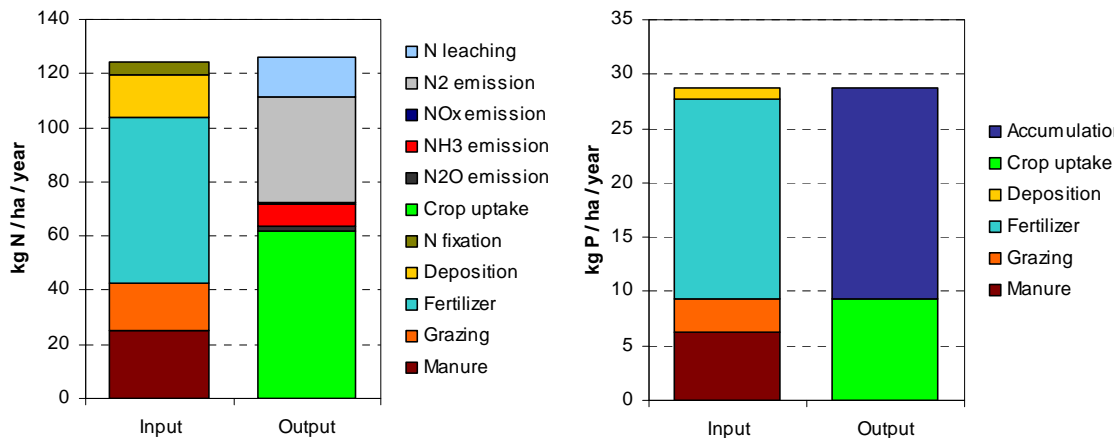
- 8 proxies for EU legislation in view of the Nitrates Directive evaluated by MITERRA (3 EU legislation are also evaluated by DNDC and 1 EU legislation is evaluated by EPIC).
- 1 proxy for the EU legislation of Ground Water and Sewage Sludge Directive related to heavy metals evaluated by MITERRA
- 3 proxy GAECs focused on carbon sequestration (crop rotations, cover crops & reduced tillage) evaluated by MITERRA and 2 proxy GAECs (cover crops & zero tillage) evaluated by EPIC and DNDC.

Here we first report results on environmental indicators for the reference situation (year 2005), followed by results of implementation of the Nitrates Directive and to GAECs focused on carbon sequestration.

Results for the reference situation

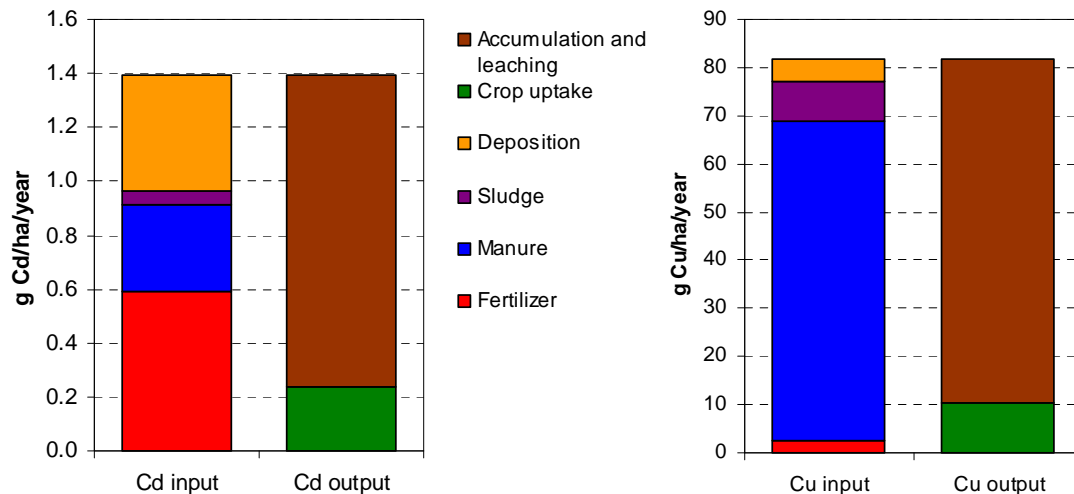
Results of complete N and P balances for the reference situation (Figure 4.7) show that the N and P input at EU27 level is dominated by fertilizer input, followed manure input, while the input by deposition is relatively small, specifically for P. Compared to the input, N uptake is larger (approximately 50%) than P uptake (approximately 30%). The N surplus is largely coming back to the atmosphere as N₂, but a significant part is also leaching or emitted to the atmosphere as NH₃ and to a lesser extent as N₂O and NO_x (Figure 4.7 left). The P surplus will mainly accumulate in the soil while part will be leached but the CCAT tool gives no information on these two fluxes, because data to assess P leaching are not available at the European scale.

Figure 4.7 Average N (left) and P (right) fluxes per hectare for all EU27 countries in the reference situation (year 2005)



Results of metal balances, limited to Cd and Cu (Figure 4.8), show that Cd input is dominated by fertilizer input, followed deposition and manure input, while the input by Cu is dominated by manure input, followed deposition and fertilizer input.

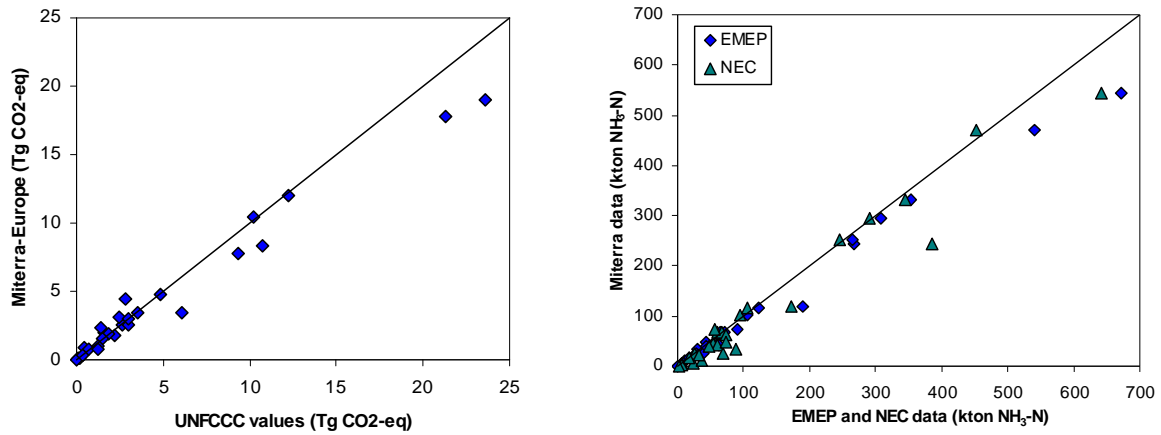
Figure 4.8 Average Cd and Cu fluxes per hectare for all EU27 countries in the reference situation (year 2005)



Compared to the input, both Cd and Cu uptake is small (approximately 10-15%), implying a large accumulation of both metals, unless the present leaching is in the same order of magnitude.

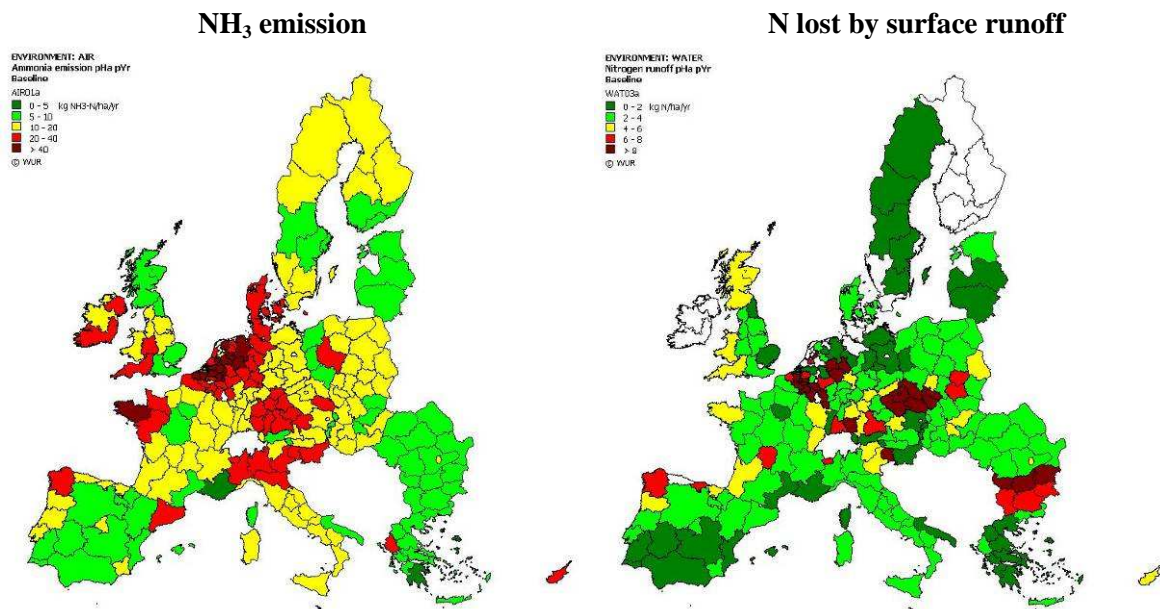
To gain insight in the reliability of the estimated N fluxes by MITERRA, a comparison is given at country level for the N₂O emissions as reported to the UNFCCC and the NH₃ emissions as reported to EMEP. Results show a very good comparability at country level (Figure 4.9). Figure 4.9 also includes the so-called National Emission Ceilings (NECs) for NH₃, showing that in various countries, the NECs are exceeded.

Figure 4.9 Total N₂O and NH₃ fluxes at country level for the EU27 countries in the reference situation (year 2005) as compared N₂O emissions reported to the UNFCCC and NH₃ emissions reported to EMEP.



The geographic variation of the environmental indicators over Europe is large. In Figure 4.10 the NH₃ emission and the N lost by surface runoff are shown as example. Livestock intensive regions (The Netherlands, Bretagne, Northern Italy) have the highest NH₃ emission, while N lost by surface runoff is more related with the environmental conditions.

Figure 4.10 NH₃ emission (left) and N lost by surface runoff (right) per NUTS2 region for the reference situation (2005)



Nitrates Directive

The CCAT tool was used to assess the impacts of the Nitrates Directive on the environmental indicators, including 8 proxy measures, i.e.:

- Maximum manure N application (170 kg N/ha)
- Limitation to N application in winter and wet periods
- Limitation to N application on sloping grounds
- Manure storage with minimum risk on leaching
- Appropriate application techniques
- Buffer zones
- Growing winter crops
- (Balanced N fertilizer application)

In the Figures 4.11 to 4.15 results of the impact assessment related to the measures taken under the Nitrate Directive are shown. Figure 4.11 presents the change in NH₃ emission, N₂O emission, N and P surplus and N leaching for the EU27 countries for the complete package of measures for the Nitrates Directive (except for balanced N fertilization), comparing present compliance (reference situation 2005) and full compliance to zero compliance. Balanced N fertilization was not included, since it is already partly covered by the other measures, and the measure as parameterised in MITERRA is much more strict compared to the few obligations defined by the member states. The largest decrease occurs for N leaching, for which the Nitrates Directive is intended. However, the figure also shows that the Nitrates Directive has positive influences on other emissions and the N surplus, mainly because of a decrease of the N input. For the 2005 baseline compliance the N leaching is about 4.2% lower, but with full compliance it could be up to 5.2%.

Besides the complete package of measures, we also assessed the impact of individual measures on the environmental indicators including balanced fertilization. Figure 4.12 shows the results of the individual measures assuming full compliance for the EU27. Balanced fertilization, i.e. tuning the amounts of applied N fertilizer and manure to the crop N demand, is by far the measure with the highest reduction in N emissions, N surplus and N leaching. Appropriate application techniques, e.g. split applications, and limitation of fertilizer application in winter and wet periods are also effective measures to decrease N leaching.

Figure 4.11 Changes in NH₃ emission, N₂O emission, N and P balance (surplus) and N leaching compared to zero compliance for all EU27 countries together

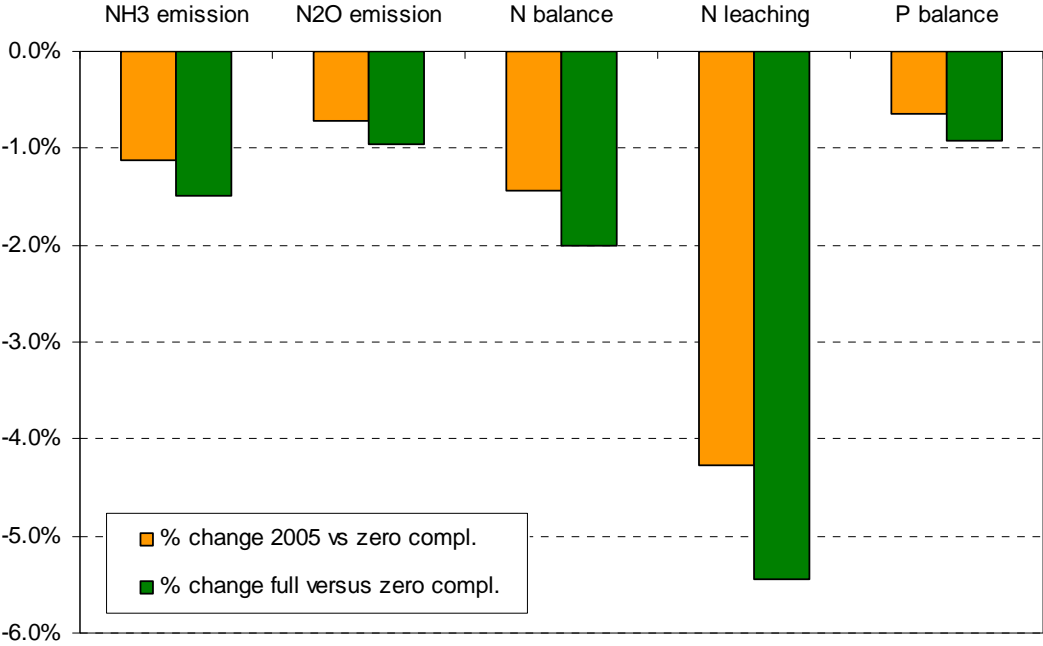
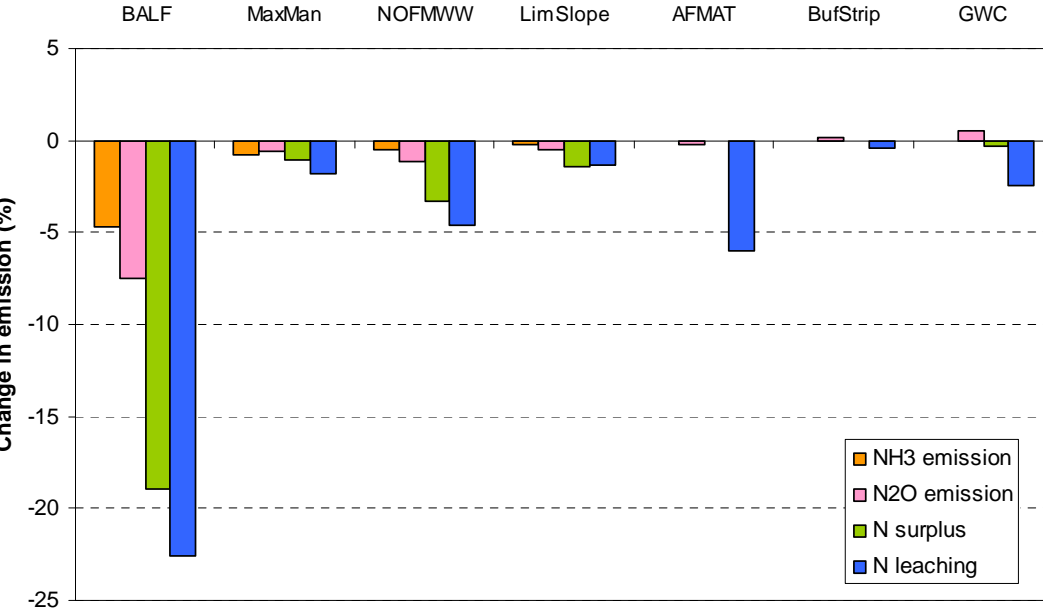


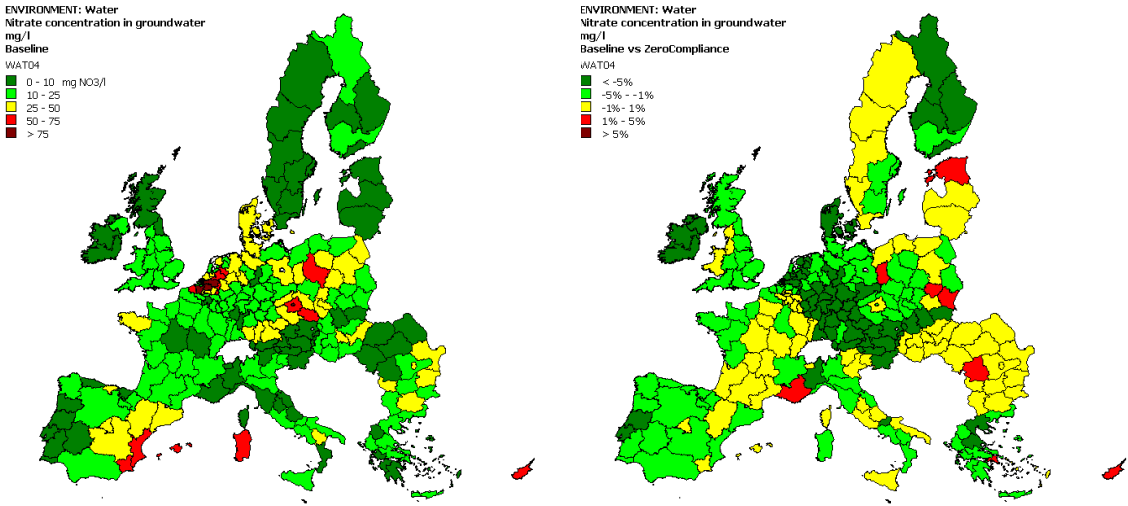
Figure 4.12 Impact of individual measures for full compliance on the environmental indicators



(BALF=Balanced N fertilization, MaxMan=Maximum manure application, NOFMWW=Limitation of fertilizer application in winter and wet periods, LimSlope=Limitation of fertilizer application on sloping grounds, AFMAT= Appropriate application techniques, BufStrip=Buffer zones, GWC=Growing winter crops)

As with the reference situation, there is a considerable geographic variation in the impacts of measures on the environmental indicators over Europe. As an example, the spatial distribution of the nitrate concentration in groundwater for the 2005 baseline and the relative decrease in NO₃ concentration compared to zero compliance, is given in Figure 4.13. The baseline shows that in several regions with intensive livestock, e.g. The Netherlands, the health limit of 50 mg NO₃/liter, as set by the WHO, is exceeded. Also some regions in southern Europe with low precipitation surpluses have NO₃ concentrations that are too high. EU legislation impacts are regionally different. In most regions, there are positive changes in agricultural emissions. However, a selection of regions experience negative environmental externalities such as Poland, Bulgaria, Romania, Alpes-Mediterranée. The relative changes, showing what has been gained already by EU legislation, are largest in Central Europe. This is because the measures will lead to a decline in N use in these regions, while it may cause an increase in their use in regions with low N inputs due to some intensification effects predicted by CAPRI. These changes, which are very minor, are mainly connected to (very small) declines in fallow land and some shifts in cropping patterns. For a further explanation of these changes see Section 4.1.3.

Figure 4.13. Nitrate concentration in groundwater for the NUTS2 regions in Europe (left) and the change in nitrate concentration due to the Nitrate Directive compared to zero compliance (right).



Besides the NO₃ concentration in groundwater also the spatial distribution of the other environmental indicators is included in the CCAT tool. As an example, the spatial distribution of two biodiversity indicators, i.e. the N concentration in surface water and the critical N load exceedance for the 2005 baseline and the relative decrease in both indicators compared to zero compliance is given in Figure 4.13 and 4.14 respectively. The spatial pattern in N concentration in surface water is very comparable to the NO₃ concentration in groundwater (Figure 4.13). An exceedance of critical N loads occurs mainly in Western and Central Europe.

Figure 4.14 Nitrogen concentration in surface water for the NUTS2 regions in Europe (left) and the change in nitrogen concentration due to EU legislation standards compared to zero compliance (right).

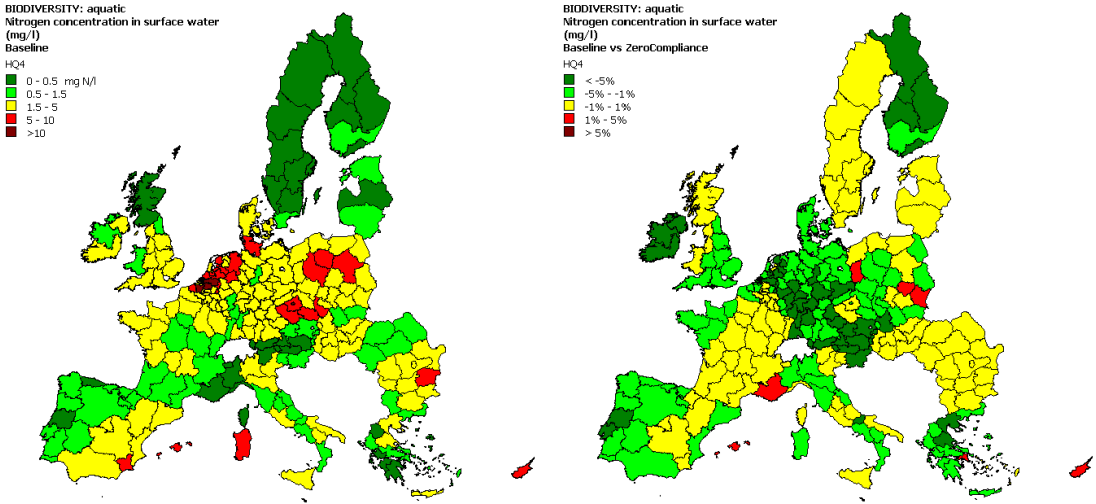
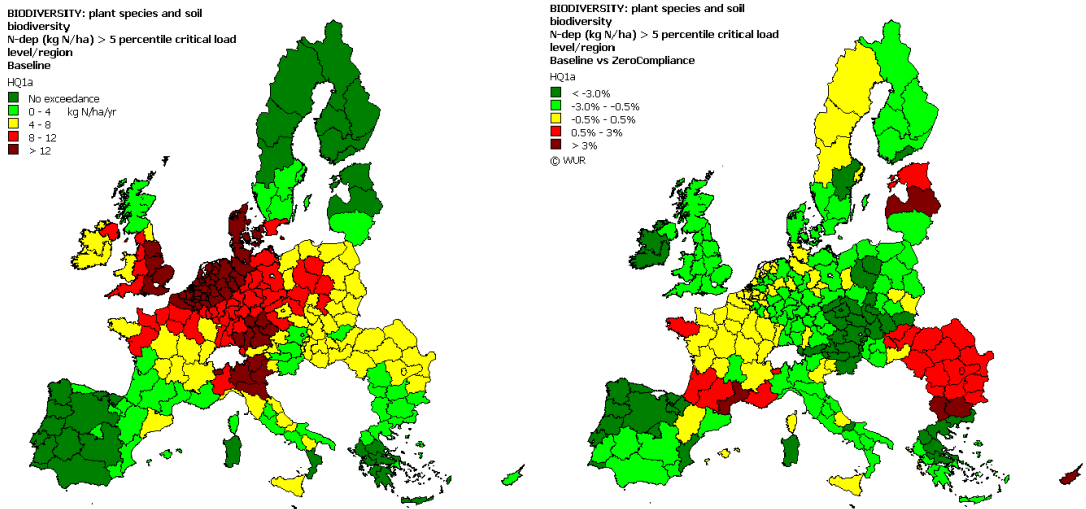


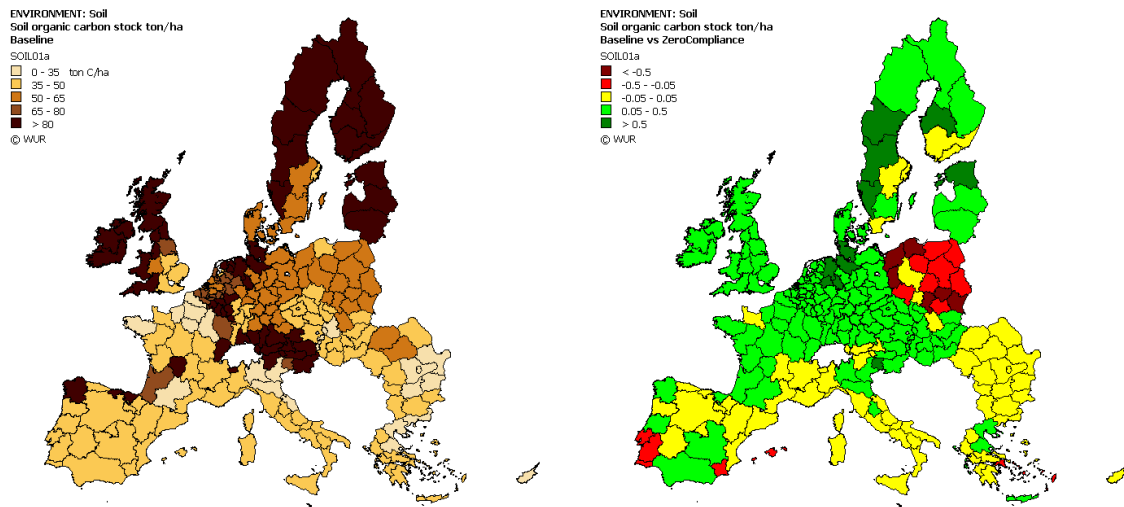
Figure 4.15 Exceedance of critical N load for the NUTS2 regions in Europe (left) and the change in critical N load exceedance due to Cross Compliance standards compared to zero compliance (right).



GAEC measures

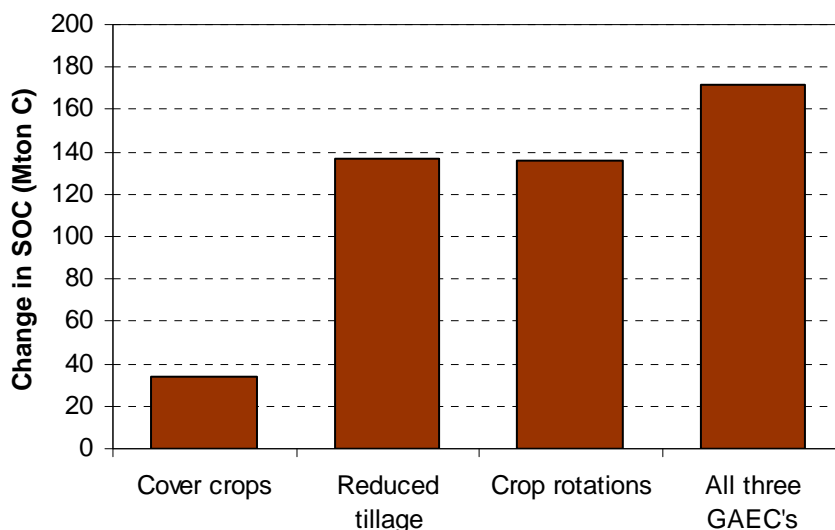
The CCAT tool was also used to assess the impacts of cross compliance from the GAEC measures. Three GAEC measures, which are mainly aimed at soil carbon sequestration, were evaluated by MITERRA, i.e. crop rotations, cover crops and reduced tillage. In Figure 4.16 the soil organic carbon stocks are presented and the change in carbon stocks due to Cross Compliance (mainly the GAEC measures). In most countries soil organic carbon stocks increase, however, in Poland and some regions in Spain and Portugal the stocks decrease, which is mainly due to intensification of the arable crop activities.

Figure 4.16 Soil carbon stocks for the NUTS2 regions in Europe (left) and the changes in soil carbon stocks due to cross compliance compared to zero compliance (right).



In Figure 4.17 the increase in soil organic carbon due to the GAEC measures is presented. This is the change in soil carbon over a period of 20 years, as is the default stock change period according to the IPCC guidelines. Converted to annual CO₂ emissions the measures have a sequestration potential of 6.3 (cover crops) to 25 (reduced tillage) Mton CO₂ per year. In relation to the total stocks, the cover crops can sequester about 0.36% of the total SOC stocks where as reduced tillage and crop rotations can sequester up to 1.4% of the total SOC stocks in the EU. Cover crops are less effective, since in large parts of Europe the growing season is not long enough to grow cover crops after the main crop. Figure 11 also nicely illustrates that not all measures are additional, since the total for all three measures is lower than the sum of the individual measures.

Figure 4.17 Changes in soil organic carbon (SOC) stocks over twenty years for full compliance for the three GAEC measures and the combination of the three measures



4.3 Biodiversity effects

CCAT provides three different assessments to analyze the effects of cross compliance on biodiversity and landscape at the regional level:

- Potential effectiveness of standards on biodiversity and landscape
- Post-model assessments of changes in the share in intensive and extensive land use and livestock categories
- Post model assessments of habitat quality indicators on level of nitrogen deposition in the air and of nitrogen concentration in surface water above the critical load levels

For the explanation of the methodologies used to assess these indicators see Chapter 2 (Sections 2.1.2 and 2.1.3). In the following a brief summary of the results for the first 2 indicator groups is presented. The third group of indicators on habitat quality change were already discussed under the environmental quality indicators in the former section (Figures 4.14 and 4.15).

3.3.1 Potential Effectiveness of standards on biodiversity and landscape.

Results at the highest aggregation level are presented: entire GAECs set and entire EU legislation set. However CCAT enables users to explore potential effectiveness at lower aggregation levels: directives and measures in the case of EU legislation and issues in the case of GAECs.

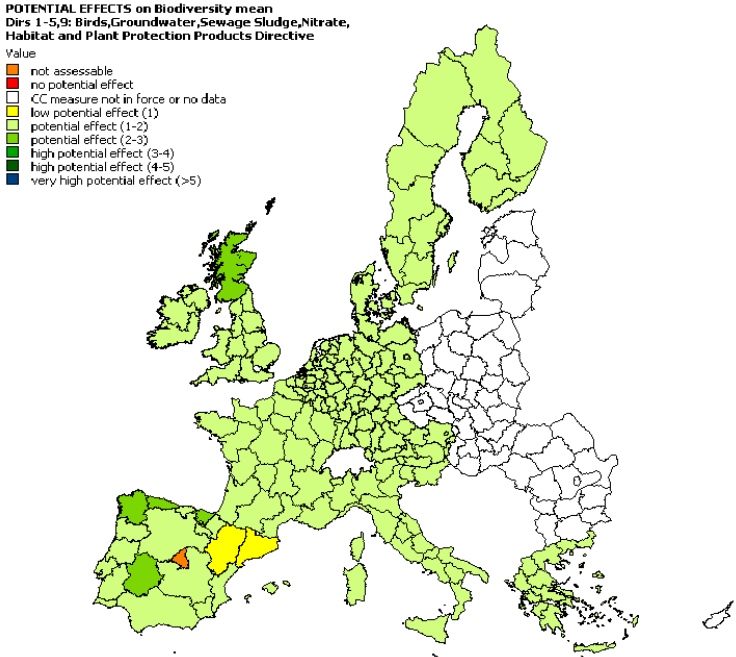
Potential effectiveness is assessed on the basis of the formulated obligations in the regional legislations wording (legal texts), independently of the regional share of UAA, of Natura 2000 and the assemblage of wild species in the region. Therefore, the comparison of potential effectiveness between regions is useful but could be made more meaningful if connected to the presence of nature and landscape values.

It is important to remark that CCAT assesses the potential effects of EU legislation and GAECs (obligations) as formulated by MS on the basis of Annex IV of Reg. 1782/2003. In the case of EU legislation, the assessment is therefore limited to the obligations stemming from the specific articles and paragraphs of the Directives mentioned in Annex III, and it does not refer to the potential effect of the whole Directives as implemented by Member States.

Potential effectiveness of EU legislation on biodiversity

Conditions stemming from 6 Directives are included in the assessment: Birds, Nitrates, Habitat, Groundwater, Sewage Sludge and Plant Protection Products Directives. The results show that the average potential effectiveness of EU legislation does not vary strongly between regions (see Figure 4.17). However, especially for the Habitat, Nitrate and Sewage Sludge Directives large variations in average scores are seen. Effects on biodiversity of Plant Protection Products and Groundwater Directives are more homogeneous among regions.

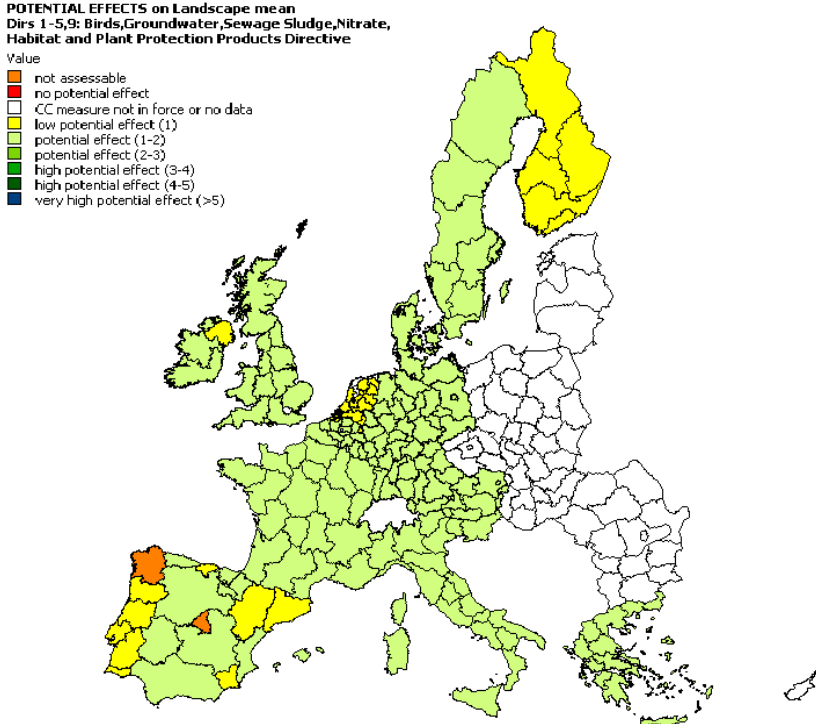
Figure 4.18 Average potential effectiveness of EU legislation for biodiversity



Potential effectiveness of SMRs on landscape

Effects on landscape follow the same regional distribution as on biodiversity. Conditions related to landscape structural elements, mainly stemming from Habitat Directive, have the highest effect on landscape.

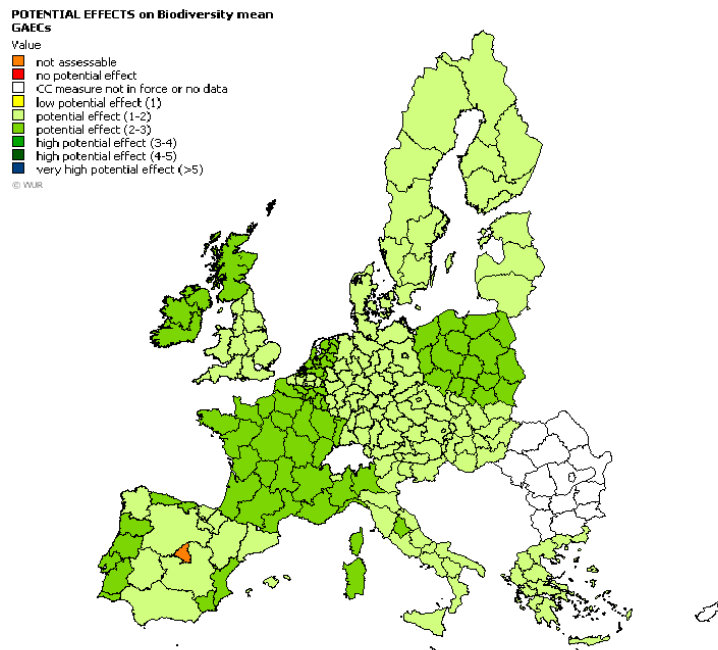
Figure 4.19 Average potential effectiveness of EU legislation for landscape



Potential effectiveness of GAECs on biodiversity

Average potential effectiveness of all GAECs together does not deliver a very diverse picture (see Figure 4.20). However, when looking at issues separately there are strong differences between regions, especially for issues *Soil erosion* and *Minimum level of maintenance*. There are important differences among Mediterranean countries in the *Soil Erosion* issue implementation, although all suffer from severe soil erosion problems.

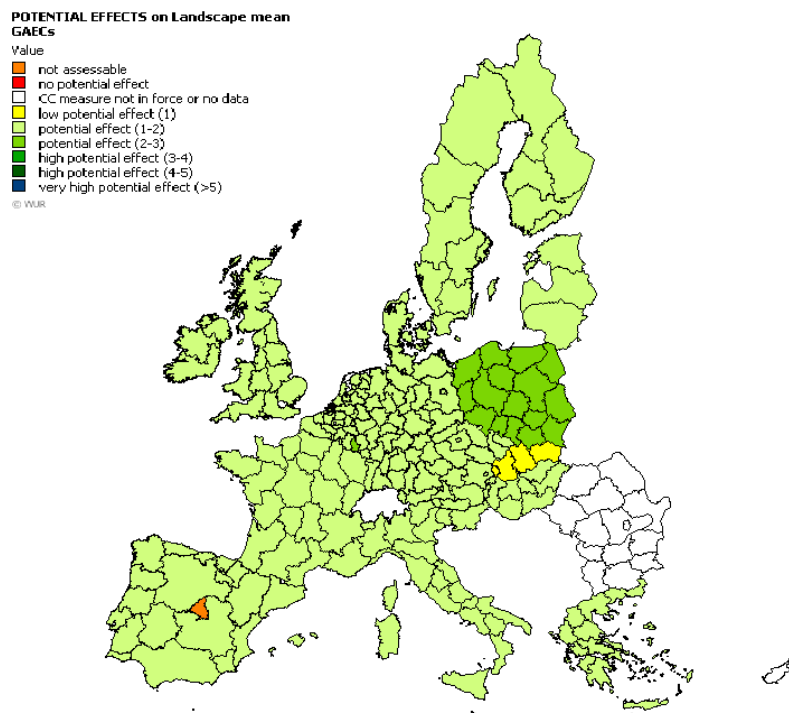
Figure 4.20 Average potential effectiveness of GAECs for biodiversity



Potential effectiveness of GAECs on landscape

Effects on landscape follow the same regional distribution as those on biodiversity (see Figure 4.21). Conditions with higher potential effectiveness on landscape have been implemented under issues *Soil erosion* and *Minimum level of maintenance issues*.

Figure 4.21 Average potential effectiveness of GAECs for landscape



3.3.1 Assessment of impacts induced by predicted land use and livestock changes.

CCAT tool provides end users with a wide set of intensity indicators, referred both to land use and livestock changes, and expressed in absolute (ha or LU) and relative figures (share of regional UAA or of LU).

Trends towards extensification are interpreted as positive for biodiversity while trends towards intensification are interpreted as negative for biodiversity.

Different scenarios of these indicators are assessed: 2005 baseline year, 0%, 25%, 50%, 75% and 100% compliance, and 50% gap closure.

Here, the main results corresponding to a selection of indicators and the scenario compliance gap 0-100% are summarized.

Effects on livestock intensity

Changes induced by EU legislation and GAECs are quite small. There is a mixed picture of gains and losses. Extensification in terms of increases in extensive livestock share are higher in Estonia, regions in North Germany and Belgium, Slovakia, Greece and Northwest Iberian Peninsula regions. Losses in extensive livestock share are higher in some regions in Poland, Czech Republic, Austria, Greece, Italy and Navarra (Figure 4.22).

When looking at the shifts in intensive livestock share we see losses (i.e. extensification) in Estonia, Latvia, and Lithuania, some regions in Poland, Greece, Slovakia, France, Portugal and Spain. While increases in the intensive livestock share are higher in Wales, País Vasco and some regions in Belgium, Hungary and Finland (Figure 4.23).

Figure 4.22 Changes in extensive livestock share between 0% and 100% compliance scenario

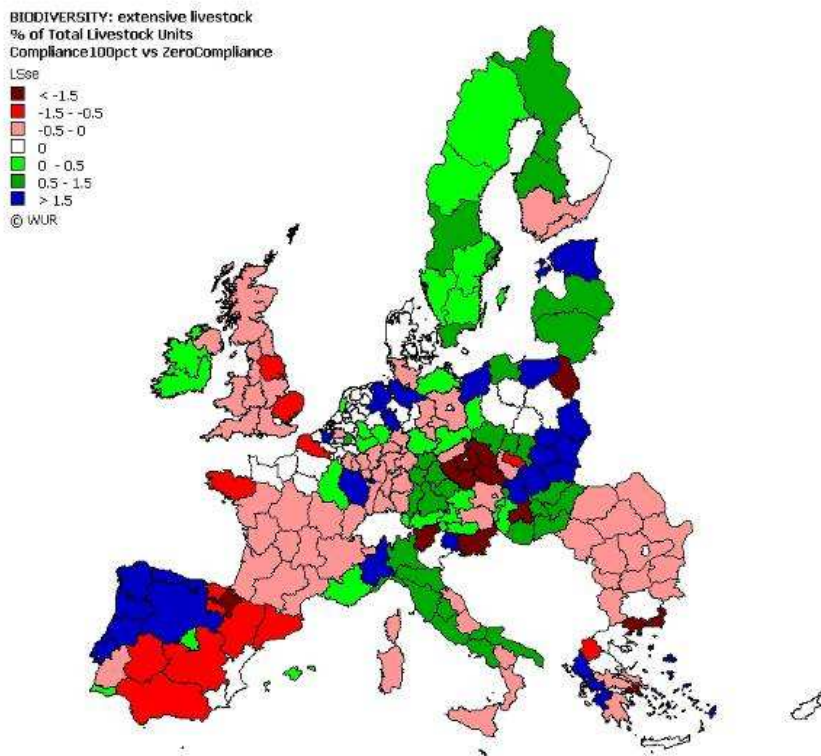
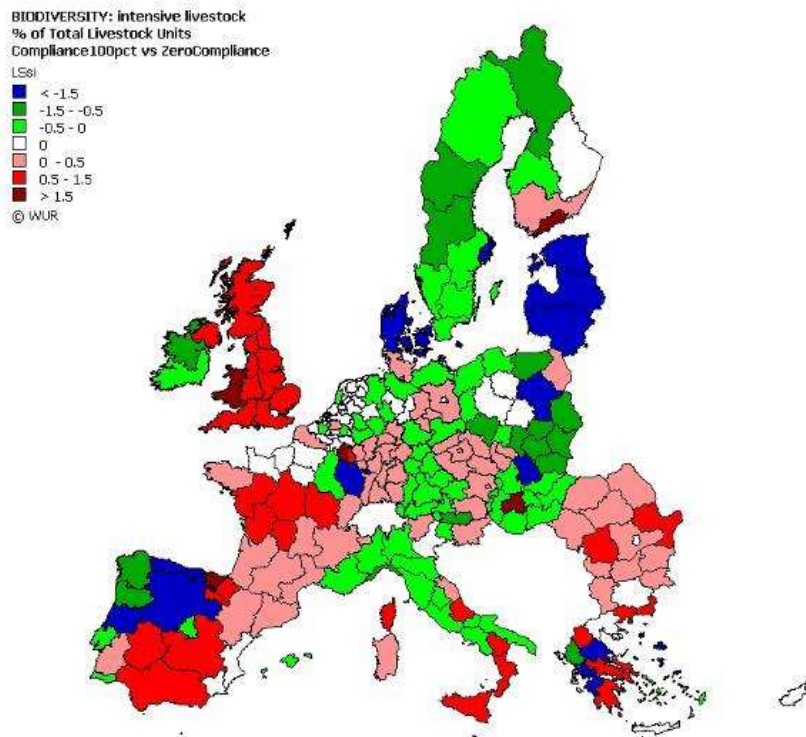


Figure 4.23 Changes in intensive livestock share between 0% and 100% compliance scenario



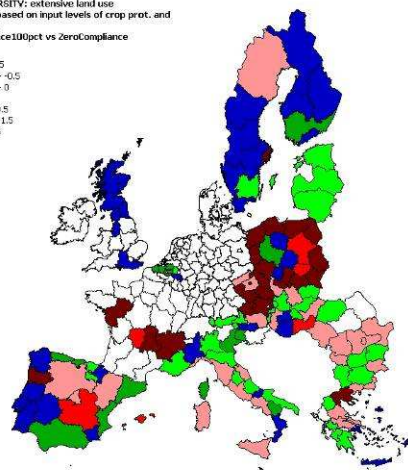
Effects on land use intensity.

Figure 4.24 Changes in share of low intensive, medium intensive and intensive land use

Extensive

BIDDIVERSITY: extensive land use
%/uaa based on input levels of crop prot. and
nitratos
Compliance100pct vs ZeroCompliance

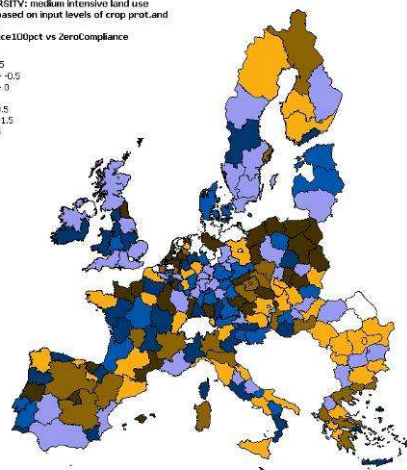
1.000
■ < -1.5
■ -1.5 - -0.5
■ -0.5 - 0
■ 0
■ 0 - 0.5
■ 0.5 - 1.5
■ > 1.5



Medium

BIDDIVERSITY: medium intensive land use
%/uaa based on input levels of crop prot. and
nitratos
Compliance100pct vs ZeroCompliance

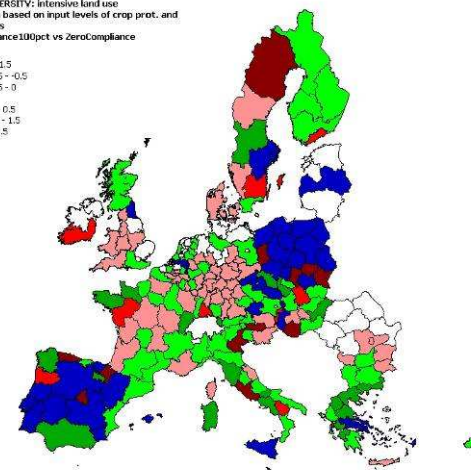
1.000
■ < -1.5
■ -1.5 - -0.5
■ -0.5 - 0
■ 0
■ 0 - 0.5
■ 0.5 - 1.5
■ > 1.5



Intensive

BIDDIVERSITY: intensive land use
%/uaa based on input levels of crop prot. and
nitratos
Compliance100pct vs ZeroCompliance

1.000
■ < -1.5
■ -1.5 - -0.5
■ -0.5 - 0
■ 0
■ 0 - 0.5
■ 0.5 - 1.5
■ > 1.5



Decreases in the relative share of UAA classified as intensive are mainly seen in the Mediterranean and Eastern European countries and in some regions in Central Europe, Finland and Scotland. There is no general trend detected in the direction of change in the extensive and medium intensive land use shares. Changes in the extensive share are mostly seen in the Mediterranean and in the CEEC, but some show a clear increase while other a clear loss. Changes in the UAA share classified as medium intensive need to be analyzed regionally to identify directions of change (extensification or intensification).

The share in intensive land increases in Estonia, Latvia, Lithuania, Finland, Scotland and some Mediterranean regions and stays constant in Central European regions.

4.4 Animal welfare effects

To assess the impacts of the farmer's adherence to EU obligations in the field of animal welfare, the legislative standard's minimum animal welfare obligations are calculated using the "Animal Needs Index", a specific indicator framework developed by Bartussek (1990). The ANI has been long tested in practice¹⁵, has proven to be suitable for the assessment of housing conditions of different farm types (see e.g. Hörning, 2000), and allows a high repeatability of the overall ANI scores in case of multiple assessments by different investigators (Amon et al., 2001).

The latest version of the Austrian ANI, the "ANI 35L" (Bartussek 1995a, 1995b, 2000), shows significant overlap with official farm monitoring and certification indicators.¹⁶ The following Table 4.2 shows the overlap between the ANI indicator scales and the respective CC indicator sets in the field of farm animal welfare, illustrated by means of numbers of overlapping categorical ANI indicator scales and their share in the final ANI score.

Table 4.25: Overlap of the ANI indicator set with CC obligations

Legal acts	Calves Directive			Pigs Directive			Animal Protection Directive ²		
	Short description of CC obligation	A ¹	B ¹ [%]	Short description of CC obligation	A ¹	B ¹ [%]	Short description of CC obligation	A ¹	B ¹ [%]
Obligation values	Min. space for group & individual housing	8	36.0	Min. space for group & individual housing	7	25.8	Freedom of movement	7	25.8
	Perforated walls for contact	1	5.6	Requirements for mixing groups of pigs	1 ³	2.2 ³	Accommod. for sick or injured animals	0	0.0
	Innoc. accommod. mat. & construction	3	11.2	Innoc. accommod. mat. & construction	4	15.1	Innoc. accommod. mat. & construction	4	15.1
	Adequate electrical circuits & equipment	1	3.4	Means to minimise aggression	1	4.3	Keeping of animals for farming purposes	0	0.0
	Air circul., temp. etc.	2	7.9	Air circul., temp. etc.	2	7.5	Air circul., temp. etc.	2	7.5
	Suitable lightning	2	9.0	Suitable lightning	2	7.5	Suitable lightning	2	7.5
	Condition of flooring	5	21.3	Condition of flooring	6	22.6	Record keeping	1	2.2
	Inspections of technical equipment	1	3.4	Requirements for noise control	1	3.2	Inspections of technical equipment	1	3.2
	Sanitary standards	2	6.7	Weaning conditions	0	0.0	Qualif. & suff. staff	0	0.0
	Inspections of calves	3	10.1	Qualif. & suff. staff	0	0.0	Inspect. of animals	3	10.8
	Restrictions for tethering, chains, etc.	3	22.5	Restrictions for tethering	4	23.7	Prohib. to administer harmful substances	1	4.3
	Feeding intervals	0	0.0	Feeding intervals	1	5.4	Feeding intervals	1	5.4
	Feed & water access	1	3.4	Feed & water access	2	8.6	Feed & water access	2	8.6
	Animal care in case of illness & injury	3	12.4	Adequate conditions of farrowing	1	4.3	Animal care in case of illness and injury	4	17.2
	Appropriate bedding	3	13.5	Suitable bedding & playing material	5	18.3	Prot. for animals not kept in buildings	1	4.3
	Colostrums after birth	0	0.0	Prot. of piglets	0	0.0	Breeding procedures	0	0.0
	-	-	-	Cond. of mutilation	0	0.0	Cond. of mutilation	0	0.0

Legend: Accommod.: Accommodation; CC: Cross Compliance; circul.: circulation; Cond.: Conditions; mat.: material; mech.: mechanical; Innoc.: Innocuous; Inspect.: Inspection; Prohib.: Prohibition; Prot.: Protection; Qualif.: Qualified; temp.: temperature; suff.: sufficient

A: Number of overlapping Animal Needs Index scales; B: Share of overlapping points in the final Animal Needs Index score

Source: Own compilation

¹: The ANI indicators, which are allocated to the specific legislative standards, partly overlap among themselves.

²: By means of the ANI of fattening pigs.

³: In case of breeding sows.

¹⁵ Since 1995 the ANI is used as official evaluation system for the assessment of housing conditions of organic cattle farms in Austria.

¹⁶ From now on, the term ANI always refers to the most recent version of the indicator framework, i.e. the ANI 35L.

As illustrated in Figure 4.25 the large majority of the CC relevant animal welfare obligations are addressed by ANI indicator scales. Especially restrictions for tethering as well as minimum requirements for floor condition and space allowance reach high shares of overlapping ANI points.

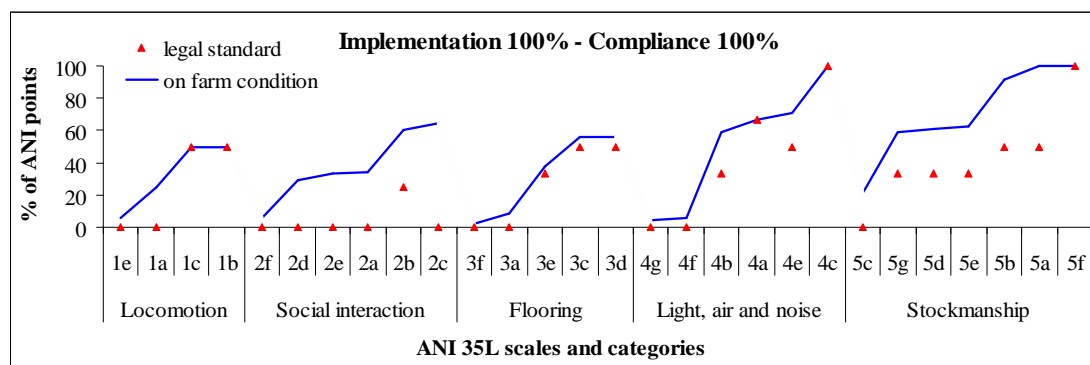
Under the assumption of full compliance with requirements of the respective standards, *minimum ANIs* based on the specific EU obligations given by the CC relevant Council Directives¹⁷ or the EU organic standard¹⁸ were calculated. In regard to space allowance calculations, the ANI was evaluated for horned adult cattle with at least 500 kg of weight, calves (under the age of 6 months) weighting between 150 and 180 kg, fattening pigs were assumed to have a weight of 60 to 110 kg and breeding sows a weight of 220 to 260 kg. In case of not specified outdoor yards for the animals, protection against weathering was not considered. The ANI assessment forms for calves were updated and aligned to the present European legislation. Because the assessment of different housing systems for cattle leads to significant differences in the ANI values, cattle farms were distinguished into farms with tie-stalls and those fitted with loose housing systems, whereas for breeding sows individual housing, a group size of 3 to 10 animals or over 100 animals is assumed. For pig fattening farms a group size of at least 30 animals is considered. All animal based assumptions do not apply to the animal numbers included in the tool.

To compare the “full compliance” minimum ANI scores with “on-farm” assessed real ANIs that reveal the actual degree of compliance of farms, an *additional step* was performed given that recent results from an on-farm assessment of animal welfare using the ANI framework exist (Annen, 2009). The on-farm assessments were conducted from February to March 2009 on 25 pig fattening and 40 cattle farms distributed over Austria and associated to various certification grades. The adherence to EU obligations was controlled by means of official monitoring forms. The calculated ANI scores based on full compliance with EU relevant legislation are plotted against the averages of on-farm measured ANI values. In the following Figure 4.26 the results are exemplarily displayed for fattening pig farms as shares of reached points per ANI scale and category.

¹⁷ Council Directive 91/630/EEC of 19 November 1991 laying down minimum standards for the protection of pigs and Council Directive 98/58/EC of 20 July 1998 concerning the protection of animals kept for farming purposes.

¹⁸ Imposed by EU Commission Regulation (EC) No. 889/2008 of 5 September 2008 laying down detailed rules for the implementation of Council Regulation (EC) No. 834/2007 on organic production and labelling of organic products with regard to organic production, labelling and control.

Figure 4.26: Fattening pig results for full EU legislation implementation and compliance



When doing on-farm assessments of animal welfare obligations, also violations with the respective codes can be found. For the EU organic pig fattening standard, these observed violations can be neglected. On conventional non-certified pig fattening farms small violations were detected in regard to the ANI categories “condition of flooring” and “locomotion”, which are reflected in on-farm conditions that nearly approach the calculated minimum standards. Whereas in these fields a high risk of non-compliance with CC relevant legislation can be assumed, the other ANI categories show a higher deviation between calculated minimum and on-farm measured results that suggest only low to medium risks of non-compliance. A more detailed grading of the expected risks of non-compliance per CC obligation involving all other animal types is given in figure 4.27.

The animal-specific ANI assessments for fattening pigs, adult cattle and calves and the resulting points per category are summarized to the final ANI scores which represent the animal welfare level of the livestock housing conditions on a specific farm that adheres to the EU animal welfare or EU organic standard. Accordingly, the livestock housing conditions can be classified as described in 2.1.4. The coloured categories with respect to welfare are used as legends in the GIS files.

Table 4.27: Rating of animal welfare levels according to the ANI framework

Sum of ANI points	Naming of categories with respect to welfare	Expressed in percentage of ANI points	Colour of legend
< 11	Not suitable	0 – 15	Red
11 - < 16	Scarcely suitable	16 – 30	Orange
16 - < 21	Somewhat suitable	31 – 50	Yellow
21 – 24	Fairly suitable	51 – 60	Light Green
>24 – 28	Suitable	61 – 75	Dark Green
> 28	Very suitable	> 75	Black

Legend: ANI: Animal Needs Index.

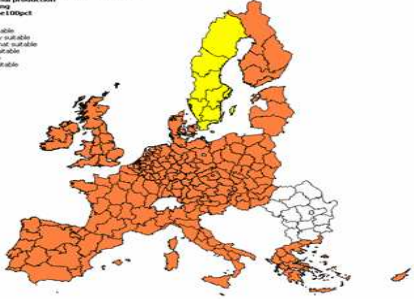

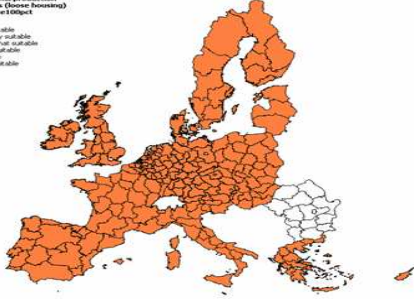
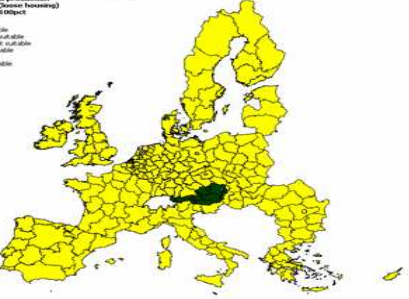
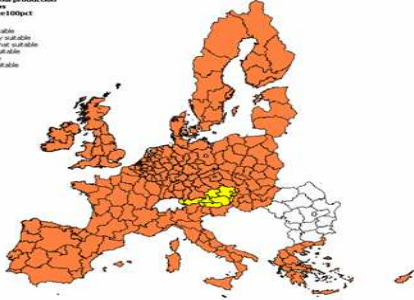



Source: Own representation based on Bartussek, 2001.

EU relevant legislation in the field of animal welfare is in some EU member states exceeded by national law. Due to higher space allowance requirements the legislative standard for conventional pig fattening in the Netherlands¹⁹ and Sweden is significantly higher than in the other EU member states. For conventionally kept breeding sows in Sweden, calves in the UK as well as adult cattle in Austria also stricter national obligations were observed. They are reflected in higher minimum ANIs that in some cases reach divergent animal welfare levels.

In the following Figure 4.28 an overview of the resulting assessments in mapped format is given for conventional farms. Whereas the minimum ANI assessments based on “full compliance” with EU relevant Directives and national legislation are given in the left column, the estimated on-farm animal welfare levels are illustrated in the right column. The latter are based on the outcomes of the Austrian field study.

¹⁹ Higher space allowance for stables built before 01.11.1998 and that have not been rebuilt or altered since 01.11.1998 the minimum requirements for old stables apply. Stables or floors that have been built or rebuilt after 01.11.1998 have to comply with the minimum space requirements for new stables

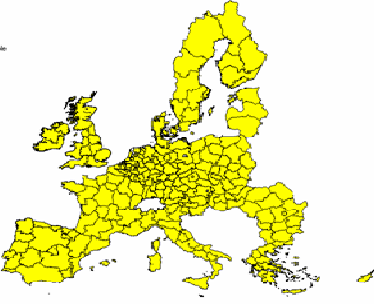


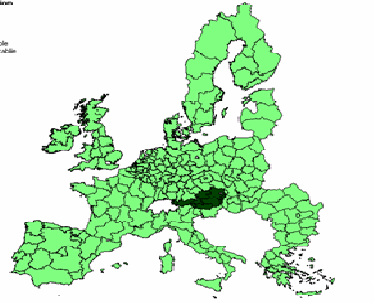




Table 4.28 Results for animal welfare assessments of conventional farms

Animal type	Minimum animal welfare level	Estimated on-farm animal welfare level
Fatt. pigs	<p>ANIMAL WELFARE: legal minimum standard - conventional production - Pig fattening Compliance 1 Output AN20101</p> 	<p>ANIMAL WELFARE: estimated on farm condition - conventional production - Pig fattening Compliance 1 Output AN20101</p> 
Dairy cows	<p>ANIMAL WELFARE: legal minimum standard - conventional production - Dairy cows (Dairy farming) Compliance 1 Output AN20101</p> 	<p>ANIMAL WELFARE: estimated on farm condition - conventional production - Dairy cows (Dairy farming) Compliance 1 Output AN20101</p> 
Suckler cows	<p>ANIMAL WELFARE: legal minimum standard - conventional production - Suckler cows Compliance 1 Output AN20101</p> 	<p>ANIMAL WELFARE: estimated on farm condition - conventional production - Suckler cows Compliance 1 Output AN20101</p> 
Calves	<p>ANIMAL WELFARE: legal minimum standard - conventional production - Calves Compliance 1 Output AN20101</p> 	<p>ANIMAL WELFARE: estimated on farm condition - conventional production - Calves Compliance 1 Output AN20101</p> 

Source: Own representation.

Following the procedure applied for conventional farms in Figure 4.29, Figure 4.30 gives an overview of the resulting CCAT GIS files for organic farms. Like the CC obligations, the EU organic standard in the field of animal welfare is in some member states exceeded by national law.

Table 4.29: Results for animal welfare assessments of organic farms

Animal type	Minimum animal welfare level (org.)	Estimated on-farm animal welfare level
Fatt. pigs	<p>ANIMAL WELFARE: legal minimum standard - organic production: Pig fattening FullRange Impact ANI02C3 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 	<p>ANIMAL WELFARE: estimated on farm condition - organic, production: Pig fattening FullRange Impact ANI02C3 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 
Dairy cows	<p>ANIMAL WELFARE: legal minimum standard - organic production: Dairy cows FullRange Impact ANI02C1 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 	<p>ANIMAL WELFARE: estimated on farm condition - organic, production: Dairy cows FullRange Impact ANI02C1 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 
Suckler cows	<p>ANIMAL WELFARE: legal minimum standard - organic production: Suckler cows FullRange Impact ANI02C3 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 	<p>ANIMAL WELFARE: estimated on farm condition - organic, production: Suckler cows FullRange Impact ANI02C3 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 
Calves	<p>ANIMAL WELFARE: legal minimum standard - organic production: Calves FullRange Impact ANI02C4 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 	<p>ANIMAL WELFARE: estimated on farm condition - organic, production: Calves FullRange Impact ANI02C4 not suitable scarcely suitable somewhat suitable fairly suitable suitable very suitable 0 max.</p> 

Source: Own representation.

It can be observed that organic farms reach significantly higher animal welfare levels than their conventional counterparts according to the applied ANI assessment system. Within the ANI indicator framework the adherence to defined free range and pasture conditions play a very important role in the final ANI scores. For fattening pigs a share of approximately 25 % of the maximum sum of reachable points can be ascribed to the compliance with free range and pasture obligations. In contrast to the animal welfare standard of conventional farms, the organic standard defined by the EU emphasises significantly higher free range requirements and leads therefore to higher ANI scores.

5 Integrated assessment tool: CCATool

5.1 Introduction

One of the main objectives of the CCAT project is to make an interactive computer application to estimate the effects of a variety of EU legislation in terms of agricultural markets, producer's income, consumer's welfare, land use, soil, water, air, climate, biodiversity and landscapes, as well as food safety, animal welfare and health.

The CCAT Final Tool connects the existing core models CAPRI and MITERRA and processes information on EU legislation, including assumed levels of implementation, compliance and cost. It also translates expert knowledge on potential effects on Biodiversity and Landscape into maps. In addition, it contains two meta models derived from the environmental models of Epic and DNDC, which are solely used for comparison with MITERRA (see par. 1.3).

The CCAT Final Tool will be delivered in two user types: end users and researchers.

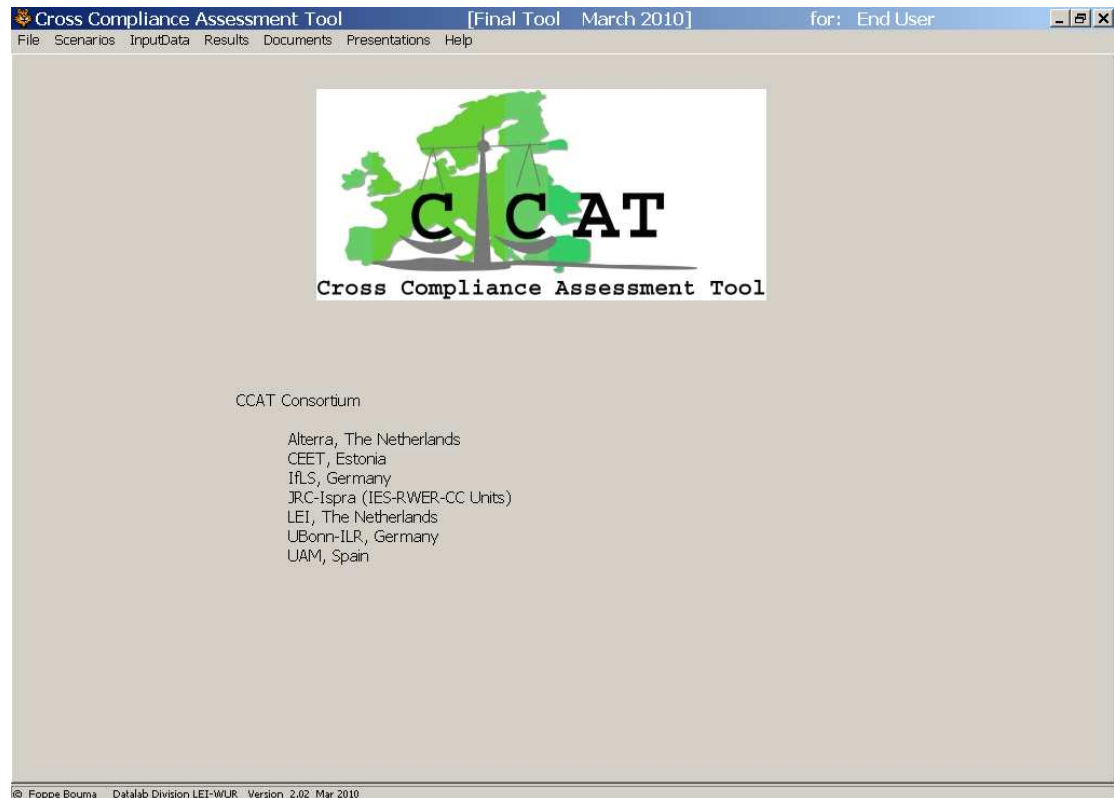
End users can investigate the results of predefined scenarios and have the possibility to extract information from these scenarios to Word, Excel, etc. They do not have the possibility to change and/or rerun these scenarios, nor have the possibility to define and create additional scenarios. End users however will have insight from within the tool in most documents and presentations and also some relevant input data.

Researchers can create and define new scenarios by inheriting from existing scenarios, can run those new scenarios and investigate the results. Researchers will also have insight in all relevant input data.

In this chapter we give a brief overview on the way the end user interacts with the tool. For more detailed information we refer to the User manual (Deliverable 5.5). For technical details we refer to the Technical description (Deliverable 5.6).

5.2 Interaction of the CCATool with the end users

When the end user starts the application the following opening screen will be presented, indicating the different functions of the tool.



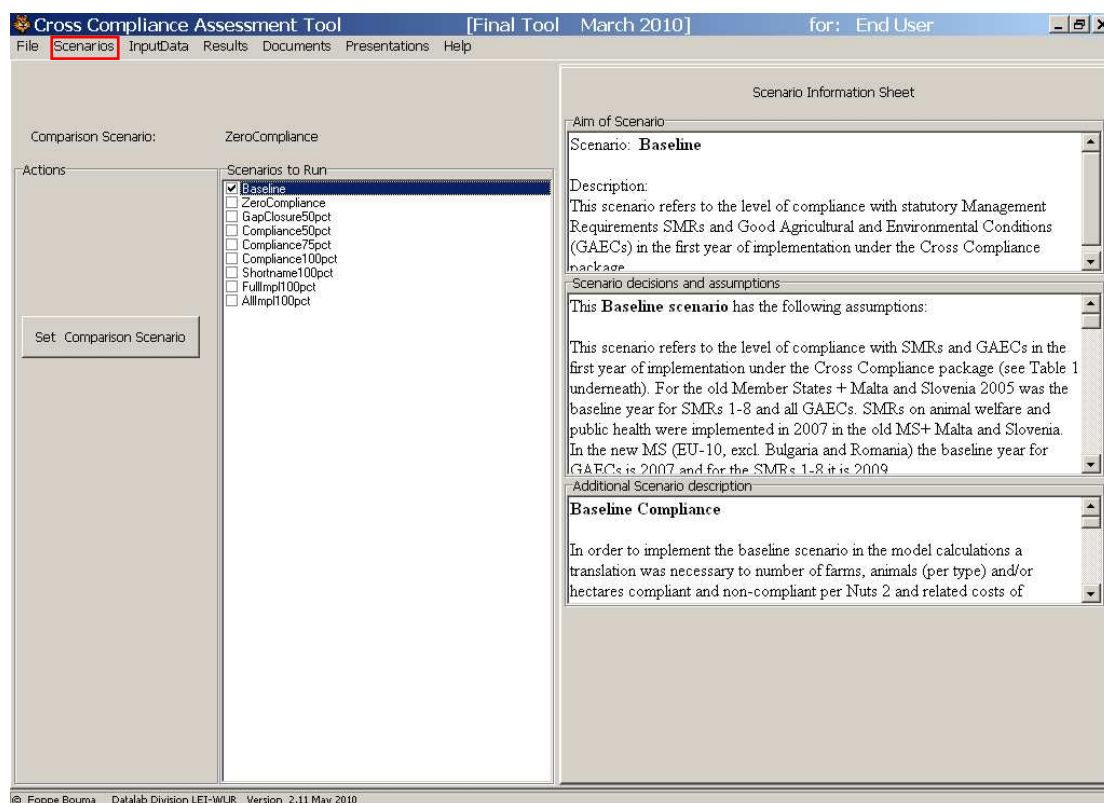
For the end user the following functions are relevant:

- **Scenarios:** to view information on the scenarios and to choose a comparison scenario
- **InputData:** to view relevant input data
- **Results:** to view all results in tabular form or in maps, and to view meta data of the indicators
- **Documents:** to view relevant documents that have been produced in the project
- **Presentations:** to view relevant power point presentations that have been produced in the project

Scenarios

If the user clicks on a scenario name, a description of the scenario will be shown in the right part of the screen.

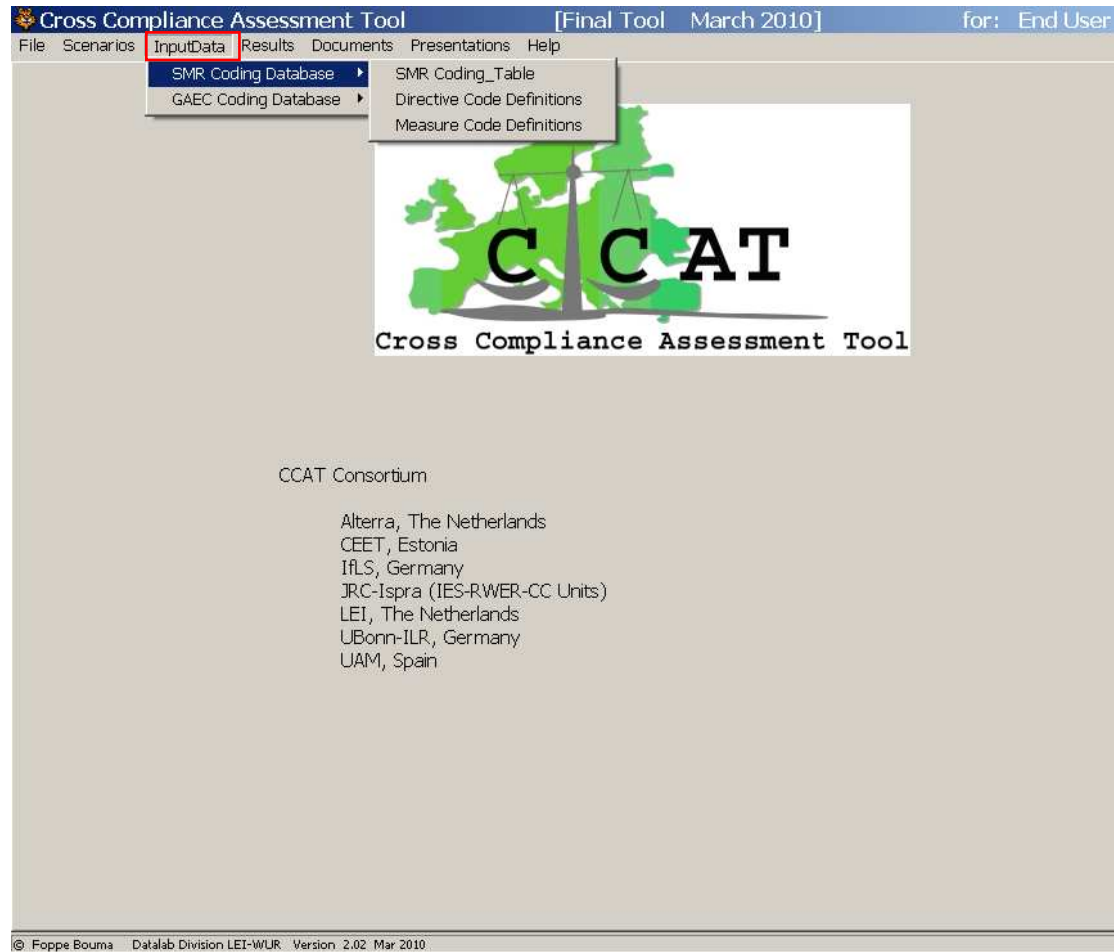
With “Set comparison Scenario” the end user may change the scenario with which the results of the other scenarios will be compared when viewing the results. By default the “Zero compliance” (or “*per se*” compliance level) scenario is the comparison scenario. For more information on the scenarios, see chapters 2 and 3.



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InputData

The end user is able to look into a part of the InputData, namely the EU legislation and GEAC coding tables that characterise the national standards and obligations (see par 2.2), also containing the Code definitions and the assumed potential impacts on Biodiversity and Landscape per region (see chapter 4).



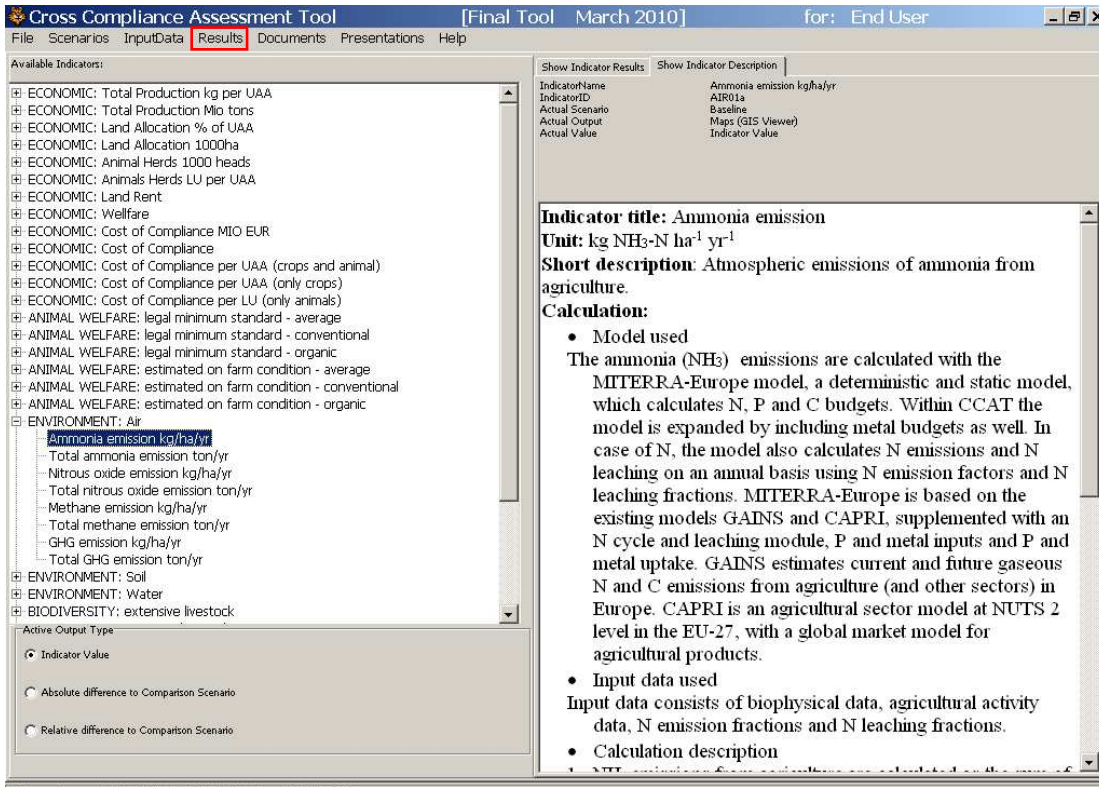
Researchers will be able to change these data, and will also be able to view and change the following data on compliance levels:

- The assumed implementation levels per region (see par. 2.2)
- The assumed compliance levels per scenario (see par. 2.3)
- The assumed cost of compliance (see par. 2.4).

To be able to change these data the “researchers version” of the tool is needed (this version will not be delivered to the EU commission, but is available at LEI, The Netherlands).

Results

The results of the CCATool are in the form of indicators. For each (group of) indicator(s) an indicator description can be viewed that gives information on the way the indicator or group of indicators has been calculated.



Indicator title: Ammonia emission
Unit: kg NH₃-N ha⁻¹ yr⁻¹
Short description: Atmospheric emissions of ammonia from agriculture.
Calculation:

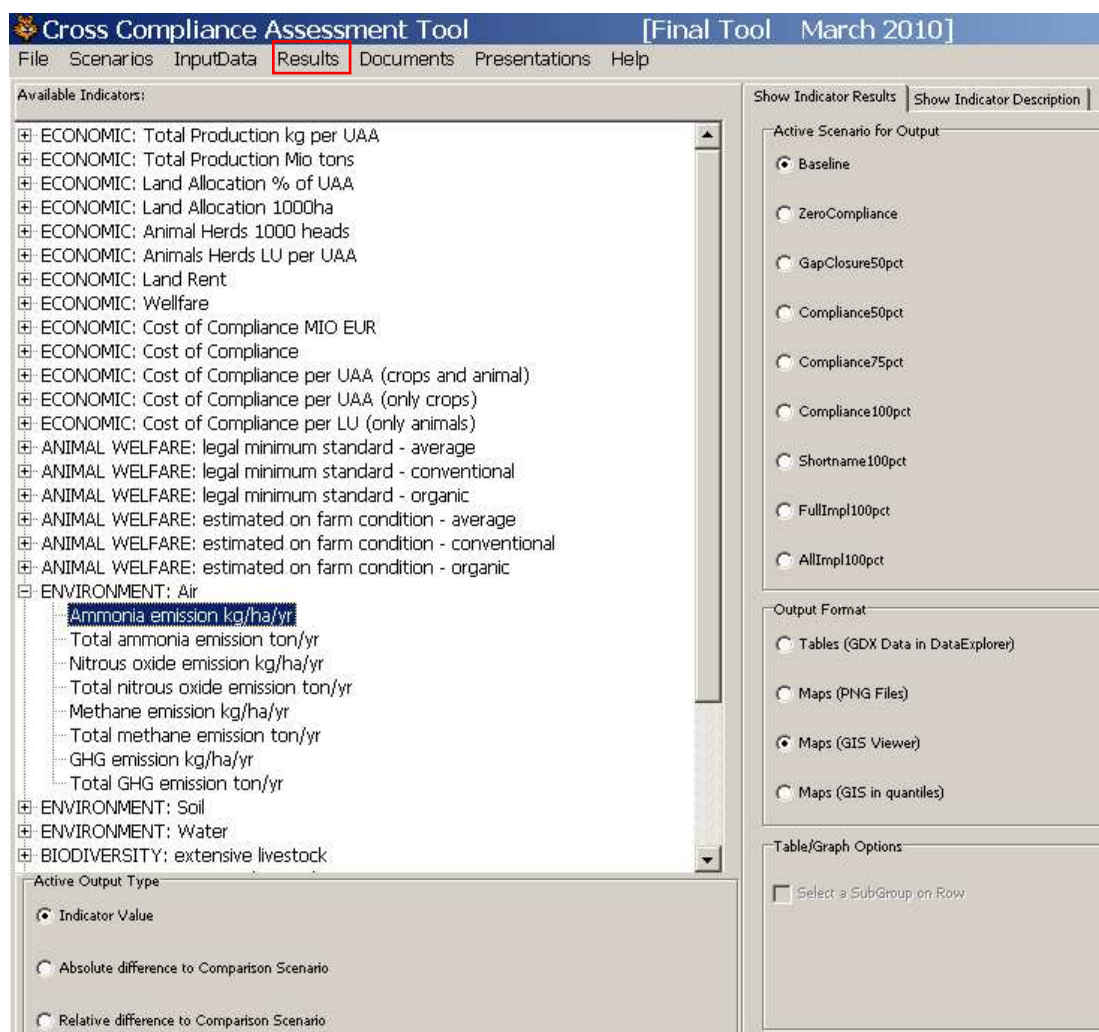
- **Model used**
 The ammonia (NH₃) emissions are calculated with the MITERRA-Europe model, a deterministic and static model, which calculates N, P and C budgets. Within CCAT the model is expanded by including metal budgets as well. In case of N, the model also calculates N emissions and N leaching on an annual basis using N emission factors and N leaching fractions. MITERRA-Europe is based on the existing models GAINS and CAPRI, supplemented with an N cycle and leaching module, P and metal inputs and P and metal uptake. GAINS estimates current and future gaseous N and C emissions from agriculture (and other sectors) in Europe. CAPRI is an agricultural sector model at NUTS 2 level in the EU-27, with a global market model for agricultural products.
- **Input data used**
 Input data consists of biophysical data, agricultural activity data, N emission fractions and N leaching fractions.
- **Calculation description**

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The results can be viewed in tabular form and in Maps. The best way to view the data is with the GIS viewer, because then maps as well as detailed data can be viewed (see Output Format in lower right part of the screen below).

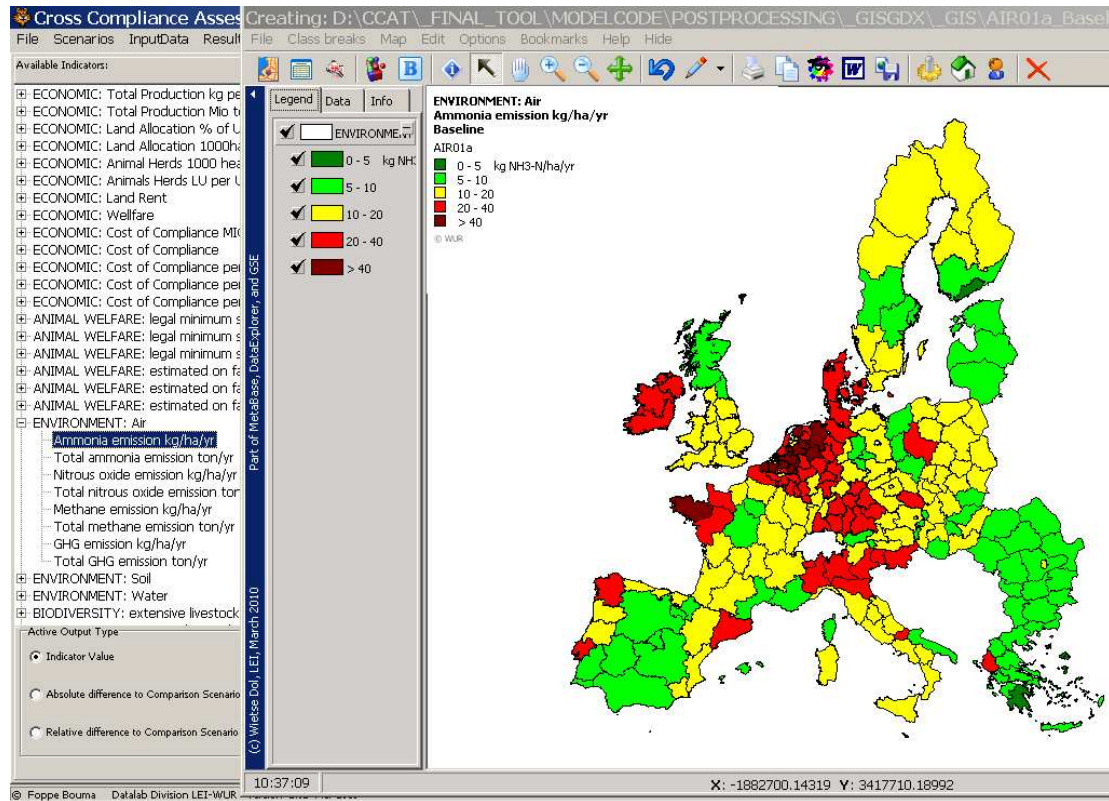
In the left part of the screen the indicator to be viewed can be selected. Since there are many indicators they are first shown in groups.

On the right side of the screen the scenario can be selected, and in the lower left part you can choose between the indicator value in the selected scenario, or the absolute or relative difference of the selected scenario to the comparison scenario (default ZeroCompliance).

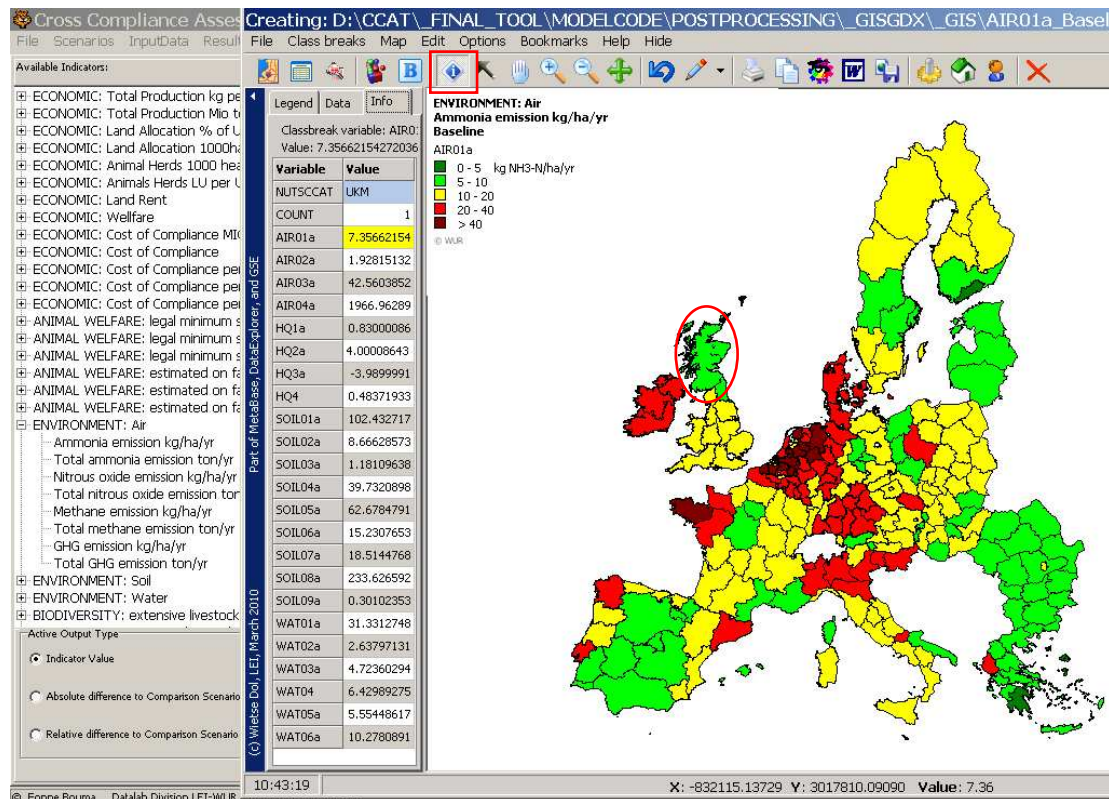


After selecting an indicator, and the option “Maps GISviewer”, a separate application will be started automatically (the GISviewer) showing the results in a map in the main viewing area....

In the example below Ammonia emission in kg N per year are shown for the baseline scenario.

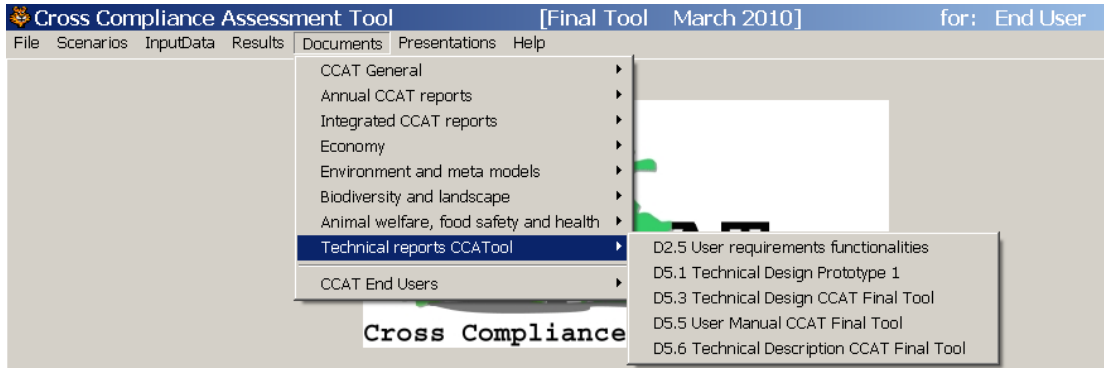


By clicking on “i” (of “information”) and then on a region (e.g. UKM) the value of the indicator of the selected region is highlighted in yellow:



Documents and presentation

Under Documents and Presentations the documents and presentations that have been produced in the CCAT project can be selected and viewed:



6 Discussion

6.1 Main findings

Effects of additional compliance (gap-closure between baseline and 100% compliance) are limited as baseline compliance is already high (average at 90% for most EU legislation standards). Overall effects of EU legislation standards are larger in economic than in environmental and biodiversity terms. However, clear regional diversity is seen.

The potential effectiveness of EU legislation standards on biodiversity and landscape is generally very positive but very strong regional variation occurs due to large differences in implementation at national and regional levels (both for EU legislation and GAECs). This effectiveness is assessed on the basis of the formulated obligations in the regional legislations wording (legal texts) which have obtained a score. Total effectiveness is then expressed as the average of scores per group of GAEC and or EU obligations.

As to the economic effects the overall conclusion is that cost for becoming compliant with EU legislation standards are only partly compensated by market effects. However, the total costs are limited, especially when concentrating on the costs for additional compliance i.e. the costs that still have to be made between baseline compliance, i.e. the level of compliance when EU legislation was introduced, to reach the 100% compliance rate.

Divergent economic effects occur in crop and animal sectors: In the crops sector the production and prices remain rather constant under influence of EU legislation standards. In the animal sectors we see a general production decrease and a price increase. This generally leads to small but regionally diverse changes leading to both intensification and extensification of livestock and land use.

As to the environmental effects we see in most regions limited declines in agricultural emissions. However, a selection of regions experience negative environmental externalities such as loss in soil carbon in regions in Poland and Southern Portugal, Ammonia emission increases in Poland, Bulgaria, Romania and Alpes-Méditerranée. However, these increases are relative and since the baseline situation refers to very small levels a relative change can be rather large.

Specific conclusions on environmental impacts

Impacts of EU legislation standards related to the Nitrates Directive show that:

- Impacts are highest on N leaching/runoff, while there is also a small positive effect on NH₃ emissions, N₂O emissions and carbon sequestration.
- Except for balanced N fertilization, the impacts are limited (<5%) on N leaching/N concentrations and very limited (<2%) for N emissions. A strict

balanced N fertilization can thus further reduce N leaching and NH₃ emissions and enhance GHG mitigation

- The difference between baseline and zero compliance (what did we gain) is considerably larger than between full compliance and baseline (what can still be gained). This is because of the level of compliance with the Nitrate Directive was already very high in most regions when EU legislation was implemented.

The GAECs standards show significant reductions in erosion and to a lesser extent increases in soil carbon stocks and reductions in N fluxes.

EU legislation standards impacts are regionally different. In most regions, there are positive changes in agricultural emissions. However, a selection of regions experience negative environmental externalities.

Specific conclusions as regards to biodiversity and landscape impacts:

Intensity changes due to EU legislation are in general quite small, although its effect on biodiversity will vary depending on regional characteristics such as share of HNV farming systems and the assemblage of wild species present in the region.

However some general trends emerge:

- Livestock intensity: An extensification trend is seen in Scandinavian and Eastern European countries and North Western Iberian Peninsula regions versus intensification in Central European Countries and Mediterranean regions (except Italy)
- Land use intensity: An extensification trend is foreseen in Mediterranean, Scandinavian and Eastern countries versus intensification in Central European countries.

Specific conclusions as regards to potential effectiveness assessment:

- The method, although an experiment and including both intended and unintended effects of EU legislation, seems useful to explore patterns of potential effectiveness of CC measures on biodiversity and landscape across the EU.
- In general, positive effects are found, although quite variable in magnitude among EU legislation and GAECs. No negative effects are foreseen.
- These results are now expressed as an average score per region to correct for differences in the number of GAEC and EU legislation implemented in every region. In a next assessment this approach could be further improved by weighting the score according to the share of regional UAA, of Natura 2000 and the assemblage of wild species present to obtain a more precise assessment.

6.2 Recommendations

Based on the obtained results and improved insights gained with respect to the trade-offs between standards with respect to the impacts they generate at different impact fields, the following recommendations can be given:

- To optimally exploit the potential of the CCATool for assessing the impacts of standards that are part of the EU's policy, it still remains crucial to improve the information on compliance rates with standards and also, although to a lesser extent, on the costs of compliance.
- The main aim of the CCAT project was to generate a tool for an integrative assessment of the standards that are part of the EU's policy. The CCAT tool provides an extensive overview of the impacts of (minimum) standards at several impact fields. Rather than using the tool for impact assessment of such standards, it would also be very interesting and feasible to use the tool in such a way as to study which standards are needed in order to achieve certain impacts (which may be public goods, or specific rural services, including climate change issues).
- The CCAT tool is also useful in understand which public services are most efficient in reaching both from an economic and environmental perspective. It helps to identify those measures with limited costs and high environmental externalities and also measures with high costs and low environmental externalities.
- More and/or stricter measures (e.g. balanced fertilization) can further enhance GHG and N-leaching mitigation as long as they do not involve significantly higher cost levels. Otherwise contrary effect may be sorted through production increase response.
- The CCAT project did not assess the permanent grassland obligation, or considers the effects on extensive grassland categories and HNV farmland, due to limitations in the models and data. This could be addressed in a follow-up by extending the approach with an improved grassland module incorporated in CAPRI and extensive data collection and land use modelling.
- Moreover, biodiversity is not assessed directly, but only through pressure indicators related to biodiversity, which reflects the state-of-the-art in biodiversity assessments, but further spatial analysis and case studies could provide better inside in real impacts
- The CCAT tool could also provide integrated assessment support in a wider context. The CCAT tool can easily be adapted to assess:
 - Climate policy options (climate proof instruments)
 - Public services and their potential effects
 - Land use changes induced by bioenergy targets

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Annex 1

Table 1: Overview of all indicators resulting from the integrated assessment of CC standards in the CCAT tool

Indicator group	Indicator name	Unit	Model
ECONOMIC			CAPRI
Total Production	Cereals	kg per ha UAA	
	Other arable	kg per ha UAA	
	Permanent crops	kg per ha UAA	
	Meat	kg per ha UAA	
	Milk	kg per ha UAA	
	Cereals	Mio tons	
	Other arable	Mio tons	
	Permanent crops	Mio tons	
	Meat	Mio tons	
	Milk	Mio tons	
Land Allocation	Cereals	% of UAA	
	Other arable	% of UAA	
	Permanent crops	% of UAA	
	Fodder production	% of UAA	
	Set aside and fallow	% of UAA	
	Cereals	1000 ha	
	Other arable	1000 ha	
	Permanent crops	1000 ha	
	Fodder production	1000 ha	
	Set aside and fallow	1000 ha	
Animal Herds	Dairy cows	1000 heads	
	Beef meet	1000 heads	
	Calves	1000 heads	
	Pigs	1000 heads	
	Poultry	1000 heads	
	Sheep and goat	1000 heads	
	Dairy cows	LU per UAA	
	Beef meet	LU per UAA	
	Calves	LU per UAA	
	Pigs	LU per UAA	
	Poultry	LU per UAA	
	Sheep and goat	LU per UAA	

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Gross Margin	Cereals	EUR per ha	
	Other arable	EUR per ha	
	Permanent crops	EUR per ha	
	Dairy cows	EUR per ha	
	Beef meet	EUR per ha	
	Calves	EUR per ha	
	Pigs	EUR per ha	
	Poultry	EUR per ha	
	Sheep and goat	EUR per ha	
Total Output	Cereals	EUR per ha	
	Other arable	EUR per ha	
	Permanent crops	EUR per ha	
	Dairy cows	EUR per ha	
	Beef meet	EUR per ha	
	Calves	EUR per ha	
	Pigs	EUR per ha	
	Poultry	EUR per ha	
	Sheep and goat	EUR per ha	
Total Input	Cereals	EUR per ha	
	Other arable	EUR per ha	
	Permanent crops	EUR per ha	
	Dairy cows	EUR per ha	
	Beef meet	EUR per ha	
	Calves	EUR per ha	
	Pigs	EUR per ha	
	Poultry	EUR per ha	
	Sheep and goat	EUR per ha	
Premium Recieved (Pillar 1)	Cereals	EUR per ha	
	Other arable	EUR per ha	
	Permanent crops	EUR per ha	
	Dairy cows	EUR per ha	
	Beef meet	EUR per ha	
	Calves	EUR per ha	
	Pigs	EUR per ha	
	Poultry	EUR per ha	
	Sheep and goat	EUR per ha	
Land Rent	Other arable	EUR per ha	
	Grassland	EUR per ha	
Welfare	Agricultural income	Mio EUR	
Cost of Compliance	All SMR and GAEC	Mio EUR	

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	All SMR	Mio EUR	
	All GAEC	Mio EUR	
	Birds and Habitats Directive (Dir 1,5)	Mio EUR	
	Groundwater and sewage sludge directives (Dir 2,3)	Mio EUR	
	Nitrate Directive (Dir 4)	Mio EUR	
	Identification and registration of animals (Dir 6,7,8,8a)	Mio EUR	
	Use of plant protection products directive (Dir 9)	Mio EUR	
	Animal and human health directives (Dir 10,11,19)	Mio EUR	
	Prevention and control of animal diseases (Dir 12-15)	Mio EUR	
	Animal welfare directive (Dir 16, 17, 18)	Mio EUR	
	% of agricultural income: all SMR and GAEC	%	
	% of total output: all SMR and GAEC	%	
	% of total input: all SMR and GAEC	%	
	% of total premium: All SMR and GAEC	%	
Cost of Compliance (crops and animal)	All SMR and GAEC	EUR per UAA	
	All SMR	EUR per UAA	
	All GAEC	EUR per UAA	
	Birds and Habitats Directive (Dir 1,5)	EUR per UAA	
	Groundwater and sewage sludge directives (Dir 2,3)	EUR per UAA	
	Nitrate Directive (Dir 4)	EUR per UAA	
	Identification and registration of animals (Dir 6,7,8,8a)	EUR per UAA	
	Use of plant protection products directive (Dir 9)	EUR per UAA	
	Animal and human health directives (Dir 10,11,19)	EUR per UAA	
	Prevention and control of animal diseases (Dir 12-15)	EUR per UAA	
	Animal welfare directive (Dir 16, 17, 18)	EUR per UAA	
Cost of Compliance (only crops)	All SMR and GAEC	EUR per UAA	
	All SMR	EUR per UAA	
	All GAEC	EUR per UAA	
	Birds and Habitats Directive (Dir 1,5)	EUR per UAA	
	Groundwater and sewage sludge directives (Dir 2,3)	EUR per UAA	
	Nitrate Directive (Dir 4)	EUR per UAA	
	Identification and registration of animals (Dir 6,7,8,8a)	EUR per UAA	
	Use of plant protection products directive (Dir 9)	EUR per UAA	
	Animal and human health directives (Dir 10,11,19)	EUR per UAA	
	Prevention and control of animal diseases (Dir 12-15)	EUR per UAA	
	Animal welfare directive (Dir 16, 17, 18)	EUR per UAA	
Cost of Compliance (only animals)	All SMR and GAEC	EUR per LU	
	All SMR	EUR per LU	

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	All GAEC	EUR per LU	
	Birds and Habitats Directive (Dir 1,5)	EUR per LU	
	Groundwater and sewage sludge directives (Dir 2,3)	EUR per LU	
	Nitrate Directive (Dir 4)	EUR per LU	
	Identification and registration of animals (Dir 6,7,8,8a)	EUR per LU	
	Use of plant protection products directive (Dir 9)	EUR per LU	
	Animal and human health directives (Dir 10,11,19)	EUR per LU	
	Prevention and control of animal diseases (Dir 12-15)	EUR per LU	
	Animal welfare directive (Dir 16, 17, 18)	EUR per LU	
ANIMAL WELFARE			CAPRI
legal minimum standard - average	Dairy cows	%	
	Cattle fattening	%	
	Sucler cows	%	
	Calves	%	
	Pig fattening	%	
	Breeding sows	%	
legal minimum standard - conventional	Dairy cows (loose housing)	%	
	Dairy cows (tie stalls)	%	
	Cattle fattening	%	
	Sucler cows	%	
	Calves	%	
	Pig fattening	%	
	Breeding sows (loose housing)	%	
	Breeding sows (fixed)	%	
legal minimum standard - organic	Dairy cows	%	
	Cattle fattening	%	
	Sucler cows	%	
	Calves	%	
	Pig fattening	%	
	Breeding sows	%	
estimated on farm condition - average	Dairy cows	%	
	Cattle fattening	%	
	Sucler cows	%	
	Calves	%	
	Pig fattening	%	
	Breeding sows	%	
estimated on farm condition - conventional	Dairy cows (loose housing)	%	
	Dairy cows (tie stalls)	%	

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	Cattle fattening	%	
	Sucler cows	%	
	Calves	%	
	Pig fattening	%	
	Breeding sows (loose housing)	%	
	Breeding sows (fixed)	%	
estimated on farm condition - organic	Dairy cows	%	
	Cattle fattening	%	
	Sucler cows	%	
	Calves	%	
	Pig fattening	%	
	Breeding sows	%	
ENVIRONMENT			MITERRA
Air	Ammonia emission	kg NH3-N/ha/yr	
	Total ammonia emission	ton NH3-N/yr	
	Nitrous oxide emission	kg N2O-N/ha/yr	
	Total nitrous oxide emission	ton N2O-N/yr	
	Methane emission	kg CH4/ha/yr	
	Total methane emission	ton CH4/yr	
	GHG emission	kg CO2-eq/ha/yr	
	Total GHG emission	ton CO2-eq/yr	
Soil	Soil organic carbon stock	ton C/ha	
	Total soil organic carbon stock	kton C	
	Soil phosphorous balance	kg P/ha/yr	
	Total soil phosphorous balance	tom P/yr	
	Metal balance for Cadmium	g Cd/ha/yr	
	Total metal balance for Cadmium	ton Cd/yr	
	Metal balance for Chroom	g Cr/ha/yr	
	Total metal balance for Chroom	ton Cr/yr	
	Metal balance for Copper	g Cu/ha/yr	
	Total metal balance for Copper	ton Cu/yr	
	Metal balance for Nickel	g Ni/ha/yr	
	Total metal balance for Nickel	ton Ni/yr	
	Metal balance for Lead	g Pb/ha/yr	
	Total metal balance for Lead	ton Pb/yr	
	Metal balance for Zinc	g Zn/ha/yr	
	Total metal balance for Zinc	ton Zn/yr	
	Metal balance for Mercury	g Hg/ha/yr	
	Total metal balance for Mercury	ton Hg/yr	

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Water	Nitrogen balance	kg N/ha/yr	
	Total nitrogen balance	ton N/yr	
	Nitrogen leaching to groundwater	kg N/ha/yr	
	Total nitrogen leaching to groundwater	ton N/yr	
	Nitrogen surface runoff	kg N/ha/yr	
	Total nitrogen surface runoff	ton N/yr	
	Nitrate concentration in groundwater	mg NO3/l	
	Nitrogen sub-surface runoff	kg N/ha/yr	
	Total nitrogen sub-surface runoff	ton N/yr	
	Nitrogen runoff to surface water	kg N/ha/yr	
	Total nitrogen runoff to surface water	ton N/yr	
BIODIVERSITY			CAPRI
extensive livestock	Total Livestock Units	LU	
	% of Total Livestock Units	% LU	
	Total Livestock Units based on stocking density	LU	
	% of Total Livestock Units based on stocking density	% LU	
	Total LU based on Concentrate and Maize spending	LU	
	% of Total LU based on Concentrate and Maize spending	% LU	
medium intensive livestock	Total Livestock Units based on stocking density	LU	
	% of Total Livestock Units based on stocking density	% LU	
	Total LU based on Concentrate and Maize spending	LU	
	% of Total LU based on Concentrate and Maize spending	% LU	
intensive livestock	Total Livestock Units	LU	
	% of Total Livestock Units	% LU	
	Total Livestock Units based on stocking density	LU	
	% of Total Livestock Units based on stocking density	% LU	
	Total LU based on Concentrate and Maize spending	LU	
	% of Total LU based on Concentrate and Maize spending	% LU	
extensive land use	Share based on €/ha crop protection spending	%	
	Share based on kg n-manure application/ha	%	
	Share based on kg n-mineral application/ha	%	
	Share based on average kg/ha yield level	%	
	Ha based on input levels of crop protection & nitrates	ha	
	% of UAA based on input levels of crop protection & nitrates	% / UAA	
medium intensive land use	Share based on €/ha crop protection spending	%	
	Share based on kg n-manure application/ha	%	

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	Share based on kg n-mineral application/ha	%	
	Share based on average kg/ha yield level	%	
	Ha based on input levels of crop protection & nitrates	ha	
	% of UAA based on input levels of crop protection and nitrates	% / UAA	
intensive land use	Share based on €/ha crop protection spending	%	
	Share based on kg n-manure application/ha	%	
	Share based on kg n-mineral application/ha	%	
	Share based on average kg/ha yield level	%	
	Ha based on input levels of crop protection & nitrates	ha	
	% of UAA based on input levels of crop protection & nitrates	% / UAA	
plant species and soil biodiversity	N-dep (kg N/ha) > 5 percentile critical load level/region	kg N/ha	MITERRA
	N-dep (kg N/ha) >10 percentile critical load level/region	kg N/ha	
	N-dep (kg N/ha) >50 percentile critical load level/region	kg N/ha	
aquatic	Nitrogen concentration in surface water (mg/l)	mg N/L	
Potential effects on Biodiversity and separate same indicators: Potential effects on Landscape	Unit for all: score of indicator group of measures:	sum and average	Expert judgement
Directives	Dir 1: Birds Directive		
	Dir 2: Groundwater Directive		
	Dir 3: Sewage Sludge Directive		
	Dir 4: Nitrate Directive		
	Dir 5: Habitat Directive		
	Dir 9: Plant Protection Products Directive		
	Dirs 1-5,9: Birds, Groundwater, Sewage Sludge, Nitrate, Habitat and Plant Protection Products Directive		
	Birds Directive: Maintain all species population		
	Birds Directive: Special protection areas		
	Birds Directive: Prohibit killing/disturbance		
	Groundwater Directive: Substances in list I: prohibition of direct discharge		
	Groundwater Directive: Substances in list I + II: prohibition of all direct discharge.		
	Groundwater Directive: Substances in list I + II: prevention of indirect discharge		
	Groundwater Directive: Substances in list I + II: may be authorized by MS under certain conditions		
	Groundwater Directive: Adequate handling of water-endangering materials		
	Groundwater Directive: Requirements for inspection, filling, and cleaning of spraying devices		
	Groundwater Directive: Restrictions for fertilizer use		

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	Groundwater Directive: Restrictions for application of waste water to water resources		
	Groundwater Directive: Conditions for groundwater extraction		
	Groundwater Directive: General conditions for of groundwater		
	Sewage Sludge Directive: Amount, contents of heavy metals and organic persistants		
	Sewage Sludge Directive: time of application		
	Sewage Sludge Directive: Type of area		
	Sewage Sludge Directive: Type of crop		
	Sewage Sludge Directive: Soil type and soil conditions		
	Sewage Sludge Directive: Time of application and type of area		
	Sewage Sludge Directive: General prohibition of spreading sewage sludge		
	Sewage Sludge Directive: General prohibition of spreading untreated sludge		
	Sewage Sludge Directive: Application only with prior indication and permission		
	Sewage Sludge Directive: Conditions of sewage storage		
	Sewage Sludge Directive: Soil analyses prior/ after spreading		
	Sewage Sludge Directive: Formal conditions		
	Sewage Sludge Directive: Restrictions on use of animal waste		
	Sewage Sludge Directive: Conditions for use of residual sludge from septic tanks		
	Sewage Sludge Directive: Conditions for application mud, silt or compost		
	Sewage Sludge Directive: Conditions for application of untreated sludge		
	Nitrate Directive: Periodical no fertiliser		
	Nitrate Directive: Prevent runoff, seepage		
	Nitrate Directive: Crop specific application		
	Nitrate Directive: Max 170 kg N/ha		
	Nitrate Directive: Limitations on sloping grounds		
	Nitrate Directive: Prevent leaching to specific zones		
	Nitrate Directive: Appropriate application techniques		
	Nitrate Directive: Growing winter crops		
	Nitrate Directive: Land use management		
	Nitrate Directive: Fertiliser use recording		
	Nitrate Directive: Irrigation systems management		
	Nitrate Directive: Nitrate Vulnerable Zones rules		

CROSS-COMPLIANCE ASSESSMENT TOOL

EC contract number 44423-CCAT

Deliverable number: 2.3

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	Nitrate Directive: Requirements making a general reference to other legislation		
	Habitat Directive: Special conservation areas		
	Habitat Directive: Preserve plant species in Annex IV(b)		
	Plant Protection Products Directive: Application amount / time		
	Plant Protection Products Directive: Keeping records		
	Plant Protection Products Directive: Planning of plant protection		
	Plant Protection Products Directive: Inspection and cleaning spraying machines		
	Plant Protection Products Directive: Treatment and containers		
	Plant Protection Products Directive: Preventive measures		
	Plant Protection Products Directive: Storage and labelling		
	Plant Protection Products Directive: Prohibition to buy, trade and store		
	Plant Protection Products Directive: Restrictions for open land application		
	Plant Protection Products Directive: Conditions for bee protection		
GAECs	GAECs issue: Soil Erosion		
	GAECs issue: Soil organic matter		
	GAECs issue: Soil structure		
	GAECs issue: Minimum level of maintenance		
	GAECs issue: Additional farmers obligations		
	GAECs: all issues		