Cross Compliance Assessment Tool

CROSS-COMPLIANCE ASSESSMENT TOOL

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Scientific support to policies SSP

Specific Targeted Research Project (STREP)

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1 Introduction

The economic impact generator in the CCAT application aims to simulate effects of CC measures on agricultural production and income within reasonable time. The existing agricultural sector model CAPRI should basically be able to fulfil this task. However modifications of the model will be necessary to meet specific demands of the CCAT application.

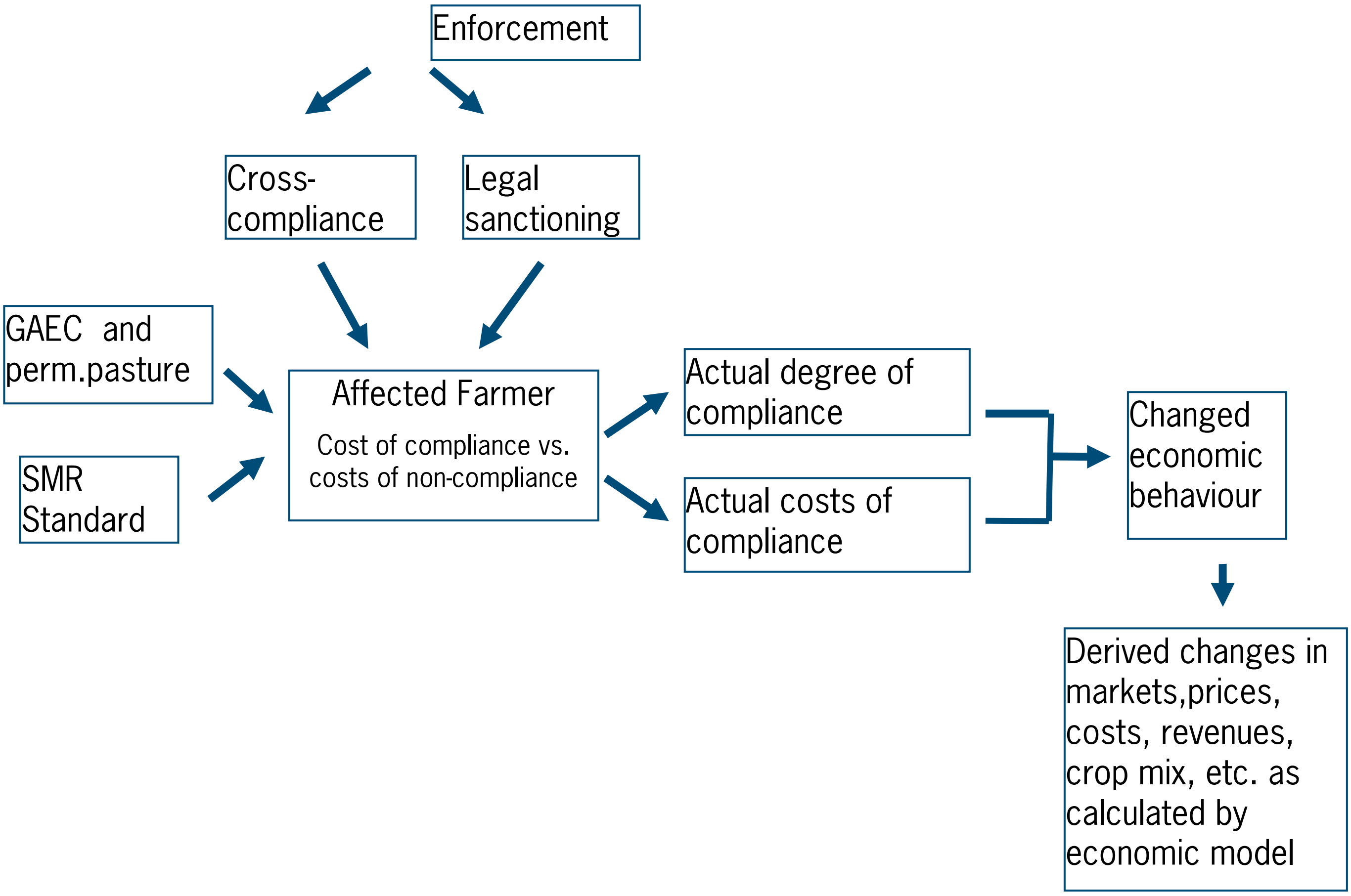
The aim of this deliverable is expressed in the project proposal as (DOW):

> Report on the design and development of the economic impact generator of CC. It should include a description on how to assess the economic impacts on producers income, agricultural markets and consumer's welfare impact indicators, including description of knowledge, data and model requirements and the design of the CAPRI economic impact generator as a component of the analytical tool.

Whereas the CAPRI model is well described elsewhere, here the focus will be on the adjustments made to this model to make it suitable for the current analysis. As such there is no need to discuss the calculation of price, market, income and welfare impacts in any detail. However, the crucial issue is how the cross-compliance related standards that will be assessed are likely to affect economic behaviour, which then subsequently affect all derived values (income, prices, quantities, etc.) as reflected in the economic logic included in the CAPRI-model (see Figure 1).

Figure 1 focuses on affected farmers. In terms of cross-compliance this means that in order to be affected by cross compliance farmers need to be eligible for direct payments. However, since in this project the primary focus is on the standards, rather that on cross-compliance as such, there is also another way in which farms may be affected or non-affected. Some standards may not apply to all farms (i.e. animal welfare standard does not apply to arable farm), or when they apply not really affect all farms (with the Nitrate Directive cross-compliance requirements being relevant for farms located in a designated nitrate vulnerable zone as a notable example).

When making their decision to either comply or not comply farmers might consider various factors such as a comparison of costs and benefits of (non-) compliance, moral and social factors, etc. The outcome of the farmers deliberation is a certain compliance rate, with involved costs of compliance and changes in farmer behaviour in order to satisfy the chosen compliance level. When the behavioural change is clear, the CAPRI model contains all what is necessary to calculate how the agricultural economy is going to adjust, including all the impact variables (specified in detail in Deliverables 2.1-2.2 and 2.3).



Source: Adjusted from Jongeneel *et al* (2008)

Figure 1 Standards, compliance choice and behavioural change

First of all CC measures have to implemented in the CAPRI model. The operational CAPRI model allows calculation of all selected economic indicators. The major challenge in this field is the suitable implementation of measures. Since cost estimations are available from previous studies we opted to focus on additional cost and neglected potential effects on input/output coefficients. The basic objective of the CAPRI supply model is profit maximization at a regional (Nuts2) level while CC measures typically refer to single farms. Therefore we have to incorporate the effects on single farms in the functions describing supply response at regional level. We assume that farmers could maintain their production, especially production level and yield, by improving their production technique in order to meet CC standards. Hence all CC measures would lead to more or less increasing production cost. These additional costs can enter the CAPRI profit maximisation at regional level. More details on this can be found in Chapter 2.

Secondly the CAPRI model has to de adopted to fit into the framework of the CCAT client application. Besides data exchange with other CCAT components the CAPRI model has to calculate results within a reasonable time, i.e. several minutes. Actually the standard CAPRI model runs for 45. To fulfil the demands of the CCAT application we develop a compacted CAPRI version producing results within 2 minutes accepting minor losses in accuracy of results. More details on this can be found in Chapter 3.

2 Implementation of CC measures in CAPRI

The core component of the economic impact generator will be the CAPRI model. Chapter 2.1 describes the way additional cost arising from CC measures should conceptually enter the CAPRI model. Subsequently the specifications of the pre-model calculation tool and scenario preparation become clear and are explained in chapters 2.2 and 2.3.

2.1 Methodology of CAPRI

The economic activities in the agricultural sector are broken down conceptually into 'production activities' (e.g. cropping a hectare of wheat or fattening a pig). CAPRI models 44 core production activities. Most of them are specific production activities (e.g. soft wheat), sometimes similar activities are merged (e.g. rye and meslin). Remaining minor activities are summarized in heterogeneous aggregates (e.g. other cereals).

Basic components of the CAPRI modelling system are supply and market model. The supply model is based on positive mathematical programming:

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

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

j activities

r revenu

c variable cost

x production level

a input coefficients

b ressouce availabilty

α and β parameter from calbration

λ dual value of contraints

Box 1: Profit maximization in supply module (standard version)

Since CC measures are supposed to cause activity specific additional cost there is potential impact on agricultural production and income that can be simulated with the agricultural sector model CAPRI. We assume that CC measures only influence variable cost, i.e. some additional cost c^* calculated in the scenario preparation tool enter the objective function.

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

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

c^* additional variable cost (CC measures)

Box 2: Extension of objective function for CC cost

This functional representation implies simplistic a shift of the regional marginal cost curve as shown in Figure 2. The production costs differ among specific farms in a region. The (regional) cost curve could be interpreted as an aggregation of all single farms.

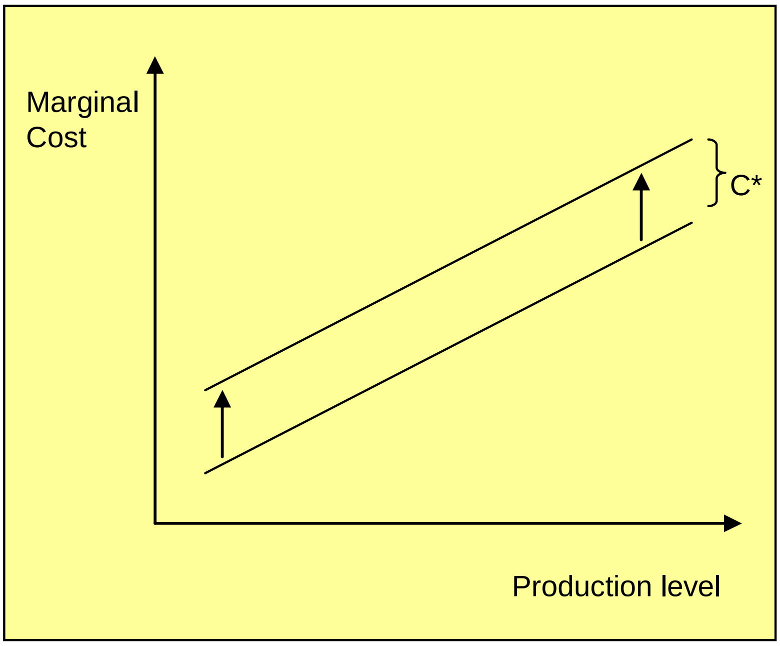


Figure 2: simplistic marginal cost curve underlying CAPRI supply model

The following figures illustrate effects of increasing cost due to CC measures based on a sample of artificial data. Lets assume in a region 50 farmers keep pigs for fattening. In the reference situation each farmer keeps 1000 pigs fully complying with the actual regulations. However the production cost differ among the farms ranging from 70€ to 80€.

After implementing CC measures some farmers are no longer in line with the regulations. Let us assume that cost of 2€ per pig would occur if the production had to be adjusted in order to meet the standards. Further the number of animals affected by these costs differs from 0% to 50% on the various farms. Actual values underlying the numerical example are taken from a sampling distribution. The actual is that 14.4% of pigs in the regions do not meet the standards and for those additional cost of 2€ per gig occur. The corresponding cost cure is shown in Figure 3. Over a significant range cost curve accounting for CC measures is indeed a parallel move of the original cost curve in the reference situation. A significant difference appears at the right where the slope of the new curve is much steeper.

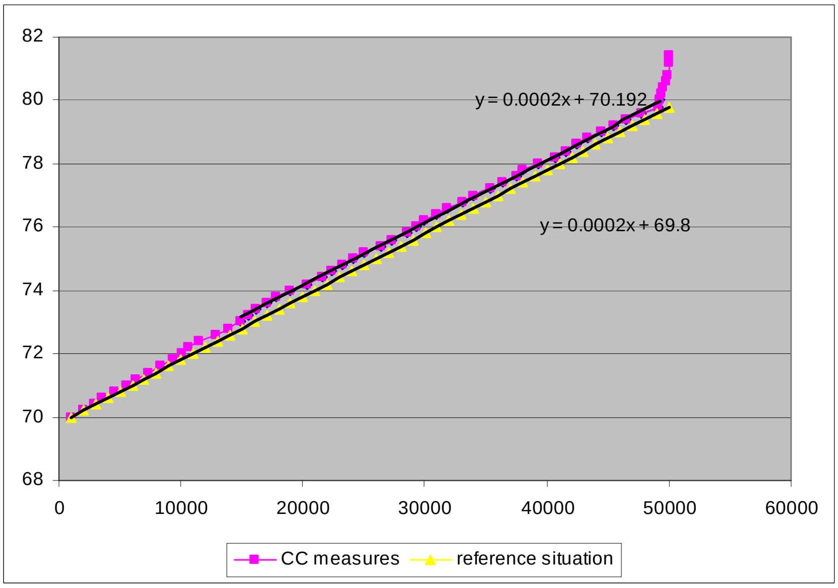


Figure 3: Cost curve based on sample results

Assuming identical[1] degrees of complying with CC measures on single farms yield the cost curve shown in Figure 4. Ignoring right and left ends of new cost curve we find that the shift (0.288) equals exactly additional cost (2€) times degree of violation (14.4%).

[1] This reveals a "large" number of farms per region and no systematic correlation among actual cost and degree of compliance per farm.

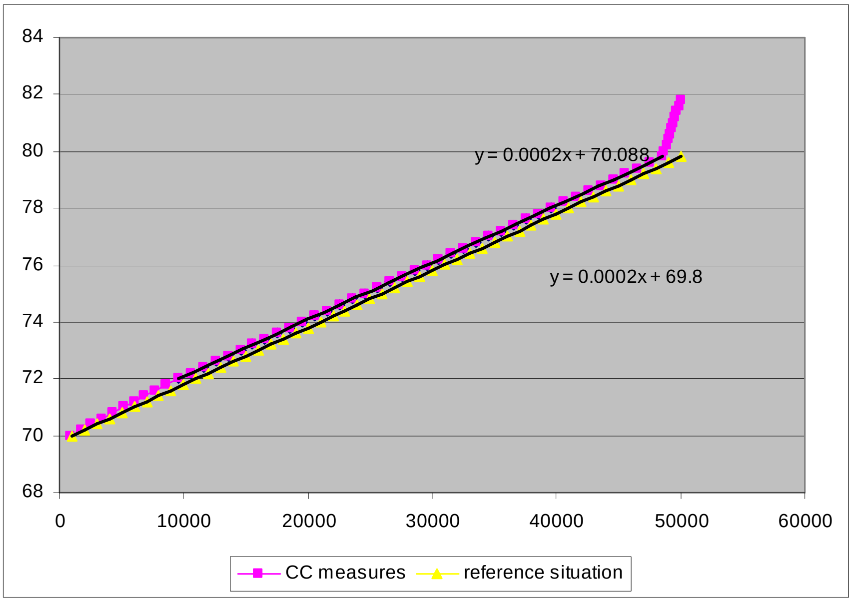


Figure 4: Cost curve based on expected degree of complying

For simplification we tend to implement shifts in marginal costs as shown in Figure 5. Potential deviation from the theoretical curve at the left end is negligible since actual adjustments of production are expected to be less drastic. Deviations at the right ends are probably more important since adoptions of production levels are supposed to occur in this range. We tend to ignore this deviation since only a minor fraction is affected. Furthermore the actual significance of deviation depends on the relation of additional cost and differences in total production cost in regions, i.e. the slope of the original cost curve. Further investigation based on real data has to be carried out before a final decision on the specification of the profit maximisation function can be taken.

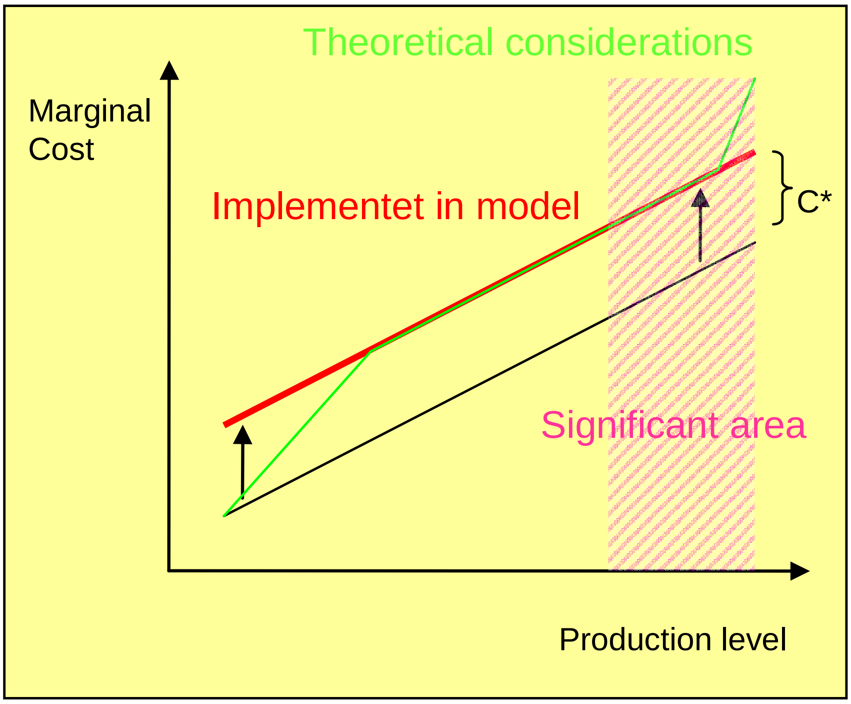


Figure 5: marginal cost curves – theoretical vs. actual implementation

For the moment we can conclude that additional cost per unit and degree of compliance are crucial parameters describing regional effects in the supply behaviour in the CAPRI model.

Additional cost should measure extra expenditures per unit to bring production in line with CC measures (in case of violation). The degree of compliance should be derived for the reference situation. Additionally the share of "anyway" complying farms is important since is needed to calculate total cost of regulations and it can serve as a lower bound of compliance in the reference situation.

2.2 Pre-model calculation tool

The pré-model calculation step will also be used to determine the best estimate of the degree of compliance as well as the per unit (hectare/animal) cost of compliance for various regulations. The Capri model will need input from a data base that has to be filled with information during the CCAT project. The pré-model calculation tool will create a table containing information on:

- Share of compliance in reference situation
- Additional cost (comparing non compliance / full compliance)

Input data will be differentiated by Region, farm type, measure and activity. As it seems nearly impossible to get all data at the most detailed level, data gaps will be filled with values from a higher aggregated level. It is proposed to use the hierarchy shown in Table 1.

Table 1 Level of aggregation for data input

	High		Level of aggregation		Low
Region	EU27	EU15/EU12	Member state	Nuts1	Nuts2
Farm typ	All farms	Specific farm type			
CC measures	Specific GAEC and SMR				
Activity	All activities	agricultural area / animals	Arable land / grassland / animals	specific activities	

In the following sub sections a number of pre-model calculation steps are discussed, with a particular focus on estimating the degree of compliance to regulations and derived measures (like for example the manure surplus), which are later used as inputs in the CAPRI model.

2.2.1 Degree of compliance

The degree of compliance to SMR and GAEC regulations differs over regulations (see discussion and Annex I of Deliverable 2.1-2.2) and over countries. In particular the Identification and Registration and nitrate Directive requirements appear to create difficulties for farmers to satisfy. These regulations which will be analysed in a more detailed way.

Input in Capri

The sheet below shows the input structure and at what format data on compliance rate have to be fed to the CAPRI model (see Table 2).

Table 2 Input sheet compliance rates for CAPRI

			DCOW	SCOW	BULF	PIGF	SOWS	HENS	POUF
			2003	2003	2003	2003	2003	2003	2003
DK000000	MAXMAN	SHGM		100.00	100.00			100.00	
DK000000	MAXMAN	BEEF	100.00	57.29	90.41			100.00	
DK000000	MAXMAN	PIGS	100.00	81.99	71.13	75.79	68.83	2.08	25.45
DK000000	MAXMAN	ARAB	100.00	99.46	99.71	100.00	100.00	100.00	100.00
DK000000	MAXMAN	PERM							
DK000000	MAXMAN	DARY	94.64	98.38	95.04	97.26	94.14	94.34	100.00
DK000000	MAXMAN	POLT		74.45	58.44	71.88	76.33	34.59	60.45
DK000000	MAXMAN	MIXF	95.05	100.00	97.95	98.88	91.77		81.70
DK000000	MAXMAN	MIXL	100.00	99.76	100.00	99.88	99.42	97.63	100.00
DK000000	MAXMAN	HORT							
DK000000	MAXMAN	ALL	95.01	97.18	96.40	89.97	77.35	48.13	74.10

Information problems

The determination of the rates of compliance is not straightforward for various reasons. First, there is a general lack of data. Second, as far as data are available they often aggregate over compliance with sub requirements. Sometimes the way of aggregation is unclear and nearly always it precludes decomposition of 'overall' or aggregated compliance rate into compliance rates associated with specific requirements. Third, the available numbers are difficult to generalize to their implications for the whole farm population, since they are conditional on risk sampling, and information about risk sampling is completely missing. Fourth, when information is available it is often available at member state level (Nuts 1), but not at lower regional levels (Nuts 2 or Nuts 3).

Within this deliverable in particular the decomposition of information at member state level into regional compliance rate estimates will be further discussed (see deliverable D3.3 for more details on the other steps). Below a calculation scheme to downscale compliance rate for the Nitrate Directive is presented.

Downscaling compliance rates with Nitrate Directive

The downscaling procedure is illustrated by the artificial calculation scheme provided below (see Box 3). The example relies on the following assumptions. An EU member state is assumed which comprises two regions, each having a specific farm structure. A simplified N-directive is assumed which consists of only two main requirements: a manure application standard and a record keeping standard[2]. Moreover it is assumed that the compliance data available at member state level allow for decomposition over the sub requirements.

The downscaling procedure follows four steps:

1) The information, assumed to be available (either because empirical estimates are directly available or because it is assumed feasible to construct such information as best-estimates, using various sources of indirect information) is presented in the upper part of the Scheme. Note that alongside the observed degrees of (non-)compliance (statistics which are assumed to be measured or expressed in terms of the whole farm population) also a line indicates the effective rates of non-compliance. This line is added to 'correct' for the potential effect of risk sampling. For example, in order to have a 0.15 degree of non-compliance at population level, is likely to imply a much higher non-compliance level when focusing on the more risky group of farms (e.g. the affected farms). Risk sampling is likely to lead to selection procedure giving high weight on farms in an NVZ and/or to those having high livestock densities. For that reason it is very important to have clear knowledge about what the compliance level reported at member state level stands for (i.e. the total number of breaches as a fraction of the selected sample, or a compliance rate calculated for the whole farm population).

[2] In reality 9 specific requirements related to the N-Directive are accounted for in the project.

2) Next, follows a table with detailed information on farm structure and the area of NVZs at regional (and national) level. This information, which is based on the farm structure survey and additional sources (i.e. for determining the NVZs), will be used to differentiate national compliance levels to the regional level.

3) The subsequent step is to calculate the numbers of non-compliant farms and the associated amount of hectares. This is done by making the following assumptions. It is assumed that only farms in the NVZs will be affected. All non-affected farms have an implicit compliance level of 100 percent. All farms in the NVZ are affected by the N-directive, but might affected differently for different sub requirements.

    a. All farms in the NVZ are assumed to be equally likely to be non-compliant with the record keeping requirement. So in order to calculate the number of non-compliant farms with this sub requirement, this (non-compliance) rate will be applied to all farms in the NVZ.

    b. As regards the manure application standard it is assumed that farms having a livestock density of less that 2 LU/ha will have no problem with satisfying this application standard and will therefore be 100 percent compliant with this standard. However, when livestock density exceeds 2 LU/ha, farms are considered as being affected by manure the application standard, and part of them will choose to be non-compliant. The number of non-compliant farms is calculated by applying the effective non-compliance rate (in the example 0.26) to the total number of farms having a livestock density of greater or equal than 2.

4) In the final step the calculated non-compliant farms are related to the total number of farms or total number of affected farms, which provides measures for the compliance rates at regional level. Alongside these estimates also lower and upper bound estimates are provided. The lower bound estimate (minimum degree of compliance) is determined as the fraction of unaffected farms (i.e. farm being outside the NVZ and having a livestock density of less than 2LU/ha), which, as the example shows, is region specific. The upper bound estimate is an estimate obtained by applying the best-practice compliance estimate found for any of the considered member states.

1) **Compliance data (disaggregated over subrequirements; measured at member state level)**

	national	manure	record
compliance	80%	0.15	0.05
calc effective rates of non-compl		0.265	0.05
max. compliance rate found for any member state			0.98

2) **Farm structure and composition data (measured at regional level)**

	region 1	region 2	country
total # farms	100	50	150
total # hectares of land	500	750	1250
total # livestock units	2500	1700	4200
NVZ : total # farms	20	5	25
NVZ : total # hectares	100	75	208
NVZ : total # LU	1600	900	2500
farms with LU/ha >2	10	4	14
NVZ: average ha/farm with LU/ha>2	10	25	14
NVZ: average LU/farm with LU/ha>2	30	40	33

3) **Calculating non-compliant farm and hectare numbers**

	region 1	region 2	country	check
# Violating farms				
record	1	0.25	1.25	0.050
manure	2.65	1.06	3.71	0.265
total	3.65	1.31	4.96	
# Violating hectares				
record	10	6.25	16.25	0.013
manure	26.5	26.5	53	0.042
total	36.5	32.75	69.25	0.055
# Violating LU				
record	30	10	40	0.010
manure	79.5	42.4	121.9	0.029
total	109.5	52.4	161.9	0.039

4) **Calculated compliance rates (bounds and best-estimate, regional level) *)**

	region 1	region 2	country
Measured as fraction of total farm population			
Calculated compliance rate	0.96	0.97	0.97
lower bound compl. rate	0.80	0.90	0.83
upper bound compl. rate	0.98	0.98	0.98
Measured as fraction of affected farm population			
Compliance rate of affected # farms	0.82	0.74	0.80
Compliance rate of affected # hectares	0.64	0.56	0.67
Compliance rate of affected # Livestock	0.93	0.94	0.94

**) Aggregated numbers comprising manure and record keeping violations!*

Box 3 Illustrative calculation scheme to downscale compliance rates

Although the procedure sketched above is general, the illustration implicitly referred to the dairy case. For beef a similar procedure can be followed. Also for pigs the calculation procedure is rather similar. The only difference being the livestock density variable, which is set at 17 pig equivalents per hectare. The livestock density criterion, which is now a single indicator, might be replaced by a composite indicator in the future (for example also including information of purchased feed use on farms).

Identification and Registration

Given the current state of data availability, it does not make sense to differentiate over farms and regions in order to assess the degree of compliance to the Identification and Registration requirement. In a later stage an effort will be made to differentiate compliance numbers depending on the farm types and used farming systems.

Scenario specific settings

The user will be able to set a desired degree of compliance in the graphical user interface. By definition this value has to be higher than the voluntary degree of compliance in the reverence situation. The setting can be done at different levels of aggregation as shown in Table 1. Missing settings on the lowest level will be filled by values entered at a more aggregated level.

2.2.2 Per unit costs of compliance

Input in CAPRI

The pre-model calculation step also includes a module determining the per-unit costs of compliance to various regulations. Being a combination of exogenous per unit costs and endogenous activity levels, the final costs of compliance will be endogenous and can only be derived from CAPRI. As regards the input of data a structure like presented in Table 3 will be followed.

Table 3 Input sheet structure for compliance costs for CAPRI

			DCOW	SCOW	BULF	PIGF	SOWS	HENS	POUF
			2003	2003	2003	2003	2003	2003	2003
DK000000	MAXMAN	SHGM	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	BEEF	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	PIGS	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	ARAB	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	PERM	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	DARY	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	POLT	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	MIXF	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	MIXL	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	HORT	75.29	53.95	23.11	3.53	24.07	0.45	0.07
DK000000	MAXMAN	ALL	75.29	53.95	23.11	3.53	24.07	0.45	0.07

Activity level per farm type

Farm type specific activity levels and regional shares can be calculated from FADN data. As FADN data is mostly reported at a level higher than Nuts2 some CAPRI model components already enable estimation of farm type information at Nuts2 combining FADN, FSS and Eurostat data.

Estimation of compliance costs for N- and I&R Directives

As regards the determination of the costs of compliance the two tables (Tables 4 and 5) below provide an illustrative and schematic calculation scheme (derived from CC project), that might be useful as a starter for further analysis. Although the discussed cases focus on the case of a specialized dairy farms, the proposed calculation schemes are generally applicable to other farm types, without needing to make fundamental changes.

Table 4 gives illustrates costs for the Nitrate directive as calculated for an artificial Italian dairy farm Italy with 100 dairy cows, 80 replacement cows and 23 hectares of available land. As can be seen from the Table the Nitrate Directive requires the farmer to invest in additional storage capacity, although the other capital goods (spreading truck) are assumed to still satisfy. Alongside investments the operational costs will change since in the new situation manure transportation and surplus placement costs increase. As can be seen it are these operation costs, which, in a relative sense, have the strongest impact on compliance costs. By comparing the numbers of costs per kilogram of milk produced the additional costs associated with the improvement from the current degree of compliance (as implicitly assumed in the initial situation) to full compliance. In order to end up with a percentage cost increase these additional costs have to be related to the total per unit costs of producing milk

Table 4 Nitrate Directive Costs calculation scheme

				Economic data	
Investments	Technical data (orig)			**(Old)**	**(New)**
Manure yard	Sq. m.	131	€	8,000	8000
Storage tank	Sq. m.	414	€	15,000	20,000
Manure spreading truck	Sq. m.	6	€	8,000	8000
Tanker truck	Sq. m.	10	€	17,000	17,000
INVESTMENTS TOTAL			**€**	**51,000**	**53,000**
Management costs					
Manure and sludge storage (in yard and tank respectively)			€	513	513
Manure transportation and spreading			€	696	6,489
Sludge transportation and spreading			€	610	11,970
Depreciation			€	4,160	4,415
Interests on costs and investments			€	1,743	2,170
Other (placement costs, production loss? ...)					5,072
TOTAL COSTS			**€**	**7,722**	**30,629**
COST PER kg OF MILK PRODUCED			**€**	**0.009**	**0.036**

Source: De Roest *et al*, 2007

As regards the Identification and Registration Directive, Table 5 provides a calculation scheme for the case of dairy farms. Whereas the previous calculation scheme presented results for a specific dairy farm, the next example focuses on a cost estimate per dairy cow, derived from data at member state level. Rather than choosing the member state as a reference (as was done in the Cross Compliance Project where this example was derived from), the approach is equally applicable to regions or farming systems. Since farming systems might differ with respect to eartag loss rates and intensity of animal movements a further desaggregation in that direction might be useful (and will be considered in subsequent Partner meeting discussion).

As Table 5 shows the scheme starts with determining the average number of livestock units per dairy farm. In a number of subsequent steps the herd composition is further developed, based on simple rules, such as the number of heifers per dairy cow, given a normalized breeding practice (which is assumed to be characterized by a certain lifetime of a dairy cow and immediate replacement of the dairy cow after this is sent for slaughter; also includes risk considerations). After having done this the costs of registration are determined by calculating the number of eartags required (including eartag replacement due to loss). Also the time (farm labour) required for putting tags in, self-inspection of tags and record keeping are accounted for.

Table 5 Illustrative Cost Calculation for I&R for selected member states

	France	**Germany**	**Italy**	**Neth.**	**EU-15**
Number of specialized dairy farms (all included) (*1000)	64	74	41	22	357
Average farm size specialized dairy farms (all farms)	67	53	30	45	48
Ave # of animals/farm	76	78	82	114	76
of which dairy cows (estimated!)	57	58	61	86	57
Estimated # calves born	40	41	43	60	40
Estimated # eartag loss (15% loss rate)	11	12	12	17	11
Labour costs per animal (€*h*wage/h)	2	2	12	2	3
I&R costs per animal (costs tags)	2	3	3	3	2
Fixed per farm costs (€, when relevant)	9				
Total I&R costs per farm	193	246	832	348	233
costs/dairy cow	3.37	4.22	13.56	4.07	4.07

Source: Based on CC-project (Jongeneel et al, 2007)

2.3 CAPRI scenario preparation

The value of interest in the CAPRI modelling system is the average additional cost per activity and region cumulated over all of CC measures. Figure 1 illustrates the way of calculating the specific value based on results from pre model calculations and scenario specific settings.

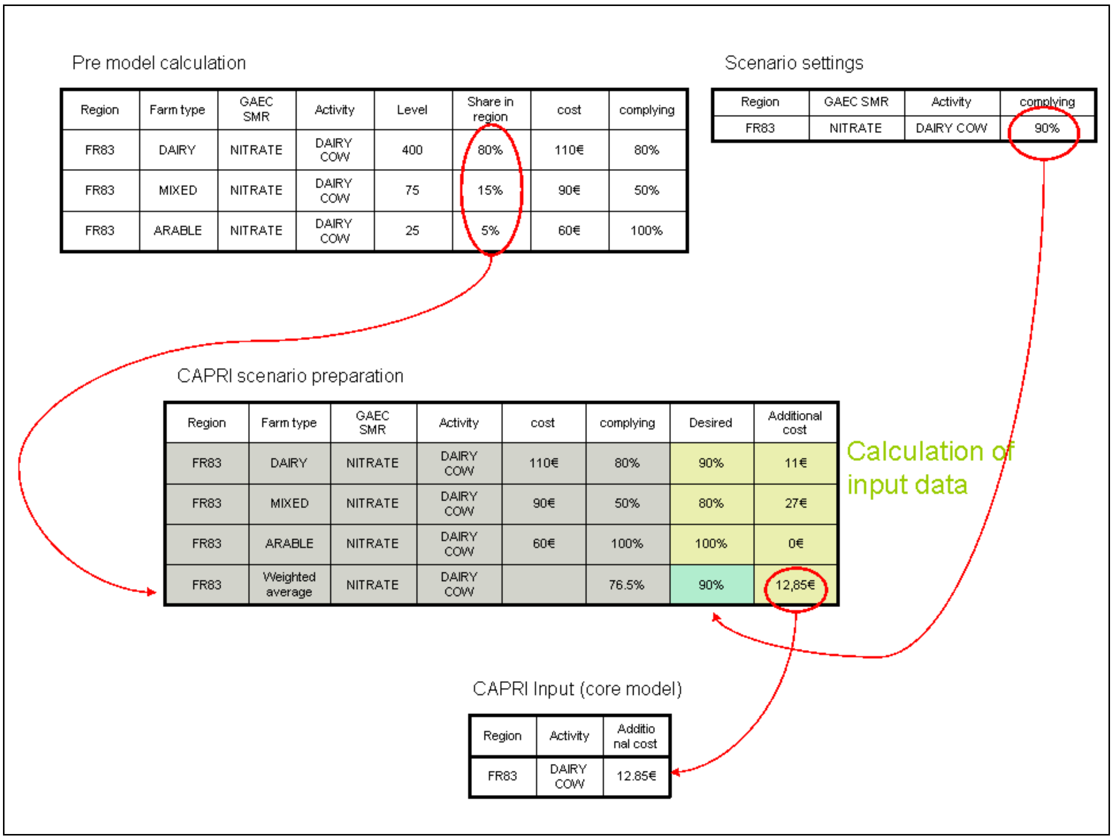


Figure 1: Calculation of additional cost

Following the numerical example in Figure 1 76.5% of the dairy cows in a specific region are anyway kept under conditions conform to the Nitrate directive. However this differs among different farm types from 50% to 100%. As in the scenario the desired degree of compliance is set to 90% the habitats of the farmers would have change what causes additional costs. The exact rules how to translate this regional value to specific farm types are subject to further discussion[3]. Assuming the values shown in Figure 1 are suitable, additional cost per farm type are calculated by multiplying the percentage increase in complying with the total cost, e.g. for transporting manure of one dairy cow. The weighted average of those additional cost (12.85€) is then used in the CAPRI simulation.

[3] Possible rules would be "lowest cost farms first" or linear increase over all farm types

3 Modification for CCAT application

3.1 Modification in CCAT

Some work will be done to speed up the calculations with the CAPRI model. This is relevant because a web based interactive model use and model linkage is foreseen, which preferably requires a quick input-output response. In its standard version the model can use up till 45 minutes to solve (see Figure 6). Partly this can be achieved by avoiding unnecessary calculation or using simplifying approximations. More about this will be reported (when necessary) in a next Deliverable.

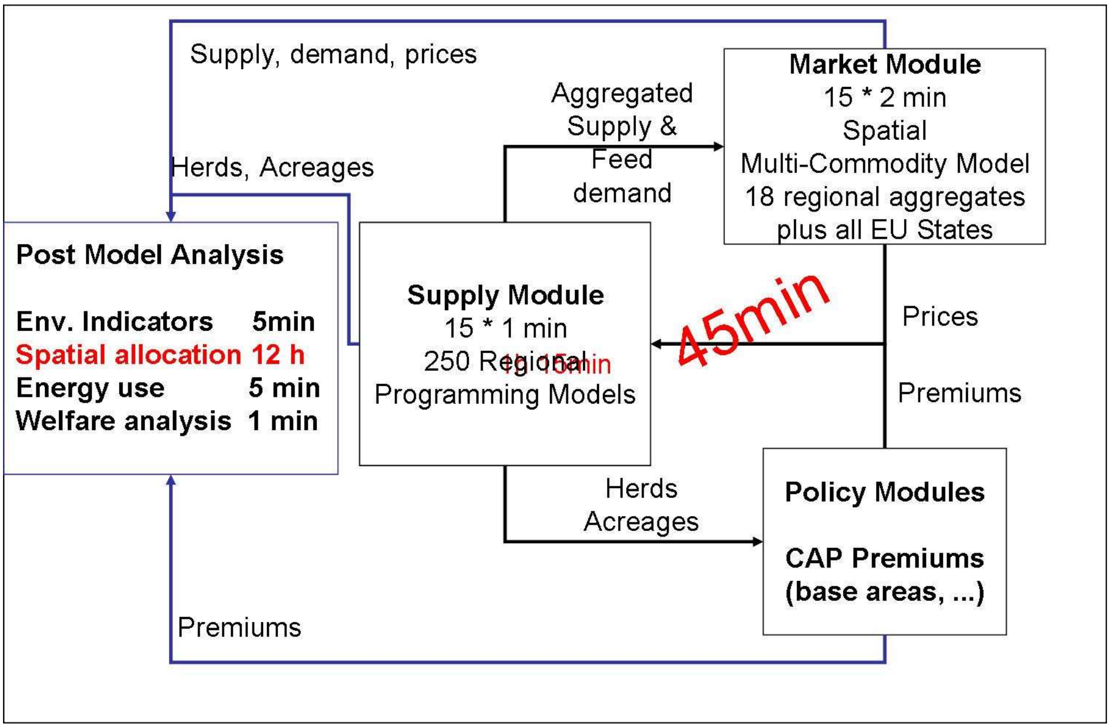


Figure 6 Solving CAPRI and module interaction

The calculation time can be substantially reduced by using some simplifying approximations. When the Market model module (see Figure 6) is replaced by a so-called Response Surface Market Module (see Figure 7) computing time can be reduced by 95% and run within a few minutes. Given the likely limited impacts of the evaluated standards on the market (see also Jongeneel et al, 2008), this approximate solution seems quite acceptable.

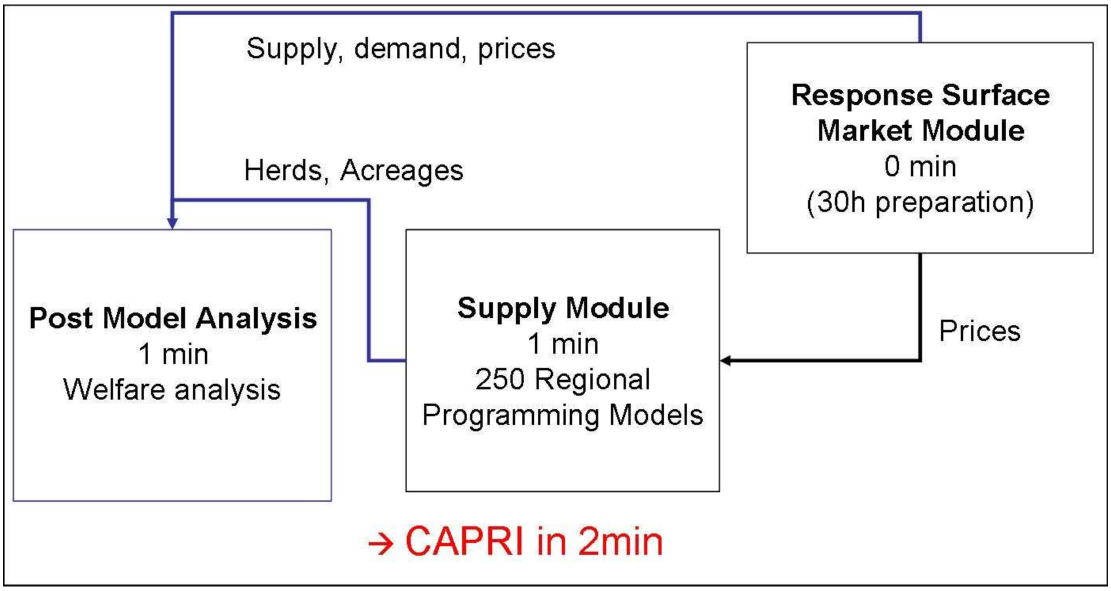


Figure 7 Solving CAPRI using a Response Surface Market module

3.2 Data transfer

Economic indicators

Most of the indicators discussed are already calculated by the CAPRI modelling system. The remaining can be added easily since raw data for their calculation is available in the model.

MITERRA Input Data

The exchange of data between the CAPRI and MITERRA model was already established in former projects. However this procedure will be re—evaluated and approved upon. New software developed by LEI, simplifying the communication of different models with each other, will be used. The main information passed to MITERRA are activity levels and fertilizer (mineral and manure) application rates.

4 Conclusions

This deliverable describes how the existing economic model CAPRI, that together with the environmental MITERRA model forms the backbone of the CCAT tool that will be developed, will be used and adjusted. The main focus is the Prototype 1 model, with the Nitrate Directive as a key case. A procedure is sketched that will be used to downscale compliance rate information measured at national level to lower-scale levels. Moreover, the main issues in the calculation of compliance costs for the Nitrate Directive as well as the Identification and Registration Directive are provided. These calculations schemes still might need some further refinement at parts, but provide a general way to calculate the input required for running CAPRI with an adequate representation of the behavioural impact of the standards considered.

Once the first results based on the methodology described before are available, sensitivity of model results against the assumptions will be tested and potential improvements will be discussed.

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