

**Auswirkungen der Mid-Term Review Beschlüsse
auf die Landnutzung in europäischen Regionen und Betrieben
– eine quantitative Analyse mit dem CAPRI Modellsystem**

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1. The CAPRI modelling system

The CAPRI modelling system is designed as a projection and simulation tool for the agricultural sector based on:

- (1) A *physical consistency framework*, building upon balances for agricultural area, young animals and feed requirements for animals as well as nutrient requirements for crops, realised as constraints in the regional supply models. The market model ensures closed fat and protein balances for processed dairy products.
- (2) *Economic accounting principles* according to the definition of the Economic Accounts for Agriculture (EAA). The model covers all outputs and inputs included in the national EAAs, with revenues and costs broken down consistently to regions and production activities.
- (3) A *detailed policy description*. The regional supply models capture all relevant payment schemes with their respective ceilings as well as set-aside obligations and sales quotas. The market side covers tariffs, TRQs, intervention purchases and subsidised exports.
- (4) *Behavioural functions* and allocation steering are strictly in *line with micro-economic theory*. Functional forms are chosen to be globally well behaved, allowing for a consistent welfare analysis.

The model distinguishes a supply and a market module which are iteratively coupled. The *supply module* consists of about 200 aggregate programming models at NUTS II level, working with exogenous prices during each iteration. After being solved, the results of these NUTS II models – crop areas, herd sizes, input/output coefficients etc. – are aggregated into Member State level models, which are then calibrated to these results by using techniques borrowed from Positive Mathematical Programming. Next, young animal prices are determined by linking these Member State models into a non-spatial EU model with market balances for young animals. Afterwards, supply and feed demand functions of the *market module* are calibrated to the results from the supply module. Solving the market model delivers producer prices at Member State level which drive the next iteration. Equally, in between iterations, premiums for activities are adjusted if ceilings are overshoot according to the rules laid down in the Common Market Organisations.

The supply modules for yearly crops and animals is based on the assumption of a two-stage decision process. In the *first stage*, producers determine optimal variable input coefficients (nutrient needs for crops and animals, seed, plant protection, energy, pharmaceutical inputs, etc.) per hectare or head for given yields exogenously determined by trend analysis. Nutrient requirements enter as constraints in the supply models, whereas all other variable inputs together with their prices define the so-called accounting costs. The proceeding reflects the calculation of

gross margins in farm management. In the *second stage*, the non-linear aggregate programming models define the profit maximising crop mix and animal numbers simultaneously with cost minimising feed and fertiliser mix. Availability of grass and arable land restrict production possibilities, with the crop mix influenced by set-aside obligations and the two tier quota system for sugar beet. A cost minimised feed mix covers animals requirements (energy, protein etc.), whereas crop nutrient need is met by either organic or purchased fertiliser. Fodder (grass, straw, fodder maize, root crops, silage, milk from suckler cows) is assumed to be non-tradable across regions and hence links animal processes to crop production and regional land availability. All other outputs and inputs can be sold and purchased at fixed prices, with milk bounded by quotas. The use of a *mathematical programming approach* allows to embed directly compensation payments, set-aside obligations, voluntary set-aside and sales quotas, as well as to capture important relations between agricultural production activities. Equally, environmental indicators as N,P,K balances and output of gases linked to global warming are implemented in the system. The *market module* breaks down the world into 12 country aggregates¹ and the EU Member States, each featuring systems of supply, human consumption, feed and processing functions. The parameters of these functions are derived from elasticities of other studies and modelling systems, and calibrated to projected quantities and prices in the simulation year, where the choice of the *functional form* (normalised quadratic for feed and supply, Generalised Leontief Expenditure function for human consumption) and *further restrictions* (homogeneity of degree zero in prices, symmetry, correct curvature) ensure regularity. Accordingly, the demand system allows for the calculation of welfare changes for the consumers. The *processing stage of dairy products* for the EU Member states comprises balancing equations for fat and protein ensuring that processed products use up exactly the amount of fat and protein comprised in the raw milk. Production of processed dairy products is then driven by the difference between the dairy product's market price and the value of its fat and protein content, based on a normalised quadratic profit function. Lastly, prices of raw milk are equal to its fat and protein content valued with fat and protein prices.

Policy instruments in the market module include bilateral tariffs (ad-valorem and specific), Producer/Consumer Subsidy Equivalent price wedges (PSE/CSE) and important bilateral

¹ EU, East European Candidate Countries, Mediterranean countries, U.S., Canada, Australia & New Zealand, Free trade developing countries, High tariff traders (as Japan), India, China, ACP countries, Rest of the World

agreements² as well as globally or bilaterally allocated TRQs for the EU and the 12 country aggregates. Additionally, intervention sales and subsidised exports under WTO commitment restrictions are explicitly modelled for the EU.

The *Armington assumption* drives the composition of demand from domestic sales and the different import origins depending on price relations and thus determines *bilateral trade flows*. The model comprises a two stage Armington system: the top level determines the composition of total demand from imports and domestic sales, the lower stage the import shares from different origins. Product markets are hence directly linked by import flows and prices, where observed in the base year. Accordingly, no uniform world market price is found in the system.

2. The reference run: Agenda 2000

The policy of the reference run reflects the Agenda 2000 policy extended to the year 2009. It is taken as the comparison point for the MTR impact analysis. Therefore, it is necessary to reflect that status quo policy representation, assumptions and exogenous shifters for this run as well as the most important results for different activity and commodity groups.

The CAPRI modelling system focuses on the EU, for supply even regionalised at NUTS II level. As the demand system is calibrated, not estimated, changes in demand behaviour not linked to income or prices changes have to be based on assumptions. In here, the demand systems for the EU Member States are calibrated to per capita consumption changes, income and population levels, in most cases in line with the data found in DG-AGRI's publication "Prospects for Agricultural Markets 2002-2009" Inflation is set to 1.9 % p.a. and nominal GDP growth for each EU Member State to 2.7 % p.a., used as a proxy for consumers' available income. Population growth at Member States level are borrowed from EUROSTAT.

Exogenous development of yields are based on trend analysis at EU Member State level, including years 1980-1999. Variable inputs are first shifted proportionally with the yields and then reduced by input saving technical progress of -0.2 % p.a.. Exceptions are nutrient needs of crops (N,P,K) and animals (energy, protein, fibre etc.) which are driven by yield dependent engineering functions.

Data relating to other world regions are borrowed ex post from the WATSIM modelling system, shifted to the year 2009 based on results of other studies. The resulting data set is adjusted to fulfil consistency conditions, both in the base and the simulation year. Main data source for the shifters in supply and demand for non-EU regions is the @2030 framework of FAO's global

² Including Double Zero Agreements with Central and Eastern European Countries and certain bilateral sugar quotas.

perspective unit (Bruinsma, 2003). The unit has a long standing tradition in forecasting the global food system, integrating modelling results, expert judgements and a multitude of other studies. The FAO checks the @2030 framework for caloric balances, land and water availability as well as feed requirements.

The *price framework* is based on representative long-term time series for world market prices of major raw and processed agricultural products, which are trend forecasted. These trends had been compared and partially revised to medium term forecasts by OECD, FAPRI and the EU Commission. Developments of domestic prices are based on these world market price developments using domestic policy definitions. For Non-EU countries, total food consumption follows accordingly the assumptions underlying the @2030 framework, calibrated to domestic consumer prices derived from the price transmission functions of the model and world market developments from DG-Agri's Market Outlook.

Milk *quotas* are supposed to increase with Member States specific rates, for the EU as a whole by 2.4 % against the base year. Percentages of under- and over-utilisation of quotas at regional level are kept constant as observed in the base year. Sugar quotas are kept at base year levels, but the system of A and B levies as well as production of C sugar is embedded in the analysis.

The modelling system considers *set-aside obligations* as a constraint in the regional programming models. Official mandatory set-aside rates for the ex-post calibration and in the reference run (10 %) are corrected according to information of Commission Services in order to reflect the small producer scheme, at least at national level. Small producer shares trend forecasted for the simulation year. In some cases, data at regional level regarding small producer shares were available for early years of the McSharry reform and the resulting regional differentiation was kept unchanged over time.

The programming models are calibrated to observed set-aside hectares, including voluntary set-aside, and non food production on set-aside land is treated as a separate production activity. Fallow land not falling into set-aside programs reflects the difference between land reported as idling in national statistics and data from commission services on actual hectares in set-aside programs.

Due to its activity based layout, the CAPRI supply model is well suited to deal with *the compensation payment scheme*. A detailed modelling component allows for the definition of payment schemes linked to outputs (current or historic yields) or activity levels in combination with ceilings in physical and/or valued terms. The following payments are included in the reference run: COP premiums for cereals, oilseeds, pulses and energy crops; traditional and

established durum wheat premiums; direct income support for dairy cows; direct payments to sheep and goat; national envelopes for dairy cows, sheep & goat and bovine meat cattle; slaughter premiums for adult cattle and calves; and national premiums to dairy cows in northern Sweden and Finland. Many of the listed premium schemes are restricted by ceilings in value and maximum amount on eligible hectares or heads defined at national or even regional level. Premiums are therefore cut in the model if these ceilings are exceeded.

The reader is reminded that the CAPRI modelling system is built as a true co-operative effort of a European network of researchers and receives funding by DG-RSRCH in the context of the 5th framework program.

3. Agricultural policy reform

In June 2003, a reform compromise for the Common Agricultural Policy was decided upon. The new policy package, to be phased in stepwise starting in 2005, is one of partial decoupling of direct payments and partial re-nationalisation of the policy decision making competence.

The main sketches of the new policy are:

- A new “decoupled farm” premium is introduced, based on production in a reference period and paid to a larger extent independent of production choices with however some production activities excluded as eligible (potatoes, sugar beet, fruit and vegetables).
- The member states have certain options to maintain proportions of some of the previous direct premium schemes linked to production, hence the term “partial decoupling”. A special premium for durum wheat production as well as a rice premium compensating for reduced intervention prices of rice can not be decoupled at all, as cannot the “carbon credit” paid for energy crops.
- Money is siphoned from the direct payment schemes under the first pillar of the CAP to rural development – the so-called second pillar - by a mechanism labelled “modulation”. Up to 5% of the “farm premium” are modulated, but with exemptions for smaller farms the average degree of modulation will be far below 5% in most regions and farm types.
- The market regulations undergo very small changes, the exceptions being butter and rice where the intervention prices are reduced by 10% and 50% respectively compared to the legislation in force (Agenda 2000, which however implies significant changes compared to the current situation).

- In addition, there are rules laid down for the management practice allowed for farms receiving the new farm premium (cross compliance), and a farm audit system designed to help farmers comply with these rules.

In this modelling exercise, we consider the new premium system, modulation and market policy changes. The rural development scheme, receiving more money in the future has not been modelled, nor the potential influences of the cross compliance rules. In the model, the new premium is introduced on NUTS 2 level, and its amount is calculated by a two step procedure. First, changes in the (coupled) premium system of Agenda 2000 are introduced for pulses, durum wheat, rice and Grandes Cultures. In the next step, all payments are reduced according to modulation based on a distribution of payments per farm derived from FADN data. The modulated premiums are used to compute the eligible payment per region *as if* the changed premiums were introduced in a historical period. The resulting amount per NUTS2 region is used as a basis for the new decoupled farm premium. The major challenges for simulations of the new premium system are:

- (1) To foresee which options for coupling each member state will use, and
- (2) To give the new decoupled premium and the correct degree of decoupling.

Regarding the first point, it is not yet clear how the individual member states will choose their strategies regarding if and to what extent premiums are kept coupled to production. It should first be noted that positions during negotiations do not necessarily reflect choices after the package has been decided upon. Take farmers' unions as an example. They may have opposed decoupled payments despite probable increases in farm income as the questionable character of direct income transfer independent of the income situation of the individual farm household becomes obvious with payments decoupled from production choices. With decoupling now possible after the council decision, the tactic of farmers' union may well be to ride along and capture the possible gains from improved allocation efficiency as long as possible, assuming that the political damage is done anyway. Secondly, whereas the effect on average farm income is generally expected to be positive, the effect on the processing industry is less clear. The processing industry depends on a predictable flow of primary products, and may hence want to keep the more rigid systems of coupled payments and ceilings to ensure the current level of regional production. Thirdly, the effects of the reform on one member state may be influenced by the options used by others, both by changed and newly emerging regional production patterns— the latter especially important for the processing industry. Indeed, this may result in a game between member states where it is unclear if there is a 'first movement' advantage. One such game may

take place in the beef market between Germany and France, with France showing traditionally a higher share of suckler cows and Germany specialising in bulls fattening. The German government may consider the decoupling of all premiums in the beef sector and using the possibility to pay a high premium for grasslands to strengthen extensive production forms like suckler cows. Compared to that option, the coupled suckler cow premium may be less effective given the relatively small German ceiling (639 535 heads compared to 3 779 866 for France). On the other hand, if France decides to keep the suckler cow premiums in coupled form, the German government may want to protect German suckler cow production by coupled premiums as well, believing that it would otherwise face competitive disadvantages against the French suckler cow producers. Finally, it is difficult to estimate how decoupled the decoupled payments really are (How decoupled is 'decoupled'?). On the one hand, the new premium has features that should make it more decoupled than the existing premiums:

- It applies to a greater number of production activities
- Trading possibilities for farm premium rights separate from land may reduce capitalisation in land values
- No upper limit on set-aside allows farmers to abandon production almost completely and still receive the direct support (as an alternative to selling the premiums)

On the other hand, there are features that would lead to the premium being not completely decoupled:

- There has to be a one to one mapping between “eligible hectares” and premium rights for each farmer, which will have some effect on land prices
- Potatoes, sugar beet, fruits and vegetables are excluded from eligible hectares, which at least limits the number of production choices open to the producer
- The only income of 100 percent set-aside is the premium, whereas an unknown cost per hectare applied is linked to cross-compliance. Producers who make a “loss at market prices” per hectare in for example cereals that is less than the cost of keeping set-aside “in good agricultural condition” would (being rational) still choose to produce cereals at a loss.
- Farmers may expect changes in policy where again past production choices establish rights – as it happened in the eighties with the milk quotas, in the nineties with farm ceilings for direct support and now again with the uniform farm premium, and may be hesitant to let land idle to larger extent.

In the simulations, the premium is assumed to fully contribute to the gross margin to the eligible production activities including set-aside, for which there is no upper limit.

4. Impact analysis of the Mid-Term Review Proposal

4.1. Introduction

The following quantitative analysis based on the CAPRI modelling system compares developments of production, land use, demand, agricultural income and some environmental indicators projected for 2009 under the policy set of the MTR proposal to the results of the reference run shown above, which represent the full implementation of the Agenda 2000 proposal in the year 2009.

4.2. Results for land use

Table 1: Difference of land use in MTR compared to Agenda 2000 (percent of area)

	European Union (%)	Germany (%)
Cereals	-8.71	-5.15
Oilseeds	-5.44	-2.31
Other arable crops	-0.27	+2.51
Fodder crops	+4.14	+5.24
Set-aside and fallow land	+5.51	-3.51

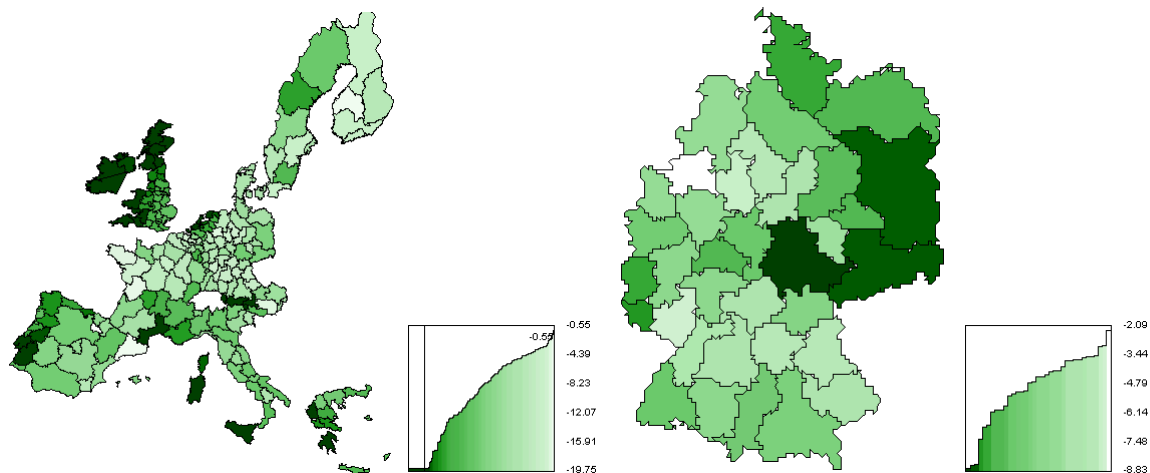
Source: Simulations with CAPRI modelling system.

Cereals production decreases compared to the reference run by around -7%, with average yields slightly increasing by 1.7% as the reduction is higher in less favourable regions. Reduction are pronounced for rye (-14%) and durum wheat (-26.5% reduction in acreage), the latter resulting from decoupling the rather high direct income support, which is further on phased out in so-called “established regions”. The shifts in regional production pattern let average durum wheat yields increase by +5%. The reduction in rye follows the abolishment of rye intervention. Almost a third of total production was simulated to be bought into intervention stocks under Agenda policy, and without that demand pull prices for rye fall some by some -12% even with production reduced, whereas prices for all other cereals profit from reduced production quantities. Cereals demand increases as well, as reduced meat production (-1.25%) in combination with higher cereals prices (+1.5%) let feed demand drop by around -5%. The pronounced difference in feed demand results from the fact that the more expensive cereals based part of the beef fattening processes shows a high reduction rate. Average cereal intake in beef fattening drops by -9%. Cereals are replaced mostly by other fodder from arable land which becomes more profitable receiving the uniform payment. Oilseeds are reduced by -3.6% in production or -5.4% in acreage as the average premium reduction is smaller than in cereals. Increases occur in potatoes by around 3% in acreage, however at prices dropping by -2.4% as farmers. Production of C- sugar

beet is increasing as well, with higher expansion in regions with a high yield, so that the average price over A,B, and C beet drops by -3%.

Fodder production is simulated to move to less intensive production branches: average grass land yields drops slightly, fodder maize is reduced by around -7.5% in acreage and other fodder on arable land increases by +23%. The remaining part of the reduction in cereals and oilseeds is compensated by an increase of idling land by 5.5%.

Figure 1: Percent difference in cereals area in MTR compared to the reference scenario in EU and Germany. Differences for Germany magnified to the right.



Source: Simulations with CAPRI modelling system. Areas are smaller in MTR than in the reference scenario in all regions. Darker colour means greater difference (see Gini plots in figure).

The situation in Germany is similar, with a smaller magnitude of changes, as production conditions are more favourable as the average of the EU. Cereals production drops by about -4.5% as does oilseeds output with -2.3%. Higher changes (drops up to -10%) occur in regions with less favourable conditions. The changes in potatoes and sugar beet are different, with production increases by around +5%. Fodder on arable land increase by around 40% or 400.000 ha from a rather small base³. Idling land in Germany is even forecasted to drop slightly some 50.000 ha.

4.3. Results for animal production

Beef meat production drops by -7% compared to Agenda 2000, whereas pork and poultry meat production increases by around +0.5%. The reduction in beef production is concentrated in suckler cows (-17.5% in herd size). Lower prices for calves let dairy herds drop and thus increases average milk yields as production is bounded by the unchanged milk quotas.

³ The effect is probably overestimated as it is assumed to all fodder maize is receiving the cereal premium in the base year, neglecting the possibility to declare fodder maize as fodder area to receive extensification payments in animal production.

If the value of young animals is considered, output value of animal products is higher (ca 100 Mio €) at European level in the MTR scenario than in the reference. Meat production is around 500 Mio t lower, with about 6 % less beef, 4.6 % less veal and slightly more pig (+0.2%) and poultry (+0.3%) production in the MTR scenario (see table 2). As a consequence, prices are higher (beef +7.5% pig and poultry around 1%). Output of cow milk increases slightly following some quota expansions in Greece and Portugal, however with prices dropping as intervention prices for butter are reduced. Overall outlays for feeding stuff are reduced, as reduced beef meat production decreases overall cereal and cake use in feed.

Table 2. Production and producer prices for meat in EU and Germany in. Difference in percent between MTR and Agenda 2000 for 2009.

Type of meat	European Union	Germany	Price
Beef	-6.0	-7.0	+7.2
Veal	-4.6	-18.5	+7.2
Pork	+0.2	+0.4	+0.7
Chicken	+0.3	+0.6	+0.9
Sheep and goat	-7.0	-6.9	+18.4

Source: Simulations with CAPRI modelling system.

Meat production in Germany follows the pattern observed for the EU (see table 2). The main difference is found in veal production, where the German veal production turns out to be 18.5% lower in the MTR scenario whereas the EU average only is 4.6% lower. The explanation to this different reaction is found in the interactions between suckler cows and adult cattle for slaughtering. In Germany, the relationship is such that the *absolute number* of calves born in the MTR scenario is small compared to the number of calves recruited by the fattening sector, leading to a (relative) shortage of calves. The relative change in number of animals is, however, not remarkable, see table 3. The suckler cows numbers are about 17% fewer in the MTR scenario than in the reference for both EU and Germany and the number of male adult cattle slaughtered are 8.2% fewer. The number of heifers slaughtered in Germany are 8.3% fewer whereas in the EU they are 2.8%.

Table 3. Relative difference of the number of beef producing cattle in the MTR scenario compared to the reference one for EU and Germany.

Kind of animal	European Union	Germany
Suckler cows	-17.3	-17.6
Male adult cattle	-8.2	-8.2
Heifers (slaughter)	-2.8	-8.3

Source: Simulations with CAPRI modelling system.

4.4. Impact analysis on agricultural income and FEOGA budget

Agricultural income increases by around 3.7 bio € of which 1.5 bio € stem from increased premiums to dairy cows and rice combined with the low “modulation rate”. Output value drops of crops drops by –0.4 bio € whereas crop specific inputs are reduce by 0.9 bio €- the effect of more efficient production choices due to decoupled premiums. Consumer losses around 1.3 bio € in purchasing power due to higher prices, the tax payer suffers from increased FEOGA outlays of 1 bio € Overall welfare increases are around 1.4 bio €

Table 4. Difference in welfare between MTR and the reference scenario (million euro)

Agent	European Union	Germany
Taxpayers	-1039	-176
Consumers	-1262	-41
Farmers	+3742	+200
Primary processing	-271	-116
Total	+1441	-17

Source: Simulations with CAPRI in Bonn

The situation in Germany is less favourable: agricultural income is increasing by 0.2 bio € less than the increase in premiums of around 0.3 bio € The effect stems mostly from increased prices for cereals, which decrease income in pig and poultry fattening. Consumers and the processing industry loose around -0.2 bio € which together with the budget increases leaves Germany with a slight welfare loss. Taking into account Germany’s position as a net contributor to the FEOGA budget, the situation becomes even worse.

Market revenues per hectare drop in all German regions, whereas direct payments increase in regions with high stocking densities of dairy cows⁴. Direct income support per hectare is by now high in mixed production regions where milk production is combined with some cereals and fodder maize.

5. Conclusions

The simulation indicates that the new proposal leads to a **higher market orientation** of European farmers. Due to less coupled premiums, allocation efficiency increases with farming decisions closer linked to market prices. Additionally, the proposal reduces scope and frequency of market interventions as expected market prices increase slightly compared to Agenda 2000 and intervention prices for butter and rice are reduced. However, a stronger European currency or temporary imbalances in world markets could still provoke a built up of intervention stocks.

⁴ Modulation factors provided by the EU commission depend on farm specialisation and not directly on the region.

The continuation of the CAP reform path of shifting from price to direct income support further detaches budget outlays from market developments and thus stabilises the FEOGA budget. The results show a *net economic benefit* at EU level of 1.4 Bio € compared to the Agenda 2000 reference run with *increasing agricultural income* (+2.5% or +3.7 Bio € measured as Gross Value Added plus premiums), but *increased budget outlays* (+1 Bio €). *Consumer welfare decreases* slightly(-1.2 Bio €).

The following list presents some of the assumptions and/or techniques in the model which influence on the results:

- (1) The council decision gives Member States considerable room especially to which degree parts of the former premium scheme are decoupled. For simplicity, we have assumed that Member States opt for full decoupling wherever possible.
- (2) In the model application presented here, the smallest units are NUTS II regions, so that the uniform premium per farm equals a uniform premium at NUTS II region.
- (3) The uniform premium was calculated based on historical land use and herd patterns from a three year average around 1998. Shifts in production for the reference period 2001-2002 as historical base would somehow affect premium values.
- (4) Modulation was based on data provided by Commission services on latest available Farm Accounting Data Network results, with factors set up per activity at Member State level.
- (5) As for the reference run, especially changes in the €/ US\$ exchange rate could change results relating to market prices, intervention sales as well as subsidised exports.
- (6) Some elements of the proposal, as compulsory farm audits cannot be modelled with the CAPRI system, but the effect on the results discussed above deems neglectable.

6. References

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