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ÖSTERREICHISCHES INSTITUT FÜR WIRTSCHAFTSFORSCHUNG

Austrian Agriculture 2005-2020

Consequences of Measures to Mitigate Greenhouse Gas Emission

Franz Sinabell (WIFO), Erwin Schmid (BOKU)

Research assistance: Dietmar Weinberger

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Abstract

Austria has to meet several obligations in the context of climate strategies and in accordance with EU regulations and international treaties. Apart from an annual report on air pollution inventories, forecasts on greenhouse gas emissions have to be provided. These forecasts provide a basis for the evaluation of past measures and potential needs for future measures to meet emission targets. The development of the Austrian agricultural sector for the period 2005 to 2020 and its production and environmental impacts are the core focus of this analysis.

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Contents

Figures and Tables

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1 Introduction

Austria has to meet several obligations in the context of climate strategies and in accordance with EU regulations and international treaties. Apart from an annual report on air pollution inventories, forecasts on greenhouse gas emissions have to be provided. These forecasts provide a basis for the evaluation of past measures and potential needs for future measures to meet emission targets.

The development of the Austrian agricultural sector for the period 2005 to 2020 and its production and environmental impacts are the core focus of this analysis. The report is structured as follows: Likely sector developments are outlined next, followed by a short summary of the international situation on agricultural markets. Then, the model for the analysis is introduced before major assumptions are stated together with brief scenario descriptions. Finally, a short discussion of the model results outlines the consequences of the findings.

2 Framework of the analysis

The development of the agricultural sector is mainly analysed from impacts of the demand for farm commodities and public services, and of technological progresses. The commodity markets are increasingly characterized by a reduction of trade impediments. Global demand for food and technological progresses are the main driving force of sector developments. The transmission of demand and supply takes place via prices which are assumed to be set on global markets. Given the small size of Austria within EU-25, an assumption can be made that any supply or demand shift does not affect equilibrium prices.

In the past, many agricultural commodity prices were either set directly by policy makers or reflected heavy policy intervention. In some markets (e.g. milk and sugar) this is even true today. However, a reduction of farm commodity prices, initiated in 1992 in the EU (1995 adopted in Austria, as well) with a further bold step during the Agenda 2000 reform in 1999 and a further corroboration during the 2003 reform of the Common Agricultural Policy (CAP). Prices of many important markets (grains and meat) are near equilibrium and currently there are no signs that farm policy will intervene in markets as heavily as it did in past decades.

Apart from demand for farm commodities, there is increasing demand for public goods which are provided by agriculture. These fall in two classes:

- the active provision of goods and services for which private markets do not exist (like open landscape, bio-diversity), and
- the reduction of production intensities and emissions below the legally binding level of standards (e.g. support for organic farming, plantation of winter cover crops).

To the extent that discretionary policy interventions in farm commodity markets were reduced over the last decade, programmes to stimulate the support of public goods which addressed the farm sector, have proliferated.

The framework of the analysis is given by three major assumptions

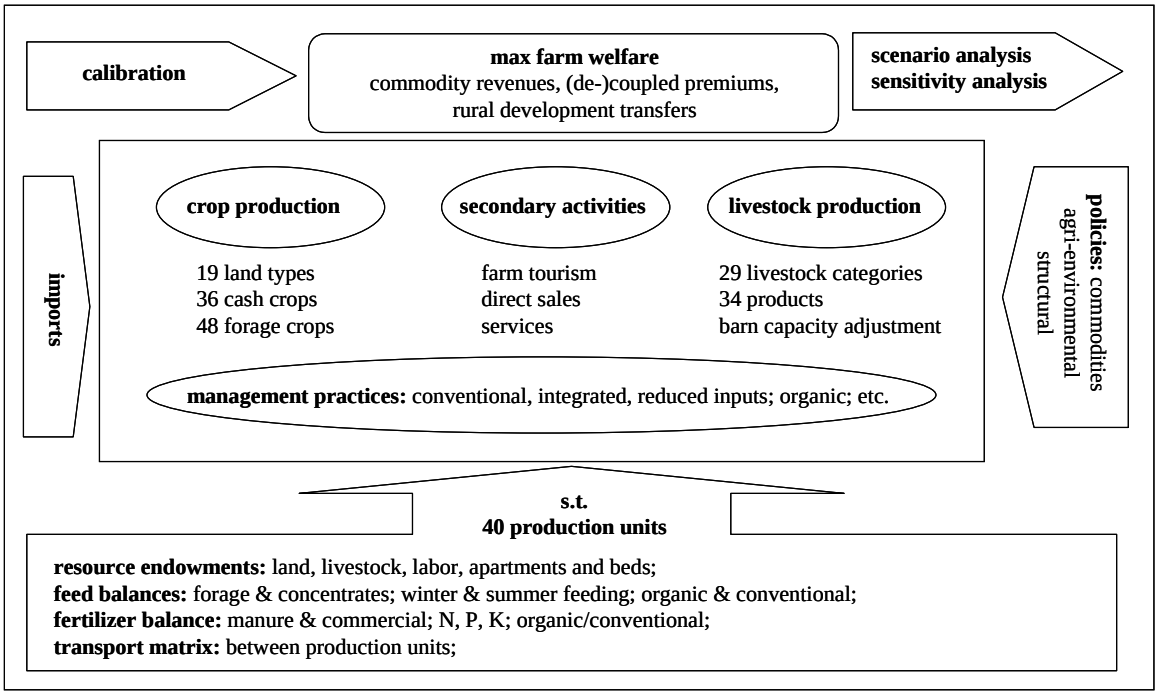
- The development on farm commodity prices is mainly driven by the demand for farm commodities and technological progresses. In affluent societies with low population growth, the overall volume of food consumption will be relatively constant. Therefore, changing demand trends affect mainly the composition of food components (e.g. substitution of red meat by white meat).
- Society will be willing to pay for non-commodity outputs of the agricultural sector in future, however, the large increase observed in recent years will come to a halt.
- Technical progress will further shift agricultural supply curves to the right, however, likely at a lesser scale than previously observed due to environmental programmes.

These assumptions are made operational in an agricultural sector model for Austria which was developed to evaluate farm policy changes. Given the partial character of the model, further assumptions must be made concerning the actual price levels. These are taken from publication focussing on market trends at EU-level.

3 Modelling the Austrian Agricultural Sector

In this chapter, we present an approach that strives to meet these challenges of forecasting agricultural production in a very detailed manner. The Positive Agricultural Sector Model Austria (PASMA) is employed to estimate the impact of the 2003 CAP reform on selected agricultural and environmental indicators to measure rural/agricultural development. PASMA depicts the political, natural, and structural complexity of Austrian farming in a very detailed manner (Fig. 1).

Figure 1: Structure of the agricultural sector model PASMA



Source: own construction.

The structure ensures a broad representation of production and income possibilities that are essential in comprehensive policy analyses, i.e., development analysis. Data from the Integrated Administration and Control System (IACS), Economic Agricultural Account (EAA), Agricultural Structural Census (ASC), Farm Accountancy Data Network (FADN), the Standard Gross Margin Catalogue, and the Standard Farm Labour Estimates provide necessary information on resource and production endowments for 40 regional and structural (i.e., alpine farming zones) production units in Austria.

Consequently, PASMA is capable to estimate production, labour, income, and environmental responses for each single unit. Most production activities are consistent with EAA, IACS and ASC activities to allow comparable and systematic policy analyses with official, standardised data and statistics.

The model considers conventional and organic production systems (crop and livestock), all other relevant management measures from the Austrian agri-environmental programme ÖPUL, and the support programme for farms in less-favoured areas (LFA). Thus the two most important components of the programme for rural development are covered on a measure by measure basis. Future model development will focus on farm investment aid and

additional diversification measures. Apart from major components of the programme for rural development the complete set of CAP policy instruments is accounted for, as well. Both, the set of instruments before and after the 2003 reform are modelled explicitly.

The model maximises sectoral farm welfare and is calibrated to historic crop, forestry, livestock, and farm tourism activities by using the method of Positive Mathematical Programming (PMP). Howitt (1995) has initially published PMP and since then it has been modified and applied in several models e.g., Lee and Howitt (1996), Paris and Arafini (1995), Heckelei and Britz (1999), Cypris (2000), Röhm (2001), Röhm and Dabbert (2003). This method assumes a profit-maximizing equilibrium (e.g., marginal revenue equals marginal cost) in the base-run and derives coefficients of a non-linear objective function on the basis of observed levels of production activities.

Two major conditions need to be fulfilled: (i) the marginal gross margins of each activity are identical in the base-run, and (ii) the average PMP gross margin is identical to the average LP gross margin of each activity in the base-run. These conditions imply that the PMP and LP objective function values are identical in the base-run. Another important assumption needs to be made by assigning the marginal gross margin effect to either marginal cost, marginal revenue or fractional to both. In PASMA, the marginal gross margin effect is completely assigned to the marginal cost and consequently coefficients of linear marginal cost curves are derived.

In PASMA, linear approximation techniques are utilized to mimic the non-linear PMP approach (Schmid and Sinabell, 2005). Thus large-scale models can be solved in reasonable time. In combination with an aggregation procedure, i.e., building convex combinations of historical crop and feed mixes (Dantzig and Wolfe, 1961; McCarl, 1982; Önal and McCarl, 1989, 1991), the model is robust in its use and results.

PASMA is a set of three almost identical Linear Programming models. The purpose of the first one is to assign all farm activity levels i.e., crop, forestry, livestock, and farm tourism, and remaining cost shares from feed and manure balances. For instance, the area of meadows is recorded in various data sources listed above. However, information on which activities are actually carried out and to what extent are not available (e.g., grazing, hay, silage, or green fodder production activities). In the model, these activities and remaining cost shares (i.e., fertilizer and feed) are accordingly assigned using historical livestock records and detailed feed and fertilizer balances (phase 1). Phase 2 is the second LP in which the perturbations coefficients (Howitt, 1995) are incorporated to compute the calibration coefficients of a linear marginal cost curve primarily following the approach of Röhm and Dabbert (2003). The third LP (phase 3) is the actual policy model. Calibration coefficients are built in using linear approximation techniques that allow calibration of crop, forestry, livestock, and farm tourism activities to observed and estimated shares. Other model features such as convex combinations of crop and feed mixes, expansion, reduction and conversion of livestock production, a transport matrix, and imports of feed and livestock are included to allow

reasonable responses in production capacities under various policy scenarios. Product prices and other model assumptions are referenced in Sinabell and Schmid (2004), and Schmid and Sinabell 2003.

4 Farm policy environment

4.1 The 2003 CAP Reform

In 1992, farm commodity prices that had been kept at high levels via government intervention were reduced significantly with a view to controlling excess production. In order to restrict to a minimum the resultant effects on farm incomes, premiums were introduced which were linked to the amount of land used for production and the number of livestock raised. Direct production incentives of higher prices were reduced, but it is still necessary to produce some crop such as wheat in order to get a crop premium. Additional premiums are granted when specified animals are slaughtered (bulls, oxen, calves, cows, heifers) or reared on the farm (suckler cows and heifers) and an extensification premium is granted when the number of livestock per hectare of land is below a specified limit.

In mid 2002, the European Commission published a mid-term review of the Agenda 2000 reform. The European Commission planned to decouple these premiums from production and to grant a transfer for the farm instead (dubbed "single farm payment"). This subsidy would be paid even if a farmer chose to produce nothing, as long as "land is maintained in good agronomic condition". The transfers which would be subject to decoupling (dubbed "crop premiums" or "livestock premiums" or "CAP premiums") are equivalent to more than half of the EU funds spent on agriculture

A final compromise on the proposals of the reform was reached on 26th June 2003. The key element is the introduction of a single farm payment (Greek Presidency, 2003; Fischler, 2003). This payment will replace premiums formerly linked to output or land.

When the reform proposals were drafted, it was anticipated that decoupled premiums have considerable impact on production incentives. Farmers will not need to plant certain crops or raise bulls in order to obtain financial support. In future, production decisions are expected to be based on market signals (i.e., prices) and consequently resource allocations are likely to improve.

The policy change has become effective on 1st January 2005. Payment entitlements are calculated on the basis of direct payments received in the reference period 2000-2002, they are transferable with or without land and between farmers within a region or a country. They can be only received if accompanied by eligible hectares and agricultural land is maintained in good ecological conditions.

Member States may choose to introduce the single farm payment in full or they may opt to keep some premiums attached to output or factor usage or to retain up to 10 % of direct payments for measures that have a positive environmental effect or improve the quality and marketing of agricultural products. In addition, they may implement the single farm payment at regional level. This implies a redistribution of money between farm enterprises (this option is chosen by Germany) and may lead to redistributions between regions.

Farm operators (but not the owners of land if they have rented it) are entitled to premiums based on historic payment entitlements (average of 2000 to 2002). These entitlements are weighted by premiums and will be adjusted during the reform period. The total of premiums per farm is divided by the sum of the relevant crop and forage area, thus obtaining the average farm premium per hectare. Premiums per hectare will therefore vary among farms.

All farmers receiving direct payments must set aside part of their land (small farms and organic farms are exempt) and will be subject to compulsory cross-compliance. Recipients of farm payments must abide by a list of 18 statutory European standards in the field of environment, food safety, and animal health and welfare (cross compliance). Direct payments to larger farms (above a threshold of € 5,000) will be reduced by 3 % in 2005, 4 % in 2006 and 5 % from 2007 to 2013 (modulation). Channelling expenditure away from market policies will make more than € 1.2 billions available for rural development.

For cereals (apart from rye), the intervention price remains the same with some modifications. Other crop regulations were simplified, but some production related premiums (notably those for durum wheat, protein crops, and energy crops) have been introduced by the reform. A reformed milk quota system will be maintained until the 2014-15 marketing year. Regulated prices of butter and skimmed milk powder will be cut asymmetrically in four stages. The quota will be moderately expanded in 2006 and a decoupled milk quota premium will add up to the single farm payment.

Many support schemes are not part of the decoupling process (e.g., subsidies for agro-environmental programmes and payments for farms in less favoured areas). Member states co-finance farm subsidies in addition to EU funds.

4.2 The programme for rural development

After the Agenda 2000 reform in 1999, the programme for rural development (dubbed "second pillar of the CAP") was introduced in the EU. A volume of 52 bn Euros from EU funds has been allocated for the programme period 2000-2006. This amount was topped by contributions of Member States. The programme for rural development is of eminent importance for the Austrian agricultural sector, because transfers from this source outweigh transfers from the "first pillar of the CAP", e.g. instruments that have been commodity related.

The current programme period will end in 2006 and a new programme will start in 2007. By the time of writing this document the final decisions, most importantly on the volume of the

programme, have been still underway. However, a draft regulation was published in 2004 by the Commission of the European Communities (CEC, 2004a) which narrows possible scenarios for this programme to a small set of plausible options.

The new programme for rural development, due to be implemented in 2007, will make several adjustments necessary. Main elements of the Commission proposal are:

* a genuine EU strategy for rural development will serve as the basis for the national strategies and programmes;
* less detailed rules and eligibility conditions will leave more freedom to the Member States on how they wish to implement their programmes;
* a strengthened bottom-up approach will better tune rural development programmes to local needs.

The new policy has three major objectives:

Axis 1: Improving competitiveness of farming and forestry: The restructuring strategy would be built on measures relating to human and physical capital and to quality aspects.

Axis 2: Environment and land management: Agri-environmental measures are a compulsory component. A general condition for the measures under axis 2 at the level of the beneficiary is respect of the EU and national mandatory requirements for agriculture and forestry. One item listed in this axes with great importance for Austria natural handicap payments to farmers in mountain areas.

Axis 3: Wider rural development. The preferred implementation method is through local development strategies targeting sub-regional entities, either developed in close collaboration between national, regional and local authorities or designed and implemented through a bottom up approach using the LEADER approach.

In Austria, we expect that the volume of axis-2 measures (agri-environment and support for farms in less-favoured areas) will be reduced but expanded in axis-1 and axis 3. This implies that the volume of total transfers is kept constant.

We make the assumption that premiums for those measures will be reduced where environmental goals are already reached after two programme periods. Given that premiums for organic farming are maintained at current levels, we expect that other modifications of the new programme of rural development will not have a significant impact on organic farming. We assume this to be a likely scenario because the political commitment to strengthen organic farming is strong after the introduction of action programmes in the EU and in Austria (CEC, 2004c and BMLFUW, 2003).

5 Market and economic environment

5.1 International food markets

European farm commodity markets are interlinked with international food markets in many ways. Given the imbalances between supply and demand in many markets, the EU is a major exporter, in particular of cereals, milk and white meat. The policy efforts to bring domestic market prices closer to equilibrium prices (see above) brings about that the gap between domestic prices world market prices is narrowing. Domestic supply – apart from heavily regulated products like milk – therefore is increasingly determined by the fluctuation of world market prices. Global demand for food and technological progresses (e.g., the adoption GMO crops in major producing countries,, organic food production) will be major driving forces of agricultural production during the next decade to come.

Short-term developments on world agricultural markets have recently been marked by a stabilisation after the wide price fluctuations of 2003/2004 (EC, 2004). Over the medium-term, world agricultural markets are projected to be essentially supported by rising food demand driven by an improved macro-economic environment, higher population, urbanisation and changes in dietary patterns. Widespread economic growth and an expanding livestock sector are projected to combine to set the stage for a strengthening of world demand and maintaining a low stock-to-use ratio.

Cereals trade would also expand, particularly in developing economies, driven by rising income, diet diversification and higher demand for livestock products and feeds, allowing for a gradual, albeit moderate, price increase over the medium term. The medium-term prospects for the oilseed sector are expected to be relatively stable. After the high prices of 2003 and the subsequent drop, short term developments are still foreseen to exhibit a slow and gradual supply adjustment in the oilseed sector owing to a combination of policy and macro-economic factors.

Meat markets are projected to be characterised by an expansion in production, consumption and trade with world meat prices showing moderate strength. Prospects for rising meat demand would mainly emerge from a favourable macro-economic environment of sustained income growth, notably in Asia and Latin America. World meat trade would increase and prices remain firm over the medium term as growing consumption is mostly expected to take place in countries that are net importers with limited possibilities to proportionally and competitively increase domestic supply (in quantity and quality).

Recovering meat demand and strengthening feed prices would support world meat prices. The medium-term outlook for the dairy sector is expected to remain dominated by a strong expansion in global demand for dairy products. The latter would reflect not only income growth in many regions of the world, but also changes in consumer preferences towards dairy products (as meat substitutes; see EC, 2004, 80).

Lower prices for farm commodities in Europe will make it necessary to adjust farming systems in the EU. Given that the value marginal product of inputs (among them land) is determined by both, technology and output prices, lower commodity prices mean that less intensive farming systems will become more profitable. Unless major changes of technology take place, the economic adjustment in Europe will likely follow the lines of extensive farming systems in countries with lower trade barriers than the EU.

5.2 National energy policies

Austrian energy policy is committed to substitute non-renewable energy sources by renewable ones. Raw materials produced by agriculture are a major alternative source. Two major legal sources are of interest in this context: the Austrian law for the provision of green electricity (Ökostromgesetz, 2002) and the European bio-fuel directive (EU, 2003) which was implemented in Austria in 2004 (aiz, 2004).

Based on expert judgement (Walla, 2005) the following resources are needed to meet the obligations of the Ökostromgesetz concerning biogas: 800,000 m^3 slurry and about 13,500 ha silage maize (44.73 t/ha) and about 10,000 ha silage of grass, clover and alfalfa (20 t/ha) by mid 2006. This mix of feed-stuff will be necessary to meet the capacity requirements of 264 biogas plants, of which 216 are run exclusively with agricultural residues/inputs. Given the bulkiness of the raw materials the assumption can be made that feed-stuffs for biogas are produced domestically.

This assumption can not be made for the second important component of the Austrian strategy to substitute non-renewable combustion fuels by renewable ones. The implementation of the bio-fuel directive will require rape seeds from 390,00 hectares by 2010 and 75,000 hectares of maize or 165,00 hectares of wheat). These figures are estimates of the potential demand for fuel usage by the transport sector in this year, based on estimates of UBA (2004).

Given the uncertainty concerning the implementation of the bio-fuel directive in the other EU-25 countries, a recent evaluation of its effects on agricultural markets concludes that "this analysis takes the current biofuel policies of Member States as unchanged for the future. Therefore, the medium-term perspectives for non-food oilseeds appear rather stable in the EU" (EC, 2004, 21). The same reasoning holds for crops which could be used as feed-stuff for ethanol production.

In Austria, the biofuel directive will be implemented before the declared deadlines in the directive. Consequently, we have good reasons to assume that the situation in Austria will be different from the situation in the rest of the EU. We do not expect any major consequences for the agricultural sector, however, the assumption is made that equilibrium prices are slightly higher due to the implementation of this policy.

These assumptions are consistent with recent forecasts on the energy demand in Austria (Kratena, 2005). In this study energy from biomass (mainly wood residues) is projected to double from approximately 42,000 TJ until 2020. Another projection of this study is made on energy usage by agriculture which is forecast to fall from 28,000 (of which are 17,000 TJ from fuels) TJ to 26,000 TJ (of which are 14,000 TJ from fuels). Such a reduction is assumed to be the consequences of reaction to changing prices, efficiency gains in the agricultural sector given a relative constant demand for food and other agricultural products.

5.3 Baseline economic assumptions

Several assumptions must be made to run the model outlined above. These are basically input prices which are derived from other sources (OECD, 2004 and FAPRI-Ireland, 2003). Price projections are based on assumption about the development of key indicators like population and GDP growth, and exchange rates (Table 1.

Table 1: Assumptions on macro-economic variables in the European Union, 2004 – 2013

		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
real GDP EU-15	%	1.80	2.50	2.50	2.40	2.20	2.10	1.90	2.10	2.10	2.10
CPI EU	%	1.50	1.40	1.50	1.60	1.60	1.60	1.60	1.60	1.60	1.60
population EU-25	million	455.8	456.6	457.3	457.9	458.5	459.1	459.6	460	460.4	460.7
exchange rate EU-15	EUR/USD	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149	1.149

Source: OECD, 2004; Note: GDP of EU-15 was 9,743.054 bn Euros in 2004 (Eurostat, 2005).

Several sources are available which can be used as basis of price forecasts. In this study, prices are derived from OECD outlooks on agricultural markets (see OECD, 2004). A comparison of this OECD-forecasts (Table 2) with projections of the Commission of the EU (CEC, 2004, Table 1.1, p. 17) shows that international bodies have very similar assumptions about future development of key economic indicators. Due to the type of model, assumptions on the Austria economic environment (GDP growth, population dynamics, etc.) are not necessary. Other driving forces (prices, technology, constraints) are referenced in the following sections.

The simulations are calculated for a number of years for which important policy changes are expected:

- the introduction of the decoupled premium takes place in 2005,
- by 2008 the milk reform will be completed,
- in this year the new programme of rural development will be already established (introduction in 2007)
- the agricultural policy of the first pillar is (more or less) guaranteed to be financed until the production year 2013/2014

For the period from 2013 to 2020 constant prices were assumed, however, technological progress was assumed to go on. Technically, results for the years between these dates, linear approximation techniques were used to obtain the specific results. Special attention was attributed to the requirement of additionally.

Exogenous economic assumptions for Austria (like GDP or population size) are not explicitly necessary for the model used for this analysis. Since production is driven by resource availability, prices and technological development, and since Austrian agriculture is an integrated part of the common market, European demand patterns carry over and determine the results.

5.4 Specific assumptions on farm commodities

The assumptions underlying future policy variables and future prices of farm commodities are referenced in the appendix (EU-prices see Table 2 and Table 3 and Austrian prices in Table 4). The forecast period in this study is going until 2020. For the period beyond 2013 neither OECD, nor FAPRI (FAPRI-Ireland, 2003) provides estimates. Therefore, the assumption is made that beyond this year, prices remain *nominally* constant.

Other assumption, in particular technical progress in plant and animal production are based on Sinabell and Schmid (2004). Deviating from this source, estimates of future milk yields per dairy cows (Table 5) are reduced according to the estimates made by Pöllinger (2005).

5.5 Baseline data

In principle, data from the baseline (2003) should be based on observations. This is not possible in all cases of this study due to a set of reasons:

* For some data there is no official statistic – this holds for many data on the share of organic versus conventional crop- and livestock production.
* Other data are only available for periods which are already longer ago (e.g. grassland acreage) – the reason is that the last general farm survey was held in 1999 and yearly updates are based on administrative data of programme participants which are only a subset of all farms.

We made the following assumptions to tackle these problems:

* Shares of conventional and organic production are derived from BMLFUW (2004) if possible, otherwise model parameters were used.
* Grassland acreages are based on the latest available data (from 1999) and forecasts are providing relative changes of model results of this grassland type relative to this base.

The major source of baseline data are various Statistik-Austria statistics on the agricultural sector, published in the monthly "Statistische Nachrichten". The distribution of organic/conventional activities and on crop allocations and livestock data is derived from the annual farm income report ("Grüner Bericht", BMLFUW, 2003 and 2004). The usage of mineral fertilizer is taken from the same source, only the usage of urea was taken from another source (FAOSTAT, 2004).

5.6 Other assumptions

The **storage of manure** has an essential influence on the level of emission from livestock. Structural information on storage facilities on Austrian farms was made available by the Austrian farm survey from 1999. These data were used to estimate the actual requirements of storage facilities depending on the type of livestock.

Multiple regression analysis was used to make theses estimates. Two linear multiple regression models were used to explain the capacity of both, slurry and solid manure storage capacity. The estimates are given in Table 6 (see appendix).

Future **milk yields** per cow are based on assumptions which are made explicit in Table 5. The milk yield per cow of 2003 is taken from Statistik Austria. The future development of milk yields is based on estimates of an exponential trend of data from 1989 to 2000 from the same source. The estimates were limited to this period because a statistics revision in 2001 brought about a large yield increase per cow. Thus future milk yields per cow are estimated relatively conservatively. Milk output at sector level is evaluated as the sum of regional milk yields times the number of dairy cows in each region minus 3 % losses. The average milk production at sector level is the consequence of three processes:

- the productivity gains per cow in each region,
- the regional shift of the cow population and
- the relation of non-organic cows to organic cows (with 5% lower yields).

The average milk production per dairy cow at sector level is therefore slightly lower than the average milk yields of dairy cows in the various Länder as listed in Table 5.

The usage of **mineral fertilizers** is calculated in two ways: the consumption of urea is not derived from the model but given exogenously based on a linear trend of past observations. The level of input of all other nutrients is determined by the model based on nutrient balances (crop demand + observed surplus = mineral inputs + manure inputs + accumulation in soil). These balances are calculated for each structural unit therefore the aggregation error can be kept at a minimum (Sinabell and Schmid, 2004). The forecasts of mineral fertilizer are therefore reflecting the consequences of land use changes (e.g. more legumes when organic farming is expanding) and changes of the livestock-herd (e.g. less manure when less

bulls are produced). Technical progress in crop production eventually has the consequence that less fertilizer is needed to produce the same amount of output.

6 Scenarios

In this section, the scenarios which are investigated in this study are outlined. We compare three sets of policy scenarios

- business as usual
- business as usual plus measures
- business as usual plus additional measures

Each of these scenarios is evaluated in three sensitivity simulations in order to identify the consequences, different assumptions (on prices / technological progress) have on key indicators of the agricultural sector.

6.1 Business as usual

The following policy measures are implemented:

- implementation of the CAP 2003 reform;
- special attention is given to the Austrian variant of implementation (maintenance of the premiums for suckler cows – including heifers- and part of the slaughter premiums; allocation of premium rights on farms – see Table 2);
- due to uncertainties concerning the flow of funds from "modulation" we make the assumption that Austrian farms who might be beneficiaries get the same amount as other farms loose through this measure;
- land is maintained in good agricultural and ecological condition ("cross compliance";
- the programme for rural development is maintained in an unmodified way.

6.2 Business as usual plus measures

- "business as usual" with the following modifications;
- implementation of the biofuels directive in Austria;
- grassland maintenance
- prices increase for the following crops: rape-seeds (+10%), sunflowers (+5%) and maize (+2,5%) starting in 2008.

6.3 Business as usual plus additional measures

- "business as usual with measures" with the following modifications;
- 25 % more organic farming within the given budget of the programme for rural development (additional premiums are offset by an equivalent reduction of premiums for "Grundförderung");
- payments for investments in emission reducing animal production technologies (funded by the programme for rural development) e. g. slurry and manure store facilities, slurry hose techniques;
- additional set aside land allocated to short rotational forests (+ 5,000 ha in 2008 and 20,000 ha from 2010 on);
- usage of 800,000 m^3 slurry for biogas production;
- usage of 13,500 hectares of set aside land for biogas production from silage-maize (from 2008 on);
- usage of 10,000 ha silage of grassland and alfalfa (from 2008 on)

6.4 Sensitivity analyses

- In the "business as usual with measures" scenario the consequences of relatively higher (+5%) and lower (-5%) prices are evaluated.
- In the "business as usual with additional measures" scenario the consequences of relatively higher (+5%) and lower (-5%) prices are evaluated; in addition in the sensitivity report dubbed "lower", the assumption is made that the total of second pillar payments is reduced by 25%.

7 Results and discussion of the model sensitivity

7.1 Overview of the scenario results "business as usual"

The results of the scenario analyses are provided in Table 7 and following (see appendix). The results are consistent with previous analyses of the Austrian farm sector after the 2003 CAP-reform (Sinabell and Schmid, 2003; Schmid and Sinabell, 2004 and 2005):

- the number of **livestock** – in particular cattle – will get smaller because production incentives are reduced (premiums per head will be decoupled for bulls);
- the number of **suckler cows** is less affected, because premiums per head will be coupled to production, even after the reform in Austria; a given share of heifers

qualifies for such premiums as well, therefore the number of suckler cows and heifers is relatively constant;

- since farmers will get coupled premiums either for suckler cows or **heifers** but other premiums for cattle will be abandoned, the population of suckler cows will not necessarily increase – the reason is that the model takes account of the profitability of the whole cattle production simultaneously – an implication is that the value of calves will drop;
- our results suggest that the additional premiums for Austria will be taken as a windfall for farmers producing heifers already (assuming that the **market for premium suckler cow premium entitlements** is working efficiently – as supported by previous experience; Marksteiner, 2003);
- the consequence of lower prices for **pork and poultry** and lower feeding cost is that output of neither of these products will be expanded – this result is a consequence of the modelling approach taken in this analysis;
- therefore, less or no supply substitution of beef by other meat is expected;
- due to the model type used for this analysis the change of pork and poultry production will be "0" under such situations;
- the acreage of **arable land** will be reduced because coupled premiums for major crops (grains, oil-seeds and protein crops) will be de-coupled after the reform;
- the acreage of **wheat** declines due to a combination of two effects: less production incentives because premiums are decoupled from 2005 on and higher per hectare yields;
- the acreage of **grassland** will be expanded because arable land will be turned to grassland and almost no grassland will be afforested, however, grassland will be more extensively managed;
- the acreage of utilised agricultural area will not change significantly, because the **single farm payment** is only paid if land is "maintained in good agricultural and ecological condition";
- the volume of **milk production** is determined by the national quota which will be expanded in two steps and which will be fixed from 2008 on; since some share of milk is used as animal feed, production also depends on its nutritional value relative to the production cost of increasingly productive milk cows; the decline of milk production from 2003 to 2005 is due to the assumption that lower milk prices will induce more farmers to refrain from an "oversupply" of milk above the quota (which effectively means that the super-levy will have economic consequences);

- the production of **manure** will shrink according to the development of the number of heads of livestock, therefore there is ample excess storage capacity at regional scales compared to 2003 (with the EU nitrate action programme implemented);
- **organic farming** will become more attractive for farmers, mainly because of the assumption that premiums of the agri-environmental programme will stay in place and prices of organic products are higher while opportunity cost will be lower after the implementation of the reform;

7.2 Overview of the results of the other scenarios and policy conclusions

The major driving forces of the sector development are the prices on farm commodity markets, technological progress, and policy variables. The differences among the three scenarios are best explained when compared to the business as usual scenario.

In the scenario "**with measures**" more land is used for the production of silage maize, sunflowers and rapeseed (which will likely be used for the production of biofuels) and the number of livestock is smaller because of the policy instrument shift; however the overall effects of this scenario are minor with respect to the volume of livestock and crop production. Policy conclusions for this scenario are:

- Even some significant price increases of certain crops (in particular rape seeds) do not boost the production markedly. Production adjustments are only relatively minor. In order to meet the quantity goals it is likely that the relevant commodities will be imported.
- The additional restriction on "grassland maintenance" does not make big differences. Agricultural land must be maintained in good ecological condition in the base scenario – which rules out forestation – there is no difference if the best alternative land use is wood land. The cross-compliance conditions therefore seem to be strong enough to prevent forestation.
- The incentive to turn grassland into arable land is bigger than in the base run scenario, because some arable crops (rape seed, maize) get higher prices. Therefore the acreage of grassland shrinks compared to the base run. However, the incentive for the production of arable crops is not strong enough to get close to the binding constraint. The price situation on crop commodity markets – even after implementation of the bio-fuel directive – does not lead to an expansion of arable land at the cost of grassland.

In the scenario "**with additional measures**" organic farming is expanded significantly compared to the other scenarios (the number of organic livestock is highest and the acreage of organic crops is expanding) mainly due to the attractive premiums assumed in this

scenario; in addition the volume of renewable energy production on set-aside land is expanded (based on exogenously given expert judgement).

- The stimulation of the production of organic crops has some beneficial environmental consequences. Most notable is the reduction of mineral fertilizers (all nutrients).
- The increase of organic crop production will likely be complemented by more environmentally friendly crop rotations and management practices. Therefore soil health is likely to improve.
- The economic consequences of this policy are not shown in the scenario results. But the assumption was made that any increase of support for organic farms will be offset by premium reductions of the most widespread measure. Such a policy shift would hurt many farms an bring benefits to only a few more farms. It is therefore not clear that such a strategy is politically feasible.
- The efforts made to strengthen the usage of crops and other biomass in the energy chain have the intended effects. However, at a national scale the acreage used for such activities is comparably small. Unless strong price increases make such uses more attractive to farmers, the overwhelming part of land will be used for food production.

7.3 General trends shown in the scenarios

All scenarios have some major trends in common:

- The **output of beef** will shrink. This is partly a consequence of ever more efficient dairy cows, partly a consequence of stagnating prices, and partly a consequence of more extensive production methods.
- When the number of heads of livestock gets smaller, the **amount of manure** will become less. Given that the total farmland acreage more or less remains constant, nutrient intensity will become lower.
- Because a nutrient deficit would diminish the crop harvest, we expect that more **mineral fertilizers** will be used if the fertilizing behaviour does not change. We did account for minor productivity effects because of better seeds, but we did not assume any efficiency gains in the fertilizing technology. Given that precision farming will likely be a standard practice by the year 2020, this assumption should be challenged. Our final conclusion is that this issue should be investigated in more depth before drawing wrong conclusions based on these results.
- Conventional arable crop production will generally decline and less **arable land** will be used for production. This is the consequence of moving administrative prices more and more in line with world market prices.

- In the medium term production will become **more extensive** and more land will be allocated for grassland production. – The cross-compliance requirements guarantee that farmland will not be turned in woodland at large scales.
- **Organic farming** will become more attractive for farmers. This result is a consequence of two major assumptions: organic products will get higher prices in future and support for environmental friendly production methods will be maintained during the period of interest. Some beneficial environmental consequences are associated with this type of farming. But the advantages compared to conventional farming will not be as large as ten years ago because standard production in future will be much less intensive than it was in the past.

The similarity of results does not come at a surprise. In all scenarios, the EU farm policy reform of 2003 is implemented and the analysed variations are only small modifications compared to a continuation of the situation before 2005. We would expect to see trends showing in markedly different directions if we compare e.g. the base run scenario with a scenario of Austrian farm policy before 1995. We would also expect significantly different results if we would abandon the programme of rural development which is extremely important for the maintenance of production in marginal areas.

7.4 Model behaviour and sensitivity of the results

A comparison between the development of the cattle population and the number of poultry makes it evident that the type of model used in this analysis is pre-determining the results. The reason why poultry production does not change is due to the underlying assumption that production cost are mainly determined by feeding cost and that feed concentrates are purchased on the market at given prices. When input prices and output prices change similarly, outputs can stay relatively constant, as observed in the results obtained in this study. Another type of model (e.g. a model incorporating time trends) would likely forecast other developments (probably shrinking numbers of hen and other poultry).

In the cattle sector, many variables which are determining production decisions are changing simultaneously:

- premiums for different types of cattle
- prices of bulls, cows, calves, and heifers
- milk yields per cow and milk quotas
- feeding cost (forage crops and feed concentrates)

All these simultaneous changes determine the development of the cattle herd and the anticipated consequences are not unambiguous. A programming model is capable of accounting for all these changes in a consistent framework. Given the CAP reform,

production incentives in the beef sector will be reduced and therefore the number of cattle will likely be reduced.

An important underlying assumption of the model is that farmers are maximizing farm welfare (products revenues, agri-environmental premiums and other subsidies minus cost). There is some justification to assume that farm households have a different objective function with a more extended bundle of decision variables (e.g. utility derived from working in a rural environment or spending time with animals). Accounting for these, additional aspects of decision making, could allow a more detailed analysis. However, in the current version of the model, such additional features are not yet implemented due to the lack of data.

The sensitivity analysis (see Table 10 in the appendix) shows the consequences of higher and lower prices for a given scenario (business as usual). Comparing the results of the "expected price" scenario (see Table 7a, 7b and 7c) with the "high" and "low" price scenario shows that results are sensitive to prices.

The variation of prices is a range of plus and minus 5% of the "expected prices" (see Table 4). The consequences of price changes (expressed as percentage changes versus "expected prices" in Table 8 and 9) are relatively limited. We observe that the levels of different activities are changing in a way we would expect, but do not alter the results fundamentally. The analysis therefore produces robust results and shows unambiguously, that the Austrian livestock herd will become smaller and consequently less greenhouse gases will be produced by the agricultural sector. This effect will likely dominate any active measures of emission mitigation.

8 Sources

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9 Appendix

Table 2: Assumptions on EU and Austrian farm policy variables

		1999 2002	2003	2004	2005	2006	2007	2008 2020
Cereal support price	EUR/t	110.0	101.3	101.3	101.3	101.3	101.3	101.3
rey support price	EUR/t	110.0	101.3	0	0	0	0	0
Cereal compensation	EUR/ha	280	290	290	0	0	0	0
Rice support price	EUR/t	302	298	150	150	150	150	150
Starch potatoe minimum price	EUR/t starch	178.3	178.3	178.3	178.3	178.3	178.3	178.3
Compulsory set-aside rate	%	9	10	5	10	10	10	10
Set-aside payment	EUR/ha	297	290	290	0	0	0	0
Direct payment for rice	EUR/ha	329	329	1120	475	475	475	475
Oilseed compensation	EUR/ha	280	290	290	0	0	0	0
Protein crop premium	EUR/ha				55.7	55.7	55.7	55.7
Quality durum premium	EUR/ha			40.0	40.0	40.0	40.0	40.0
Energy crop premium[1)]	EUR/ha				45.0	45.0	45.0	45.0
Starch potatoe premium	EUR/t starch				66.32	66.32	66.32	66.32
Beef basic price	EUR/kg dw	3.09	2.22	2.22	2.22	2.22	2.22	2.22
Beef buy-in price	EUR/kg dw		1.56	1.56	1.56	1.56	1.56	1.56
Pig meat basic price	EUR/kg dw	1.51	1.51	1.51	1.51	1.51	1.51	1.51
Sheep meat basic price	EUR/kg dw	5.04	5.04	5.04	5.04	5.04	5.04	5.04
Sheep basic rate	EUR/head		21	21	21	21	21	21
Male bovine premium	EUR/head	183	229	229	0	0	0	0
Adult bovine slaughter premium	EUR/head	45	102	102	0	0	0	0
Calf slaughter premium	EUR/head	20	50	50	0	0	0	0
Suckler cow premium EU	EUR/head	167	200	200	0	0	0	0
Coupled premium heifers, suckler cows AT[2)]	EUR/head				230	230	230	230
Coupled premium adult cattle AT	EUR/slaughtered animal				32	32	32	32
Coupled premium young cattle AT					20	20	20	20
Milk premium	EUR/t quota			11.81	23.65	35.50	35.50	35.50
Modulation	percent				3	4	5	5
Milk quota AT	mt	2,749	2,749	2,749	2,749	2,791	2,791	2,791
Milk quota EU	mt	139	139	139	139	140	140	141
Butter intervention	price	3,282	3,282	3,167	2,938	2,708	2,528	2,462
SMP intervention price	EUR/t	2,055	2,055	2,004	1,901	1,798	1,747	1,747

Source: OECD, 2004, WIFO assumptions;
Notes: [1)]not on set-aside land; [2)] including national supplement (EUR 30);

Table 3: Assumptions on EU farm prices

		1999 2002	2003	2004	2005	2006	2007	2008
wheat	EUR/t	120	113	104	108	109	109	109
coarse grains	EUR/t	109	106	103	103	102	101	101
rice	EUR/t		255	216	216	216	214	176
oilseeds	EUR/t	227	306	251	247	257	257	256
oilseed meals	EUR/t	195	233	189	178	180	179	178
vegetable oils	EUR/t	456	566	553	551	563	573	578
beef and veal	EUR/100 kg cwe	245	245	243	241	245	249	249
pig meat	EUR/100 kg dw	127	125	123	129	133	135	133
poultry meat	EUR/100 kg rtc	99	104	103	98	98	98	97
sheep meat	EUR/100 kg dw	368	363	331	336	336	338	340
milk	EUR/litre	0,314	0,310	0,291	0,284	0,272	0,258	0,257
butter	EUR/100	332	317	299	292	277	260	254
cheese	EUR/100	413	411	418	415	403	387	370
SMP	EUR/100	222	203	194	191	187	183	185
sugar	EUR/t	632	632	632	632	632	632	632

Source: OECD, 2004

Table 3 (continued): Assumptions on EU farm prices

		2008	2009	2010	2011	2012	2013
wheat	EUR/t	109	108	108	107	107	106
coarse grains	EUR/t	101	101	101	100	100	100
rice	EUR/t	176	149	153	155	158	161
oilseeds	EUR/t	256	254	251	254	255	255
oilseed meals	EUR/t	178	178	177	177	177	177
vegetable oils	EUR/t	578	573	569	574	578	581
beef and veal	EUR/100 kg cwe	249	248	247	248	248	248
pig meat	EUR/100 kg dw	133	133	130	134	134	135
poultry meat	EUR/100 kg rtc	97	97	97	97	97	97
sheep meat	EUR/100 kg dw	340	343	345	348	350	353
milk	EUR/litre	0,257	0,259	0,264	0,267	0,268	0,269
butter	EUR/100	254	256	264	267	268	270
cheese	EUR/100	370	376	377	379	380	381
SMP	EUR/100	185	186	187	188	188	188
sugar	EUR/t	632	632	632	632	632	632

Source: OECD, 2004

Table 4: Assumptions on nominal farm prices in Austria (expected prices)

	base price	organic prices[1)]	2005	2008	2013	2020
wheat	111.8	1.60	0.89	0.90	0.88	0.88
coarse wheat	98.5	0.75	0.89	0.90	0.88	0.88
durum	123.8	1.60	1.10	1.06	10.70	1.07
rye	105.4	1.50	0.93	0.91	0.90	0.90
coarse rye	84.8	0.60	0.93	0.91	0.90	0.90
winter barley	114.0	0.75	0.93	0.91	0.90	0.90
summer barley	100.2	0.75	0.93	0.91	0.90	0.90
oats	95.1	0.60	0.93	0.91	0.90	0.90
triticale	93.4	0.70	0.93	0.91	0.90	0.90
spelt	140.0	2.20	0.93	0.91	0.90	0.90
maize	106.1	0.80	0.93	0.91	0.90	0.90
beans	140.0	0.75	0.84	0.85	0.84	0.84
peas	100.9	0.75	0.84	0.85	0.84	0.84
soy-beans	178.6	0.75	0.84	0.85	0.84	0.84
sunflower	164.9	0.75	1.29	1.36	1.36	1.36
sugar-beet	46.1	0.00	1.00	1.00	1.00	1.00
starch potatoes	32.7	0.00	0.93	0.91	0.90	0.90
rape-seed	157.4	0.75	1.29	1.36	1.36	1.36
fruits	262.6	1.50	1.00	1.00	1.00	1.00
wine	1,652.2	1.50	1.00	1.00	1.00	1.00

Source: own assumptions based on OECD, 2004.

Note: [1)] Price mark-up of organic products relative to conventional ones.

Table 4 (continued): Assumptions on nominal farm prices in Austria (business as usual)

	base price	organic prices[1)]	unit	2005	2008	2013	2020
milk-A-quota	303.9	0.091	t	0.98	0.83	0.83	0.83
milk-D-quota	334.3	0.091	t	0.98	0.83	0.83	0.83
milk home consumption	113.9	0.091	t	0.98	0.83	0.83	0.83
veal	4.3	0.25	kg SW	0.90	0.94	1.01	1.01
heifer for breeding	1275.9	0.15	head	0.90	0.94	1.01	1.01
heifer for suckler cow	783.1	0.15	head	0.90	0.94	1.01	1.01
beef of heifer	2.3	0.15	kg SW	0.90	0.94	1.01	1.01
mutton	4.0	1.15	kg SW	0.90	0.94	1.01	1.01
beef (oxen)	2.5	1.15	kg SW	0.90	0.94	1.01	1.01
sheep cheese	0.6	0.15	head	0.90	0.94	1.01	1.01
pork	1.4	0.3	kg SW	0.99	0.96	0.93	0.93
beef	2.6	0.0	kg SW	0.90	0.94	1.01	1.01
turkey	2.8	0.1	kg SW	0.96	0.93	0.91	0.91
fallow deer	4.3	1.5	kg SW	1.00	1.00	1.00	1.00
wool	0.7	0.0	kg	1.00	1.00	1.00	1.00
boar	727.0	0.0	head	0.99	0.96	0.93	0.93
goat meat	4.0	0.0	jkg SW	0.92	1.13	1.12	1.12
goat cheese	1.9	0.15	head	0.82	0.83	0.83	0.83
farrows	60.7	0.15	head	0.99	0.96	0.93	0.93
male calves	348.6	0.15	head	0.90	0.94	1.01	1.01
male calves for beef	3.8	0.4	kg SW	0.90	0.94	1.01	1.01
female calves	258.7	0.25	head	0.90	0.94	1.01	1.01
female calves for beef	3.8	0.25	kg SW	0.90	0.94	1.01	1.01
eggs	0.1	0.25	head	0.96	0.93	0.91	0.91
chicken	1.8	0.25	jkg SW	0.96	0.93	0.91	0.91
young sow	264.2	0.8	head	0.99	0.96	0.93	0.93
young chicken	3.6	1.5	jhead	0.96	0.93	0.91	0.91
cow	1.8	0.3	kg SW	0.90	0.94	1.01	1.01
sow	0.9	1.5	kg SW	0.99	0.96	0.93	0.93
sheep meat	1.6	0.15	kg SW	0.92	1.13	1.12	1.12

Source: own assumptions based on OECD, 2004.
Note: [1)] Price mark-up of organic products relative to conventional ones.

Table 5: Assumptions on milk yields per cow in Austria

	2003	2005	2008	2013	2020
	t/cow	multiple of base-year yield per cow			
Burgenland	6,2	1.002	1.070	1.18	1.22
Kärnten	5,9	1.013	1.054	1.17	1.22
Niederösterreich	5,7	1.008	1.075	1.19	1.23
Oberösterreich	5,5	1.011	1.062	1.17	1.22
Salzburg	5,3	1.039	1.104	1.21	1.25
Steiermark	5,7	1.072	1.153	1.26	1.30
Tirol	5,9	1.025	1.030	1.13	1.18
Vorarlberg	6,3	1.020	1.057	1.16	1.21

Source: Sinabell and Schmid, 2004 and Pöllinger, 2005. Data source: Statistik Austria, various years.

Table 6: Estimates of distribution of slurry and solid manure

	storage requirement	Coef.	Std. Err.	t	[95% Conf.	Interval]
	m^3			slurry		
milk cows	11	3.454	0.043	80.21	3.37	3.539
other cows	9.5	1.161	0.077	15.14	1.011	1.311
other cattle <1 year	1.3	2.127	0.047	45.06	2.035	2.22
other cattle 1-2 years	8.2	2.662	0.066	40.31	2.533	2.792
other cattle >2 years	9.5	-0.015	0.216	-0.07	-0.438	0.408
porkers >50 kg	1.1	0.693	0.009	78.42	0.676	0.71
breeding pigs >50 kg	1.4	1.021	0.037	27.91	0.95	1.093
pigs <50 kg	1.4	0.605	0.013	45.18	0.579	0.631
chicken	0.088	0.003	0	16.84	0.002	0.003
constant		-9.392	0.349	-26.94	-10.076	-8.709
	m^2			solid manure		
milk cows	11	2.646	0.021	128.12	2.606	2.687
other cows	9.5	2.688	0.037	73.09	2.616	2.76
other cattle <1 year	1.3	0.292	0.023	12.9	0.248	0.336
other cattle 1-2 years	8.2	1.512	0.032	47.73	1.45	1.574
other cattle >2 years	9.5	1.438	0.104	13.89	1.235	1.641
porkers >50 kg	1.1	0.028	0.004	6.67	0.02	0.037
breeding pigs >50 kg	1.4	0.792	0.018	45.13	0.758	0.827
pigs <50 kg	1.4	0.046	0.006	7.22	0.034	0.059
chicken	0.04	0.002	0	31.88	0.002	0.002
constant		28.61	0.167	171.1	28.282	28.938

Source: Estimates, based on Agrarstrukturerhebung 1999 (Statistik Austria, 1999) obtained by multiple regression analysis (STATA, 8.1). Coefficients of storage requirements (weights for storage allocation – left most column) based on own estimates.

Table 7a: Scenario results "business as usual"

Livestock (December)	2003	2005	2008	2010	2015	2020
	conventional farming (1,000 heads)					
equids	76	76	76	76	76	76
cattle (total)	1,733	1,678	1,658	1,641	1,614	1,608
milk cows	473	466	451	442	426	421
other cows	183	177	180	180	181	182
other cattle < 1 year	533	525	517	510	500	497
other cattle 1-2 years	392	361	361	360	360	360
other cattle > 2 years	150	149	149	148	148	148
hens (total)	11,726	11,726	11,726	11,726	11,726	11,726
laying hens	6,269	6,269	6,269	6,269	6,269	6,269
broiler	5,456	5,456	5,456	5,456	5,456	5,456
other poultry	617	617	617	617	617	617
pigs (total)	3,209	3,165	3,169	3,174	3,180	3,182
porker > 50 kg	1,229	1,203	1,205	1,207	1,211	1,212
breeding pigs > 50 kg	334	334	334	334	334	334
pigs < 50 kg	1,646	1,628	1,630	1,632	1,635	1,636
sheep (total)	249	249	254	255	257	258
goats (total)	39	39	35	36	36	36
fallow deer	33	33	33	33	33	33
	organic farming (1,000 heads)					
equids	11	11	11	11	11	11
cattle (total)	319	310	303	299	291	290
milk cows	85	82	77	74	68	67
other cows	60	58	59	58	58	58
other cattle < 1 year	108	105	103	101	98	97
other cattle 1-2 years	54	51	51	52	53	53
other cattle > 2 years	14	13	13	14	14	14
hens (total)	629	629	629	629	629	629
laying hens	256	256	256	256	256	256
broiler	372	372	372	372	372	372
other poultry	36	36	36	36	36	36
pigs (total)	36	38	41	43	46	46
porker > 50 kg	15	17	18	19	21	22
breeding pigs > 50 kg	0	0	0	0	0	0
pigs < 50 kg	20	21	22	23	25	25
sheep (total)	77	77	78	79	80	80
goats (total)	16	16	14	14	14	14
fallow deer	7	7	7	7	7	7
	conventional and organic farming					
Ø milk production/cow (t/year)	5.6	5.6	5.8	6.2	6.6	6.7
milk producition (1,000 t)	3,230	3,094	3,086	3,191	3,260	3,260

Source: own calculations

Table 7a (continued): Scenario results "business as usual"

Land use	2003	2005	2008	2010	2015	2020
			conventional farming (1,000 ha)			
cereals (without maize)	557	536	534	533	532	532
winter wheat	236	227	227	227	228	228
sugar beet	43	41	41	41	42	42
rapeseed	44	42	41	42	42	42
sunflowers	25	24	24	24	25	25
grain maize + CCM	193	187	185	183	180	179
silage maize	69	67	67	66	65	65
soy beans	14	14	14	13	13	13
field peas	32	30	30	30	29	29
hoarse beeans	2	3	3	3	3	3
red clover	5	6	6	6	6	6
alfalfa	5	5	5	5	5	5
grass clover	29	28	28	27	27	26
fodder beet	1	1	1	1	1	1
other forage	6	6	6	6	6	6
vegetables	11	11	11	11	11	11
			organic farming (1,000 ha)			
cereals (without maize)	52.4	52.0	52.6	53.8	54.7	54.7
winter wheat	12.4	12.0	12.1	12.4	12.7	12.7
sugar beet	0.2	0.2	0.2	0.2	0.2	0.2
rapeseed	0.3	0.3	0.3	0.3	0.3	0.3
sunflowers	0.6	0.6	0.6	0.6	0.6	0.6
grain maize + CCM	3.4	3.5	3.3	3.3	3.3	3.3
silage maize	3.0	3.1	3.4	3.6	4.0	4.1
soy beans	1.2	1.2	1.2	1.2	1.2	1.2
field peas	10.3	10.7	10.9	11.4	11.8	11.8
hoarse beeans	1.0	1.1	1.1	1.1	1.1	1.1
red clover	1.6	0.9	0.8	1.3	1.7	1.8
alfalfa	3.7	4.1	3.3	3.6	3.6	3.6
grass clover	25.9	25.3	25.0	24.5	24.0	23.9
fodder beet	0.1	0.1	0.0	0.1	0.1	0.1
other forage	1.2	1.2	1.2	1.3	1.4	1.4
vegetables	0.9	0.9	0.9	0.9	0.9	0.9
			conventional and organic farming (1,000 ha)			
permanent grassland (total)[1)]	1,640	1,693	1,693	1,682	1,672	1,671
extensive grassland[1)]	994	1,002	1,003	1,007	1,010	1,010
arable land	1,380	1,328	1,323	1,316	1,309	1,308
vineyards	51	51	51	51	51	51
			non agricultural use (1,000 ha)			
energy crops (on set aside land)	12	12	12	12	12	12
set aside land	97	93	92	92	91	91
residential areas	74	74	75	76	79	80
tourism areas						

Source: own calculations;
Note: [1)] acreage based on STAT (1999; Agrarstrukturerhebung 1999)

Table 7a (continued): Scenario results "business as usual"

	2003	2005	2008	2010	2015	2020
			crop yield conventional farming (t per ha)			
cereals (without maize)	4.2	4.7	4.8	4.9	5.0	5.1
winter wheat	4.4	5.4	5.4	5.5	5.7	5.7
grain maize + CCM	8.7	8.8	9.1	9.4	9.9	10.0
silage maize	41.8	45.6	46.0	46.5	48.9	49.8
sugar beet	57.5	62.4	63.0	63.0	63.4	63.6
rapeseed	1.8	2.8	2.8	2.9	3.0	3.0
sunflowers	2.8	2.8	2.9	2.9	3.0	3.0
fodder beet	45.3	46.7	46.7	46.7	46.7	46.7
			crop yield organic farming (t per ha)			
cereals (without maize)	3.4	3.8	3.9	3.9	4.1	4.1
winter wheat	3.8	4.7	4.7	4.8	4.9	5.0
grain maize + CCM	6.5	6.6	6.8	7.0	7.3	7.4
silage maize	19.0	30.5	31.6	32.2	33.6	34.0
sugar beet	45.6	42.3	42.3	42.6	44.6	45.3
rapeseed	1.4	2.2	2.2	2.3	2.4	2.4
sunflowers	2.1	2.1	2.1	2.1	2.1	2.1
fodder beet	38.5	39.4	39.9	39.7	39.9	40.0
			mineral fertilizers (1,000 t)			
N (pure nutrients)	94	94	95	96	100	101
P (pure nutrients)	45	45	47	48	51	52
K (pure nutrients)	50	51	53	54	55	56
Urea (exogeneous)	5.1	5.4	5.9	6.2	6.9	7.7
			pasture (percentage of summer feed demand)			
milk cows	25.3	25.4	25.0	25.1	24.6	24.3
other cows	100.0	100.0	100.0	100.0	100.0	100.0
heifers	70.0	70.0	74.1	75.7	72.1	70.2
			manure (1,000 m³/1,000 t per year)			
slurry milk cows	3,475	3,414	3,289	3,213	3,077	3,042
slurry other cows	697	675	685	683	686	688
slurry other cattle <1 year	733	720	708	698	683	679
slurry other cattle 1-2 years	2,333	2,156	2,157	2,158	2,158	2,158
slurry other cattle >2 years	21	21	21	21	21	21
slurry porkers >50 kg	1,315	1,289	1,293	1,297	1,302	1,303
slurry breeding pigs >50 kg	264	264	263	263	264	264
slurry pigs <50 kg	2,167	2,145	2,149	2,153	2,158	2,159
slurry chickens	570	570	570	570	570	570
solid dung milk cows	2,662	2,615	2,520	2,462	2,357	2,330
solid dung other cows	1,613	1,562	1,586	1,582	1,589	1,592
solid dung other cattle <1 year	101	99	97	96	94	93
solid dung other cattle 1-2 years	1,325	1,225	1,225	1,226	1,226	1,226
solid dung other cattle >2 year	1,530	1,520	1,520	1,520	1,520	1,520
solid dung porker >50 kg	54	53	53	53	53	53
solid dung breeding pigs >50 kg	204	204	204	204	204	204
solid dung pigs <50 kg	166	164	165	165	165	166
solid dung chickens	517	517	517	517	517	517

Source: own calculations; Urea consumption based on FAOSTAT.

Table 7b: Scenario results "business as usual with measures"

Livestock (December)	2003	2005	2008	2010	2015	2020
	conventional farming (1,000 heads)					
equids	76	76	76	76	76	76
cattle (total)	1,733	1,679	1,659	1,643	1,616	1,610
milk cows	473	467	452	443	427	422
other cows	183	177	180	180	181	182
other cattle < 1 year	533	525	517	511	501	498
other cattle 1-2 years	392	361	361	361	360	360
other cattle > 2 years	150	149	149	148	148	148
hens (total)	11,726	11,726	11,726	11,726	11,726	11,726
laying hens	6,269	6,269	6,269	6,269	6,269	6,269
broiler	5,456	5,456	5,456	5,456	5,456	5,456
other poultry	617	617	617	617	617	617
pigs (total)	3,209	3,165	3,169	3,173	3,179	3,181
porker > 50 kg	1,229	1,203	1,205	1,207	1,211	1,212
breeding pigs > 50 kg	334	334	333	334	334	334
pigs < 50 kg	1,646	1,628	1,630	1,632	1,634	1,635
sheep (total)	249	249	253	255	258	258
goats (total)	39	39	35	36	36	36
fallow deer	33	33	33	33	33	33
	organic farming (1,000 heads)					
equids	11	11	11	11	11	11
cattle (total)	319	310	303	297	289	287
milk cows	85	82	77	73	67	65
other cows	60	58	59	58	58	58
other cattle < 1 year	108	105	103	100	97	96
other cattle 1-2 years	54	51	51	52	53	53
other cattle > 2 years	14	13	13	14	14	14
hens (total)	629	629	629	629	629	629
laying hens	256	256	256	256	256	256
broiler	372	372	372	372	372	372
other poultry	36	36	36	36	36	36
pigs (total)	36	38	41	43	47	47
porker > 50 kg	15	17	18	20	22	22
breeding pigs > 50 kg	0	0	0	0	0	0
pigs < 50 kg	20	21	22	23	25	25
sheep (total)	77	77	78	79	80	80
goats (total)	16	16	14	14	14	14
fallow deer	7	7	7	7	7	7
	conventional and organic farming					
Ø milk production/cow (t/year)	5.6	5.6	5.8	6.2	6.6	6.7
milk producition (1,000 t)	3,230	3,099	3,095	3,194	3,260	3,260

Source: own calculations

Table 7b (continued): Scenario results "business as usual with measures"

Land use	2003	2005	2008	2010	2015	2020
			conventional farming (1,000 ha)			
cereals (without maize)	557	536	534	532	533	533
winter wheat	236	227	227	227	228	229
sugar beet	43	41	41	41	42	42
rapeseed	44	42	42	42	43	43
sunflowers	25	24	24	25	25	25
grain maize + CCM	193	187	185	183	182	182
silage maize	69	67	67	66	65	65
soy beans	14	14	14	13	13	13
field peas	32	30	30	29	29	29
hoarse beeans	2	3	3	3	3	3
red clover	5	6	6	6	6	6
alfalfa	5	5	5	5	5	5
grass clover	29	28	28	27	27	27
fodder beet	1	1	1	1	1	1
other forage	6	6	6	6	6	6
vegetables	11	11	11	11	11	11
			organic farming (1,000 ha)			
cereals (without maize)	52.4	51.9	52.5	53.5	54.2	54.3
winter wheat	12.4	12.0	12.1	12.4	12.6	12.6
sugar beet	0.2	0.2	0.2	0.2	0.2	0.2
rapeseed	0.3	0.3	0.3	0.3	0.3	0.3
sunflowers	0.6	0.6	0.6	0.6	0.6	0.6
grain maize + CCM	3.4	3.5	3.3	3.2	3.2	3.2
silage maize	3.0	3.1	3.4	3.6	3.9	4.0
soy beans	1.2	1.2	1.2	1.2	1.2	1.2
field peas	10.3	10.7	10.9	11.3	11.6	11.6
hoarse beeans	1.0	1.1	1.1	1.1	1.2	1.2
red clover	1.6	0.9	0.8	1.3	1.6	1.7
alfalfa	3.7	4.1	3.2	3.6	3.7	3.6
grass clover	25.9	25.3	24.9	24.3	24.0	24.0
fodder beet	0.1	0.1	0.0	0.1	0.1	0.1
other forage	1.2	1.2	1.2	1.2	1.3	1.3
vegetables	0.9	0.9	0.9	0.9	0.9	0.9
			conventional and organic farming (1,000 ha)			
permanent grassland (total)[1)]	1,640	1,693	1,692	1,681	1,669	1,668
extensive grassland[1)]	994	1,002	1,003	1,007	1,010	1,010
arable land	1,380	1,328	1,323	1,318	1,317	1,318
vineyards	51	51	51	51	51	51
			non agricultural use (1,000 ha)			
energy crops (on set aside land)	12	12	12	12	12	12
set aside land	97	93	92	92	92	92
residential areas	74	74	75	76	79	80
tourism areas						

Source: own calculations;
Note: [1)] acreage based on STAT (1999; Agrarstrukturerhebung 1999)

Table 7b (continued): Scenario results "business as usual with measures"

	2003	2005	2008	2010	2015	2020
			crop yield conventional farming (t per ha)			
cereals (without maize)	4.2	4.7	4.8	4.9	5.0	5.1
winter wheat	4.4	5.4	5.4	5.5	5.7	5.7
grain maize + CCM	8.7	8.8	9.1	9.4	9.9	10.0
silage maize	41.8	45.6	46.0	46.5	48.9	49.8
sugar beet	57.5	62.4	63.0	63.0	63.4	63.6
rapeseed	1.8	2.8	2.8	2.9	3.0	3.0
sunflowers	2.8	2.8	2.9	2.9	3.0	3.0
fodder beet	45.3	46.7	46.7	46.7	46.7	46.7
			crop yield organic farming (t per ha)			
cereals (without maize)	3.4	3.8	3.9	3.9	4.1	4.1
winter wheat	3.8	4.7	4.7	4.8	4.9	5.0
grain maize + CCM	6.5	6.6	6.8	7.0	7.3	7.4
silage maize	19.0	30.5	31.8	32.5	33.7	34.0
sugar beet	45.6	42.3	42.3	42.6	44.6	45.3
rapeseed	1.4	2.2	2.2	2.3	2.4	2.4
sunflowers	2.1	2.1	2.1	2.1	2.1	2.1
fodder beet	38.5	39.4	39.9	39.6	39.5	39.5
			mineral fertilizers (1,000 t)			
N (pure nutrients)	94	94	95	96	100	102
P (pure nutrients)	45	45	46	48	52	53
K (pure nutrients)	50	51	53	54	55	56
Urea (exogeneous)	5.1	5.4	5.9	6.2	7.0	7.7
			pasture (percentage of summer feed demand)			
milk cows	25.3	25.9	27.9	25.8	25.5	26.0
other cows	100.0	100.0	100.0	100.0	100.0	100.0
heifers	70.0	70.0	70.0	70.1	70.0	70.0
			manure (1,000 m³/1,000 t per year)			
slurry milk cows	3,475	3,419	3,297	3,214	3,072	3,037
slurry other cows	697	674	684	683	687	688
slurry other cattle <1 year	733	720	708	699	683	679
slurry other cattle 1-2 years	2,333	2,156	2,158	2,159	2,158	2,158
slurry other cattle >2 years	21	21	21	21	21	21
slurry porkers >50 kg	1,315	1,289	1,293	1,297	1,303	1,304
slurry breeding pigs >50 kg	264	264	263	263	263	263
slurry pigs <50 kg	2,167	2,145	2,149	2,152	2,157	2,159
slurry chickens	570	570	570	570	570	570
solid dung milk cows	2,662	2,619	2,526	2,462	2,353	2,327
solid dung other cows	1,613	1,561	1,582	1,581	1,590	1,593
solid dung other cattle <1 year	101	99	97	96	94	93
solid dung other cattle 1-2 years	1,325	1,224	1,225	1,226	1,226	1,225
solid dung other cattle >2 year	1,530	1,520	1,520	1,521	1,520	1,519
solid dung porker >50 kg	54	53	53	53	53	53
solid dung breeding pigs >50 kg	204	204	204	204	204	204
solid dung pigs <50 kg	166	164	165	165	165	165
solid dung chickens	517	517	517	517	517	517

Source: own calculations; Urea consumption based on FAOSTAT.

Table 7c: Scenario results "business as usual with additional measures"

Livestock (December)	2003	2005	2008	2010	2015	2020
			conventional farming (1,000 heads)			
equids	76	76	76	76	76	76
cattle (total)	1,733	1,679	1,657	1,639	1,609	1,603
milk cows	473	467	452	442	425	420
other cows	183	177	179	179	180	180
other cattle < 1 year	533	525	516	510	498	495
other cattle 1-2 years	392	361	361	360	359	359
other cattle > 2 years	150	149	149	148	148	148
hens (total)	11,726	11,726	11,726	11,726	11,726	11,726
laying hens	6,269	6,269	6,269	6,269	6,269	6,269
broiler	5,456	5,456	5,456	5,456	5,456	5,456
other poultry	617	617	617	617	617	617
pigs (total)	3,209	3,165	3,170	3,174	3,181	3,182
porker > 50 kg	1,229	1,203	1,206	1,208	1,212	1,213
breeding pigs > 50 kg	334	334	334	334	334	334
pigs < 50 kg	1,646	1,628	1,631	1,632	1,635	1,636
sheep (total)	249	249	253	255	257	257
goats (total)	39	39	35	36	36	36
fallow deer	33	33	33	33	33	33
			organic farming (1,000 heads)			
equids	11	11	11	11	11	11
cattle (total)	319	310	304	301	294	292
milk cows	85	82	77	74	69	68
other cows	60	58	59	59	59	59
other cattle < 1 year	108	105	103	101	99	98
other cattle 1-2 years	54	51	51	52	53	53
other cattle > 2 years	14	13	13	14	14	14
hens (total)	629	629	629	629	629	629
laying hens	256	256	256	256	256	256
broiler	372	372	372	372	372	372
other poultry	36	36	36	36	36	36
pigs (total)	36	38	40	42	45	46
porker > 50 kg	15	17	18	19	21	21
breeding pigs > 50 kg	0	0	0	0	0	0
pigs < 50 kg	20	21	22	23	24	25
sheep (total)	77	77	78	79	79	79
goats (total)	16	16	14	14	14	14
fallow deer	7	7	7	7	7	7
			conventional and organic farming			
Ø milk production/cow (t/year)	5.6	5.6	5.8	6.2	6.6	6.7
milk producition (1,000 t)	3,230	3,099	3,096	3,195	3,260	3,260

Source: own calculations

Table 7c (continued): Scenario results "business as usual with additional measures"

Land use	2003	2005	2008	2010	2015	2020
			conventional farming (1,000 ha)			
cereals (without maize)	557	536	532	530	529	529
winter wheat	236	227	227	226	226	226
sugar beet	43	41	41	41	42	42
rapeseed	44	42	42	42	42	42
sunflowers	25	24	24	24	25	25
grain maize + CCM	193	187	185	182	180	179
silage maize	69	67	67	66	65	65
soy beans	14	14	14	13	13	13
field peas	32	30	30	29	28	28
hoarse beeans	2	3	3	3	3	3
red clover	5	6	6	6	6	6
alfalfa	5	5	5	5	5	5
grass clover	29	28	28	27	26	26
fodder beet	1	1	1	1	1	1
other forage	6	6	6	6	6	6
vegetables	11	11	11	11	11	11
			organic farming (1,000 ha)			
cereals (without maize)	52.4	51.9	55.8	56.7	57.4	57.4
winter wheat	12.4	12.0	12.4	12.8	13.1	13.2
sugar beet	0.2	0.2	0.2	0.2	0.2	0.2
rapeseed	0.3	0.3	0.3	0.3	0.3	0.3
sunflowers	0.6	0.6	0.6	0.6	0.6	0.6
grain maize + CCM	3.4	3.5	3.4	3.3	3.3	3.3
silage maize	3.0	3.1	3.4	3.6	3.9	4.0
soy beans	1.2	1.2	1.2	1.2	1.2	1.2
field peas	10.3	10.7	11.2	12.0	12.5	12.6
hoarse beeans	1.0	1.1	1.2	1.2	1.2	1.2
red clover	1.6	0.9	0.8	1.3	1.7	1.7
alfalfa	3.7	4.1	3.6	4.1	4.5	4.4
grass clover	25.9	25.3	25.9	25.5	25.2	25.2
fodder beet	0.1	0.1	0.0	0.1	0.1	0.1
other forage	1.2	1.2	1.1	1.2	1.3	1.3
vegetables	0.9	0.9	0.9	0.9	0.9	0.9
			conventional and organic farming (1,000 ha)			
permanent grassland (total)[1)]	1,640	1,693	1,688	1,678	1,668	1,666
extensive grassland[1)]	994	1,002	1,002	1,007	1,010	1,010
arable land	1,380	1,328	1,322	1,314	1,307	1,307
vineyards	51	51	51	51	51	51
			non agricultural use (1,000 ha)			
energy crops (on set aside land)	12	12	41	44	46	46
set aside land	97	93	64	60	58	58
residential areas	74	74	75	76	79	80
tourism areas						

Source: own calculations;
Note: [1)] acreage based on STAT (1999; Agrarstrukturerhebung 1999)

Table 7c (continued): Scenario results "business as usual with additional measures"

	2003	2005	2008	2010	2015	2020
	crop yield conventional farming (t per ha)					
cereals (without maize)	4.2	4.7	4.8	4.9	5.0	5.1
winter wheat	4.4	5.4	5.4	5.5	5.7	5.7
grain maize + CCM	8.7	8.8	9.1	9.4	9.9	10.0
silage maize	41.8	45.6	46.0	46.5	48.9	49.8
sugar beet	57.5	62.4	63.0	63.0	63.4	63.6
rapeseed	1.8	2.8	2.8	2.9	3.0	3.0
sunflowers	2.8	2.8	2.9	2.9	3.0	3.0
fodder beet	45.3	46.7	46.7	46.7	46.7	46.7
	crop yield organic farming (t per ha)					
cereals (without maize)	3.4	3.8	3.9	3.9	4.1	4.1
winter wheat	3.8	4.7	4.7	4.8	4.9	5.0
grain maize + CCM	6.5	6.6	6.8	7.0	7.3	7.4
silage maize	19.0	30.5	31.7	32.2	33.5	33.9
sugar beet	45.6	42.3	42.3	42.6	44.6	45.3
rapeseed	1.4	2.2	2.2	2.3	2.4	2.4
sunflowers	2.1	2.1	2.1	2.1	2.1	2.1
fodder beet	38.5	39.4	39.9	39.7	40.1	40.3
	mineral fertilizers (1,000 t)					
N (pure nutrients)	94	94	94	95	99	100
P (pure nutrients)	45	45	46	47	51	52
K (pure nutrients)	50	51	53	53	55	55
Urea (exogeneous)	5.1	5.4	5.9	6.1	6.9	7.6
	pasture (percentage of summer feed demand)					
milk cows	25.3	25.9	25.0	25.4	24.7	24.4
other cows	100.0	100.0	100.0	100.0	100.0	100.0
heifers	70.0	70.0	70.0	70.2	70.6	70.7
	manure (1,000 m³/1,000 t per year)					
slurry milk cows	3,475	3,419	3,297	3,216	3,075	3,040
slurry other cows	697	674	682	682	684	685
slurry other cattle <1 year	733	720	708	698	682	678
slurry other cattle 1-2 years	2,333	2,156	2,158	2,156	2,155	2,155
slurry other cattle >2 years	21	21	21	21	21	21
slurry porkers >50 kg	1,315	1,289	1,293	1,297	1,303	1,304
slurry breeding pigs >50 kg	264	264	263	263	263	263
slurry pigs <50 kg	2,167	2,145	2,149	2,152	2,158	2,159
slurry chickens	570	570	570	570	570	570
solid dung milk cows	2,662	2,619	2,526	2,464	2,356	2,329
solid dung other cows	1,613	1,561	1,578	1,578	1,584	1,587
solid dung other cattle <1 year	101	99	97	96	94	93
solid dung other cattle 1-2 years	1,325	1,224	1,225	1,224	1,224	1,224
solid dung other cattle >2 year	1,530	1,520	1,520	1,519	1,518	1,518
solid dung porker >50 kg	54	53	53	53	53	53
solid dung breeding pigs >50 kg	204	204	204	204	204	204
solid dung pigs <50 kg	166	164	165	165	165	165
solid dung chickens	517	517	517	517	517	517

Source: own calculations; Urea consumption based on FAOSTAT.

Table 8: Sensitivity report on "business as usual with measures" scenario

	lower prices			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	conventional farming					
equids	0.00	0.00	0.00	0.00	0.00	0.00
cattle (total)	-0.44	-0.27	-0.26	0.25	0.00	-0.02
milk cows	-0.46	0.08	0.15	0.10	-0.37	-0.37
other cows	-0.34	-0.71	-0.83	0.61	0.31	0.20
other cattle < 1 year	-0.41	-0.16	-0.15	0.21	-0.11	-0.13
other cattle 1-2 years	-0.54	-0.60	-0.62	0.30	0.33	0.30
other cattle > 2 years	-0.40	-0.29	-0.24	0.23	0.27	0.27
hens (total)	0.00	0.00	0.00	0.00	0.00	0.00
laying hens	0.00	0.00	0.00	0.00	0.00	0.00
broiler	0.00	0.00	0.00	0.00	0.00	0.00
other poultry	0.00	0.00	0.00	0.00	0.00	0.00
pigs (total)	-0.17	-0.21	-0.22	0.58	0.59	0.59
porker > 50 kg	0.04	-0.01	-0.02	-0.15	-0.12	-0.11
breeding pigs > 50 kg	-0.39	-0.43	-0.43	1.63	1.59	1.59
pigs < 50 kg	-0.29	-0.32	-0.32	0.90	0.91	0.91
sheep (total)	0.61	1.04	1.21	-0.01	0.29	0.24
goats (total)	-5.55	-5.27	-5.15	3.87	4.21	4.21
fallow deer	-0.38	-0.95	-1.09	2.74	2.17	2.03
	organic farming					
equids	0.00	0.00	0.00	-0.03	-0.03	-0.03
cattle (total)	-0.07	-0.04	-0.15	1.83	2.01	2.02
milk cows	0.24	1.53	1.32	2.22	3.62	3.69
other cows	-0.97	-0.71	-0.74	1.20	1.67	1.68
other cattle < 1 year	-0.09	0.24	0.13	1.71	2.15	2.18
other cattle 1-2 years	0.23	-1.48	-1.53	2.03	0.55	0.53
other cattle > 2 years	1.17	-1.14	-1.14	2.62	0.33	0.33
hens (total)	0.00	0.00	0.00	0.00	0.00	0.00
laying hens	0.00	0.00	0.00	0.00	0.00	0.00
broiler	0.00	0.00	0.00	0.00	0.00	0.00
other poultry	-2.00	-2.00	-2.00	0.00	0.00	0.00
pigs (total)	0.99	-0.02	0.22	-2.52	-3.72	-3.67
porker > 50 kg	1.48	0.18	0.48	-3.52	-4.93	-4.84
breeding pigs > 50 kg	0.09	0.37	0.37	0.64	0.92	0.92
pigs < 50 kg	0.59	-0.20	-0.01	-1.69	-2.69	-2.67
sheep (total)	-0.72	-1.20	-1.20	-0.54	-0.62	-0.62
goats (total)	-5.69	-5.93	-5.93	3.04	2.72	2.72
fallow deer	-0.77	-1.16	-1.16	2.10	1.91	1.91

Source: own calculations

Table 8 (continued): Sensitivity report on "business as usual with measures" scenario

	lower prices			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	conventional and organic farming					
Ø milk production/cow in t/year	-0.16	-0.27	-0.30	-0.06	-0.15	-0.16
milk producition	-0.49	0.01	0.01	0.33	0.02	0.02
	conventional farming					
cereals (without maize)	-0.16	-0.54	-0.66	0.44	0.21	0.16
winter wheat	-0.40	-1.05	-1.11	0.56	0.35	0.35
sugar beet	-0.13	-0.73	-0.75	0.72	0.32	0.33
rapeseed	-0.51	-2.21	-2.12	0.65	-0.51	-0.51
sunflowers	0.05	-1.01	-0.91	1.07	0.36	0.46
grain maize + CCM	-0.65	-1.50	-1.70	0.15	-0.59	-0.85
silage maize	0.02	-0.04	-0.30	0.07	-0.04	-0.17
soy beans	-0.45	0.19	0.07	-0.41	0.09	0.02
field peas	-0.89	0.71	0.61	-0.13	1.72	1.71
hoarse beeans	-0.59	-1.52	-2.07	-0.35	-2.38	-2.86
red clover	0.00	3.33	2.91	-1.52	1.27	1.26
alfalfa	-2.62	-1.55	-1.62	-1.22	0.13	0.08
grass clover	-1.08	-1.55	-1.64	-0.06	0.27	0.23
fodder beet	0.00	0.00	0.00	0.00	0.00	0.00
other forage	-1.22	-0.28	-0.39	-0.41	1.19	1.20
vegetables	0.00	0.00	0.00	0.00	0.00	0.00
	organic farming					
cereals (without maize)	-0.20	-0.28	-0.41	2.01	2.19	2.11
winter wheat	-0.69	-0.35	-0.31	2.76	2.98	2.87
sugar beet	-0.96	-1.73	-1.73	2.59	1.72	1.73
rapeseed	-0.31	-1.24	-1.28	1.11	0.10	0.10
sunflowers	-0.61	-1.27	-1.22	1.68	0.77	0.71
grain maize + CCM	1.24	0.38	0.06	-0.19	-0.71	-0.84
silage maize	-0.14	-5.58	-7.14	-0.80	-5.65	-7.08
soy beans	-0.42	-0.08	-0.10	0.64	0.83	0.82
field peas	1.18	0.60	0.45	1.84	2.42	2.48
hoarse beeans	-1.49	-1.57	-1.82	-1.73	-3.42	-3.65
red clover	16.85	-2.69	-2.21	17.47	-7.26	-8.09
alfalfa	18.03	12.56	12.46	7.78	-1.28	-1.27
grass clover	-1.79	-2.99	-3.35	-0.20	-0.35	-0.73
fodder beet						
other forage	0.51	-3.13	-3.14	1.32	-2.90	-3.04
vegetables	0.00	0.00	0.00	0.00	0.00	0.00

Source: own calculations

Table 8 (continued): Sensitivity report on "business as usual with measures" scenario

	lower prices			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	conventional and organic farming					
permanent grassland (total)	-0.38	0.09	0.09	-0.31	0.10	0.11
extensive grassland	0.30	0.04	0.04	0.29	0.04	0.04
arable land	-0.32	-0.94	-1.08	0.36	0.00	-0.10
vineyards	0.00	0.00	0.00	0.00	0.00	0.00
	non agricultural use					
energy crops (on set aside land)	0.00	0.00	0.00	0.00	0.00	0.00
set aside land	-0.36	-1.06	-1.22	0.40	0.00	-0.11
residential areas	0.00	0.00	0.00	0.00	0.00	0.00
tourism areas						
	conventional farming					
cereals (without maize)	-0.01	-0.01	0.00	0.00	0.01	0.02
winter wheat	0.00	0.00	0.00	0.00	0.00	0.00
grain maize + CCM	0.00	0.00	0.00	0.00	0.00	0.00
silage maize	0.27	0.12	0.00	0.54	0.85	0.84
sugar beet	0.00	0.00	0.00	0.00	0.00	0.00
rapeseed	0.00	0.00	0.00	0.00	0.00	0.00
sunflowers	0.00	0.00	0.00	0.00	0.00	0.00
fodder beat	0.00	0.00	0.00	0.00	0.15	0.21
	organic farming					
cereals (without maize)	-0.09	-0.04	-0.03	0.03	0.05	0.05
winter wheat	0.00	0.00	0.00	0.00	0.00	0.00
grain maize + CCM	0.00	0.00	0.00	0.00	0.00	0.00
silage maize	-1.97	-0.55	-0.29	-1.97	-0.34	0.00
sugar beet	0.00	0.00	0.00	0.00	0.00	0.00
rapeseed	0.00	0.00	0.00	0.00	0.00	0.00
sunflowers	0.00	0.00	0.00	0.00	0.00	0.00
fodder beat	-0.20	1.05	1.27	-0.51	-0.18	-0.25

Source: own calculations

Table 8 (continued): Sensitivity report on "business as usual with measures" scenario

	lower prices			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	mineral fertilizers (1,000 t)					
N (pure nutrients)	-1.95	-3.00	-3.30	-0.80	-0.63	-0.62
P (pure nutrients)	-2.57	-3.45	-3.69	-1.66	-1.54	-1.56
K (pure nutrients)	-4.27	-4.83	-4.98	-3.67	-3.54	-3.50
Urea (exogeneous)						
	pasture (percentage of summer feed demand)					
milk cows	-3.95	-3.64	-5.77	-4.81	-4.75	-6.54
other cows	0.00	0.00	0.00	0.00	0.00	0.00
heifers	-0.09	-0.04	0.00	-0.09	-0.04	0.00
	manure (1,000 m³/1,000 t per year)					
slurry other cows	-0.36	0.28	0.30	0.40	0.16	0.18
slurry other cattle <1 year	-0.50	-0.71	-0.81	0.76	0.64	0.56
slurry other cattle 1-2 years	-0.35	-0.09	-0.10	0.46	0.26	0.24
slurry other cattle >2 years	-0.44	-0.72	-0.73	0.52	0.36	0.33
slurry porkers >50 kg	-0.27	-0.36	-0.32	0.43	0.27	0.27
slurry breeding pigs >50 kg	0.07	-0.01	-0.01	-0.20	-0.20	-0.20
slurry pigs <50 kg	-0.39	-0.43	-0.43	1.63	1.59	1.59
slurry chickens	-0.28	-0.32	-0.32	0.87	0.86	0.86
solid dung milk cows	0.00	0.00	0.00	0.00	0.00	0.00
solid dung other cows	-0.36	0.28	0.30	0.40	0.16	0.18
solid dung other cattle <1 year	-0.50	-0.71	-0.81	0.76	0.64	0.56
solid dung other cattle 1-2 years	-0.35	-0.09	-0.10	0.46	0.26	0.24
solid dung other cattle >2 year	-0.44	-0.72	-0.73	0.52	0.36	0.33
solid dung porker >50 kg	-0.27	-0.36	-0.32	0.43	0.27	0.27
solid dung breeding pigs >50 kg	0.07	-0.01	-0.01	-0.20	-0.20	-0.20
solid dung pigs <50 kg	-0.39	-0.43	-0.43	1.63	1.59	1.59
solid dung chickens	-0.28	-0.32	-0.32	0.87	0.86	0.86
slurry other cows	0.00	0.00	0.00	0.00	0.00	0.00

Source: own calculations

Table 9: Sensitivity report on "business as usual with additional measures" scenario

	lower prices & less premiums			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	conventional farming					
equids	0.00	0.00	0.00	-0.05	-0.05	-0.05
cattle (total)	-0.91	-0.67	-0.69	0.32	0.27	0.29
milk cows	-0.40	0.13	0.10	0.40	0.31	0.37
other cows	-1.77	-1.85	-1.84	0.42	0.30	0.30
other cattle < 1 year	-0.82	-0.51	-0.53	0.32	0.27	0.30
other cattle 1-2 years	-0.99	-0.97	-1.00	0.25	0.25	0.21
other cattle > 2 years	-1.51	-1.30	-1.30	0.10	0.16	0.16
hens (total)	0.00	0.00	0.00	0.00	0.00	0.00
laying hens	0.00	0.00	0.00	0.00	0.00	0.00
broiler	0.00	0.00	0.00	0.00	0.00	0.00
other poultry	0.00	0.00	0.00	0.00	0.00	0.00
pigs (total)	0.01	-0.03	-0.03	0.59	0.58	0.58
porker > 50 kg	0.00	-0.05	-0.06	-0.16	-0.16	-0.17
breeding pigs > 50 kg	0.14	0.10	0.10	1.68	1.63	1.63
pigs < 50 kg	-0.01	-0.04	-0.04	0.93	0.92	0.92
sheep (total)	0.18	0.49	0.70	-0.42	-0.20	-0.21
goats (total)	-5.89	-5.83	-5.72	3.27	3.24	3.24
fallow deer	-1.60	-1.92	-1.92	2.32	2.00	2.00
	organic farming					
equids	0.00	0.00	0.00	0.00	0.00	0.00
cattle (total)	-0.54	-0.48	-0.40	0.70	-0.10	-0.14
milk cows	-1.10	0.41	0.70	0.00	-1.02	-1.16
other cows	-1.07	-1.08	-1.12	0.71	0.88	0.91
other cattle < 1 year	-0.68	-0.33	-0.23	0.53	-0.13	-0.17
other cattle 1-2 years	0.55	-1.13	-1.20	1.60	0.07	0.07
other cattle > 2 years	1.52	-0.89	-0.91	2.29	-0.18	-0.18
hens (total)	0.00	0.00	0.00	0.00	0.00	0.00
laying hens	0.00	0.00	0.00	0.00	0.00	0.00
broiler	0.00	0.00	0.00	0.00	0.00	0.00
other poultry	-2.00	-2.00	-2.00	0.00	0.00	0.00
pigs (total)	2.35	0.51	0.25	-0.28	-0.23	-0.15
porker > 50 kg	3.25	0.86	0.53	-1.05	-0.90	-0.79
breeding pigs > 50 kg	-0.24	-0.26	-0.26	0.46	0.45	0.45
pigs < 50 kg	1.62	0.21	0.01	0.35	0.34	0.40
sheep (total)	-0.21	-0.54	-0.54	0.27	0.54	0.54
goats (total)	-6.32	-6.16	-6.16	2.88	3.34	3.34
fallow deer	-0.47	-0.63	-0.63	2.46	2.50	2.50

Source: own calculations

Table 9 (continued): Sensitivity report on "business as usual with additional measures" scenario

	lower prices & less premiums			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	conventional and organic farming					
Ø milk production/cow in t/year	-0.12	-0.16	-0.18	-0.02	-0.14	-0.17
milk producition	-0.59	0.00	0.00	0.30	-0.01	-0.01
	conventional farming					
cereals (without maize)	-1.30	-1.45	-1.52	0.60	0.74	0.78
winter wheat	-1.24	-1.28	-1.27	1.02	1.20	1.21
sugar beet	-1.14	-1.70	-1.80	0.97	0.85	0.85
rapeseed	-1.28	-2.62	-2.76	1.79	1.17	1.08
sunflowers	-1.32	-2.93	-3.20	1.78	1.16	1.08
grain maize + CCM	-0.77	-0.49	-0.42	0.60	0.74	0.71
silage maize	-1.50	-1.37	-1.43	-0.31	-0.17	-0.11
soy beans	-1.20	-1.39	-1.63	-0.63	-0.60	-0.79
field peas	-1.18	-0.48	-0.79	-0.44	1.75	1.72
hoarse beeans	-1.94	-2.01	-2.20	-0.81	-1.77	-1.81
red clover	-4.84	-4.54	-5.34	-3.19	-1.56	-1.50
alfalfa	-2.72	-1.88	-2.02	0.32	2.22	2.27
grass clover	-0.37	0.02	0.00	0.51	1.60	1.62
fodder beet	0.00	0.00	0.00	0.00	0.00	0.00
other forage	-0.78	0.45	0.19	-1.27	0.06	-0.01
vegetables	0.00	0.00	0.00	0.00	0.00	0.00
	organic farming					
cereals (without maize)	2.34	1.62	1.44	-0.79	-1.09	-1.16
winter wheat	0.19	-1.01	-1.36	0.41	-0.84	-1.05
sugar beet	-0.28	-1.87	-1.86	1.05	0.05	0.05
rapeseed	0.82	-0.18	-0.52	2.30	1.55	1.37
sunflowers	0.72	0.46	0.58	2.10	1.36	1.37
grain maize + CCM	0.43	-0.25	-0.48	-1.36	-1.45	-1.43
silage maize	-0.20	-1.42	-1.41	-0.05	-1.30	-1.29
soy beans	-1.63	-1.82	-1.93	0.58	0.56	0.57
field peas	4.78	1.32	1.21	2.18	-1.37	-1.38
hoarse beeans	-3.53	-3.55	-3.65	-2.32	-4.10	-4.12
red clover	3.51	-5.85	-1.71	19.67	-2.55	-2.95
alfalfa	-1.83	-10.21	-11.10	-3.68	-14.59	-15.03
grass clover	0.17	0.57	0.72	0.56	0.67	0.55
fodder beet						
other forage	-3.84	-6.35	-5.19	6.16	3.61	4.01
vegetables	0.00	0.00	0.00	0.00	0.00	0.00

Source: own calculations

Table 9 (continued): Sensitivity report on "business as usual with additional measures" scenario

	lower prices & less premiums			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	conventional and organic farming					
permanent grassland (total)	-1.06	-0.64	-0.61	-0.47	-0.27	-0.28
extensive grassland	0.00	-0.28	-0.28	0.26	-0.04	-0.04
arable land	-1.03	-1.24	-1.30	0.55	0.67	0.69
vineyards	0.00	0.00	0.00	0.00	0.00	0.00
	non agricultural use					
energy crops (on set aside land)	0.00	0.00	0.00	0.00	0.00	0.00
set aside land	-1.78	-2.22	-2.34	0.96	1.20	1.23
residential areas	0.00	0.00	0.00	0.00	0.00	0.00
tourism areas						
	conventional farming					
cereals (without maize)	-0.03	-0.02	-0.01	0.00	0.00	0.00
winter wheat	0.00	0.00	0.00	0.00	0.00	0.00
grain maize + CCM	0.00	0.00	0.00	0.00	0.00	0.00
silage maize	0.81	0.97	0.84	0.36	0.26	0.14
sugar beet	0.00	0.00	0.00	0.00	0.00	0.00
rapeseed	0.00	0.00	0.00	0.00	0.00	0.00
sunflowers	0.00	0.00	0.00	0.00	0.00	0.00
fodder beat	0.00	0.00	0.00	0.00	0.15	0.21
	organic farming					
cereals (without maize)	-0.23	-0.24	-0.26	0.03	0.02	0.01
winter wheat	0.00	0.00	0.00	0.00	0.00	0.00
grain maize + CCM	0.00	0.00	0.00	0.00	0.00	0.00
silage maize	-0.37	0.00	0.00	-0.37	0.00	0.00
sugar beet	0.00	0.00	0.00	0.00	0.00	0.00
rapeseed	0.00	0.00	0.00	0.00	0.00	0.00
sunflowers	0.00	0.00	0.00	0.00	0.00	0.00
fodder beat	-0.81	-0.86	-0.99	-0.81	-1.75	-2.23

Source: own calculations

Table 9 (continued): Sensitivity report on "business as usual with additional measures" scenario

	lower prices & less premiums			higher prices		
	2010	2015	2020	2010	2015	2020
	percentage change versus "expected" prices					
	mineral fertilizers (1,000 t)					
N (pure nutrients)	-3.24	-4.66	-5.02	-0.69	-0.07	0.09
P (pure nutrients)	-4.43	-6.34	-6.81	-1.42	-0.75	-0.60
K (pure nutrients)	-5.72	-7.39	-7.82	-3.54	-3.57	-3.57
Urea (exogeneous)						
	pasture (percentage of summer feed demand)					
milk cows	-2.76	-0.75	0.41	-3.15	0.06	2.05
other cows	0.00	0.00	0.00	0.00	0.00	0.00
heifers	-0.26	-0.12	0.00	-0.26	-0.83	-0.99
	manure (1,000 m³/1,000 t per year)					
slurry other cows	-0.50	0.16	0.19	0.34	0.13	0.16
slurry other cattle <1 year	-1.60	-1.66	-1.67	0.49	0.44	0.45
slurry other cattle 1-2 years	-0.80	-0.48	-0.48	0.36	0.20	0.22
slurry other cattle >2 years	-0.79	-0.99	-1.03	0.42	0.23	0.19
slurry porkers >50 kg	-1.25	-1.26	-1.27	0.29	0.13	0.13
slurry breeding pigs >50 kg	0.05	-0.04	-0.05	-0.17	-0.18	-0.18
slurry pigs <50 kg	0.14	0.10	0.10	1.68	1.63	1.63
slurry chickens	0.01	-0.03	-0.04	0.92	0.91	0.91
solid dung milk cows	0.00	0.00	0.00	0.00	0.00	0.00
solid dung other cows	-0.50	0.16	0.19	0.34	0.13	0.16
solid dung other cattle <1 year	-1.60	-1.66	-1.67	0.49	0.44	0.45
solid dung other cattle 1-2 years	-0.80	-0.48	-0.48	0.36	0.20	0.22
solid dung other cattle >2 year	-0.79	-0.99	-1.03	0.42	0.23	0.19
solid dung porker >50 kg	-1.25	-1.26	-1.27	0.29	0.13	0.13
solid dung breeding pigs >50 kg	0.05	-0.04	-0.05	-0.17	-0.18	-0.18
solid dung pigs <50 kg	0.14	0.10	0.10	1.68	1.63	1.63
solid dung chickens	0.01	-0.03	-0.04	0.92	0.91	0.91
slurry other cows	0.00	0.00	0.00	0.00	0.00	0.00

Source: own calculations