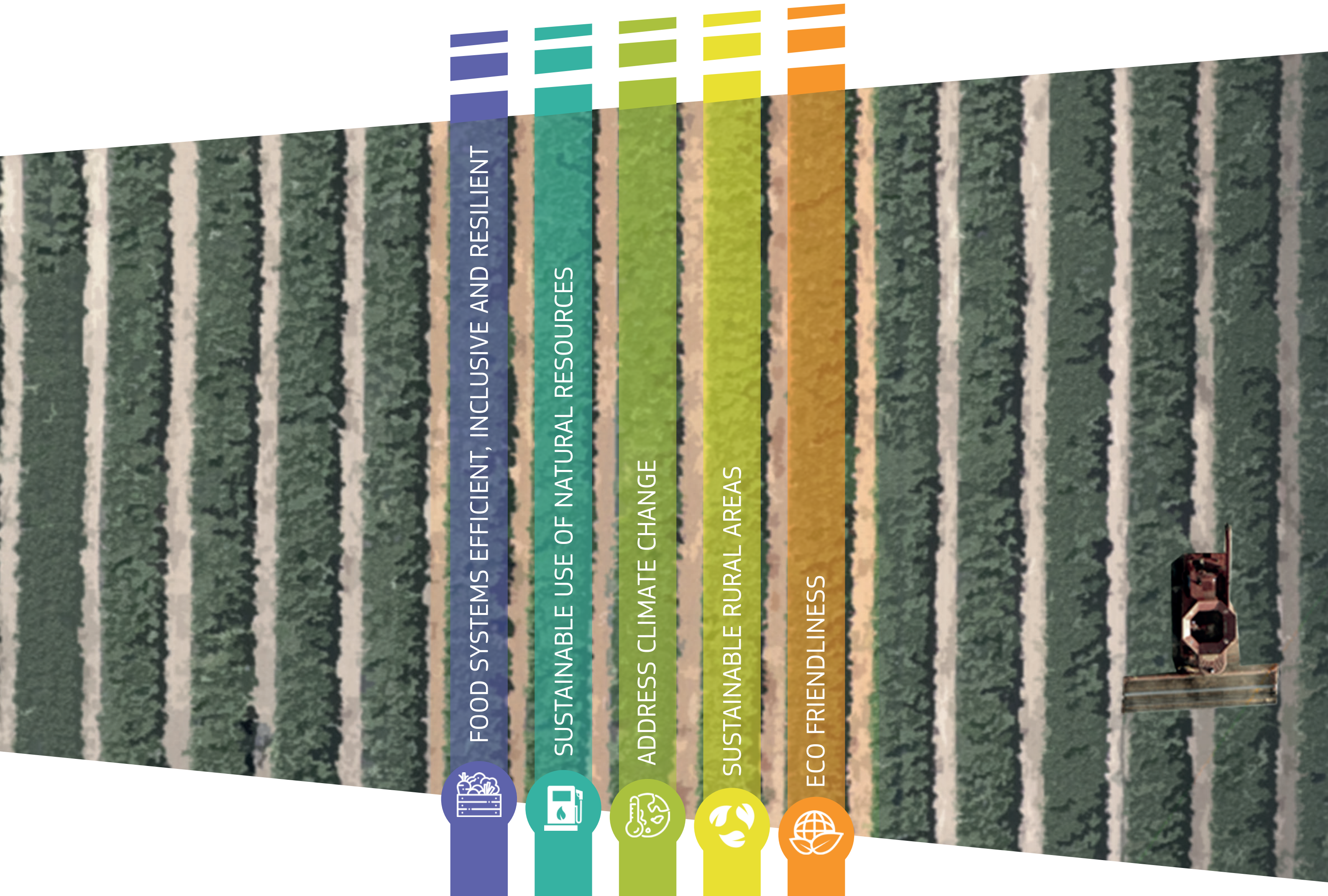
European Commission

# SCENAR 2030

## PATHWAYS FOR THE EUROPEAN AGRICULTURE AND FOOD SECTOR BEYOND 2020





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**Complex pathways for the European agriculture and food sector by 2030**
Analysing stylised scenarios with economic modelling tools reveals complex relations, incentives and trade-offs of the different policy instruments, in particular regarding the environmental dimension. Marginal areas of the EU are most vulnerable to drastic policy changes.

**Visualisation of results**
The reader is invited to consult the JRC agro-economic portal DataM at https://datam.jrc.ec.europa.eu for more details of the modelling results in interactive dashboards. The interactive infographics about this study is under the "Agro-economic studies" visualisation section.

Direct link: (scan this QR code with your mobile or tablet)

*Printed in Spain*

# SCENAR 2030

## Pathways for the European agriculture and food sector beyond 2020

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# ACKNOWLEDGEMENTS / EXECUTIVE SUMMARY

## Acknowledgements

The 'Scenar 2030 – Pathways for the European agriculture and food sector beyond 2020' report was prepared by the European Commission's Joint Research Centre (JRC) with support from Wageningen Economic Research (WECR) and EuroCARE, as well as contributions from the Directorate-General for Agriculture and Rural Development.

The overall coordination of the study was the responsibility of Robert M'barek, who also edited the report together with George Philippidis.

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The MAGNET model work was carried out by the JRC CGE team under the leadership of Emanuele Ferrari (EF) with valuable support from George Philippidis (GP) at WECR. The other team members are: Pierre Boulanger (PB), Hasan Dudu (HD) and Robert M'barek (RM). GP and EF provided the baseline and implemented the scenarios; HD took care of result visualisation; and RM, PB, HD and EF analysed the results and drafted the relevant sections of the report.

The CAPRI model work was carried out by the JRC CAPRI team under the leadership of Jesus Barreiro-Hurle (JBH) with support from Peter Witzke (PW) at EuroCARE. The other team members are: Thomas Fellmann (TF), Mihaly Himics (MH) and Guna Salputra (GS). MH provided the baseline; MH and GS, with the support of PW, implemented the scenarios; and TF, MH, GS and JBH analysed and cross-checked the results and drafted the relevant sections of the report.

The IFM-CAP model work for Scenar 2030 was carried out by the JRC IFM-CAP team under the leadership of Pavel Ciaian (PC). The other team members are: Kamel Louhichi (KL), Maria Espinosa (ME), Angel Perni (AP) and Sergio Gomez y Paloma (SGP). The tasks were performed by the team members as follows: data preparation and implementation of CAP direct payments was performed by ME, KL, PC and AP; baseline preparation was performed by PC, KL and ME; model setting and the implementation of scenarios was undertaken by KL, PC, ME and AP; result visualisation was carried out by AP, KL and ME; and result cross-checking and analysis, and drafting relevant sections of the report was conducted by PC, KL, ME, AP and SGP.

The visualisation of results was implemented mainly by Arnaldo Caivano, Celso Gorrin Gonzalez and Saulius Tamosiunas. Emiliano Bruno and Massimiliano Fucci designed the cover page. Administrative support was provided by Sandra Marcolini, Mathilde Drouin, Els De Rademaker and Tanja Acuna.

# Executive summary

The Common Agricultural Policy (CAP) of the European Union faces the challenge of evolving towards a multifunctional policy that responds to the constantly changing needs of society. The CAP must respond to demands related to increased market efficiency and competitiveness; fostering jobs and 'smart' growth; contributing to climate change mitigation while adapting to a changing climate; ensuring responsible and sustainable biologically renewable resource management; and still respecting its initial aim of ensuring food security.

The present report was carried out by the Joint Research Centre (JRC) and external experts in the context of the JRC's analytical support to the Directorate-General for Agriculture and Rural Development. The report analyses the impact on the agricultural sector of stylised scenarios, reflecting the main drivers of policy debate and thus providing a framework for further exploration of the process of designing the future CAP. While the scenarios presented do not represent real policy options, they underline the potential for changes to current agri-food policies to address societal challenges and demands.

The analysis of the social, economic and environmental impacts of various options for the next CAP employs the iMAP platform models MAGNET, CAPRI and IFM-CAP in an integrated manner, covering different spatial scales (global, EU, Member State, NUTS 2 region and individual farm level). The use of three different models and their (soft) linkages adds complexity, particularly when trying to compare results across models (e.g. different commodity categories), but allows the analysis of a wider range of aspects and details.

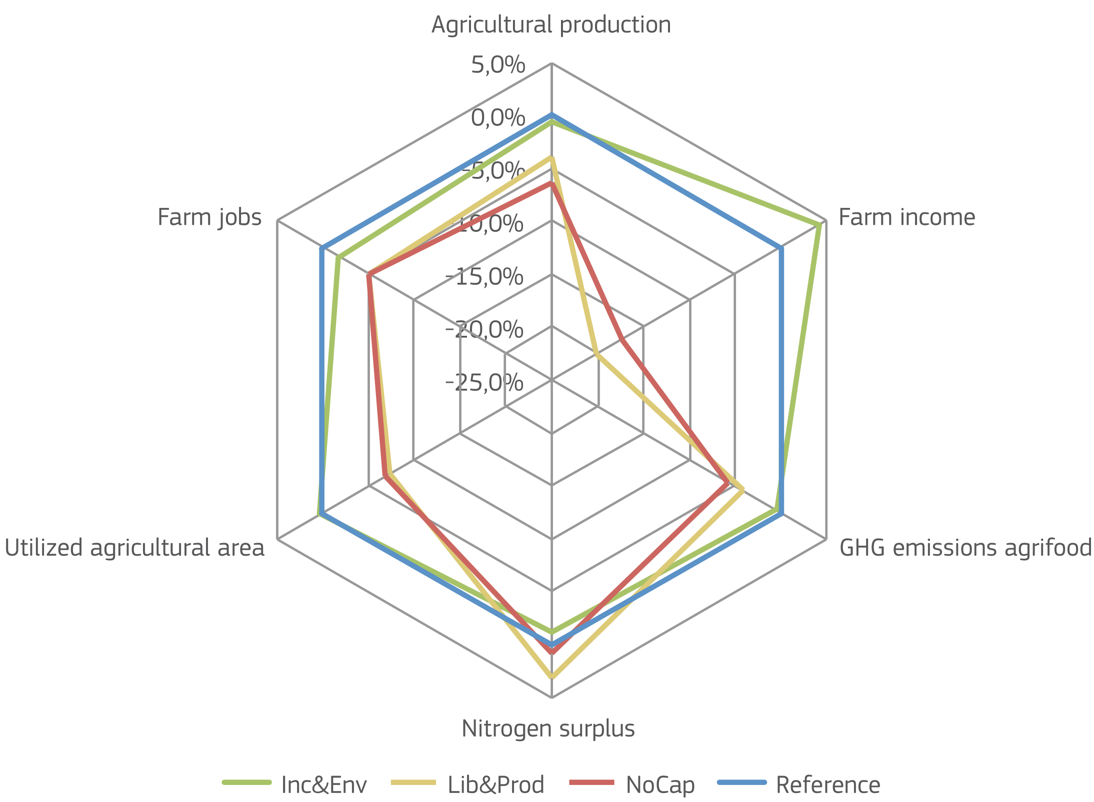
The study considers three scenarios, designed beginning of 2016, that take polar paths, against a reference scenario, to characterise different visions for the CAP. The first scenario, Income & Environment (Inc&Env), assumes a more restrictive compliance with agri-environmental objectives needed for direct payment eligibility while maintaining the EU's CAP budget at its current nominal level. The second scenario, Liberalisation & Productivity (Lib&Prod), assumes a strong reduction in subsidies (the removal of Pillar 1 direct payments, which are returned to tax payers), with a shift of Pillar 2 payments to productivity-increasing measures and further trade liberalisation. As a variant of the Lib&Prod scenario, the No Policy (NoCAP) scenario also eliminates Pillar 2 payments, thus removing all budgetary support to agriculture.

## *Main findings*

The vulnerability of small farms, in particular in marginal areas of the EU, where agriculture (and its subsidies) is far more important economically than market income, has to be emphasised. The trade liberalisation scenarios reveal opportunities for some but risks for most agri-food sectors. Special attention must be paid to the complex relations, incentives and trade-offs of the different instruments, in particular regarding the environmental dimension. The objective of direct payments has to be clearly defined, as they still represent the largest share of the budget dedicated to agriculture and steer most of the sector's responses. If distributional aspects are key, then the target population needs to be better defined; if environmental performance is key, then conditionality has to be better designed.

The policy scenarios are assessed with regard to their impact on markets (production, demand, trade and prices), land use, the environment and farmer income from the global level to the farm level. The figure below summarises the impact of the three scenarios on agricultural production, farm income, greenhouse gas (GHG) emissions from the agri-food sector, nitrogen surplus, utilised agricultural area and farm jobs. Negative values show a reduction in these indicators under a given scenario and positive values an increase. While an increase in agricultural production and farm income are considered a positive outcome, an increase in GHG emissions and nitrogen surplus indicate a negative impact on the environment and the climate.

Overview of scenario impacts




The **Inc&Env scenario** shows only marginal changes for production, land use and emissions. The more pronounced focus of this scenario on the environment, implemented through extended greening measures and a limit on nitrogen use, is associated with a small, economy-wide cost, but contributes to an improving trend for agricultural nitrogen balance. However, the reduction of about 1% of the nitrogen surplus in this scenario compared with the reference is not sufficient to address the nitrogen balance problem in areas already in surplus. Under this scenario, farm income in the EU increases, but not its distribution, as measured by a Gini coefficient. Thus, key challenges related to the environment and a fair standard of living for farmers are only partly addressed, suggesting that even more stringent environmental and distributional conditions are needed to achieve those objectives.

The **Lib&Prod scenario** and its even more extreme variant, the **NoCAP scenario**, have a much stronger impact on farm income, land use, production and emissions. The decrease in agricultural production, leading to price increases in the NoCAP scenario, is within the limit of interannual variation, but is associated with a pronounced reduction in land use. This affects territorial balance, with marginal areas being further marginalised or, at worst, abandoned, possibly leading to environmental degradation, with fewer jobs, and intensive agricultural areas being further concentrated. Less production, in principle, reduces the overall use of resources and thus reduces environmental impacts like for example, GHG emissions. However, if GHG emissions decline in the EU, this decline is likely to be levelled out through the leakage effect, by which increased emissions occur in the other world regions to which production is shifted. Releasing land from agricultural uses could also provide an opportunity for the creation of carbon dioxide sinks, such as forests and other ecological areas, with important benefits for biodiversity. However, additional measures would be needed to ensure that abandoned land is indeed used to benefit the environment. While a reduction in nitrogen use could be seen as an environmental improvement, its reduction will not be homogenously distributed and might even lead to an increase in nitrogen use in some areas, which could increase the corresponding envionmental pressure.

Under both the Lib&Prod and NoCAP scenarios, there would be trade-offs between slightly reduced production, a mixed impact on the environment and a strongly negative impact on farm income. Beyond the structural job contraction common in baseline and all scenarios, most of the additional impacts on jobs will affect small farms in the net beneficiary countries, and would increase farm income inequality even more and put the resilience of many farms at risk. The scenarios show, also as a consequence of further trade liberalisation, that there would be an increase in the vulnerability of crop and cattle/beef farmers. As production decreases and consumption remains more or less constant, Europe would become a net importer of many commodities under these scenarios. This gives rise to concerns about the transfer of the positive and negative externalities associated with agricultural production to other world regions.

Finally, the aggregated welfare results are contingent on how effectively the funds released from agricultural policy are used for alternative public expenditure. Our analysis assumes that expenditure in other sectors will increase welfare.

## ■ *Key conclusions*

Designing an agricultural policy that tackles all of its societal objectives is a daunting task. At best, the policy will have to focus on key priorities and accept that trade-offs will have to be made with regard to others. An internationally competitive agriculture sector in Europe might come at the expense of increased environmental pressures or further job losses in the sector.

Despite the extreme nature of the scenarios chosen, some objectives would be only partly achieved. Further increasing the performance of agricultural policy in some areas would require even more far-reaching policies to be implemented, which might not be possible under the current institutional architecture.

The general caveats that apply to all modelling exercises (i.e. a simplified representation of reality, no forecasting models, high uncertainty, etc.) apply to this study.

Moreover, many of the concerns that surround the agricultural policy debate, such as generational renewal, value distribution along the food chain and structural change, cannot be captured in the model results and warrant additional investigation before any conclusions are made with regard to which policy option best meets them. In this context, expanding the analysis to a food systems approach could provide further insights into other impacts of the policy options.

## *Related and future JRC work*

During the course of this study, experiences have revealed repeatedly that the linkage of models is a challenge and, in some cases, the resulting improvement in the quality of the analysis is minor. Further research must be dedicated to identifying the areas in which investing in model linkage does in fact improve analytical capacity. Furthermore, the assumptions on key parameters (e.g. the impact on productivity of Pillar 2 payments) are crucial to identifying the magnitude of some of the shocks (while the direction of the shocks will not be affected). The JRC should also invest some additional resources in improving these parameters.

At the time of finalising this report, the main uncertainties about the future of the agricultural sector and its related policies stemmed from the early stages of discussions on the Multiannual Financial Framework 2021-2027 and Brexit negotiations. The JRC will continue to support the analysis of these topics using the tools described in this report.

# 1

# BACKGROUND TO SCENAR 2030

# 1 Background to Scenar 2030

## 1.1 | The CAP – an ongoing process of change

The Common Agricultural Policy (CAP) has come a long way since its inception in 1962. At that time, the focus was to design a system of incentives for agricultural production, which would put to rest the fear of European food shortages in the wake of the Second World War. On this barometer, the CAP was undeniably an unqualified success. By the 1980s, however, a very different Europe had emerged where peace and prosperity were commonplace and food self-sufficiency goals had been surpassed. In fact, Europe now faced a food problem of a different kind – surpluses and heavy storage costs. It became clear that this, now antiquated policy mechanism required a rethink to reduce food production and free up agricultural markets.

These changing needs of European society prompted a series of major reforms in the CAP. The earliest example was the reform of the milk sector in the mid-1980s, although it was not until 1992 that a whole package of reforms was introduced to control production through limits to essential inputs (i.e. set-aside and stocking limits). The reforms at the end of the 1990s under the auspices of 'Agenda 2000' introduced for the first time notions of rural livelihoods, environmental responsibility and sustainability. As a result, the hitherto traditional system of agricultural payments was clearly delineated into a market support pillar (Pillar 1) and rural development programmes (RDPs) (Pillar 2), which have formed the basis for administering payments to the present day.

In a further bid to control overproduction, increase market orientation and encourage sustainable production practices, the Mid-term Review Reforms in 2003 began the process of de-coupling support payments from output decisions, while ensuring that said payments became conditional upon maintaining land in a good agricultural and environmental condition and complying with good environmental, food safety and animal health practices. Under the 'Health Check' in 2009, this template of de-coupling was extended so that almost all remaining direct payment schemes and the milk quota were eliminated, greater flexibility was introduced to the process of transferring payments from Pillar 1 to Pillar 2 ('modulation'), and efforts were undertaken to further reduce the link between payments and production through the 'regionalisation' of support to Member States (MSs).

After the economic crisis of 2008-2009, the needs of European society shifted once again and were reflected in the reforms of the CAP, agreed in 2013 and enacted in 2015. Financial discipline came to the fore, while efforts were stepped up to provide a 'fairer' CAP that could both distribute payments more equitably within and across MSs ('convergence' criteria) and limit receipts to larger agricultural holdings ('degressivity and capping'). In a bid to tailor the CAP more to the needs of individual MSs, greater flexibility in allocating payments between pillars was granted. Furthermore, the Single Payment Scheme (SPS) was superseded by the Basic Payment Scheme (BPS). In addition to the income support component, 30% of the national envelope for Pillar 1 became explicitly tied to the provision of non-market or public environmental goods ('Greening'), while additional payments were linked to specific farmer status (e.g. young farmers, farming in areas with natural constraints (ANCs)).

The above discussion highlights the need for an evolving, multifunctional policy that can respond to the constantly changing needs of society. The CAP must meet market-efficiency and competitiveness criteria; be a motor of jobs and 'smart' growth; continue to aid the fight against climate change as an environmentally accountable policy measure; act (in tandem with other policies) as a custodian of responsible and sustainable biologically renewable resource management; and still respect its initial aim of ensuring food security.

Given the above, the design of post-2020 farm policy is once again under consultation and includes a wide range of policy options, from retaining the status quo to a radical reform. The European Commission President's commitment 'to modernise & simplify the CAP' is a guiding principle. Several high-level discussions[1] have already taken place, in particular under the Dutch Presidency of the Council of the European Union (EU) and the Cork 2.0 declaration on rural development. The stakeholder consultation and the Inception Impact Assessment (IIA) resulted in November 2017 in the Communication on the Common Agricultural Policy post-2020 "The future of food and farming"[2]. The Communication proposes simpler rules and a more flexible approach to ensure that the CAP delivers real results in supporting farmers and leads the sustainable development of EU agriculture.

The present report, in the tradition of the 'Scenar 2020' studies, contributes to the analysis of selected scenarios and provides a framework for further exploration of the process of designing the future CAP. The first edition of Scenar 2020 (Nowicki et al., 2007) was presented under the slogan 'Understanding Change'. The second Scenar 2020 report (Nowicki et al., 2009) focused on 'Preparing for Change'. As a result, the current, and in a way third, edition could be viewed as preparation for 'Performing Real Change'.

Scenar 2030 aims to identify major future trends and driving factors for European agriculture and rural regions, and the perspectives and challenges resulting from them. The use of a suite of economic simulation models allowed the construction of a well-founded and plausible reference scenario ('baseline') and different policy scenarios resulting in a comprehensive set of outcomes depicting economic, social and environmental indicators.

The Scenar 2030 preparatory work began in 2015, more than a year before the policy options were announced in the IIA. Therefore, of the three scenarios featured in the Scenar 2030 study, listed below, two scenarios related to contrasting policy options do not reflect the options announced in the IAA:

*Income & Environment (Inc&Env): farmers striking a balance between public and private goods.*

*Liberalisation & Productivity (Lib&Prod): low-cost farming in an open world.*

*No Policy (NoCAP): farming without a CAP.*

## 1.2 | Rationale for the methodological approach – the iMAP modelling platform

To provide the necessary sectoral and regional detail, the Scenar 2030 study draws from the **iMAP modelling platform** of the European Commission's Joint Research Centre (JRC) (M'barek et al., 2012; M'barek & Delincé, 2015), which hosts a set of complementary economic simulation models for the European agri-food sector. The iMAP platform supports evidence-based policy-making with economic analysis.

The Scenar 2030 study builds in particular on a JRC exploratory research project with initial results presented at the European Association of Agricultural Economists (EAAE) 2014 congress (Philippidis, et al., 2014), which led to the publication of a full report in spring 2016 (Philippidis, et al., 2016).

For the Scenar 2030 work, the multisector models described below were employed.

**MAGNET (Modular Applied GeNeral Equilibrium Tool)** (Woltjer & Kuiper, 2014) is a global neoclassical computable general equilibrium (CGE) model, whereby the standard core based on the Global Trade Analysis Project (GTAP) has been augmented with specialist modules tailored to the specific focus of the study, including endogenous land supply treatment, heterogeneous land allocation across agricultural sectors, explicit modelling of CAP policy, limited factor mobility between agricultural and non-agricultural subsectors, and biofuel mandates. The 'in-house' development of the model by JRC improved the representation of CAP support payments (Boulanger &

[1] The well-known blog 'CAP Reform' provides a page that brings together relevant contributions from political, think tank, academic, industry and non-governmental organisation (NGO) sources, as well as relevant blog posts on the post-2020 CAP discussions: http://capreform.eu/bibliography-of-proposals-for-cap-post-2020-nov-2016/.
[2] See http://ec.europa.eu/smart-regulation/roadmaps/docs/2017_agri_001_cap_modernisation_en.pdf for the IAA and https://ec.europa.eu/agriculture/sites/agriculture/files/future-of-cap/future_of_food_and_farming_communication_en.pdf for the Communication COM(2017) 713 final.

Philippidis, 2014; Boulanger & Philippidis, 2015) by fully capturing the MS allocation of expenditures across pillars and within each pillar (e.g. co-financing, rural development measures, coupled–de-coupled splits) using data from the Clearance Audit Trail System (CATS), which gathers details of all CAP payments made to the recipients of the EAGF (European Agricultural Guarantee Fund) and the EAFRD (European Agricultural Fund for Rural Development).

**The CAPRI (Common Agricultural Policy Regionalised Impact) model** (Britz & Witzke, 2014) is a global, spatial, comparative static partial equilibrium (PE) model, specifically designed to analyse CAP measures and trade policies for agricultural products based on a fully consistent dataset over different regional scales (global, European Union (EU), MS, NUTS (Nomenclature of Territorial Units for Statistics) 2 region, farm type). The CAPRI model is designed to analyse a wide range of policies and topics related to the agricultural sector, including agri–environment interactions.

**The IFM-CAP (Individual Farm Model for Common Agricultural Policy Analysis)** (Louhichi, et al., 2017a,b) is a micro-level farm model, specifically developed for the *ex ante* assessment of the short- to medium-term adaptation of individual farmers to policy and market changes. It allows a flexible assessment of a wide range of policies and simulates their distributional effects on farm population.

Over recent years, in addition to stand-alone applications, different tools of the iMAP modelling platform have been used in combination to deliver *ex ante* assessments of policy options. Notable examples are for biofuels (Blanco et al., 2010; using the models CAPRI, ESIM and AGLINK-COSIMO), EU–Mercosur trade (Burrell et al., 2011; using the models GLOBE and CAPRI), greening of the CAP (European Commission, 2016; using the models CAPRI and IFM-CAP) and free trade agreements (Boulanger et al., 2016a; using the models AGLINK-COSIMO and MAGNET).

A common feature of these studies is that various models are employed to provide different perspectives (a partial or general perspective) on a policy question, to include both the biophysical and the economic dimension of agriculture, and/or to further downscale results.

The selection of baseline drivers and the development of scenarios in Scenar 2030 were performed through a number of participatory workshops with several colleagues from the Directorate-General for Agriculture and Rural Development (DG AGRI) representing a broad range of expertise.

Although important efforts have been made to address in particular the empirical bases of the impact of policy measures, limitations exist and these are conveyed throughout the report. Indeed, the main caveat noted in the Scenar 2020 report continues to apply, namely that 'The reader is reminded that no scenario study can claim to present what *will* happen, but merely can portray what *may* happen. What is important afterwards is that these eventualities are debated, and that the necessary choices concerning the future of agriculture and the rural world are as fully informed as possible.' (Nowicki et al., 2007).

## 1.3 | Structure of the report

Chapter 2 explains the rationale behind the selection of drivers and describes the scenarios. Chapter 3 gives an overview of the models employed in the study and how relevant policies are represented in the models. Furthermore, it details a number of refinements that have been made to the parameterisation of the models. Chapter 3 elaborates on the model chain. Chapter 4 explains the design and implementation of the baseline (or reference scenario), including the relevant assumptions and how they interact with the narratives or storylines within each of the scenarios. Chapter 5 presents the results of the reference scenario.

Chapters 6 to 9 describe the results. Finally, chapter 10 provides a consolidated analysis.

In many places, the interested reader can find links to additional studies or material. This report is also accompanied by interactive infographics available under https://datam.jrc.ec.europa.eu/datam/mashup/SCENAR2030.

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# DEVELOPING DRIVERS AND SCENARIOS

# 2 Developing drivers and scenarios

## 2.1 | Drivers of the agricultural sector

The agricultural sector, with its multiple linkages to the biophysical and socioeconomic spheres, is a central element in the EU's strive to achieve long-term sustainable development. Several European policy initiatives and strategies affect and are affected by the agricultural sector and the CAP as illustrated in Figure 1.


**FIGURE 1:** THE CAP IN THE CONTEXT OF DIFFERENT EU AND INTERNATIONAL INITIATIVES.
*Source:* own presentation.

In the recent literature, the 'grand challenges' are exhaustively discussed and different pathways to more sustainable development are proposed (see, for example, EXPO 2015 EU Scientific Steering Committee, 2015; European Commission, 2015; IPES Food, 2015; Maggio et al., 2015; European Commission, 2016a; European Commission, 2016b; Hubeau, 2017).

For the present study, the identification and (in part) quantification of drivers were elaborated in 2016 during participatory workshops with experts from different units of DG AGRI in the preparatory phase of the modelling exercise. The decisions on whether or not to include/change specific drivers were also based on considerations of a time horizon of less than 15 years and, in some cases, more pragmatic concerns relating to the model's capabilities.

Concerning **environmental drivers**, the following aspects were considered:

- The impact of climate change on agricultural production: this could be a common trend for all scenarios. However, given that the main impacts are not expected until after 2030, the high degree of uncertainty as to what those impacts might be and that the focus of this study is on options for the CAP, climate change induced impacts were not included.

- Water availability for agriculture: a diminishing trend is anticipated, although within the period in question this impact is expected to be relatively limited. Indeed, this factor is directly linked to the uncertainty surrounding different potential climate change scenarios.

- Yield growth in the EU and the world: this should follow current trends with steady growth in the EU, while the rest of the world is likely to close the yield gap. The EU trend could foreseeably change in response to legislative alterations or the acceptance of genetically modified organisms. In broader terms, the question of yield is also linked to the development of factor productivity, i.e. the uptake of technological advancements. However, such issues are not considered in this study.

- Arable land: a continuation of a slightly decreasing or stable trend in land use in the EU is expected.

Concerning **economic drivers**, the following aspects were considered:

- Macroeconomic and demographic trends: these are expected to follow the most recently available official projections.

- Biomass use: this was seen as a central question. However, the knowledge base is not yet available. The JRC, mandated by several Directorate-Generals of the European Commission, is currently carrying out an assessment on EU and global biomass supply and demand and its (environmental, social and economic) sustainability (https://biobs.jrc.ec.europa.eu/page/biomass-assessment-study-jrc).

- Immigration: at the time of the preparation of this study, the so-called immigration crisis was culminating. For CAP options specifically, no important influence could be identified.

- The food budget as a proportion of the total budget: continuation of the current, slightly decreasing trend is expected.

- Structure of the agri-food supply chain: it is expected that more foreign and global players will intervene. The quantification of this, however, is difficult.

- Domestic agricultural policies outside the EU: generally, an increase in subsidies in China, India and other emerging countries is expected. The impact on trade is difficult to estimate. A further consideration is the need to recognise and include trade liberalisation agreements.

- Biofuel use: a renewal of the mandate in 2020 is not seen as a realistic option. An intermediate solution with the best available assumptions, as in the DG AGRI market outlook (December 2015), was agreed.

- Price of energy: given the price volatility in energy markets, this is difficult to gauge. The report should include several scenarios of energy price level.

Concerning **social drivers**, the following aspects were considered:

- Enlargement and development policies (Sustainable Development Goals (SDGs), food security): compared with the status quo, no changes are expected.

- Population dynamics in the EU: a continuation of growth pattern trends is expected. Whereas rural/urban demographic developments shall have only little impact on the food demand side, important implications are foreseeable for social issues.

- Social and redistributive policies: no implications for the CAP can be foreseen until 2030.

- Consumer preferences: this is seen as an important issue. Whereas the trend for increasing animal protein consumption worldwide is expected to continue, the EU might experience a slightly decreasing trend, with the prevalence of fish in the diet stagnating. Environmental or animal welfare legislation could also influence consumer preferences.

- Number of farmers in the EU: the current, strongly decreasing trend could slow down in response to specific policies. External factors, e.g. improved competitiveness in other countries, are also taken into account.

The outcomes of the driver analysis in the workshops were condensed and translated into a consistent reference scenario (baseline) framework and two alternative scenarios.

## 2.2 | Scenario narratives

A multitude of scenarios can be imagined. The focus of this study is on agricultural policies; however, taking a holistic perspective, to develop a framework for coherent policy-making, other influencing policies are also taken into account.

Comparing with a reference scenario, the three scenarios described below, developed jointly with various DG AGRI experts, take polar paths to characterise different visions for the CAP.

The third scenario ('NoCAP'), a variation of the second scenario ('Lib&Prod'), is described in the IIA as 'No policy', and is considered useful for demonstrating the EU value-added of the CAP.

### 2.2.1 Income & Environment: farmers striking a balance between public and private goods

This scenario presents an EU agricultural policy developed as part of a broader EU strategy, striving towards circular and sustainable development for Europe in 2030. Within this policy vision, the agricultural sector, as the primary custodian of land and environmental management, should ensure the sustainable use of natural resources in rural landscapes and the provision of wider public goods to society. Nevertheless, providing food and agricultural products continues to be a priority to ensure food and nutrition security in the EU and elsewhere. Therefore, the main aim of EU agricultural policy is to help farmers to find a balance between the provision of public goods and ensuring farm incomes from the market.

The equilibrium between providing public and private goods will differ between farms based on their individual characteristics: location, farm structure, resources available, etc. These individual characteristics translate into different farming practices, product typologies and qualities of public goods provision. This scenario requires farmers to make a rational assessment of their specific situations and decide what their individual preferences and abilities to provide private and public goods are, in order to ensure a fair income. For this to materialise, the policy design has to be flexible, targeted and conditional on farmer behaviour.

The key policy assumptions under this scenario are:

- The EU budget for agricultural policy is kept at the current level.
- The basic direct payment is substantially reduced and the process of both internal and external convergence is continued. This basic income layer requires that the farmer follow some basic practices (further elaborated good agricultural and environmental conditions (GAEC) and cross compliance).
- Additional direct payments can be provided to the farmer conditional on compliance with more stringent requirements (50% of current direct payment). Within the reality of the models, this translates into stronger greening requirements (crop rotation, 10% ecological focus area (EFA) without alternative practices and the maintenance of permanent grassland)
- Coupled support is minimised and is only justified if the production provides a specific public good. An example could be extensive livestock grazing to maintain grasslands in less productive areas.
- Price support measures (intervention and threshold prices) or supply management do not have a place in this scenario, as they target uniform bulk commodities where prices are a result of world markets and co-movement with other commodity prices.
- The reduction of direct payments and market measures allows a shift in the budget towards programmed policies and the current rural development measures.
- Farmers in areas with high natural value or natural constraints receive an extra payment. However, this payment is conditional on the farming practices providing a service to the area. It should not lead to the maintenance of the resource damaging production systems in those areas.

- Strong Pillar 2 support is given towards:[3]
  - agri-environmental and climate change measures;
  - investment in human capital;
  - investment in physical capital: investment should contribute either towards the development of value-added production or the provision of public goods; investment support should not be targeted at substituting resources, i.e. labour for capital.
- Trade policies follow a status quo. The EU preference is to advance multilateral trade agreements, as they also look at other aspects such as domestic support for agriculture. Further free trade area agreements, where the focus is solely on market access, have little value for the EU, as it is not interested in commodity goods entering the EU market. However, progress is made on sanitary and phytosanitary m*easures* and non-trade barriers (NTBs) as they ensure that imports are in line with EU consumer demands and ensure that EU value-added products have access to third countries.
- Given the EU push towards a circular and sustainable economy, environmental policy is stringent. This will result in strong greenhouse gas (GHG) emission reduction targets for all economic sectors including agriculture.
- Biofuels based on agricultural products are not actively supported in this scenario following the incorporation of indirect land use change (ILUC) values and GHG emissions into EU energy legislation.

### 2.2.2 Liberalisation & Productivity: low-cost farming in an open world

The Lib&Prod scenario presents an EU agricultural policy focused on providing quality agricultural commodities and food in a globally competitive market. As a result, the EU should become a key player in ensuring food and nutrition security throughout the world. The agricultural sector is treated the same as most other sectors of the economy in that it is forced to focus on competitive products and gain its income solely from the market. In this scenario, it is assumed that the EU's agriculture-specific market support policies will be abolished by 2030. The remaining policies mainly focus on ensuring a competitive and innovative sector by targeting investment and the restructuring of the sector. Market competitiveness is achieved by lowering costs and optimising economies of scale. Farmers, subject to available physical and labour endowments, pursue greater market orientation by focusing on those products demanded by the global market.

The volatile nature of agricultural commodity markets, determined by unforeseen climatic events and animal diseases, and a strong co-movement with general commodity markets, means that farmers are exposed to price and income fluctuations. Therefore, a system is needed to ensure that farmers can continue to operate under such market disruptions. This safety net should support farmers in bad years and be financed by farmers in good years. Because of asymmetric information issues and the systemic risk of such schemes, a policy to support the setup of such an EU-wide income stabilisation tool seems needed.

The key policy assumptions under this scenario include:

- The abolishment of the direct payment scheme. This includes both the basic payment and the conditional greening part of the payment.
- Coupled production support is abolished.
- No supply management of price support measures are foreseen. The markets should regulate themselves to ensure an equilibrium between demand and supply
- The RDP is drastically reduced. Some measures are maintained and other schemes would complement the current system:
  - support to young farmers to start or assume control of a farm, to ensure restructuring in the sector;

[3] In the MAGNET model, all Pillar 2 measures are classified under five categories: agri-environmental, LFAs, investment in physical capital, investment in human capital and other measures.

- investment support to modernise the chain and realise economies of scale;
- investments in human capital to ensure a well-educated, versatile farmer population.

- To be globally competitive, the EU takes a strong step towards the liberalisation of its markets. Significant progress is made in bilateral trade agreements ensuring increased market access for export-oriented products and access to cheap inputs and commodities.
- Multilateral trade negotiations are not only expected to advance market access, but would also fit with the view of EU agricultural policies.
- Climate policy will be a reality by 2030. Binding GHG emissions targets will be set for the different economic sectors. However, the impacts on EU agriculture may be moderate, as some of the GHG-intensive sectors (livestock) might decrease in this scenario, while the modernisation of the sector will ensure that the most efficient technologies are used.

### 2.2.3 NoCAP: farming without a CAP

This scenario is a variant of the Lib&Prod scenario. In addition to the removal of Pillar 1 payments, all Pillar 2 payments are also eliminated. The assumptions guiding trade policy are identical to those in the Lib&Prod scenario.

The IIA describes this option as follows: 'Option 2 (no policy) while dismantling CAP would not be in line with the Treaty, hence not realistic nor desirable, this scenario is considered nonetheless useful in demonstrating the EU value-added of CAP as well as the economic, social and environmental impact of the absence of an EU-wide policy intervention.'

3

# THE METHODOLOGICAL **APPROACH OF SCENAR 2030**

# 3 The methodological approach of Scenar 2030

The scientific literature (e.g. IPES Food, 2015), policy-oriented research (e.g. EXPO 2015 EU Scientific Steeering Committee, 2015; Maggio et al., 2015; European Commission, 2016b) and policy-makers (European Commission, 2016a) stress the need for a system-based approach.

The final paper on a strategic approach for EU agricultural research and innovation elaborates on socioeconomic research and support for EU policies:

'The system-based approach requires socioeconomic research to be embedded in all relevant research and innovation activities. Indeed socioeconomic research is critical to the design and implementation of efficient and effective policies affecting rural territories and food and non-food systems. This concerns a range of policies, not just the CAP, and requires attention at various levels (e.g. both by individuals and society; from local to global, from sectoral land use to integrated landscape management). In addition, research has a strong role to play in contributing to the development of the analytical tools and models which are necessary for assessing the EU policies concerned. In view of the various objectives that apply to policies targeting agriculture, forestry and rural economies and societies at large (environmental, economic and social objectives), it is important that these analytical tools and models are able to cover a large range of issues at various geographical scales. This may necessitate a greater integration of models and data. Socioeconomic research needs to be harnessed to assess the economic sustainability of the various activities relevant in rural areas, including farming and forestry activities, taking due account of the social and environmental dimensions. The development of suitable standards to measure, assess, monitor and ensure a healthy functioning of the food or non-food supply chains need to be given due attention.' (European Commission, 2016b, p. 31).

The approach selected in Scenar 2030 acknowledges these requirements and addresses many of the challenges raised.

The use of three different models (MAGNET, CAPRI, IFM-CAP) allows the inclusion of a wide range of factors while connecting global markets to individual farms (see section 3.1). All models were updated and equipped with the requested policy modules.

The use of partial equilibrium (PE) and CGE models enables the inclusion of different policies that influence the development of the agricultural sector (see section 3.2).

Section 3.3 discusses a number of observations and caveats that the reader should be aware of when interpreting the results from simulation models.

A major effort was undertaken to improve the model parametrisation. This is crucial to enable the model calculations to be based more on empirical evidence, e.g. through econometric estimations, updated literature searches and consultation with experts.

Broadly speaking, the connection of models can be performed either through 'soft-linking' or 'hard-linking'. Some advancement in soft-linkage has been made in harmonising model outlooks through assumptions and calibration to the projections of agricultural markets. Further improvements focusing on hard-linkages are ongoing and should be implemented only after a careful assessment. Section 3.4 and the annexes provide further discussion of these topics.

It should be noted that, throughout Chapter 3, a number of insights and links to several scientific studies by well-known researchers are provided which look at further developing the data and modelling tools for Scenar 2030 and upcoming studies.

## 3.1 | Models used

### 3.1.1 MAGNET

MAGNET (Woltjer & Kuiper, 2014) is a multiregion CGE model which is a derivative of the well-known GTAP model. It is developed and applied by Wageningen Economic Research (WECR) at the University of Wageningen and is also employed by the Thünen Institute (TI) and the JRC. MAGNET has been recently used at the European Commission (JRC) for an economic analysis on the cumulative effects of trade agreements on the EU agricultural sector (Boulanger et al., 2016a) as well the bioeconomy (Phillipidis et al., 2016). In 2015 the grounds for modelling the CAP with MAGNET were developed (Boulanger & Phillipidis, 2016).

As a GTAP model derivative, MAGNET is calibrated to the GTAP Version 9 database with 2011 as a reference year (Aguiar et al., 2016). The GTAP database describes production, use and international trade flows of goods and services, as well as primary factor use differentiated by sectors. The GTAP database distinguishes 140 countries or regions (among them the 28 EU MSs), 57 sectors and 5 factor endowments. It is based on country input–output tables and includes consistent bilateral trade flows, transport and protection data. Additional datasets are used for specific MAGNET modules to make the analysis richer. The sources of these datasets include the International Energy Agency (IEA), the Food and Agriculture Organization of the United Nations (FAO), the United States Department of Agriculture (USDA) and the CATS database for CAP analysis. The choice of regions[4] and sectors[5] from the database can be flexibly aggregated to set up a model version specific for the problem in question.

By construction, quantities and values in neoclassical CGE models are equal in the benchmark year because of the assumption that prices in the model are normalised to 1. CGE models employ convenient functional forms which are typically linearly homogenous (homogeneous of degree 1), which implies that quantity changes remain invariant to changes in the general price level. In the absence of any 'money illusion', it means that standard neoclassical CGE models typically provide very little insight about the role of financial markets. Hence, the focus of these model is on how movements in relative prices affect resource allocations, output and income flows within the economy. Keeping this in mind, one can quantify CGE model results as changes either in quantities or in values. The former would ignore the effects of changes in relative prices due to changing demand and supply conditions. The latter, on the other hand, would reflect the changes in values and prices together.

Within this class of mathematical market simulation models, MAGNET consists of a system of three types of equations. First, 'behavioural equations' employing 'convenient' mathematical functions represent, under conditions of constrained optimisation, the theoretical tenets of neoclassical economic demand and supply. Subject to a series of 'market clearing' (i.e. supply equals demand) and 'accounting' equations (i.e. income equals expenditure equals output; zero 'economic' profits), and consistent with the underlying accounting conventions of the database, the model enforces 'equilibrium'. To solve the model, the number of equations and (endogenous) variables within the system must be the same (known as the model 'closure'). Additional variables under the direct control of the modeller (defined as 'exogenous'), which capture market imperfections (tax rates), factor endowments or technological change, can be manipulated or 'shocked', whereupon the model finds a new matrix of prices and quantities to arrive at a post-shock equilibrium subject to the aforementioned accounting and market clearing restrictions.

A key strength of the MAGNET model is that it allows the user to choose *a la carte* those sub-modules of relevance to a specific study. The user can (inter alia) choose between different nesting structures; apply different assumptions about the workings of the factor markets; include different agricultural, trade and biofuel policy mechanisms; and incorporate dynamic assumptions relating to investment allocation over time.

To characterise the peculiarities of agricultural markets, the model accounts for the heterogeneity of land use by

[4] https://www.gtap.agecon.purdue.edu/databases/regions.asp?Version=9.211.

[5] https://www.gtap.agecon.purdue.edu/databases/v9/v9_sectors.asp.

agricultural activity; a regional endogenous land supply function; the sluggish mobility of capital and labour transfer between agricultural and non-agricultural sectors with associated wage and rent differentials; the inclusion of explicit substitution possibilities between different feed inputs in the livestock sectors; and additional behavioural and accounting equations to characterise EU agricultural policy mechanisms (e.g. production quotas, the Single Farm Payment (SFP), coupled payments, rural development measures) (Boulanger & Philippidis, 2015).

The results of the MAGNET model are typically presented in value terms or in price and quantity percentage changes. The MAGNET model compiles a large number of indicators, in particular related to production, trade flows, consumption, use of endowments, intermediate input use, income and price changes, land use, emissions and employment. An overview of the standard GTAP variables can be found here: https://www.gtap.agecon.purdue.edu/models/setsVariables.asp.

As an additional tool of analysis, this study draws on the GEMPACK **decomposition method** known as '**subtotals**' based on the pioneering work of Harrison et al. (2000). More specifically, on running a complex scenario with an array of shocks (i.e. endowments, tariffs, technology change, etc.), it is possible to calculate the part-worth of the resulting endogenous variable change that corresponds to a specific exogenous shock, or pre-specified group of exogenous shocks. Thus, when comparing each of the scenarios with the reference scenario, the comparative 'part-worth' importance of the four policy indicators is evaluated in order to better understand the role that policy has to play (if any) in shaping bio-based market trends.

### 3.1.2 CAPRI

The CAPRI modelling system is a comparative static PE model for the agricultural sector developed for policy and market impact assessments from global to regional and farm-type scales. The model has been used for the *ex ante* impact assessment of various agricultural, environmental and trade policy options. Typical model results include simulated impacts on agricultural production, trade, commodity prices, and producer and consumer welfare, as well as environmental indicators, calculated in a consistent modelling framework. Examples of relevant model applications include the first Scenar 2020 study (Nowicki, et al., 2007), the assessment of the impact of the CAP 'Health Check' reforms on the dairy sector (Witzke et al., 2009), the assessment of the impacts of a possible EU–Mercosur trade deal (Burrell et al., 2011), the analysis of the effects of the expiry of the EU sugar quota system (Burrell et al., 2014), an examination of agriculture in the context of climate change mitigation (Van Doorslaer et al., 2015) (Pérez Dominguez et al., 2016) and an assessment of the impacts of CAP greening measures (Gocht et al., 2017).

The following brief description of CAPRI is based on the most recent CAPRI documentation (Britz & Witzke, 2014). More details are available (including the list of commodities and geographical coverage) on the CAPRI web page (www.capri-model.org).

The core of the CAPRI modelling system consists of European-focused template[6] models for primary agricultural supply linked to a spatial multicommodity model for global agri-food markets. The supply models are independent, non-linear programming models covering the EU, Norway, the Western Balkans and Turkey. They represent the major agricultural production activities at regional level[7] (Gocht & Britz, 2010). The programming models follow a positive mathematical programming (PMP) approach (Howitt, 1995; Heckelei et al., 2012) that combines linear cost terms for variable inputs with non-linear cost terms capturing the effects of labour and capital on farmers' decisions, and allowing perfect calibration. The non-linear cost function allows perfect calibration of the models and a smoother simulation response than linear approaches. Each regional programming model optimises the profit of the representative farm under restrictions related to land availability, nutrient balances for cropping and animal activities, and, if applicable, policy obligations. Decision variables of the profit maximisation models include crop areas, herd sizes, fertiliser application rates, irrigated water use and a cost-effective feed mix. With

[6] The supply models for all regions or farm types are structurally identical; differences are due to parameterisation.

[7] Regional level refers to NUTS2 under the Classification of Territorial Units for Statistics. Currently CAPRI has 225 regional aggregate programming models for the EU-28.

respect to policy implementation, the CAP is depicted in great detail in the regional supply models (including both Pillar 1 and Pillar 2 instruments). Direct payments are linked to specific production activities, while a number of rural development and agro-environmental subsidies are linked to agricultural land. Prices are exogenous to the supply module; they are updated and provided by the global market module in each iteration.

The global market module is a multiregional and multicommodity model for about 60 primary and processed agricultural products, covering about 80 countries/country blocks, which are organised into 40 trading blocks. The market module is a squared system of equations consisting of behavioural equations representing supply and demand for primary agricultural and processed commodities (including human and feed consumption, biofuel use and import demand from multilateral trade relations), balancing constraints and model-endogenous policy instruments (e.g. tariff rate quotas). Agricultural land is identified as a specific production factor, and total utilised agricultural area (UAA) is assumed to be an equilibrium between land demand for production activities and potential land supply, taking into account estimated land buffers. Import demand is modelled following the Armington approach (Armington, 1969); products are differentiated by place of origin, allowing the simulation of bilateral trade flows and the calibration to simultaneous imports and exports (cross-hauling) of the same commodity that is often observed in trade statistics. Bilateral import prices are derived by taking into account trade policy measures at the border, such as tariffs, tariff-rate quotas (TRQs), variable levies and the entry-price system for fruits and vegetables. Some further market measures, such as public intervention and export subsidies, are also implemented. The market module of CAPRI delivers (equilibrium) commodity prices for the supply module, and allows global market effects on the EU and national scales to be pinned down.

The CAPRI system features an agricultural database on EU and other European countries compiled mainly from Eurostat datasets and made consistent with the model structure, named CoCo (for complete and consistent). CAPRI includes a routine to break down CoCo consistently to the regional (NUTS 2) and farm-type levels, named CAPREG. The database of the global CAPRI market model is mainly based on FAOSTAT datasets on market balances and international trade, extended with trade statistics from COMEXT and UN-COMTRADE. Global trade policies for non-EU countries are mainly calibrated to the MAcMap-HS6 data of the International Trade Centre (ITC). Other important data sources include the Organisation for Economic Co-operation and Development (OECD), the Farm Accountancy Data Network (FADN) and the CORINE Land Cover databases.

CAPRI also takes advantage of projections derived by other simulation models. The AGLINK-COSIMO model of the OECD and FAO provides inputs for the development of agricultural and food commodity markets. PRIMES provide information on the development of bioenergy-related agricultural production at the national level. GLOBIOM provides vital information on the costs of GHG mitigation technologies in agriculture.

With regard to the behavioural parameters, the regional/farm-type supply response is technically defined by the PMP calibration approach which builds on time series data on land use, price and cost developments (Jansson & Heckelei, 2011). The parameters of the global market model are synthetic, i.e. to a large extent taken from the literature and other modelling systems, but consistency with microeconomic economic theory (e.g. homogeneity conditions, correct curvature) is ensured by several elasticity calibration routines.

Following a comparative static approach for impact assessment, CAPRI requires a comparison point, a so-called baseline, against which the counterfactual scenarios are evaluated. The baseline is in fact a projected equilibrium state of the economy. For medium-term baselines, the price-quantity structure of the model is calibrated to the annual report 'Medium-term prospects for EU agricultural markets and income' of the European Commission (DG AGRI, 2015). To produce longer-term baselines, as was done for this study, trend estimations and other model projections also need to be exploited.

### 3.1.3 IFM-CAP

The IFM-CAP model is designed for the economic and environmental analysis of the European agricultural systems at the farm level. Rather than to provide forecasts or projections, the model aims to generate scenarios — or "what if" — analyses. It simulates how a given scenario, for example a change in prices, farm resource, or environmental and agricultural policies might affect a set of performance indicators important to decision makers and stakeholders. Performance indicators include, among others, changes in crop allocation, input use, crop and animal production, farm income, livestock density and CAP expenditures.

The IFM-CAP is a PMP model, which builds on the EU-FADN data, and is complemented by other relevant EU-wide data sources such as Eurostat, the Farm Structure Survey (FSS), the CAPRI database, etc. In order to achieve the best representativeness and to capture the full heterogeneity of the EU farm, all farms represented in the FADN sample in the year 2012 (around 80,000 farms) are individually modelled (Louhichi et al., 2017a, b).

The IFM-CAP model distinguishes 53 activities.

Crop activities (38): soft wheat, durum wheat, rye and meslin, barley, oats, grain maize, other cereals, rape, sunflower, soya, other oilseed, other industrial crops, nurseries, flowers, other crops, new energy crops, fodder maize, fodder root crops, fodder other on arable land, permanent grassland, rough grazing, rice, olive, pulses, potatoes, sugar beet, flax and hemp, tobacco, tomatoes, other vegetables, apples pears and peaches, other fruits, citrus fruits, table grapes, table olives, wine, fallow land, set aside.

Animal activities (15): dairy cows, male adult fattening, heifers fattening, suckler cows, heifers raising, calves male fattening, calves female fattening, calves male raising, calves female raising, pig fattening, sows, sheep and goats for milk production, sheep and goats for fattening, laying hens, poultry fattening.

**Data:** the primary data source used to parameterise the IFM-CAP is individual farm-level data from the FADN database (FADN, 2015) for the period 2007-2012. The FADN data are complemented by other external, EU-wide data sources such as the FSS and CAPRI databases for variables not available in FADN (Figure 2). However, most of these external data are not directly used in the model but used as inputs in the estimations. All farms represented in the FADN sample in the year 2012 (around 80,000 farms), used as the base year, are included in the model. However, in order to improve the model parameterisation, past observations (2007-2012) on yields, prices and input unit costs for these farms are also exploited (e.g. to construct price expectations).

**Dynamics:** as the IFM-CAP is a comparative static supply model that does not take into account the dynamics of market developments and market interlinkages (price feedback), the baseline construction relies on an external baseline. We use the CAPRI baseline to construct the IFM-CAP baseline for the year 2030, taken as the time horizon for running policy simulations.

To construct the IFM-CAP baseline, three assumptions are adopted: (1) a continuation of the current CAP up to 2030; (2) an assumed inflation rate of 1.9% per year for input costs, as for the CAPRI baseline; and (3) an adjustment of baseline prices and yields using growth rates from the CAPRI baseline. As the CAPRI growth rates of yields and prices are defined at NUTS 2 level, we impose the same growth rate on all farms belonging to the same NUTS 2 region. It is assumed that all the other parameters (e.g. farm resource endowments and farm weighting factors) will remain unchanged up to 2030. The generated baseline is used as a reference point for the comparison of the effects of the scenarios.

This harmonisation of the IFM-CAP baseline with the CAPRI baseline ensures a relatively similar starting point for subsequent scenario analyses. However, despite this harmonisation, the simulated effects may not always be the same, as both models differ in a number of methodological aspects. For example, the IFM-CAP assumes a fixed supply of agricultural land, whereas CAPRI allows for changes in the total agricultural land. CAPRI features an upwards-sloping land-supply curve, which allows for land leaving and entering the agricultural sector in response to relative price or policy changes. Other methodological differences between the IFM-CAP and CAPRI include farm-level implementation of polices versus regional-level implementation of policies, and baseline simulation versus baseline calibration, for the IFM-CAP and CAPRI, respectively. These methodological differences between models might lead to different responses of the IFM-CAP and CAPRI to the policy changes simulated in this report.

**Indicators:** the IFM-CAP generates a set of indicators covering land use, animal numbers, production, farm income, farm utility, etc. (Figure 2). These indicators can be reported at different aggregation levels, from MS and farm-type levels up to distribution across the farm population.

Recently, the IFM-CAP has been used for the following policy assessments:

- to assess the economic impacts of crop diversification measures (Louhichi et al., 2017a);
- as a contribution to the European Commission Staff Working Document 'Review of greening after one year' (European Commission, 2016c);
- Economic Impacts of CAP greening: An application of an EU-wide Individual Farm Model for CAP analysis (IFM-CAP) (Louhichi et al., 2017b).

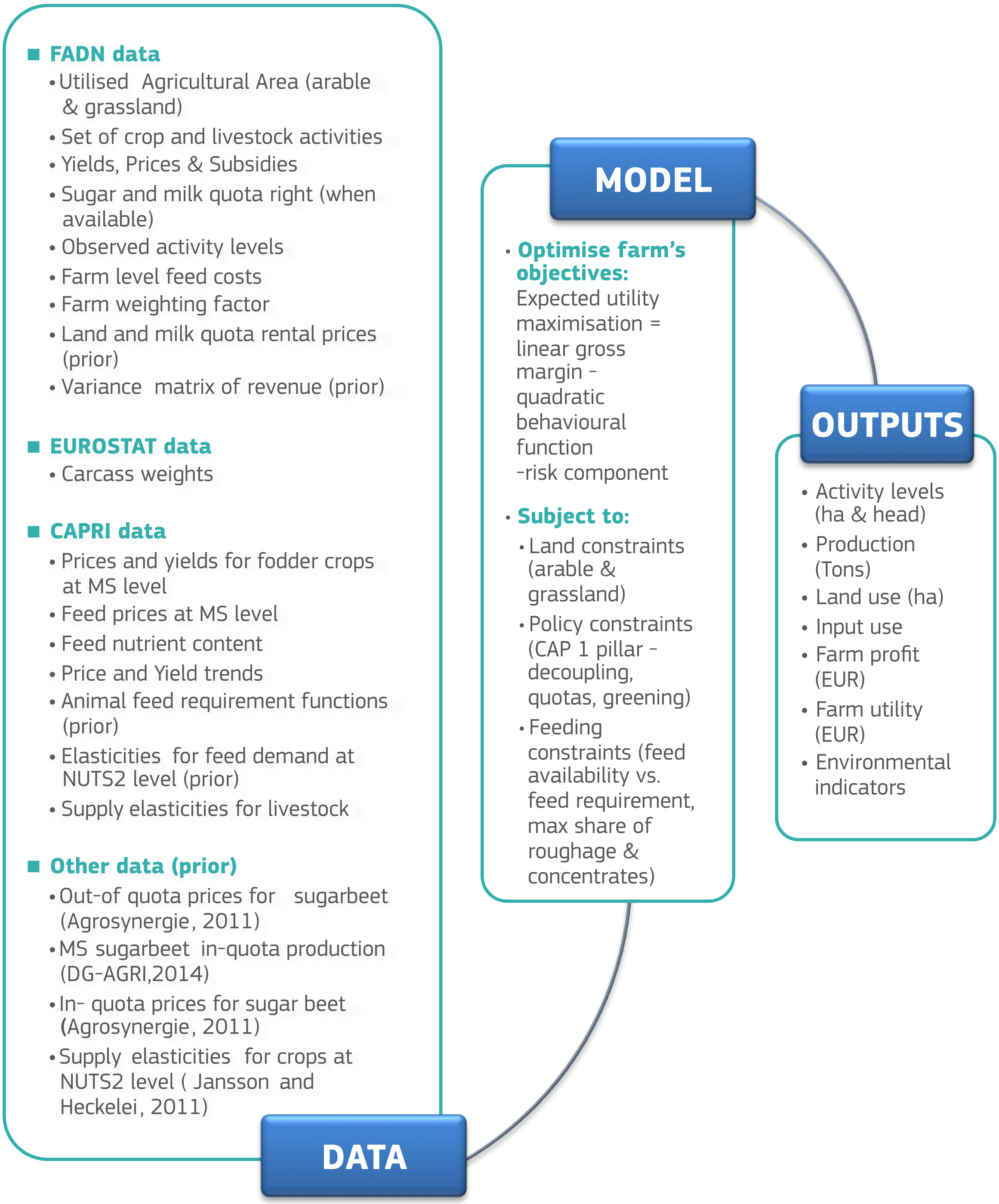



**FIGURE 2:** IFM-CAP DESCRIPTION.
*Source:* own presentation.

# 3.2 | The representation of policies in the models

## 3.2.1 Overview

The models represent the policies' details in different ways. Table 1 provides an overview of the policies covered by the three models.

| CAP – direct payments | MAGNET | CAPRI | IFM-CAP |
|---|---|---|---|
| Decoupled payment allocation | Subsidy to land, capital and labour | Subsidy to land | Subsidy to land |
| SFP model: from historical to regional system | ✓ | ✓ | ✓ |
| SFP entitlement value convergence, within MSs | | ✓ | ✓ |
| SFP entitlement value convergence, between MSs | ✓ | ✓ | ✓ |
| Transfers between pillars | ✓ | ✓ | ✓ |
| Redistributive payment Pillar 1, i.e. top-up to basic payment | | ✓ | ✓ |
| Capping | ✓ | ✓ | ✓ |
| Voluntary coupled scheme | ✓ | ✓ | ✓ |
| Green payment – crop diversification | ✓ | ✓ | ✓ |
| Green payment – permanent grassland | ✓ | ✓ | ✓ |
| Green payment –ecological focus area (EFA) | ✓ | ✓ | ✓ |
| Young farmer scheme | | | |
| **CAP – market measures** | | | |
| Sugar quota (including C sugar) and quota expiry | ✓ | ✓ | ✓ |
| Isoglucose quota | | ✓ | |
| Dairy quota | ✓ | ✓ | ✓ |
| Intervention and threshold prices | | ✓ | |
| Export refunds | ✓ | ✓ | |
| **CAP – rural development policies** | | | |
| Area with natural constraints (ANC) | ✓ | ✓ | |
| Agri-environmental measures | ✓ | ✓ | |
| Investment measures (physical and human capital) | ✓ | | |
| Other | ✓ | | |
| **Other policies** | | | |
| Climate change policies | ✓ | ✓ | |
| Biofuel policies | ✓ | ✓ | |
| Trade policies | ✓ | ✓ | |

**TABLE 1:** OVERVIEW OF THE POLICIES COVERED BY THE THREE MODELS
*Note:* Complementary National Direct Payments are modelled in CAPRI and IFM-CAP.

## 3.2.2 Common Agricultural Policy

The future evolution of the CAP is a key factor for the development of the scenarios mentioned above. In general, all three models represent the national implementation of the CAP. Agricultural policy that is sourced directly from national governments (vis-a-vis the central EU budget) is only represented in the MAGNET model using the OECD's Producer Support Estimate (PSE) at MS level.

### MAGNET

The JRC has improved the representation of the CAP in the MAGNET model (Boulanger & Philippidis, 2014; Boulanger & Philippidis, 2015), fully capturing the allocation of all CAP expenditures, using data from CATS, which gathers details of all CAP payments made to the recipients of the EAGF and the EAFRD.

Pillar 1 expenditures are represented by both coupled and decoupled payments. In the case of decoupled support (including greening payments), payments can be assigned exclusively and uniformly to land (this guarantees that the payments are fully decoupled) or allocated to more than one production factor according to pre-specified coupling factors. Remaining payments (i.e. coupled direct payments, market measures, additional direct transfers, other EAGF payments, agri-monetary transfers) are linked to their specific output-, input- and endowment-subsidy variables in each agricultural activity.

There are five classes of Pillar 2 payments: (1) investment in human capital (vocational training, assisting young farmers, use of advisory services, etc.); (2) investment in physical capital (modernisation of agricultural holdings, infrastructure investments, adding value to agricultural and forestry products, etc.); (3) agri-environmental payments (Natura 2000 payments, forest-environment payments, etc.); (4) less favoured areas (e.g. payments to farmers in mountainous areas); and (5) wider rural development schemes (diversification into non-agricultural activities, encouragement of rural tourism, village renewal and development, etc.). By their nature, 'agri-environmental schemes' and 'least favoured areas' are almost completely tied to the land factor, while other Pillar 2 measures are linked (in varying degrees) to land, capital, both labour types and intermediate inputs based on the aims of the policies and discussions with experts. Concordance between 2007-2013 and 2014-2020 Pillar 2 measures is not straightforward given (1) changes in the scope of measures, (2) the existence of sub-measures, and (3) the setup of new measures. In the appendix, based on current 2007-2013 measure classification/breakdown in MAGNET (Tables A.1 and A.2) and latest EU regulations, breakdowns of 2014-2020 RDP measures by MAGNET categories and by GTAP subsidy wedges and payment classification are proposed in Tables A.3 and A.4, respectively.

In terms of endogenous CAP payment-induced productivity effects, agro-environmental schemes and greening payments have land endowment productivity-inducing effects (positive and negative, respectively). Investments in physical capital are posited to lead to increases in productivity in agricultural capital, while investments in human capital are assumed to increase productivity in agricultural labour.

From the perspective of the own resources of the budget, 75% of each EU MS's tariff revenue is collected (the remaining 25% is assigned to administrative costs), while the proportion of this tariff revenue that finances the 'CAP budget' is extrapolated based on the CAP's share of EU budget expenditure. In line with the European Council Agreement of February 2013, from 2014, in addition to the Netherlands and Sweden, Denmark has also received an (exogenous) annual lump sum transfer payment. The cost of these intra-budgetary transfers is met endogenously by the remaining MSs as a function of their value share of EU gross domestic product (GDP). Further equations are used to account for the United Kingdom (UK) rebate and subsequent corrections for other MSs. In accordance with the EU budgetary agreement, the UK rebate is calculated as 66% of its net contribution. The (negative) value of rebates for remaining EU Member States (MSs) is assigned to other EU MSs by their GDP-value shares of the UK rebate. This calculation has been modified, however, to account for the fact that Austria, Germany, the Netherlands and Sweden pay only 25% of their GDP-share contribution to the UK's rebate, which is compensated for by the remaining EU MSs in proportion to their EU GDP value shares. Additional switch variables are employed to incorporate Croatia within the CAP budget's own resources, the UK rebate and subsequent MS correction mechanisms.

Common Market Organisation instruments, such as quotas for milk and sugar production, are taken into account even though not directly modelled. In MAGNET, EU-28 milk and sugar production are tied to AGLINK. Because no comprehensive data are available on quota-constrained changes for each and every MS, they are not explicitly modelled.

## CAPRI

The implementation of the latest post-2014 CAP reform in the CAPRI model implies changes in terms of both the budget and applicable policy measures. The interaction between premium entitlements and eligible hectares for the newly established BPS, Single Area Payment Scheme (SAPS) and other payments remains explicitly considered. For the CAPRI baseline, it is assumed that MS decisions/notifications will not change after 2015.

The current CAPRI version explicitly covers those Pillar 1 direct support measures of the CAP that can be implemented at the national or regional level, such as national ceilings for direct payments, basic payments or single area payments, and voluntary coupled support (VCS). This level can be covered by CAPRI at NUTS 2 level. The specificity of the basic payment in terms of its dynamic implementation and the target option (regional, flat-rate or 'tunnel' model) is also captured. VCS is explicitly modelled by assigning the payments to activities eligible for that particular type of support. Decoupled area payments are allocated to eligible-for-payments land and hence afterwards are attributed to agricultural activities. Measures that need to be implemented at farm level, e.g. payment for agricultural practices beneficial to the climate and the environment (so-called green payments), are captured by application of the Shannon index calculated in the CAPRI farm module. The shares accounted for by EFA and permanent grassland as well as crop diversity requirement are considered. Voluntary redistributive payment is implicitly covered in the underlying market projections (European Commission, 2015) as well as by allocating part of the envelope, which will, however, be treated as the basic payment and not made explicit, since this would require the use of the CAPRI model at farm level. The young farmers' payment, the small farmers' scheme, the reduction of higher payments in cases where redistributive payment for first hectares is applied, and areas with natural constraints are modelled in a similar way to basic payment.

The Pillar 2 agri-environmental measures, including in relation to areas with natural constraints and Natura 2000 payments, are implemented as area payments, and the share of envelopes is assumed to remain the same, as for similar measures in the previous policy planning period.

The Common Market Organisation instruments – tariffs and tariff rate quotas – are maintained at the current implementation level or schedule, unless new trade agreements have already been concluded.

## IFM-CAP

The IFM-CAP models all major Pillar 1 measures of the 2013 CAP reform. This includes both coupled and decoupled direct payments. However, neither the young farmer scheme nor the small farmer scheme are modelled in IFM-CAP because of data limitations. Rural development measures are also not modelled in the current version of the IFM-CAP.

Following the 2013 CAP reform, the IFM-CAP takes into account the transfer of funds between direct payments (Pillar 1) and RDP (Pillar 2), as well as the external and internal convergence of the direct payments. The modelling of direct payments takes into consideration MS heterogeneity in the implementation of the policy.

For decoupled payments, the IFM-CAP considers the following policy elements:

- *Entitlements*: the IFM-CAP considers the maintenance of the pre-reform entitlements or the allocation of new entitlements depending on the actual implementation by a given MS.[8] The entitlements are defined based on the 2012 base year data for which the IFM-CAP is calibrated.

- *Internal convergence of decoupled payments (convergence within MSs)*: this concerns MSs that implemented the historical model or the static hybrid model prior to the 2013 CAP reform. Other schemes allocated flat-rate payments prior to the reform (i.e. SAPS, a regional model or a dynamic hybrid model that moved to a flat rate) and thus are not subject to the convergence requirements. The IFM-CAP applies full convergence or partial convergence of decoupled payments depending on the actual implementation in a given MS. This implies that the entitlement values are heterogeneous across IFM-CAP farms within MSs that apply the partial convergence of decoupled payments.

- *Redistributive payment*: the redistributive payments were considered in the IFM-CAP. In empirical terms, the entitlement value of each farm is adjusted by the value of the redistributive payment.

- *CAP greening*: the IFM-CAP models the greening payment (30% of the total direct payment) and all three greening measures (crop diversification, maintenance of permanent grassland and EFA). The implementation of greening restriction is compulsory and farm specific.

[8] Note that there are several implementation restrictions that MSs could choose when allocating entitlements. For example, for the first option, MSs could impose an additional restriction that the number of entitlements does not exceed the eligible area in 2015. For the second option, MSs could limit the allocated entitlements to the minimum between the eligible area in 2013 and the declared eligible area in 2015. Furthermore, for both options, MSs could choose to allocate fewer entitlements for grassland (i.e. to apply the reduction coefficient) or to exclude land cultivated with vineyards and greenhouse. Alternatively, MSs could grant new entitlements to farmers that were not eligible to receive direct payments under the old system (in 2013) such as vegetable producers, vineyards producers, etc. We consider these elements when relevant, but consider 2012 for determining the eligible area.

- *Capping of payments*: the IFM-CAP accounts for a reduction of basic payments to large farms in the MSs in which it is implemented.

The IFM-CAP models all major VCS schemes. The model takes into account the VCS eligibility restrictions at farm level (i.e. VCS is allocated to only those farms and/or specific sectors that are eligible for support as defined by MSs).

The IFM-CAP models, as closely as possible, the **CAP greening** as adopted by the 2013 CAP reform. The implementation of greening restrictions are at farm level.

The modelling of the **crop diversification measure** considers farm-level land allocation in determining which farms need to adjust their crop choices. This, following the 2013 CAP reform, applies to only farms with an arable area greater than 10 ha. Farms with more than 75% of their total eligible land covered by grassland and farms with 75% of their arable area cultivated with forage are also not subject to the crop diversification measure. Furthermore, there are stricter requirements for farms with more than 30 ha of arable land than for farms with an arable land area of between 10 and 30 ha. The latter farms need to have at least two different crops and the main crop should not exceed 75% of the arable land area. The former farms are required to have at least three crops, the main crop should not cover more than 75% of the arable land area and the two main crops together should not cover more than 95% of the arable land area.

For the **maintenance of permanent grassland measure**, the IFM-CAP imposes land use restrictions at farm level on concerned farms, requiring them to maintain a ratio of grassland to total agricultural area of not lower than 5% of the reference ratio. Furthermore, under this measure, farms are restricted in term of ploughing and converting permanent grassland in areas designated by the MS as environmentally sensitive.[9] Two grassland types are considered in the IFM-CAP: permanent grassland and rough grazing area. The IFM-CAP assumes that farmers may rotate between permanent grassland and arable land if relative returns change, while rough grazing area is assumed to be non-substitutable with other crop activities (i.e. it is assumed to be fixed), as this type of land is usually of lower quality. Only permanent grassland is subject to the greening measure.

We consider the base year 2012 as the reference year for modelling grassland measures, as this is the last year for which data are available in the IFM-CAP. That is, we calculate the ratio of grassland to total agricultural area for 2012 and compare it with the ratio in the baseline. If in a MS/region[10] the ratio is more than 5% lower in the baseline than in the base year, the grassland obligation is imposed at farm level. Following the EU regulation, the exception is applied to the grassland measure for regions where the proportion of forest area is large relative to total area. In these regions, the grassland measure is not implemented irrespective of the magnitude of grassland change. For environmentally sensitive areas, Natura 2000 grassland is assumed to be subject to the grassland measure restriction of no conversion to arable land.[11]

The **EFA measure** requires farms larger than 15 ha to allocate at least 5% of the farm's eligible area (excluding areas under grassland restriction) to EFA. Areas that qualify as EFAs include land left fallow, terraces, landscape features, buffer strips, agro-forestry, areas with short rotation, afforested areas, catch crops and nitrogen-fixing crops (EU, 2013; EU, 2014). MSs can choose which land elements are eligible to be EFAs. The eligible land elements have different weightings in contributing to EFA levels (varying between 0.3 and 30), depending on their conversion and weighting factors.

The IFM-CAP considers the following four land elements as potential EFAs: (1) fallow land (including voluntary set-aside), (2) afforested areas, (3) catch crops and (4) nitrogen-fixing crops, with their corresponding weightings as defined in the CAP regulations. Other land elements are not included in the IFM-CAP because there are no data available to capture them at farm level.

Under EU regulation, only specific crops (selected by each MS) are eligible to be considered catch crops/green cover or nitrogen-fixing crops. Given that the IFM-CAP has aggregated some activities linked to these land

[9] These areas could be within 'Natura 2000' or outside 'Natura 2000'.

[10] Depending on whether the grassland measure is applied at the national, regional or sub-regional level.

[11] Note that FADN contains information if the majority of the UAA of a farm is situated in a Natura 2000 area. IFM-CAP assumes that the grassland area of these farms is an environmentally sensitive area. Note that some MSs could include areas outside Natura-2000 as sensitive permanent grassland (LV, LU, CZ and UK-Wales), whereas MSs are not obliged to include all grassland located in Natura 2000 as environmentally sensitive areas. These two elements are not considered in the IFM-CAP as there are no information on the exact locations of sensitive grassland area outside Natura 2000 and which Natura 2000 grassland is not designated as sensitive area.

elements, they cannot be mapped exactly with specific crops as implemented by MSs. We assume that all cereals, pulses and other crops (as defined in the IFM-CAP) are eligible catch crops. Regarding the nitrogen-fixing crops, in the IFM-CAP the specific eligible crops are grouped as pulses and/or soya activities. In addition, MSs can specify management practices (sowing period, input restriction, mixtures, presence in the field, geographical criteria) that need to be applied to the EFA. These additional constraints are not incorporated into the IFM-CAP.[12]

The simulated greening scenario considers EFA implementation at farm level by assuming a 5% EFA rate. Similar to the crop diversification measure, farms with more than 75% of their total eligible land covered by grassland and farms with 75% of their arable area cultivated with forage are not subject to the EFA measure. In addition, exemptions from the EFA measure are considered for MSs with relatively large forest areas.[13]

### 3.2.3 Climate change policies/greenhouse gas emissions accounting

#### MAGNET

Under the auspices of the GTAP consortium, the development of a global database of carbon dioxide ($CO_2$), non-$CO_2$ (methane ($CH_4$), nitrous oxide ($N_2O$), fluorinated GHG (F gas)) and $CO_2$ equivalent ($CO_2e$) emissions for all economic activities is available, benchmarked to 2011 (compatible with Version 9 of the GTAP database). The MAGNET GHG module includes a series of technical coefficients linking fertiliser and combustion emissions to intermediate input usage by sector and non-combustion emissions to sectoral output changes (it is assumed that emission factors for different activities remain constant). Carbon taxes are also included for different configurations of environmental emission reduction schemes (e.g. ad hoc single sectors, diffuse sectors, domestic and/or international permit trading schemes). The resulting tax-induced price changes in tandem with assumptions of input substitutability determine the input and output changes, consistent with the hypothetical exogenous changes in GHG emissions. This application of MAGNET does not take into account a more detailed picture of climate policies such as the inclusion of differentiation between sectors belonging to the EU Emissions Trading Scheme (ETS) and non-ETS sectors, auctioning in the power sector and renewable energy targets as laid out in the 2030 Framework for Climate and Energy policies (European Commission, 2014). Thus, country-/region-specific top-down shocks to GHG emissions could be applied to generate the emergence of a single country-/region-wide carbon tax.

#### CAPRI

The agricultural sector is a large contributor of non-$CO_2$ GHG emissions, namely methane and nitrous oxide, and the CAPRI modelling system is adapted to calculate these emissions based on agricultural activities. The regional supply models in CAPRI capture links between agricultural production activities in detail (e.g. food and feed supply and demand interactions or animal life cycle, explicit feeding and fertilising activities, i.e. the balancing of nutrient needs with availability). Based on the inputs and outputs of these activities, agricultural GHG emissions are endogenously calculated following the Intergovernmental Panel on Climate Change (IPCC) guidelines (IPCC, 2006). Generally, a Tier 2 approach is used for the calculation of GHG emissions; however, for activities where the relevant information is missing, a Tier 1 approach is applied (e.g. for rice cultivation). The CAPRI model's reporting of agricultural GHG emissions mimics the reporting of emissions by the EU to the United Nations Framework Convention on Climate Change (UNFCCC). A detailed description of the general calculation of agricultural emission inventories on activity level in CAPRI is given in Leip et al. (2010), Pérez Domínguez et al. (2012), and Van Doorslaer et al. (2015). The latest model developments on specific technological GHG mitigation options and related improvements regarding emission accounting are presented in Van Doorslaer et al. (2015), Pérez Dominguez et al. (2016) and Fellmann et al. (2017).

[12] FADN does not contain information on the farm location; as a result, the collective implementation of EFA (applied in NL and PL) is not considered in IFM-CAP.

[13] That is, for regions with forest covering more than 50% of their land surface and if the ratio of forest land to agricultural land is higher than 3:1. Note that, due to data limitations (i.e. exact farm location is not available in FADN), this exemption is applied at NUTS 3 and not at LAU-2 as defined in the regulations.

CAPRI also incorporates a module to account for emission leakages to non-EU countries. Changes in EU policies can result in changes in imports and exports that can induce production increases in non-EU countries, and hence lead to higher emissions in these regions (i.e. 'emission leakage'). To account for emission impacts outside the EU, CAPRI incorporates a specific module to estimate emission factors for agricultural products for non-EU countries. For a detailed description of the CAPRI emission leakage methodology, see Pérez Domínguez et al. (2012), Van Doorslaer et al. (2015), Barreiro-Hurle et al. (2016) and Pérez Dominguez et al. (2016).

The calculation of GHG emissions allows the CAPRI model to report the impact of (general) policy changes on agricultural GHG emissions in the EU, including the impact of possible climate change-related policies targeting reductions in agricultural GHG emissions. Furthermore, CAPRI can account for and report policy-induced emission leakage to non-EU countries.

#### IFM-CAP

The IFM-CAP does not model climate policies. The effects of the climate policies modelled by CAPRI are accounted for only indirectly through price effects, as the IFM-CAP uses price developments from CAPRI in all scenarios.

### 3.2.4 Energy/biofuel policies

#### MAGNET

EU biofuel mandates are explicitly modelled (with varying degrees of ambition) by imposing exogenous blending limits, which are targeted by endogenous subsidies on biofuel usage in petroleum paid for by taxes on final purchases of petroleum (budget neutral). In the MAGNET database, both first-generation (bioethanol and biodiesel) and second-generation (biochemical and thermal technologies) biofuels are included, while the data also capture animal feed distillers, dried grains and solubles (bioethanol by-product), and oilcakes (biodiesel by-product). However, it should be noted that no biofuel policy change is included in the present exercise.

An enhanced version of the MAGNET database includes three fertiliser activities and commodity usage (sub-divided into nitrogen (N), phosphorus (as $P_2O_5$) and potassium (as $K_2O$)) in all agricultural crop sectors for all regions (Von Lampe et al., 2014). The original chemical sector is split into four parts (inorganic nitrogen, phosphorus and potassium fertilisers, plus other chemicals) using data from the International Fertilizer Association (IFA) and FAOSTAT; the intermediate consumption of fertilisers is calculated for each agricultural activity in each region. Given the strong link between fertilisers and energy (in particular between nitrogen and natural gas, which accounts for the largest proportion of the cost involved in producing nitrogen), this database improves the link between energy prices, agricultural inputs and agricultural final prices, depicting more realistically the current situation of agricultural markets.

#### CAPRI

CAPRI includes a behavioural market representation for biofuels and biofuel feedstocks. The biofuel module is a detailed representation of global biofuel markets, covering first- and second-generation production technologies, biofuel by-products, bilateral biofuel trade and a link to global fuel markets. From a methodological point of view, CAPRI provides an endogenous representation of biofuel markets (ethanol and biodiesel), meaning that biofuel supply and feedstock demand react flexibly to biofuel and feedstock prices, and at the same time biofuel demand and bilateral trade flows react flexibly to biofuel and fossil fuel prices. The CAPRI biofuel module allows a detailed analysis of most relevant biofuel support instruments, such as consumer tax exemptions or quota obligations, at the EU MS and international levels. In addition, the model permits the analysis of scenarios regarding biofuel trade policies and the availability of second-generation technologies. For this, the CAPRI database includes biofuel information based on many sources (the PRIMES and AGLINK-COSIMO models, as well as Eurostat, F.O. Licht and national sources). A more detailed description of the treatment of biofuels can be found in Blanco et al. (2013).

In the baseline, biofuel production in the EU stands at 15.9 billion tonnes, of which 11.7 billion tonnes come from first-generation biofuels and the rest includes a small supply of second-generation biofuels (0.2 billion tonnes of ethanol) and biofuels from non-agricultural sources. This use of biofuels by the transport sector implies that biofuels will account for 7.6% of total fuel use by 2030, of which 1.9% of total fuel use will come from biodiesel and 5.7% from bioethanol.

#### IFM-CAP

The IFM-CAP does not model biofuel policies. Similar to climate policies, the effects of the biofuel policies modelled by CAPRI are accounted for only indirectly through price effects, as the IFM-CAP uses price developments from CAPRI in all scenarios.

### 3.2.5 Trade policy

#### MAGNET

In its ninth version, the trade data component of the GTAP database captures gross bilateral trade flows between 140 regions worldwide, with accompanying bilateral transport margins. For each of these bilateral flows, average *ad valorem* applied tariffs and export taxes/subsidies are included. The price transmission from region of origin, 'r', to region of destination, 's', therefore faces several stages, from market prices to free-on-board prices to cost, insurance and freight (CIF) prices to destination market prices. In addition, the model allows additional explicit modelling of TRQs (although these must be supported by relevant secondary data on fill rates, lower and upper tariff rates) and trade bans (Elbehri and Pearson, 2005). Unfortunately, the model database does not currently represent non-tariff measures (NTMs) because of the difficulty in quantifying how much they restrict trade. Typically, such measures can be inserted for specific trade policy scenarios by employing one of a range of indirect or direct estimation procedures. This omission from the GTAP database represents a source of bias in the measurement of trade losses and gains when undertaking FTA impact assessments.

To model two-way trade flows (i.e. inter-industry trade), the MAGNET model does not currently have an explicit endogenous treatment approach for product varieties, although this is under development. Instead, it follows an exogenous treatment approach for product differentiation by region of origin using the Armington (1969) assumption. More specifically, in the lower nest of the import demand function, an extraneous elasticity of the substitution parameter between tradable 'j' from different regions of origin is inserted. The higher the elasticity, the more homogeneous the product (i.e. rice, wheat, etc.) and therefore the more sensitive imports are to changes in relative prices from competing regions of origin. In the upper nest, a further substitution elasticity parameter is inserted to differentiate between domestic products and the composite import. In the GTAP database, the elasticities of substitution are based on econometric estimates (Hertel et al.,, 2016), while upper-nest elasticities are assumed to be half the value of those of the lower nest.

#### CAPRI

CAPRI follows the Armington (1969) assumption for modelling bilateral trade, i.e. goods are differentiated by their country of origin. A substitution between domestically produced and imported goods, as well as between imports from different origins, in the optimal consumption mix is possible and is driven by changes in relative consumer prices. The Armington assumption allows cross-hauling (simultaneous import and export of the same commodity) to be modelled and facilitates the calibration of the model to observed bilateral trade patterns.

A number of trade policy instruments applied on the border are implemented in the standard CAPRI model, such as import duties, TRQs, export subsidies, an entry price system for fruits and vegetables (for the EU), and variable levies. Those border policy instruments are translated into a mark-up or price wedge on CIF prices, which define final producer prices. Consumer prices, on the other hand, are derived from the average domestic market prices taking into account consumer price margins in the benchmark.

The detailed trade policy instruments normally allow for a detailed implementation of the FTA tariff schedules in CAPRI, including, for example, reduction in specific and applied tariff rates as well as quota expansions under the TRQ. Nevertheless, in this study we opted for a simplified representation of trade agreements simply because detailed tariff schedules are not yet available for the majority of the covered FTAs. That missing information forced us to design simplified scenarios for increased market access, such as eliminating tariffs altogether or reducing them by 50% for sensitive products. To facilitate the implementation of simplified tariff cuts, all trade policy instruments were converted into an ad valorem equivalent AVE tariff rate in the benchmark. That tariff conversion introduces potential biases in the simulated results. An ad valorem equivalent of a specific tariff, for example, depends on the benchmark import prices, and therefore can lead to under- or overestimated tariff reductions. Not having explicit TRQ functions in the model, to give another example, possibly overestimates the impact of tariff reduction, as a sudden increase in applied tariff rates after reaching the quota level is no longer present in the model.

As for all numerical models working with aggregated product categories, CAPRI is also subject to aggregation bias: trade policy instruments need to be aggregated from the tariff line level (where policies are usually defined) to the composite goods of CAPRI. Both the level and the method of aggregation influence the magnitude of the bias. In general, fixed weight tariff aggregators lead to biased welfare results, as they do not take into account the different marginal impact of tariff changes on consumer expenditures versus tariff revenues (Anderson, 2009; (Laborde et al., 2017). Although welfare-consistent tariff aggregation has already been implemented in CAPRI (Himics & Britz, 2016), it was not applied in the current study due to data constraints.

NTMs, such as sanitary and phytosanitary measures or technical barriers to trade, are not considered in this study, as there is a lack of an adequate database on agri-food NTMs at the global scale. Modern trade agreements often include important chapters, or even mainly focus on, facilitating market access via NTM reduction. Agri-food markets are specifically impacted by a large number of sanitary and phytosanitary measures and other food safety regulations that can impede trade. Therefore, not considering potential NTM reduction in this study leads to an underestimation of the impacts of the EU's current trade agenda on domestic agricultural production and global food trade.

## IFM-CAP

The IFM-CAP does not directly model the interaction between farm production decisions and agricultural markets, and thus trade policies are not explicitly captured in the IFM-CAP simulations. The impacts of trade policies are captured only indirectly in the IFM-CAP. The price effects simulated by CAPRI are introduced as an exogenous shock in the IFM-CAP model. Note that the price changes simulated by CAPRI are a combined effect of all policy changes considered in the scenarios and not only trade policies (e.g. climate policies, biofuel policies).

## 3.3 | Observations and caveats related to the approach

### 3.3.1 General caveats of all modelling exercises

Economic models provide a conceptual framework that allows the representation of the economy in a structured but schematic and simplified manner. By definition, they cannot reproduce reality in its fullest complexity and thus have shortcomings and limitations.

The three models employed here are designed as tools for conducting policy experiments, in which a reference scenario or baseline is first simulated over a future period and then, after changing one or more underlying assumptions (policy settings, exogenous macroeconomic developments, weather trends, etc.), a new scenario incorporating these changes is run over the same period.

Comparison of the new scenario with the reference scenario at a given point in the simulation period, usually in terms of percentage differences, establishes the direction and relative magnitude of any impacts on all the endogenous variables of the change that is depicted in the hypothetical scenario at that point in time. In this study, the year of interest is 2030, and the alternative states of the world correspond to different assumptions regarding EU agricultural policy and trade between the EU and third countries.

Although these models can be used to project individual values of particular variables, it must be stressed that simulation models are not designed to predict economic trends in the future (i.e. for forecasting). These models merely use the best available current knowledge of the market to project over a future time horizon – called a baseline. The strength of simulation models is their ability to describe the mechanisms that drive departures from that baseline ascribed to a policy change, productivity changes or some other shock to the market. There are limited examples of forward-looking inter-temporal neoclassical CGE models, although the investment mechanisms are still rather ad hoc, while the notion of market uncertainty within a deterministic framework is not treated at all.

Although this type of model is calibrated to fit a given year, its solutions become less reliable the further into the future it goes because of structural economic change. Given the very large number of assumptions, estimated or calibrated parameters, and stylised specification features that these models assemble, each of which is 'plausible' up to only an (unknown) probability, it is difficult to establish exact confidence intervals or margins of error around individual projected numbers.

Finally, but equally important, the quality of the model output is directly related to the input data. Whereas calibration procedures allow matching key exogenous variables such as production, trade or GDP, the parameters, in particular the behavioural elasticities, often remain unchanged over time in the models. A particular effort has therefore been made to improve the parameterisation in the policy areas particularly relevant for this study. More specifically, these relate to available land uptake, agricultural payment productivity effects and first pillar payment coupling factors (see also the next sub-sections).

### 3.3.2 Model linkage

A fundamental point to understand is that any type of model linkage is fraught with difficulty, since major model differences exist in terms of the data, the assumed behavioural parameters and the underlying structural mechanisms of the models. This, however, does not mean that such a linkage should not be attempted, but, rather, one should have realistic expectations of what can be achieved when trying to harmonise different modelling approaches.

It is well known that PE and CGE models have structural differences, in terms of both the data and the behavioural elements (i.e. explicit or implicit elasticities), that can generate divergent results, while precedents in the literature even show that CGE and PE models can generate contradictory findings for the same scenario.[14] Although this is recognised within the modelling community, in the policy arena it can often be hard to reconcile the findings

[14] Conducting an impact analysis of the Uruguay Round, Anderson and Tyers (1988) predicted in their study that a fall in the economic welfare of the developing countries would follow liberalisation by industrialised nations due to the rise in international food prices, with consumer losses outweighing producer gains. The same scenario was conducted under CGE conditions (Burniaux and Waelbroeck, 1985; Loo and Tower, 1989) both of which showed welfare gains due to the effects of the non-agricultural sectors. Noting the reconciliation of the structural differences between the model approaches, Anderson and Tyers (1993) reverse their initial estimates from a sizeable loss (1985; USD 14 billion) into a significant gain (USD 11 billion).

of both types of model when presenting a consistent argument for a given policy reform.

In the past, DG AGRI-commissioned research established a 'soft' model linkage (see, for example, Nowicki et al., 2007; Nowicki et al., 2009; Helming et al., 2010), such that different types of models generated a mutually consistent storyline. Typically, a soft linkage is driven by an ad hoc assessment of the overall results (i.e. are the models broadly telling the same story?), while one plays to the strengths of each model to serve as a source of input to the other. For example, the CGE model, with an explicit or endogenous treatment of factor markets, world trade and macroaggregates, could conceivably be used within a PE model. Similarly, the sectoral detail and econometric foundation in supply response that serves some PE models well could be employed to assess and improve the veracity of CGE model results.

The advantage of the soft approach is that it is relatively straightforward to implement in terms of the necessary modelling modifications. On the other hand, the 'soft' approach adopted in the Scenar 2020 project through the linkage of variables was, as noted above, implemented on more of an ad hoc basis rather than by following a systematic framework. Thus, subject to the prejudices of the model scenario (i.e. the scenario design, the type of shocks, etc.), the choice of variable linkage could conceivably vary considerably.

In Philippidis et al. (2017), a 'test bed' study, which considered a class of 'soft' model linkage between CAPRI and MAGNET, was carried out as a preparatory step of the Scenar 2030 study. The aim of the study was to ascertain the extent to which the MAGNET model results diverge between two experiments, a 'standard' MAGNET experiment and a scenario where MAGNET implements agri-food output results from the CAPRI model directly by performing a closure swap with a Hicks neutral output productivity variable, while sectoral prices are allowed to be continually adjusted endogenously.

The aim of the exercise was to ascertain the extent to which MAGNET model results diverge from the 'standard' results when soft-linking to CAPRI and to assess the degree of compromise required in MAGNET to accommodate said changes. It was found that the standard MAGNET model and the CAPRI model predictions implemented in MAGNET 'more often than not' predict the same signs for output. In the EU-15, however, where a more significant number of agri-food sectors are linked, there are quite a few sign differences between CAPRI predictions and those of the standard MAGNET model, while in the non-EU regions, the level of convergence is generally good. This evidence suggests that there is a need to have some form of linkage between the models, especially if the focus is on the EU.

The choice of a 'hard' linkage to forge a union between the structural or behavioural elements of the model (see, for example, Britz & Hertel, 2011; Pelikan, et al., 2015) becomes appealing because it follows a very specific methodological approach, but it requires considerably more modelling expertise to implement, while the potential robustness of the two models being linked is, at the current time, under scrutiny and far from certain.[15] In the abovementioned papers, an elegant method for structurally linking CAPRI to a specific GTAP model version was applied. The approach does not have to impose heavy restrictions in either of the two models (especially if, in CAPRI, one does not pass back crop supply prices from the GTAP model). Such an approach would be worth pursuing for potential policy-orientated work, and a 'pilot' study is currently under development involving CAPRI and MAGNET modellers.

These tests and literature reviews give insights into the scientific dimension of how to link models. As research and trials with large-scale models, mainly with CAPRI and MAGNET, are still ongoing, Scenar 2030 takes a more pragmatic approach. In a follow-up study, it is hoped that a more sophisticated, 'hard-linkage' approach will be pursued to link CAPRI and MAGNET.

Chapter 4 further outlines the detailed implementation of the baseline and the scenarios in Scenar 2030.

[15] Within the two cited studies, the policy shocks were very discrete, while a more aggressive set of policy shocks (i.e. projections, etc.) which are typically used to characterise policy outlooks have, hitherto, not been attempted.

### 3.3.3 Improved land supply elasticities in MAGNET

The land supply elasticity with respect to the land price (land rent) is a key parameter in determining the land responsiveness arising from economic shocks and policies, and the resulting impacts on food prices and food and nutrition security. However, values for land supply elasticities are rarely available in the literature. Because of reliable time series data on land prices and concerns about the quality of UAA data, such values are available for only some countries of the world.

As a result of the relatively limited documentation and literature concerning land supply elasticities, the choice of these elasticities for medium- and long-term projections can be rather subjective. This can be illustrated by the choice of elasticities used in the MIRAGE model (Decreux and Valin, 2007). The MIRAGE model uses a land supply elasticity value of 0.25 for land-constrained countries and a value of 1 for other countries. This model was used by Bouët and Laborde (2010) for the evaluation of Doha trade liberalisation proposals. In the MIRAGE-BIOF model used in the study 'European Union and United States Biofuel Mandates, Impacts on World Markets (Al-Riffai P., et al., 2010), the land supply elasticity value was set at 0.02 for the EU and the USA, and at 0.035 for Brazil. In a similar study by the same authors (Al-Riffai P., et al., 2010a), varying regional elasticity values of between 0.05 and 0.1 were used. Finally, in another study using the MIRAGE-BIOF model (Laborde and Valin, 2012), elasticity values of between 0.01 and 0.05 were employed. As the authors of these papers point out, the land supply elasticity is an uncertain parameter and they advise that sensitivity analyses around its chosen value be conducted in the simulation experiment.

This overview of land supply elasticities suggests that these response parameters are rather inelastic. This is confirmed by statistical data which show that agricultural areas for the majority of countries increase very slowly or have even decreased since 2000, while agricultural value-added per unit of agricultural area often increases significantly.

The approach adopted in the work of Tabeau (2017) is to follow the work of Gurgel et al. (2007) and Barr et al. (2010). More specifically, land supply elasticity values were calculated directly from the observed percentage changes in UAA and the percentage changes in the total return to agriculture per unit of agricultural land. This approach therefore assumes that returns from agricultural production are capitalised in land prices in the long run, and therefore percentage changes in the return to agriculture per unit of agricultural land serve as a proxies for unobserved percentage changes in land prices. To support this work for the GTAP regions, time series data are taken from both the CAPRI database (UAA and changes in average gross margins) from FAOSTAT[16] and the World Bank World Development Indicators (WDI) database.[17]

On completing the estimation of land supply elasticities, a selection procedure for MAGNET was based on the following criteria:

- As the default, rather than choose calibrated elasticities from the MAGNET database, land supply elasticities were taken from agricultural land and return time series for all countries for which data were available.
- We chose an elasticity value of 0.015 for countries that are analysed but for which data do not show an increase in agricultural area since 2000 and at the same time show an increase in agricultural return (e.g. European countries, the USA, South Korea, Japan, Oceania, Australia and India). This elasticity value is close to zero but, at the same time, does not make the land supply function too inelastic, which could create problems.
- For selected countries for which the elasticities cannot be calculated because of a lack of time series data, neighbouring countries' data were used based on the ratio of the calibrated and time series land supply estimates for that specific neighbouring country/region. This ratio was then applied to the calibrated land supply estimates for MAGNET regions for which time series data were unavailable.
- A land supply elasticity value of 0.015 was chosen for all remaining, mostly small, countries.

[16] http://faostat.fao.org/.
[17] http://databank.worldbank.org/data/reports.aspx?source=world-development-indicators.

### 3.3.4 Productivity effects of EU domestic support

The impact of agricultural subsidies on productivity has long been discussed in the literature without any clear conclusions. Depending on the model specification, statistical method and data source, mixed results are reported. The empirical evidence shows that there is still a large knowledge gap in the literature regarding the understanding of the role of CAP Pillar 2 subsidies on agricultural productivity. Indeed, few studies comprehensively examine the impacts of CAP subsidies at NUTS 2 level for the EU MSs and compare the productivity effects across the different CAP subsidy categories. Furthermore, most studies use farm-level data (mostly from FADN), while capturing private returns, and do not consider the public or social returns that are obtained from public investment. Moreover, in most of the studies, agricultural subsidies are treated ad hoc and as a uniform category. However, as Minviel and Latruffe (2014) point out, when separating the individual subsidy groups, the productivity effects of subsidies might, in fact, be positive.

From examining the relevant literature, it appears that a significant proportion of the empirical evidence is based on the use of a parametric stochastic frontier approach (SFA) or a non-parametric data envelopment analysis (DEA) method. The general consensus of these studies is that a negative technical efficiency effect from subsidies is observed. However, as shown in various papers, this negative impact on technical efficiency is not incompatible with a positive effect on productivity.[18]

It should also be pointed out that all existing studies have looked at the effects on total factor productivity, whereas, in reality, different types of CAP subsidies might provoke a factor-biased technical change (e.g. human capital subsidies are expected to stimulate labour productivity more than land productivity). Finally, none of the studies so far can provide reliable inputs for the parameterisation of economy-wide models (e.g. partial or general equilibrium models such as MAGNET or CAPRI) because of the different uses of functional forms (typically Cobb–Douglas or translog functions, instead of constant elasticity of substitution (CES), are used) and the prevalence of micro-level studies (causing difficulties in generalising the results at the sector level).

This lack of understanding is both a constraining factor for policy-makers that are interested in the *ex post* evaluation of the effectiveness of public investments and for modellers who need a reliable quantification of subsidies' impact on productivity in their *ex ante* exercises such as in Scenar 2020 (Nowicki, et al., 2007; Nowicki, et al., 2009).

The latest published research by Dudu & Smeets Kristkova (2017) contributes to bridging this gap by providing a comprehensive empirical assessment of the role of CAP subsidies on productivity across EU-27 countries. More specifically, the contribution of this work is three-fold: (1) the study uses regional (NUTS 2) level data which allow us to capture sector- rather than farm-level behaviour; (2) the effects of the four major types of Pillar 2 subsidies on factor-augmenting technical change can be compared in a systematic way; and (3) the adopted methodological framework enables the simultaneous estimation of both CES and productivity parameters, which can be readily used in impact assessment models.

Combining this research with expert opinion, the following assumptions of the effects are made: (1) agri-environmental payments = 0; (2) human capital payments/investments = 0.025%; and (3) physical capital payments/investments = 0.015%.

The following example explains how to interpret the numbers: if the proportion of human capital-related subsidies of total production value is doubled, then one can produce the same amount of output by using 2.5% less human capital; or if one uses the same amount of human capital, output will increase (by how much depends on the coefficients of production function, i.e. substitution elasticities and factor shares).

The econometric estimations and the application of different productivity rates clearly show that there is a need for more research related to the key parameters used for CAP analysis.

[18] While productivity can be expressed as the ratio between outputs and inputs, efficiency can be defined as the distance between a certain input–output relationship and the optimum input–output relationship on the production possibilities frontier.

## 3.3.5 Modelling EU decoupled payments

In the work by Boulanger et al. (2016b), literature analysing the effect of the SPS and SAPS in the EU is reviewed. This detailed literature review explores how the EU SPS/SAPS payments affect farm decisions though a number of coupling channels such as the capitalisation of the payment in land rents/land sales prices; impacts on the farmers' perceptions of risk; access to credit; uncertainty about future policies; and on/off farm labour allocation. Within this literature review, the emphasis is on understanding, as far as reasonably possible, the empirical evidence arising from relevant studies and to use this as a basis for making an informed decision about how to allocate (i.e. couple) the SPS/SAPS across production factors in each of the MSs within the MAGNET simulation model.

However, reviewing the literature according to this objective reveals several limitations and obstacles. Although there has been a steadily growing number of studies investigating the impact of decoupled payments in EU MSs in recent years, most of the research has been conducted on the basis of data obtained before the introduction of the SPS. Empirical results addressing the second period, from 2013 to 2020, are difficult to find.

In addition, several studies cover only relatively short data periods, so that they do not fully capture long-term rent adjustments. Furthermore, the duration of land rental contracts differs widely between the EU MSs. Consequently, the effects for the post-2013 period are difficult to derive. Third, most of the empirical analyses apply FADN data, which, of course, are a good point of departure for comparing different studies, but, nevertheless, the experimental design differs considerably across studies with regard to selected countries or regions within a country, various sectors, farm types and payment types.

Fourth, some studies, particularly those assessing the extent to which the SFP is linked to production via future expectations, have applied individual farm-level data and survey results, giving rise to the question of how to generalise the results to the aggregated sector level. In addition, it is difficult to transfer qualitative effects of surveys assessing farmers' intentions into numbers that can be used in a simulation model environment.

The empirical results that may serve as a starting point for generating parameter adjustments in CGE or PE models examine the capitalisation of the SPS/SAPS into land rents. Michalek et al. (2014) utilised the most realistic data and provided estimations of the effects for all of the EU-15 MSs that reveal that these MSs have an average SPS capitalisation rate of between 4 and 18%. Ciaian & Kancs (2012) conducted a study estimating the degree of capitalisation in selected new EU MSs that suggests a capitalisation rate, in these MSs, of 5 to 18%. These studies therefore indicate that much of the remaining 96 to 82% of the SPS/SAPS may be coupled to production via other channels, which suggests that the SPS needs to be distributed to other, non-land, factors such as labour and capital.

Although there are estimates determining the capitalisation rate of the SPS into the value of land, appropriate estimation results that can be used to improve the distribution of the SPS in CGE models are still not available. Thus, this literature review emphasises the need for further research to obtain better estimates of the SPS's effect on production decisions that can be used in CGE or PE models. Moreover, on the basis of existing information, the favoured approach is to divide the allocation of the SPS/SAPS into two components. The first component should be based on the share of the SPS/SAPS that capitalises into the value of land as a uniform country-wide land subsidy rate (based on the literature estimates cited above) and can be regarded as fully decoupled from production decisions. The second component should capture the effect of the SPS through the remaining four coupling channels – risk, credit constraint, future expectations and labour. Owing to the lack of clear empirical evidence on the strength of each of these coupling channels, best practice seems to be the distribution of the second component of the SPS as a uniform subsidy rate across all agricultural factors of production in the MAGNET model.

### 3.3.6 Assumptions on trade policy modelling

The considered trade scenarios investigate only the effects of tariff liberalisation, but do not consider the possible reduction of NTMs. In fact, since there are currently no widely accepted estimates of NTMs for the agricultural sector at disaggregated level, and given the limited time to complete the exercise, it was decided to omit them from the study. The non-quantification of trade impacts arising from NTMs may hide important benefits for EU exporters, as several trade partners impose cumbersome and unjustified procedures that are usually streamlined in an FTA. On the other hand, regarding EU imports, past experience shows that the EU has not compromised its standards of consumer protection in any FTA chapter, for example when authorising so-called growth promoters or modifying its science-based genetically modified organism approval process. These barriers to EU imports stay in place (e.g. the Comprehensive Economic and Trade Agreement), even when tariffs are removed or reduced.

NTMs can be considered any policy measure that affects trade other than ordinary customs tariffs. NTMs are classified according to their scope and/or design and include a wide range of instruments such as sanitary and phytosanitary measures, technical barriers to trade, pre-shipment inspections and other formalities, contingent trade-protective measures, intellectual property rights, rule of origin, etc. (UNCTAD, 2015). In contrast with transparent and measurable tariffs, there is no common agreement on the aim, collection, quantification or modelling of NTMs, although several initiatives have contributed to a more transparent record of the inventory of measures in place (such as the TRAINS-NTMs database, promoted by the United Nations Conference on Trade and Development (UNCTAD) and other institutions, and the World Trade Organization (WTO) Integrated Trade Intelligence Portal (I-TIP)). Agri-food sectors are among those which face many different NTMs. Indeed, meat, dairy, and fruits and vegetables (and cereals to a lesser extent) are the commodities for which the highest number of NTMs can be found.

Because of their inherent nature, the quantification of the trade impact of NTMs, and the estimation/calculation of *ad valorem* equivalents (AVEs) of NTMs, is problematic, with the result that there is currently no globally consistent bilateral database on NTM AVEs. On a unilateral level, though, Kee (2009) provide a highly disaggregated database with NTM AVEs by sector and by country.

Gravity models have gained much attention as a method for estimating the trade restrictiveness of NTMs and their AVEs for insertion into simulation models. The scientific literature has provided the theoretical underpinnings and the appropriate estimators, as well as allowing improvements in the model specifications, that have contributed to making the gravity equation the workhorse for NTM AVE estimation (see, for instance, UN/WTO (2012) and Piermartini & Yotov (2016) for a thorough set of practical recommendations). Nevertheless, the estimation results depend on the approach followed (quantity-gap versus price-gap), the quality of the underlying data (e.g. elasticities of substitution to convert the quantity impact of NTMs on tariff equivalents; the NTM indicator variable; the prices if a price-gap approach is used) and the decisions undertaken in terms of the sample chosen for estimation (trade partners, years, sectoral aggregation).

Furthermore, an aggregation problem exists when matching the typically disaggregated NTM results from econometric studies with the more highly aggregated nature of activities typically found within the GTAP database. Finally, the literature is not conclusive on the correct representation of NTMs within a CGE framework, and provides several options for NTM representation. Thus, NTMs may be modelled either as a component of border support (with associated rent-seeking impacts) or as a type of efficiency gain (representing NTM harmonisations that reflect the 'sand-in-the-wheels' of trade flows). In addition, when considering the burden bestowed upon EU trading partners from the adoption of EU product standards and regulations, it is necessary to accommodate this observation through an adjustment in the (fixed) cost structure for partner countries' economic activities.

Importantly, liberalising trade does not mean eliminating all NTMs. Many NTMs are not of a protectionist nature but serve legitimate purposes, such as for food safety, or address market failures (e.g. asymmetry of information between producers and consumers, externalities) or enhance consumer demand for goods by increasing quality attributes (e.g. production process requirements or standards). Eliminating those NTMs is not the objective of any trade negotiation. Therefore, quantifying the size of the reduction in NTMs due to trade agreements remains difficult. For instance, in Bureau et al. (2014), NTMs were cut between 15% and 30% in the context of the Transatlantic Trade and Investment Partnership (TTIP), while in Francois et al. (2013), they were reduced by 10-25%.

Finally, non-members of a trade agreement (third countries) can also benefit from any NTM harmonisation (reduction) if it decreases the cost associated with export to both markets. Quantifying this secondary (spill-over) effect is difficult, and often neglected, although further bilateral AVEs in the CGE models should be assessed and reduced for relevant third-country exporters.

For the above reasons, NTMs are not modelled explicitly and no assumptions are made on possible NTM quantification, modelling or reduction arising from the FTAs in our baseline design.[19] The trade-restricting impact of NTMs is implicitly considered in the underlying trade database of MAGNET, as far as it concerns the current (observed) pattern of international trade. Thus, the modelling results will underestimate the magnitude of the potential effects of the current EU FTA agenda. The quantification of NTMs is an area that requires considerable additional research.

Finally, another issue that the study does not consider, although it could certainly have implications for EU free trade negotiations, is the impact of the UK's departure from the EU. On conceptualising the study design, the conditions of this separation were far from clear. It was therefore decided that rather than speculate on a single possible outcome and its associated impacts in terms of trade flows, production and (in the case of the CGE model) welfare, the current status quo would be preserved.

[19] It is pertinent to note that, owing to many of the considerations highlighted in this section, OECD (2016) does not contemplate NTMs when examining the possible impacts of multilateral trade reforms.

# 4

# IMPLEMENTATION **OF BASELINE AND SCENARIOS**

# 4 Implementation of baseline and scenarios

This chapter describes how the macroeconomic assumptions, policies and improved parameters are implemented in the baseline and scenarios, focusing also on each model individually.

## 4.1 | Baseline implementation

### 4.1.1 Overall concept and inclusion of policies

The baseline in Scenar 2030 is based on 'EU Agricultural Outlook: Prospects for EU agricultural markets and income 2015-2025', published in December 2015 (DG AGRI, 2015).

It is therefore similar to Option 1 (baseline) described in the IIA.[20] Option 1 (baseline) assesses 'the impact of the CAP remaining as it currently stands, except for simplifications already adopted or proposed, including in the Omnibus proposal, based on the most recent agricultural market outlook developed by Commission services'.

The most recent agricultural market outlook was published in December 2016, so could not be used in this comprehensive study with an extended time horizon and complex scenarios. However, the changes from the 2015 edition are small and it is not envisaged that these will significantly alter the overall results of the study.

Figure 3 gives an overview of the baseline (Option 1) construction.

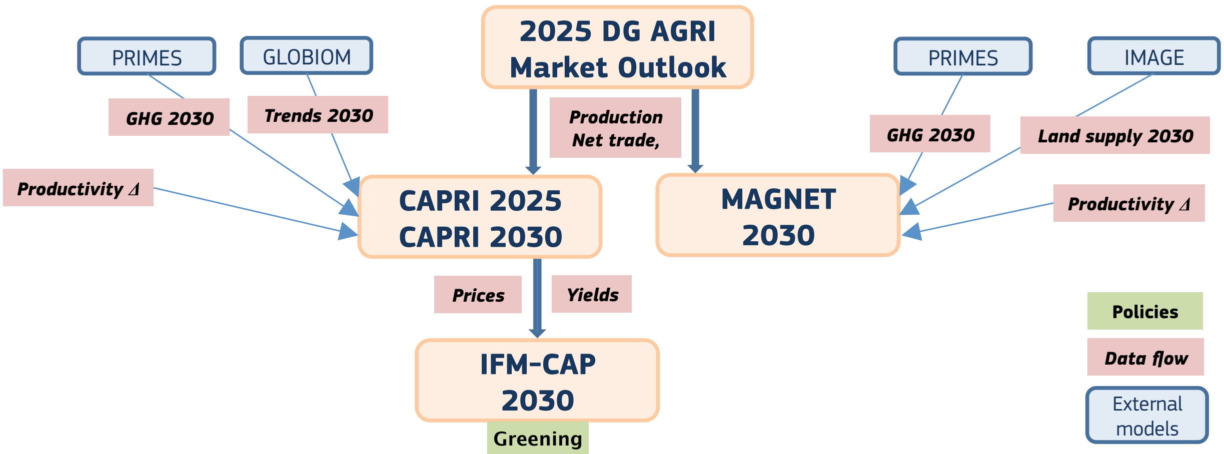



**FIGURE 3:** CONSTRUCTION OF THE MODEL CHAIN BASELINE
*Source:* own presentation.

The CAPRI and MAGNET models use the same macroeconomic assumptions (GDP, population) as in the EU Agricultural Outlook (DG AGRI, 2015).

As the time horizon of Scenar 2030 is five years longer than that of the EU Agricultural Outlook time horizon (DG AGRI, 2015) and because no projections from AGLINK-COSIMO are available, linear time trends are assumed and, in the case of CAPRI, additional information from GLOBIOM and PRIMES is used to reach the year 2030.

To further harmonise the future agricultural market situation in CAPRI and MAGNET with the projections of the EU Agricultural Outlook, specific calibration measures were carried out. This is further explained in the individual model chapters below.

[20] http://ec.europa.eu/smart-regulation/roadmaps/docs/2017_agri_001_cap_modernisation_en.pdf.

It should be noted that the IFM-CAP runs with prices and yields taken from CAPRI.

The **CAP** in the baseline represents the current implementation in as much detail as possible according to the specificities of the models employed.

Following the DG AGRI (2015) outlook 'The effects of "greening" are also taken into account to the extent possible. At the EU aggregate level, the effects on area allocation, especially crop diversification, are rather limited. Further work is under way to estimate better the impacts of "greening" on individual farmers.'

Thus, CAPRI and MAGNET mimic the AGLINK approach, whereas the farm model IFM-CAP by nature shows a more detailed picture.

Variations of the CAP, particularly in relation to greening, are featured in the scenarios.

The **trade policies** in the baseline follow the assumptions made in the 2015 DG AGRI market outlook. More specifically:

'As regards international trade negotiations and agreements, it is assumed that all commitments under the Uruguay Round Agreement on Agriculture, in particular on market access and subsidised exports, will be fulfilled. No assumptions are made as to the outcome of the Doha Development Round. The implications of the Bali Ministerial Declaration and the upcoming Nairobi Declaration have not been explicitly taken into account.

The Association Agreements with Moldova and Georgia, as provisionally applied since 1 September 2014, are taken into account. The Deep and Comprehensive Free Trade Agreement with Ukraine, which is part of the Association Agreement, applying as of 1 January 2016 is factored in. However, bilateral and regional trade deals that have still to be ratified, e.g. the FTA with Canada, are not taken into account.' (DG AGRI, 2015).

In one of the scenarios, a deviation from the status quo is presented.

**Climate change policies**: the reduction in GHG emissions will be treated as a continuation of the baseline and the scenarios.

The DG AGRI baseline does not explicitly take into account environmental policies; 'however, the effects of the Nitrates Directive and the need to reduce GHG emissions are factored into the analysis.' (DG AGRI, 2015).

### 4.1.2 MAGNET

MAGNET is calibrated to the GTAP database Version 9, with 2011 as the base year.

For the purposes of this study, the MAGNET model distinguishes 25 groups of commodities:

- nine in primary agricultural sectors: (1) wheat; (2) other cereal grains; (3) vegetables, fruits, nuts; (4) oilseeds; (5) sugar cane, sugar beet; (6) other crops; (7) bovine cattle, sheep, goats, horses; (8) other animal products (mainly pigs and poultry, but also features (inter alia) other live animals and eggs); (9) raw milk;
- eight in processed food and related agricultural input supplying sectors: (10) bovine meat products (i.e. red meat); (11) other meat products (i.e. white meat); (12) vegetable oils and fats; (13) dairy products; (14) processed rice; (15) sugar; (16) other food products; (17) beverages and tobacco; (18) feed; (19) fertilisers;
- those in four primary sectors: (20) natural resources (forestry and fishing); (21) crude oil; (22) extracted gas; and (23) coal; those in (24) a composite sector for all manufacturing sectors; and those in (25) a composite sector for all service sectors.

In terms of regions, the database has been disaggregated into 35 countries or regions: (1-28) each of the 28 EU MSs; (29) NAFTA (North America Free Trade Agreement) countries (i.e. Canada, Mexico and the USA); (30) Mercosur; (31) Australia and New Zealand; (32) China; (33) Asian countries signing an FTA with the EU (Indonesia, Japan, Philippines, Thailand, Vietnam); (34) least developed countries (LDCs); and (35) Rest of the World.

The baseline for 2011-2030 was calibrated so that MAGNET represents, as closely as possible, the assumptions and market projections of the medium-term prospects for EU agricultural markets and their income for 2015-2025 (DG

AGRI, 2015). This market outlook was based on information available at the end of October 2015 for agricultural production and the EU version of the OECD–FAO AGLINK-COSIMO model, used by the European Commission. The macroeconomic developments (GDP, population growth rate, world crude oil price) were exogenously imposed on the model in accordance with the forecasts adopted in the DG AGRI outlook. While population, land productivity and non-land endowment changes remain exogenous in the scenarios, GDP and world fossil fuel price projections are targeted by exogenous economy-wide productivity and global fossil tax shifter variables, respectively.

To replicate the EU Agricultural Outlook trends (production, imports and exports) for the different commodities in MAGNET, relevant exogenous shifter parameters need to be adjusted. Thus, to mimic specific AGLINK agricultural sector production trends, a sectoral productivity parameter was employed. To replicate EU-28 net trade balances for agri-food commodities, taste shifters within the Armington import functions are used. Given that the EU outlook produces only total extra-EU imports and exports, the bilateral trade flows of main commodities in the baseline were adjusted on the basis of expert knowledge.

The baseline and scenarios were implemented in MAGNET over four periods. More specifically, the model runs from the benchmark year (2011) to 2016 then to 2020 and 2025, and finally to 2030.

In terms of the CAP, Pillar 1 includes 30% greening by the end of the first period, which is maintained until the end of the simulation run. Pillar 2 follows the standard CAP baseline, based on data from DG AGRI (2015) (Table 2).

| **The 2016-2030 period** |
|---|
| **Trade policy (trade)** |
| • EU-28 enlargement elimination of border protection between incumbent EU-27 members and Croatia.<br>• Extension to Croatia of an EU common external tariff (CET) on third-country trade and reciprocal third-country CETs extended to Croatia as an EU-28 member.<br>• Elimination of remaining EU-28 tariffs with Peru, Columbia and South Korea. |
| **Agricultural policy (CAP)** |
| • Pillar 1 and Pillar 2 nominal expenditures are reduced by 13% and 18%, respectively. This corresponds to a 15.2% reduction in nominal CAP budgetary funding, consistent with the 2014-2020 MFF agreement.<br>• Phasing in of decoupled payments for 2007 accession members and Croatia.<br>• Greening of 30% of Pillar 1 payments, represented as Pillar 2 agro-environmental payments.<br>• Pillar 2 payments extended to Croatia.<br>• Abolition of raw milk (2015) and raw sugar (2017) quotas.<br>• Croatia incorporated within the CAP budget and UK rebate mechanism.<br>• Projected reduction in CAP expenditure share of the EU budget consistent with a 15.2% cut in nominal CAP budget reduction.<br>• Change in Swedish, Dutch and Danish lump sum rebates corresponding to CAP expenditure share in EU budget. UK rebate is maintained. |

**TABLE 2:** ASSUMPTIONS SHAPING THE BASELINE SCENARIO (2016-2030).
*Source:* own presentation.

### 4.1.3 CAPRI

CAPRI was calibrated to a projected equilibrium state of the global agri-food markets for the year 2030 in order to perform a comparative static impact assessment in the scenarios. The main source of data for calibrating the EU agricultural markets was the European Commission's EU Agricultural Outlook (DG AGRI, 2015) with the projection year being 2025. These projections have been extended to the final projection year, 2030, of this study by using trend data from external sources (GLOBIOM, PRIMES, etc.). The calibrated model provides the benchmark (or baseline) for further comparative static analysis.

The baseline requires assumptions on model-exogenous economic and policy variables that can be classified as policy, macroeconomic and market assumptions. Regarding policy assumptions, agricultural and trade policies approved to be implemented until the simulation time horizon are included. Policy measures of the EU CAP are covered in detail, including the latest 2014-2020 reform options. Regarding trade policies, the baseline does not anticipate any potential multilateral or regional agreements in the future (even if such agreements are under negotiation). Some environmental policies, such as the limits on nitrogen application as a consequence of the Nitrates Directive, are also taken into account. The policy and market assumptions in the baseline scenario are further outlined below.

## CAP assumptions

The policy assumptions in CAPRI until 2014 are described in detail in Britz and Witzke (2014). The latest CAP reform, however, implies significant budgetary shifts and a different structure for direct payments in order to better target three key areas of priority: economic, environmental and territorial challenges. The former SPS has been replaced by the BPS, while the SAPS remains in place. Both external and internal convergences are core elements of the reform, both of which lead to more uniform levels of payment entitlements (within and between MSs). Additional flexibility is built into the CAP that enables MSs to transfer funding between the two pillars, and to provide (limited) coupled support for specific agricultural sectors. The environmental performance of the CAP is strengthened with the greening component, which is subject to compliance with specific farming practices guaranteed by three types of greening measures: crop diversification, maintenance of permanent grassland and the establishment of EFAs. The CAPRI baseline assumes that the MS decisions/notifications for the national implementation options communicated in December 2015 apply.

The current CAPRI baseline covers those direct support measures of the 2014-2020 CAP reform that can be implemented at the national or regional level, such as

| **PILLAR 1** | | |
|---|---|---|
| **Instrument** | **Base year 2008** | **Baseline 2025 and 2030** |
| Direct payments | As defined in the 2003 reform and the 2008 Health Check; covering SFP (or SAPS) | The 2013 reform (partially) implemented |
| *Decoupling* | Historical/regional/hybrid schemes | BPS |
| *Coupled direct payment options* | As defined in the 2003 reform (including Article 68/69 and CNDPs) | VCS according to the options notified by MSs up to 31/08/2015 |
| *Redistributive payment* | NA | Not implemented |
| *Young farmer scheme* | Not implemented | Not implemented |
| *Green payment* | NA | Green payment component granted without restriction (only limitation: no conversion of permanent grassland) |
| *Capping* | Modulation implemented | Implemented according to 2013 reform. Capped budget redistributed over rural development measures |
| *Convergence* | NA | Included |
| **PILLAR 2** | | |
| **Instrument** | **Base year 2008** | **Baseline 2025 and 2030** |
| Agri-environmental schemes | Less favoured area (LFA) and Natura 2000 payments | ANCs and Natura 2000 |
| Business development grants/ investment aid | Not considered | Not considered |
| **Common Market Organisation** | | |
| **Instrument** | **Base year 2008** | **Baseline 2025 and 2030** |
| Sugar quotas | Yes | Abolition of the quota system in 2017 |
| Dairy quotas | Yes | Quota system expires in 2015 |
| Tariffs, TRQs | Yes | Maintained at current implementation level or schedule |
| Export subsidies | Yes | Not applied in 2025 |

**TABLE 3:** POLICY ASSUMPTIONS FOR THE CAPRI 2016 BASELINE.
*Note:* NA = not applicable; Source: own presentation.

national ceilings[21] for direct payments, basic payments[22] and VCS.[23] This level can be covered by CAPRI at NUTS 2 level. Measures that need to be implemented at farm level, e.g. payment for agricultural practices beneficial to the climate and the environment[24] (so-called green payments), are captured by the application of the Shannon index calculated in the CAPRI farm module. Voluntary redistributive payments[25] are implicitly covered in the underlying market projections (DG AGRI, 2015) but not made explicit, since that would require the use of the CAPRI model at farm level. The core policy assumptions on the CAP in the current CAPRI baseline are summarised in Table 3.

## The Nitrates Directive

The Nitrates Directive aims to protect water quality across Europe by preventing nitrates from agricultural sources from polluting ground and surface waters. The Nitrates Directive forms an integral part of the Water Framework Directive.[26]

Most indicators in the CAPRI model that can be related to the Nitrates Directive are rather robust pressure indicators and can be calculated based on fixed parameter approaches from the endogenous variables of the regional aggregate supply models (Pérez Dominguez et al., 2016). The CAPRI model captures the input allocation for fertilisers and calculates the nutrient balances. The calculation of nitrogen balances ensures compliance with the Nitrates Directive at the regional level (i.e. the maximum nitrogen surplus (N-surplus) as prescribed by this directive shall not be exceeded at the average NUTS 2 regional level).

## Macroeconomic and market assumptions

The CAPRI baseline integrates a multitude of external information sources for assumptions on macroeconomic and market developments. Exogenous macroeconomic indicators cover, for example, GDP growth rates, inflation rates, exchange rates and population growth, while exogenous market indicators comprise, for example, assumptions on biofuel production from agricultural feedstock, use of mineral fertilisers and agricultural markets in general. For example, GDP and population growth rates are taken from AGLINK/Global Insight (from 5 November 2015); however, for the biofuel module, input from the PRIMES model is used. The key macroeconomic and market assumptions for the current CAPRI baseline are summarised in Table.

| Variable | Source | What is determined |
|---|---|---|
| **Macroeconomics (inflation, GDP growth)** | AGLINK/PRIMES/FAO/IFPRI and elsewhere. | Some nominal prices, position of demand functions, starting point for future simulations. |
| **Demographics** | AGLINK/PRIMES/FAO/IFPRI and elsewhere. | Position of demand functions, starting point for future simulations. |
| **Market balances for EU** | DG AGRI (2015), supplemented with national/ industry sources, sometimes defined by constrained trends. | Target values for CAPRI trend estimator (e.g. beef supply). |
| **World markets** | European Commission (2015)/FAO/IFPRI projections plus data consolidation. | International market variables, position of behavioural functions, starting point for simulations. |
| **Biofuel policy** | European Commission (2015)/F.O. Licht/COMEXT. | Implicitly harmonised with those in DG AGRI 2015) through calibration to biofuel supply/use and trade. |
| **Yields** | European Commission (2015)/FAO/IFPRI or constrained trends. | Market results, position of behavioural functions, starting point for simulations. |
| **Technological progress** | Often own assumptions (e.g. maximum yields, 0.5% input saving per annum), sometimes taken from IIASA studies (emission controls). | Market results, position of behavioural functions, starting point for simulations. |
| **Fertiliser use** | European Fertilizer Manufacturers Association projections and over-fertilisation/availability parameter trends. | Environmental indicators, farm income. |

**TABLE 4:** MACROECONOMIC AND MARKET ASSUMPTIONS FOR THE CAPRI 2016 BASELINE.
*Note:* IFPR = International Food Policy Research Institute; IIASA = International Institute for Applied Systems Analysis; *Source:* own presentation.

[21] Regulation (EU) No 1307/2013, Article 6.
[22] Regulation (EU) No 1307/2013, Article 22.
[23] Regulation (EU) No 1307/2013, Article 53.
[24] Regulation (EU) No 1307/2013, Article 47.
[25] Regulation (EU) No 1307/2013, Article 42.
[26] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.

### 4.1.4 IFM-CAP

IFM-CAP baseline scenario is simulated taking CAP subsidies, prices, yields and input costs as given over the simulated time horizon. This modelling implies that farmers adjust output and area allocation to changes of these parameters.

The development of CAP subsidies, prices, yields and input costs in IFM-CAP are made consistent with CAPRI. That is, the decoupled payments are harmonised between CAPRI and the IFM-CAP in the baseline (BPS, SAPS, greening and redistributive payments), so that the average unit payments at MS level in both models are equal. This assumption was made for the purpose of maintaining the heterogeneity of payments among farms in a MS, while at the same time ensuring consistency with CAPRI. The unitary coupled payments (per head or hectare) (VCS and coupled complementary national direct payments (CNDPs)) are taken from CAPRI. This implies that IFM-CAP indirectly considers the adjustments in the unitary payments when the overall envelope is exceeded.

In line with CAPRI, IFM-CAP baseline assumes an adjustment of baseline prices and yields using growth rates from the CAPRI baseline and inflation rate of 1.9 % per year for input costs.

## 4.2 | Scenario implementation

### 4.2.1 Scenario 1: 'Income & Environment'

The main concept of the Inc&Env scenario (Figure 4) is that a more restrictive compliance with agri-environmental objectives is required to be eligible for direct payments. Trade policies remain with the status quo, as in the baseline.

In Pillar 1 and Pillar 2, budget totals remain unchanged compared with the baseline over the 2020-2030 period.

In the 2020-2025 period, Pillar 1 payments are distributed as follows: 40% is dedicated to decoupled payments, 40% is dedicated to greening, 5% is allocated to coupled support (assuming the same payment structure as the baseline), and the remaining 15% is allocated according to CAPRI (in function of high nature value (HNV) farms) and modelled as an agro-environmental payment.

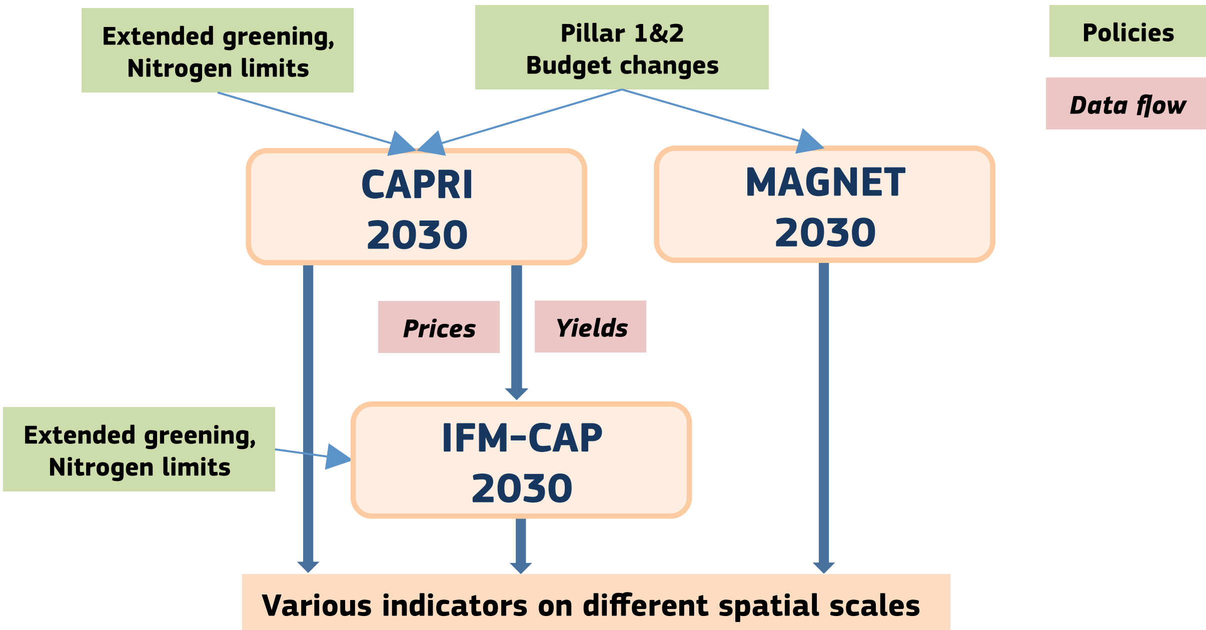



**FIGURE 4:** CONSTRUCTION OF THE MODEL CHAIN FOR SCENARIO 1 (INC&ENV).
*Source:* own presentation.

MAGNET implements, in the 2020-2025 period for Pillar 2, a 60% reduction in investments in human and physical capital. This saving is redirected into agri-environmental schemes. In the 2025-2030 period, the new distribution of first- and second-pillar payments is maintained.

The narrative that drives the results in the Inc&Env scenario is based on two main groups of assumptions. The first is a restructuring of both the Pillar 1 budget, by reducing coupled support, and the Pillar 2 budget, by switching 80% of the budget from human and physical capital investments to agri-environmental area payments. The shift in the Pillar 2 budget directly increases the average income per hectare while creating mainly negative productivity effects.

The second group of assumptions includes (1) a limit imposed on nitrogen input for agricultural activities, which leads to lower expected crop yields, and (2) restrictions regarding livestock stocking density, which lead to a reduction in livestock in NUTS 2 regions with highly intensified production, while providing more favourable conditions for extensive production.

The distribution of Pillar 1 payments across different policy areas in IFM-CAP is the same as in CAPRI. The same holds for modelling the BPS and coupled support, with the exception that the IFM-CAP implements eligibility criteria for coupled support at farm level. The main difference between IFM-CAP and CAPRI lies in the modelling of greening measures, which is naturally a consequence of the complementarities of the two models. Because IFM-CAP can capture farm-level implementation of greening requirements, similar to baseline, the greening restrictions are imposed at individual farm level. IFM-CAP assumes more stringent rules for crop diversification and EFA measures in the Inc&Env scenario than in the baseline. All farms with an arable area of more than 3 ha are assumed to be subject to crop diversity requirements, i.e. the main crop should not cover more than 75% of the arable land and the two main crops together should not cover more than 95% of the arable land. The EFA measure assumes that a greater proportion (7%) of land needs to be allocated to ecological uses than is considered in the baseline. For both measures, this scenario considers similar exemption rules related to grassland and forage area as in baseline (i.e. that farms with a grassland or forage area of more than 75% of the total eligible area are exempt). The assumptions for the grassland measure are the same as in the baseline in IFM-CAP.

For the IFM-CAP, the following specific assumptions regarding scenario implementation have been made:

- In the scenarios, the unitary values of subsidies in the IFM-CAP were taken directly from CAPRI, i.e. for the BPS, greening, VCS and coupled CNDPs.

- Since the unitary payments for the VCS and coupled CNDPs (as well as the livestock/crops benefits) are taken from CAPRI in the baseline and the scenario, this implies that the IFM-CAP indirectly considers the adjustments in the unitary payments derived from a potential overshooting of the envelope.

- A Natura 2000 area is assumed to be an HNV area in the Inc&Env scenario, as there are no FADN data that can be used to distinguish HNV areas.

- The uniform EU-wide HNV payment was calculated by dividing the EU budget envelope of HNV (taken from CAPRI) by the Eurostat Natura 2000 area.[27] This unitary payment was distributed over the total area of farms located in Natura 2000 areas.

- To be consistent with the Inc&Env scenario assumption of a fixed Pillar 1 budget (i.e. the same budget in baseline and the scenario), the calculated HNV payment was modified when necessary. That is, if the total value of the Pillar 1 budget was overshot in the Inc&Env scenario relative to the baseline, the HNV payments were reduced accordingly. The reverse adjustment was made in the case of a Pillar 1 budget undershot. In MSs where there are no farms in Natura 2000 areas in the FADN sample (e.g. in Finland), the HNV payment was distributed across all farms.

### 4.2.2 Scenario 2: 'Liberalisation & Productivity'

In the Lib&Prod scenario (Figure 5), Pillar 1 (including the funds dedicated to greening) is eliminated in the 2020-2025 period.

The total Pillar 2 budget is assumed to be the same as in the 2020-2030 baseline, but payments are redistributed as follows in the 2020-2025 period: all LFA payments are eliminated; agri-environmental payments are reduced by 50%; and the resulting saving from both of these measures in each MS is distributed equally to each of investment in physical capital and investment in human capital. In the 2025-2030 period, the new distribution of Pillar 2 payments is maintained.

MAGNET, having a specific module on Pillar 2 measures, differentiates among the measures, which are grouped into five broad categories: (1) agri-environmental measures (land-augmenting productivity impact), (2) LFAs (no productivity effects), (3) investment in physical capital (capital-augmenting productivity impact), (4) investment in human capital (labour-augmenting productivity impact), and (5) wider rural development measures (no productivity effects).

Based on the most recent estimations (Dudu and Smeets Kristkova, 2017), the percentage change in productivity of factors used in agricultural production is calculated by multiplying the percentage change in CAP payment types with a constant coefficient based on econometric estimation and expert opinion.[28] These productivity changes are applied in both MAGNET and CAPRI. Indirectly, they are

[27] We use Eurostat for Natura 2000 areas because in FADN is not well represented.

[28] If human capital related CAP Pillar 2 payments increase by A%, and the coefficient is 0.032, then labour productivity increases by 0.032*A%. If human capital payments rise by 100%, labour productivity rises by 3.2%.

taken up by the IFM-CAP through the transmission of CAPRI prices and yields.

The trade liberalisation follows the theoretical ambitious scenario, providing full tariff liberalisation for 98.5% of Harmonized System (HS) six-digit lines, and a partial tariff reduction of 50% for the other lines (sensitive products) for the ongoing and upcoming FTAs between the EU and 12 trade partners (USA, Canada, Mercosur, Australia, New Zealand, Japan, Vietnam, Thailand, Turkey, Mexico, Philippines and Indonesia). Details can be found in Boulanger et al. (2016a).

The trade scenarios are implemented in MAGNET and CAPRI, whereas the IFM-CAP receives the impacts transmitted through price changes from CAPRI.

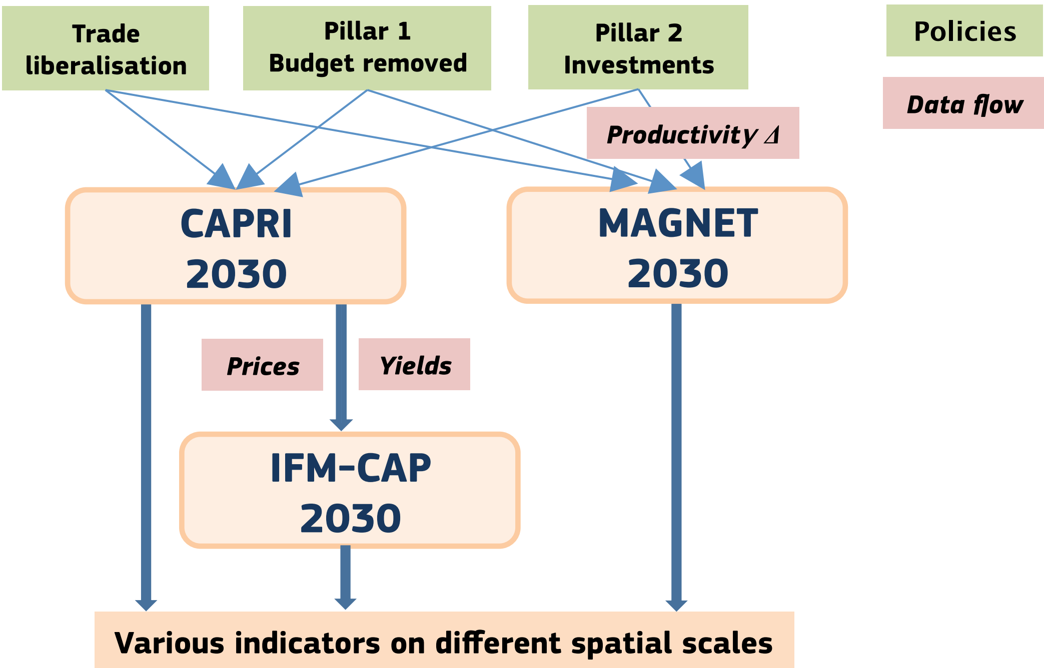



**FIGURE 5:** CONSTRUCTION OF THE MODEL CHAIN FOR SCENARIO 2 (LIB&PROD).
*Source:* own presentation.

## CAPRI-specific scenario implementation

The Lib&Prod scenario includes full elimination of Pillar 1 subsidies in line with a reduction in Pillar 2 agri-environmental payments by 50%, and simultaneously with the elimination of the LFA budget. These assumptions have more direct impacts on simulated results than indirect cross effects, e.g. they directly reduce agricultural income through lower direct subsidies. Even though the removed Pillar 2 funding is transferred to investment subsidies for human and physical capital, which has mostly positive productivity effects, in general this has less of an effect on income. These assumptions make the Lib&Prod scenario more 'incentive driven' than the Inc&Env scenario, which, rather, is 'restrictions driven'.

The scenario setup includes a number of FTAs that the EU is currently negotiating, and it is assumed that these will be concluded and implemented by 2030. For many of the FTAs considered, the negotiation offers have not yet been exchanged, which implies that the treatment and lists of sensitive products and other reciprocal concessions granted under, for example, TRQs are largely unknown. Therefore, the scenario assumes simplified (and ambitious) tariff reductions: full tariff elimination for the majority of traded commodities, except for those declared sensitive and which are subject to a 50% tariff reduction. The list of sensitive tariff lines has been constructed based on the expert judgement of different Commission services, complemented by a statistical analysis of historical tariff revenues. The FTAs covered include those with the USA, Mercosur, Japan, Thailand, the Philippines and Indonesia. Two additional FTAs, with Canada and Vietnam, have been implemented with more precise market access assumptions according to the concluded (but not yet ratified) legal texts.

The standard CAPRI model includes explicit functions that mimic the TRQ mechanism. However, in order to (1) avoid making assumptions on quota expansions for FTA members and (2) to harmonise the scenario implementation with MAGNET, the TRQs for sensitive products have been replaced with an AVE tariff representation. Although it is a simplification relative to the explicit TRQ-function representation, and it might lead to overestimated impacts on trade, this allowed us to implement the 50% tariff reduction for sensitive products directly.

### 4.2.3 Scenario 3: 'No CAP'

The NoCAP scenario is a variant of the Lib&Prod scenario (Figure 6), but, in addition to the elimination of Pillar 1 payments, all Pillar 2 payments are also eliminated. The assumptions regarding trade policy are kept the same as in the Lib&Prod scenario.

The IIA describes this option as follows:

'Option 2 (no policy) while dismantling CAP would not be in line with the Treaty, hence not realistic nor desirable, this scenario is considered nonetheless useful in demonstrating the EU value-added of CAP as well as the economic, social and environmental impact of the absence of an EU-wide policy intervention.'[29]

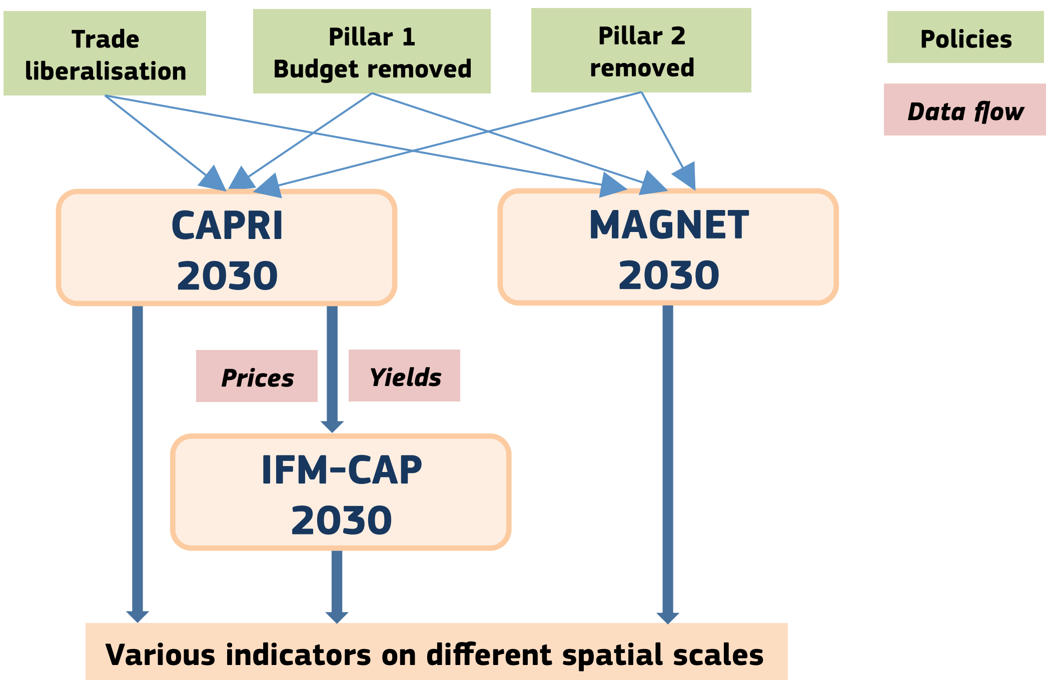



**FIGURE 6:** CONSTRUCTION OF THE MODEL CHAIN FOR SCENARIO 3, 'NO CAP'.
*Source:* own presentation.

[29] http://ec.europa.eu/smart-regulation/roadmaps/docs/2017_agri_001_cap_modernisation_en.pdf.

5

# REFERENCE SCENARIO
# RESULTS (2016–2030)

# 5 Reference scenario results (2016-2030)

In this chapter, the results of the reference scenario are presented, starting with the EU in a global context, focusing in particular on the development of the main agricultural markets over the next 15 years, presenting the situation for EU farms and, finally, depicting the key environmental indicators.[30]

## 5.1 | The EU in a global context

### 5.1.1 Global macroeconomic context (MAGNET)

The macroeconomic assumptions presented in this chapter are similar to those employed in the EU Agricultural Outlook as of December 2015 (DG AGRI, 2015).

In this edition of the outlook, a world GDP growth of 2.6% was expected for 2015 given the turmoil in the BRICS countries[31]. Based on the assumptions and model outcome, Table 5 shows the projected sizes of economies in 2016 for the EU and its trading partners. The EU has a slightly lower GDP than the NAFTA countries (USA, Canada, Mexico). Over the time horizon of 15 years until 2030, the LDCs, although the smallest in terms of economic size in 2016, and China, still the engine of world economic growth, are expected to have the highest rates of growth, with yearly growth rates of more than 5%. NAFTA is expected to grow steadily by about 2.4%.

| BASELINE | 2016 (EUR million) | 2016-2030 (% change) | Yearly growth (%) |
|---|---|---|---|
| EU-28 | 13,343,926 | 26.7 | 1.8 |
| EU-15 | 12,189,162 | 24.8 | 1.6 |
| EU-13 | 1,154,764 | 47.2 | 2.8 |
| NAFTA | 14,732,908 | 38.0 | 2.4 |
| Mercosur | 2,212,930 | 45.4 | 2.9 |
| China | 7,479,412 | 118.6 | 5.5 |
| Australia & New Zealand | 1,270,883 | 42.1 | 2.7 |
| Asian FTA countries | 5,876,310 | 32.7 | 2.0 |
| LDCs | 636,332 | 95.1 | 5.0 |
| Rest of the World | 12,526,565 | 68.9 | 3.7 |

**TABLE 5:** GDP AND GDP GROWTH FOR THE EU-28 AND ITS TRADE PARTNERS.
*Source:* Scenar 2030. MAGNET.

Since the economic crisis in 2012, the EU's GDP has picked up. Between 2016 and 2030, annual GDP growth is anticipated to be, on average, 1.8% in the EU, which is significantly below that in the rest of the world. However, economic growth among the EU MSs is quite diverse: the yearly GDP growth of the EU-13 (2.7% on average) is expected to far exceed that of the EU-15, which is expected to be, on average, approximately 1.7% per year between 2016 and 2030.

It should be noted that EU economic growth in 2016 and 2017 is likely to be slightly lower than initially expected at the beginning of 2016. Certain factors weighed negatively on the economic growth path of the EU, such as an elevated level of geopolitical uncertainty, the slowing down of world growth and world trade, and some legacies from the recent economic and financial crisis (in terms of public and private debt, ongoing recovery process in the banking sector, etc.).

[30] More details can be found under this link: https://datam.jrc.ec.europa.eu/datam/mashup/SCENAR2030.
[31] The BRICS countries are Brazil, Russia, India, China and South Africa.

Concerning the oil price (Table 6), since the sharp fall in oil prices at the end of 2014 and the record low of early 2016, the Brent crude oil price picked up slightly throughout 2016, but is still much lower than 2 years ago. Lower prices in the last 2 years can be explained by a combination of lower demand (due to slow economic growth and higher use efficiency), abundant supply to the market from some traditional players such as Libya or Iran, strong output increases from the USA and no downwards adjustment in production by Russia and countries of the Organization of Petroleum Exporting Countries (OPEC). This led to an increase in inventories and low prices. According to the EU reference scenario 2016,[32] in the longer term, the assumption is that the oil price will rise to reach USD 95 per barrel (in nominal terms) by 2030 (assuming a price of around 68 USD per barrel in 2016). There is consensus among oil price projections that there will be a gradual increase in the oil price in the coming 10 years. This reflects continuing demand growth, particularly from emerging economies, and higher extraction costs for the non-conventional oil that will be needed to meet the increasing world demand.

The energy price (Table 6) is closely linked to the oil price. The less pronounced growth expected over the period up to 2030 is due to the variable and growing sources of alternative energies (in particular renewables).

| | 2016 | 2020 | 2025 | 2030 |
|---|---|---|---|---|
| Oil price | 100 | 97.2 | 110.4 | 125.3 |
| Energy price | 100 | 96.7 | 114.7 | 136.2 |

**TABLE 6:** OIL AND PRICE DEVELOPMENT, INDEX 2016-2030.
*Source:* Own calculation based on EC (2016d).

Oil price affects the agricultural outlook in several ways: it impacts production costs (directly or indirectly through the cost of fertilisers and other inputs) and has an effect on the demand for biofuels.

Continued world population growth and economic growth drive demand and support prices for agricultural commodities. However, population growth is slowing down in Europe, North America, Russia and China. In the latter, the average annual growth rate expected over the 2016-2030 period is 0.2%, while in the previous decade it amounted to 0.5%.

| BASELINE | 2016 (million) | 2016-2030 (% change) | Yearly growth (%) |
|---|---|---|---|
| EU-28 | 510,284 | –0.23 | –0.02 |
| EU-15 | 388,037 | 1.0 | 0.1 |
| EU-13 | 107,507 | –4.7 | –0.3 |
| NAFTA | 450,198 | 12.35 | 0.8 |
| Mercosur | 235,713 | 10.38 | 0.7 |
| China | 1,327,798 | 2.40 | 0.2 |
| Australia & New Zealand | 25,617 | 16.31 | 1.1 |
| Asian FTA | 601,588 | 9.35 | 0.6 |
| LDCs | 412,771 | 35.46 | 2.2 |
| Rest of the World | 2,340,381 | 17.20 | 1.1 |

**TABLE 7:** POPULATIONS IN THE EU AND TRADING PARTNER COUNTRIES.
*Source:* Figures for 2016 from ESTAT.

World population growth is concentrated in Africa and Asia (Table 7). The annual population increase, which is currently around 80 million people per year, is expected to decelerate. In Europe, the continued population growth in the EU-15 is partly offset by a depopulation trend in the EU-13. Moreover, for the years 2015 and 2016, the annual EU-15 population growth was adjusted to be 0.1 percentage points higher than in DG AGRI (2015), mostly because of the recent increase in the number of asylum seekers from the Middle East and North Africa.

[32] To be coherent and consistent with the data on GHG emissions included in the MAGNET model, the baseline takes into account the energy prices (coal, oil and gas) from the European Commission's trends to 2050 EU Reference Scenario 2016 (EC, 2016d).

## 5.1.2 The agri-food sector in the global economy

The structures of the economies (Table 8) are expected to show only small changes over the period analysed. The EU-28, similar to the NAFTA countries, Australia and New Zealand, and the Asian FTA countries, is expected to have similar shares of the agriculture (primary production) and food processing (food proc.) sectors in 2016 and in 2030, amounting to about 5% in both years. Clearly dominating are the service and industry sectors in the OECD countries. Mercosur, China and the Rest of the World have shares of almost 10% in the agri-food sector. The LDCs reach nearly a 20% share in the agri-food sector, but show a decreasing trend towards 2030.

| | | EU-28 (%) | NAFTA (%) | Mercosur (%) | China (%) | AUS&NZZ (%) | Asian FTA (%) | LDCs (%) | ROW (%) |
|---|---|---|---|---|---|---|---|---|---|
| **Agriculture** | 2016 | 1.6 | 1.1 | 6.3 | 6.1 | 2.4 | 2.9 | 15.3 | 6.2 |
| **Agriculture** | 2030 | 1.6 | 1.1 | 5.8 | 6.1 | 2.3 | 2.8 | 13.2 | 5.7 |
| **Food proc.** | 2016 | 3.1 | 2.0 | 3.0 | 2.3 | 2.3 | 2.7 | 4.3 | 2.9 |
| **Food proc.** | 2030 | 3.1 | 2.0 | 3.1 | 2.2 | 2.3 | 2.7 | 4.4 | 2.9 |
| **Industry** | 2016 | 26.8 | 24.1 | 21.7 | 48.3 | 24.8 | 23.9 | 32.7 | 36.4 |
| **Industry** | 2030 | 27.7 | 24.3 | 23.7 | 47.4 | 24.4 | 24.2 | 32.8 | 36.6 |
| **Service** | 2016 | 68.5 | 72.7 | 69.0 | 43.4 | 70.5 | 70.6 | 47.7 | 54.5 |
| **Service** | 2030 | 67.7 | 72.5 | 67.5 | 44.3 | 71.0 | 70.3 | 49.5 | 54.7 |

**TABLE 8:** DIFFERENT COUNTRIES' SHARES OF SECTORS IN 2016 AND 2030
*Source:* Scenar 2030, MAGNET; ROW = Rest of world.

As suggested by the EU Agricultural Outlook as of December 2015 (DG AGRI, 2015), EU-28 agri-food production is expected to grow in real terms by about 8% (Table 9). Within the overall growth, sectors such as dairy and beverages and tobacco are expected to grow the most, while growth in several sectors such as crops is, in general, expected to be more limited or even negative (oilseeds and meals) (Figure 7).

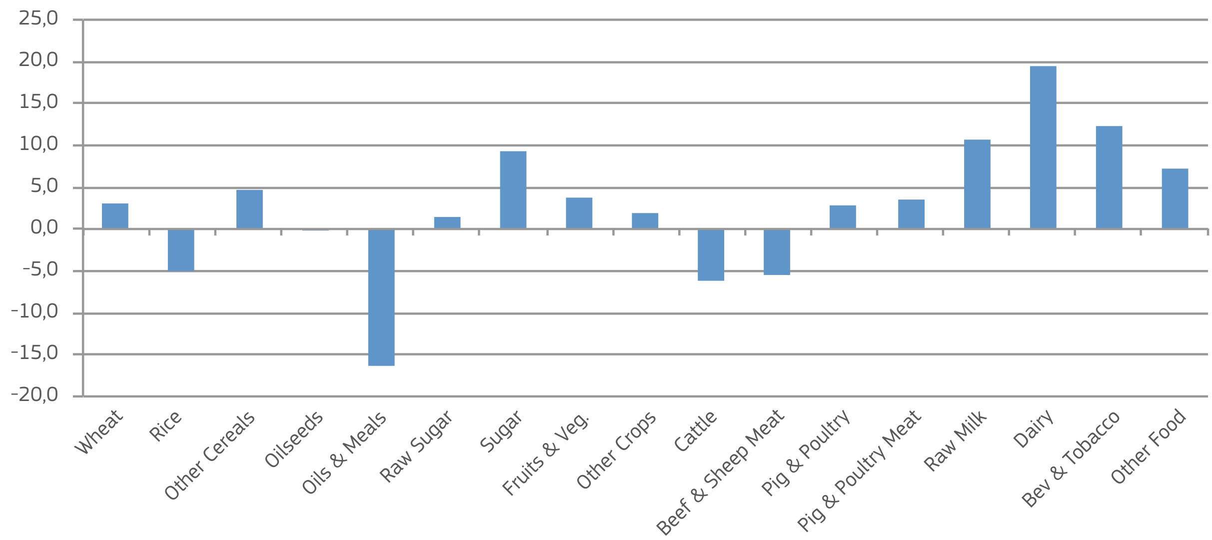



**FIGURE 7:** REAL PRODUCTION IN THE EU-28 BY PRODUCT, % CHANGE 2016-2030.
*Source:* Scenar 2030, MAGNET model.

Details on production, imports, exports and domestic use are presented in Table 10 and Table 11. The changes in LDC aggregates are particularly striking. Indeed imports of both agricultural and food products more than double over the period in LDCs. On the other hand, exports of agricultural products decrease by one third, whereas those of food increase by one fifth. In China, exports of agricultural products decrease by half. Interestingly, only Asian FTA countries and Mercosur experience major increases in agricultural exports, which double and increase by one half, respectively.

| BASELINE | 2016 (EUR million) | 2016-2030 (% change) | Yearly growth (%) |
|---|---|---|---|
| Wheat | 31,078 | 3.1 | 0.2 |
| Rice | 3,669 | –4.9 | –0.4 |
| Other cereals | 28,208 | 4.7 | 0.3 |
| Oilseeds | 16,570 | –0.3 | 0.0 |
| Oils & meals | 42,390 | –16.5 | –1.3 |
| Raw sugar | 3,545 | 1.7 | 0.1 |
| Sugar | 17,830 | 9.4 | 0.7 |
| Fruits & veg. | 60,744 | 3.8 | 0.3 |
| Other crops | 63,704 | 1.8 | 0.1 |
| Cattle | 32,226 | –6.1 | –0.5 |
| Beef & sheep meat | 52,831 | –5.4 | –0.4 |
| Pig & poultry | 67,214 | 2.8 | 0.2 |
| Pig & poultry meat | 138,363 | 3.5 | 0.2 |
| Raw milk | 55,279 | 10.7 | 0.7 |
| Dairy | 259,276 | 19.5 | 1.3 |
| Bev. & tobacco | 294,854 | 12.3 | 0.8 |
| Other food | 441,621 | 7.3 | 0.5 |
| **Total** | **1,609,400** | **7.9** | **0.6** |

**TABLE 9:** REAL PRODUCTION IN THE EU-28 BY PRODUCT.
*Source:* Scenar 2030. MAGNET model.

| Countries | Base 2016 (EUR million) | | | | Base 2030 (EUR million) | | | | Change in % (2016-2030) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production | Import | Export | Use | Production | Import | Export | Use | Production | Import | Export | Use |
| Mercosur | 215,348 | 4,097 | 48,146 | 171,300 | 266,988 | 4,512 | 72,264 | 199,236 | 24.0 | 10.1 | 50.1 | 16.3 |
| Asian FTA | 237,631 | 31,366 | 15,132 | 253,865 | 285,178 | 31,397 | 30,724 | 285,851 | 20.0 | 0.1 | 103.0 | 12.6 |
| Australia & New Zealand | 56,523 | 1,871 | 17,516 | 40,877 | 67,991 | 2,347 | 24,526 | 45,812 | 20.3 | 25.4 | 40.0 | 12.1 |
| China | 737,265 | 50,274 | 10,321 | 777,218 | 939,133 | 90,687 | 5,431 | 1,024,388 | 27.4 | 80.4 | -47.4 | 31.8 |
| LDCs | 132,645 | 8,142 | 9,617 | 131,170 | 184,640 | 16,428 | 6,473 | 194,595 | 39.2 | 101.8 | -32.7 | 48.4 |
| NAFTA | 364,471 | 43,361 | 91,466 | 316,366 | 424,978 | 49,814 | 121,363 | 353,430 | 16.6 | 14.9 | 32.7 | 11.7 |
| Rest of the World | 1,130,715 | 108,393 | 81,402 | 1,157,705 | 1,404,698 | 145,281 | 98,133 | 1,451,846 | 24.2 | 34.0 | 20.6 | 25.4 |

**TABLE 10:** PRODUCTION, IMPORT, EXPORT AND USE IN OTHER REGIONS, AGRICULTURE (REAL).
*Source:* Scenar 2030, MAGNET model.

| Countries | Base 2016 (EUR million) | | | | Base 2030 (EUR million) | | | | Change in % (2016-2030) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Production | Import | Export | Use | Production | Import | Export | Use | Production | Import | Export | Use |
| Mercosur | 277,149 | 7,617 | 51,601 | 233,165 | 346,712 | 9,937 | 61,548 | 295,101 | 25.1 | 30.5 | 19.3 | 26.6 |
| Asian FTA | 530,411 | 65,833 | 57,269 | 538,975 | 636,789 | 79,142 | 72,887 | 643,044 | 20.1 | 20.2 | 27.3 | 19.3 |
| Australia & New Zealand | 91,118 | 10,716 | 27,953 | 73,882 | 108,829 | 14,645 | 29,383 | 94,091 | 19.4 | 36.7 | 5.1 | 27.4 |
| China | 804,290 | 26,673 | 33,896 | 797,067 | 1,089,972 | 39,146 | 40,825 | 1,088,294 | 35.5 | 46.8 | 20.4 | 36.5 |
| LDCs | 109,011 | 23,020 | 5,589 | 126,442 | 195,622 | 46,679 | 6,774 | 235,527 | 79.5 | 102.8 | 21.2 | 86.3 |
| NAFTA | 862,328 | 94,965 | 84,199 | 873,094 | 1,045,466 | 116,590 | 102,427 | 1,059,629 | 21.2 | 22.8 | 21.6 | 21.4 |
| Rest of the World | 1,284,037 | 201,822 | 141,115 | 1,344,745 | 1,893,486 | 271,292 | 221,134 | 1,943,644 | 47.5 | 34.4 | 56.7 | 44.5 |

**TABLE 11:** PRODUCTION, IMPORT, EXPORT AND USE IN OTHER REGIONS, FOOD (REAL).
*Source:* Scenar 2030. MAGNET model.

There are no important developments in price apart from in the milk and dairy sector, which shows a critical decreasing trend (Table 12). Other food, beverages and tobacco, and feed also face minor price decreases. In general, a slight increase in other agri-food prices can be observed. Oilseeds, raw sugar, cattle and meat increase the most.

| | 2020 | 2025 | 2030 |
|---|---|---|---|
| Wheat | 96.6 | 106.9 | 110.7 |
| Rice | 94.2 | 92.8 | 92.5 |
| Other cereals | 91.3 | 101.7 | 105.8 |
| Oilseeds | 223.3 | 282.8 | 269.1 |
| Oils & meals | 94.4 | 109.6 | 109.9 |
| Raw sugar | 141.0 | 143.5 | 137.1 |
| Sugar | 110.2 | 108.7 | 105.1 |
| Fruits & veg. | 100.6 | 101.6 | 101.9 |
| Other crops | 101.5 | 101.1 | 101.1 |
| Cattle | 111.1 | 131.1 | 150.4 |
| Beef & sheep meat | 106.4 | 113.6 | 121.2 |
| Pig & poultry | 104.5 | 106.4 | 103.9 |
| Pig & poultry meat | 102.7 | 104.4 | 104.1 |
| Raw milk | 89.8 | 73.0 | 57.9 |
| Dairy | 94.9 | 86.4 | 76.8 |
| Other food | 98.4 | 96.2 | 93.5 |
| Bev. & tobacco | 98.3 | 95.8 | 93.1 |
| Feed | 100.1 | 102.9 | 98.8 |
| Fertiliser | 99.0 | 101.3 | 103.9 |

**TABLE 12:** PRICE (PRODUCER) DEVELOPMENT IN THE EU-28 BY PRODUCT (INDEX 2016 = 100).
*Source:* Scenar 2030. MAGNET model.

### 5.1.3 The EU's trade position

The EU's net trade position (Table 13)[33] is expected to improve by about EUR 17.7 billion between 2016 and 2030. Most notably, the wheat, sugar, dairy, pig and poultry meat, and beverages and tobacco sectors are expanding their exports compared with imports, while the trade balance is worsening for oilseeds and oils and meals; the trade balance in the beef and sheep meat sector is stable. Dynamics in the EU sector appear to be very positive, particularly in sectors with the highest value-added.

Agri-food net trade with China, NAFTA, the LDCs and the Rest of the World is improving. By contrast, imports from Mercosur are increasing more substantially than the exports to this region.

The analysis of trade flows sheds some light on the outstanding position of Mercosur within EU markets as a supplier of many commodities, such as oilseeds, oils and meals, beef and sheep meat, sugar, and pig and poultry meat. For beef and sheep meat, pig and poultry meat, and sugar, this prominence is strongly linked to preferential access to the EU market, granted under country-specific WTO TRQs under the Uruguay Round, successive EU enlargements and TRQs opened under Article XXVIII negotiations.

Other countries also have significant shares in the EU market, such as the NAFTA countries for oilseeds, and Australia and New Zealand for beef and sheep meat.

| | NAFTA | | Mercosur | | China | | AUS&NZZ | | Asian FTA | | LDCs | | ROW | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 |
| Wheat | –650 | –1,359 | –16 | –27 | 1 | 3 | –48 | –87 | 13 | 26 | 562 | 1,379 | 3,098 | 5,075 | 2,960 | 5,010 |
| Rice | –3 | –42 | –8 | –14 | –7 | –6 | 12 | 0 | –390 | –416 | –127 | –82 | –12 | –309 | –535 | –869 |
| Other cereals | –350 | –403 | –369 | –421 | 51 | 222 | –17 | –18 | –17 | –14 | –30 | 8 | 434 | 1,369 | –298 | 743 |
| Oilseeds | –2,060 | –2,893 | –3,543 | –5017 | –256 | –229 | –601 | –678 | –15 | –20 | –61 | –15 | –1,252 | –62 | –7,788 | –8,914 |
| Oils & meals | 52 | 428 | –3,816 | –5912 | 47 | 163 | 55 | 196 | –1,249 | –1,853 | 119 | 489 | 449 | –307 | –4,343 | –6,796 |
| Raw sugar | –1 | –2 | 0 | 0 | –1 | –3 | 0 | 0 | 0 | –1 | –4 | –4 | –29 | –74 | –35 | –84 |
| Sugar | 20 | 280 | –1,175 | –1384 | 2 | 13 | –31 | –17 | –29 | 38 | –209 | 235 | –175 | 1,786 | –1,597 | 951 |
| Fruits & veg. | –1,956 | –1,852 | –1,049 | –1046 | –415 | –184 | –295 | –246 | –384 | –363 | –230 | –47 | –9,175 | –7,860 | –13,504 | –11,598 |
| Other crops | –113 | –275 | –4,653 | –6895 | –196 | 172 | –225 | –218 | –1,549 | –2,819 | –1,629 | –852 | –4,462 | –3,981 | –12,827 | –14,868 |
| Cattle | 37 | –498 | 13 | 3 | 6 | 15 | 60 | 44 | 35 | 8 | –18 | –17 | 1,153 | 996 | 1,286 | 551 |
| Beef & sheep meat | –382 | –460 | –1,627 | –1585 | 248 | 572 | –2,230 | –2,193 | 38 | 13 | 16 | 44 | 1,209 | 899 | –2,728 | –2,710 |
| Pig & poultry | –177 | –249 | –132 | –160 | 155 | 499 | –114 | –107 | 31 | 5 | 1 | 17 | 470 | 353 | 234 | 358 |

**TABLE 13:** NET TRADE BETWEEN THE EU-28 AND OTHER REGIONS PER COMMODITY, 2030 AND 2016 (IN EUR MILLION).
*TABLE CONTINUES ON NEXT PAGE →*

[33] The agri-food trade balance in 2016 is negative (in contrast with official figure) because it includes the aggregate other food which includes processed fishery products. These products have a negative trade balance. By excluding them, the balance will become positive.

| | NAFTA | | Mercosur | | China | | AUS&NZZ | | Asian FTA | | LDCs | | ROW | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 | 2016 | 2030 |
| Pig & poultry meat | 209 | 147 | -668 | -1477 | 104 | 565 | 69 | 138 | 695 | 630 | 401 | 1,129 | 2,941 | 4,811 | 3,751 | 5,943 |
| Raw milk | 38 | 163 | 5 | 21 | 6 | 39 | 9 | 24 | 13 | 42 | 4 | 39 | 139 | 956 | 214 | 1,284 |
| Dairy | 1,830 | 2,639 | 114 | 180 | 501 | 625 | 213 | 435 | 1,152 | 1,665 | 692 | 1,488 | 6,507 | 9,619 | 11,009 | 16,651 |
| Other food | 9,287 | 10,836 | 267 | 418 | 1,697 | 2,168 | -123 | -3 | 2,104 | 2,387 | 972 | 2,158 | 8,916 | 13,388 | 23,120 | 31,352 |
| Bev. & tobacco | 1,224 | 1,681 | -1,174 | -1078 | -3,211 | -3,299 | 790 | 1,050 | -1,250 | -1,093 | 162 | 1,100 | 1,253 | 180 | -2,206 | -1,459 |
| Feed | -70 | -138 | -39 | -89 | 65 | -71 | 5 | 0 | 20 | -80 | 54 | 78 | 315 | -429 | 350 | -729 |
| Totals | 6,935 | 8,003 | -17,870 | -24,483 | -1,203 | 1,264 | -2,471 | -1,680 | -782 | -1,845 | 675 | 7,147 | 11,779 | 26,410 | -2,937 | 14,816 |

**TABLE 13:** NET TRADE BETWEEN THE EU-28 AND OTHER REGIONS PER COMMODITY, 2030 AND 2016 (IN EUR MILLION).
Source: Scenar 2030. MAGNET model.

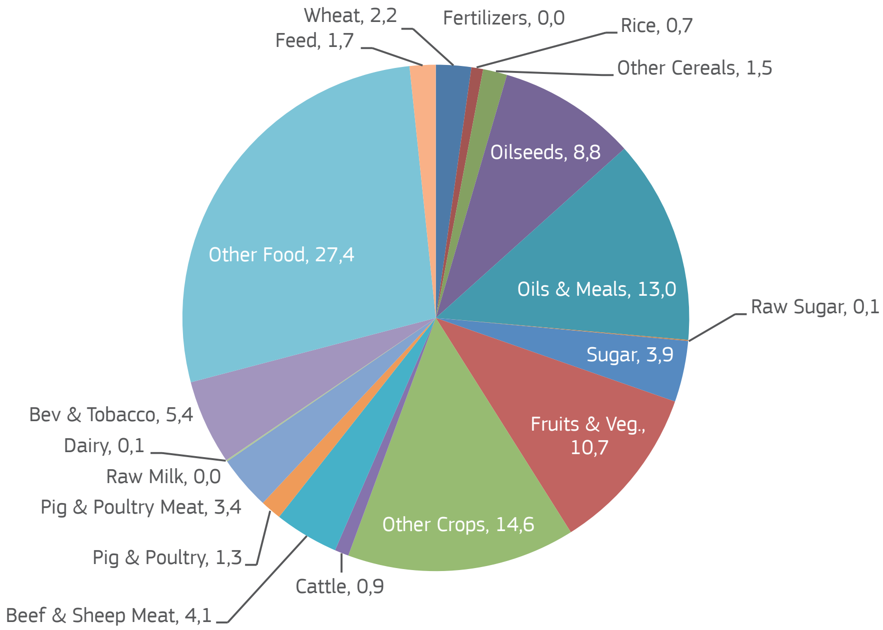



**FIGURE 8:** COMPOSITION OF EU-28 AGRI-FOOD IMPORTS (2030, BASELINE).
*Source:* Scenar 2030, MAGNET model.

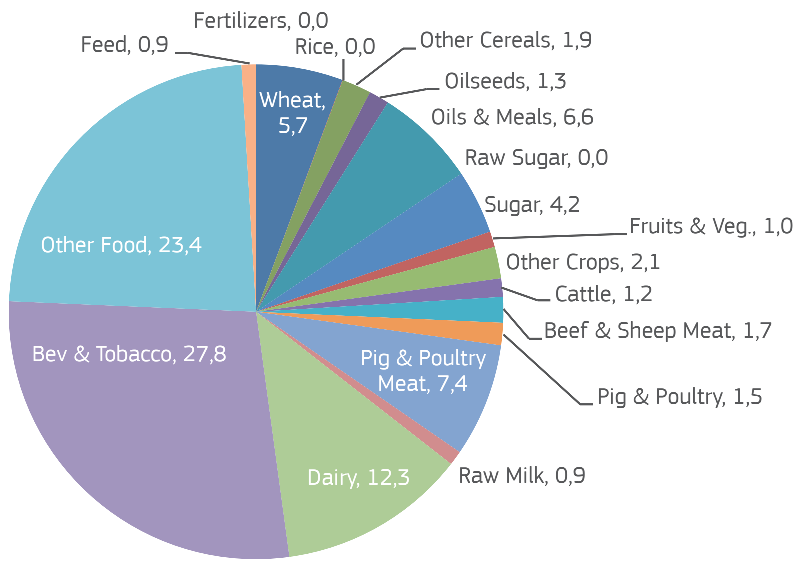



**FIGURE 9:** COMPOSITION OF EU-28 AGRI-FOOD EXPORTS (2030, BASELINE)
*Source:* Scenar 2030, MAGNET model.

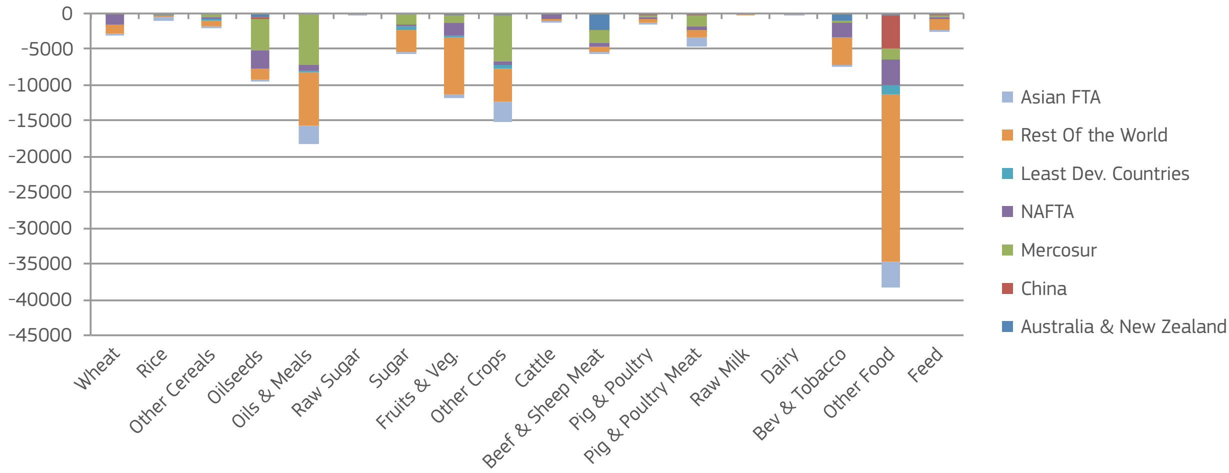



**FIGURE 10:** EU IMPORTS BY PRODUCTS AND BY TRADE PARTNERS.
*Source:* Scenar 2030, MAGNET model.

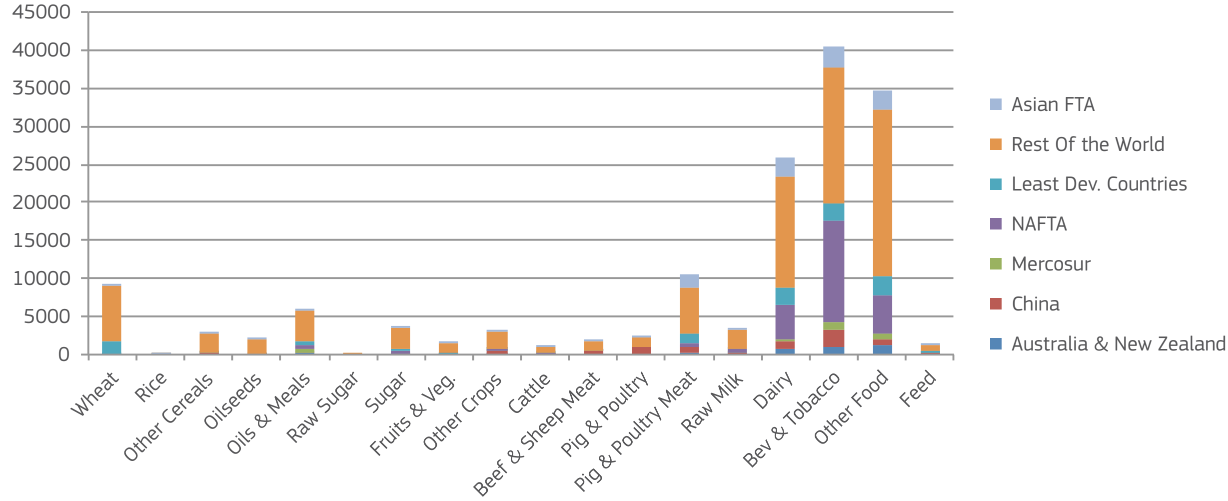



**FIGURE 11:** EU EXPORTS BY PRODUCTS AND BY TRADE PARTNERS.
*Source:* Scenar 2030, MAGNET model.

## 5.1.4 Global land use change

The baseline does not show any large differences in terms of land use (Table 14) within the EU between 2016 and 2030. The slow but constant increase in productivity, together with an almost non-existent change in the population level within the EU contribute to keeping land use almost constant over this time.

On the other hand, where population pressures are more severe (mainly in Asian and African countries), more land has to be exploited to satisfy the food needs of local populations.

| | 2016 (km²) | 2016-2030 (% change) | Yearly growth (%) |
|---|---|---|---|
| EU-13 | 371,217 | –0.1 | 0.0 |
| EU-15 | 925,183 | –0.6 | 0.0 |
| EU-28 | 1,296,400 | –0.4 | 0.0 |
| NAFTA | 4,131,224 | 1.3 | 0.1 |
| Mercosur | 3,361,371 | 9.6 | 0.7 |
| China | 3,740,554 | 2.5 | 0.2 |
| Australia & New Zealand | 3,043,113 | 1.0 | 0.1 |
| Asian FTA | 776,195 | 8.9 | 0.6 |
| LDCs | 5,986,905 | 11.0 | 0.8 |

**TABLE 14:** LAND USE AND LAND USE CHANGE UNTIL 2030.
*Source:* Scenar 2030, MAGNET model.

| | 2030 | 2016-2030 | Yearly growth |
|---|---|---|---|
| EU-28 | 92.5 | –7.5 | –0.6 |
| EU-13 | 99.7 | –0.3 | 0.0 |
| EU-15 | 89.6 | –10.4 | –0.8 |
| NAFTA | 149.6 | 49.6 | 2.9 |
| Mercosur | 145.4 | 45.4 | 2.7 |
| China | 325.9 | 225.9 | 8.8 |
| Australia & New Zealand | 201.5 | 101.4 | 5.1 |
| Asian FTA | 117.4 | 17.4 | 1.2 |
| LDCs | 331.0 | 231.0 | 8.9 |
| Rest of the World | 196.7 | 96.7 | 5.0 |

**TABLE 15:** LAND PRICE FOR THE EU-28 AND OTHER REGIONS (INDEX 2016 = 100).
*Source:* Scenar 2030. MAGNET model.

### 5.1.5 Global greenhouse gas emissions

The reference scenario includes critical increases of GHG emissions for all regions. LDCs and China experience the highest increases, the EU-28 the lowest (Figure 12). One has to keep in mind that modelling assumptions behind MAGNET and CAPRI can result in potential output discrepancies (see section 9.2).

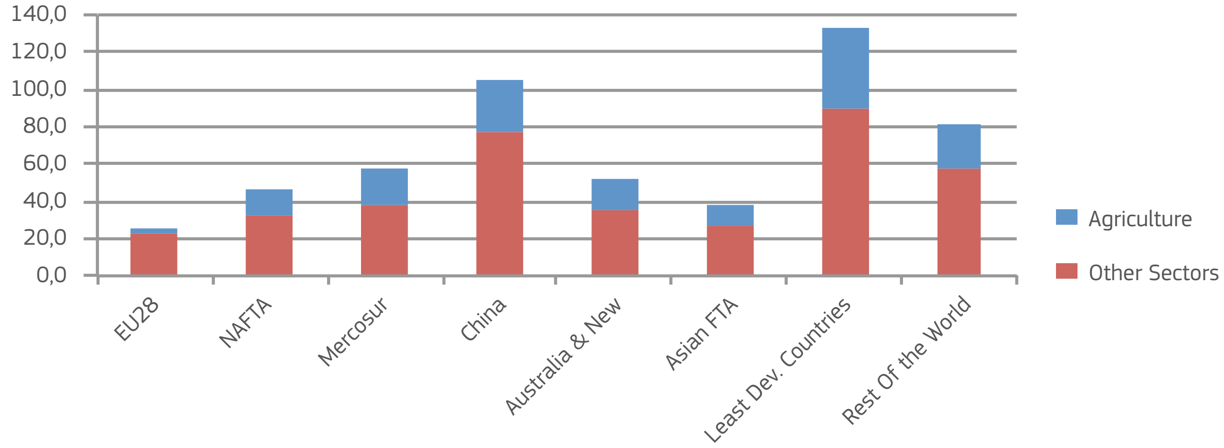



**FIGURE 12:** GHG EMISSIONS IN ALL SECTORS AND AGRICULTURE, % CHANGE, 2016-2030.
*Source:* Scenar 2030, MAGNET model.

## 5.2 | Employment in the agri-food sector

For MAGNET, job number data were obtained from DataM bioeconomy data[34], which are based on the EU Labour Force Survey (LFS). We have opted to use data from the LFS as it is annually updated, while the last year for which data on the agricultural labour force (excluding forestry and fishing) in the National Economic Accounts are available is 2011. The LFS (coded lfsa_egan22d), conducted by Eurostat, is a data source usually used to compare employment data across different sectors of activities. According to this survey, 9.6 million persons employed in agriculture (Nace rev.2 code A01) in the EU in 2014 reported agriculture as their main activity.

The numbers are expressed in full-time equivalents (FTE), both paid labour and self-employed. Over the period, change of employment in both agricultural and food sectors is negative, with a yearly loss of 1.8% and 1.4%, respectively. The drop is higher in EU-13 than in EU-15, and slightly greater in the agricultural sector than in the food industry. That said, in the year 2030 the former shall employ 6.7 million FTE, the latter 0.8 million FTE.

| | 2016 (FTE) | 2030 (FTE) | Absolute change (FTE) | Change (%) | Yearly change (%) |
|---|---|---|---|---|---|
| Austria | 170,757 | 141,144 | –29,613 | –17.3 | –1.4 |
| Belgium | 48,381 | 43,349 | –5,032 | –10.4 | –0.8 |
| Bulgaria | 172,031 | 105,603 | –66,428 | –38.6 | –3.4 |
| Croatia | 213,224 | 151,954 | –61,271 | –28.7 | –2.4 |
| Cyprus | 13,646 | 10,677 | –2,970 | –21.8 | –1.7 |
| Czech Republic | 92,076 | 76,128 | –15,949 | –17.3 | –1.3 |
| Denmark | 51,933 | 43,845 | –8,088 | –15.6 | –1.2 |
| Estonia | 14,981 | 11,057 | –3,924 | –26.2 | –2.1 |
| Finland | 69,889 | 54,055 | –15,835 | –22.7 | –1.8 |
| France | 612,157 | 535,821 | –76,336 | –12.5 | –0.9 |
| Germany | 513,606 | 385,590 | –128,016 | –24.9 | –2.0 |
| Greece | 437,941 | 320,118 | –117,824 | –26.9 | –2.2 |
| Hungary | 134,414 | 107,258 | –27,155 | –20.2 | –1.6 |
| Ireland | 68,673 | 60,863 | –7,810 | –11.4 | –0.9 |
| Italy | 707,694 | 603,970 | –103,724 | –14.7 | –1.1 |
| Latvia | 44,135 | 30,111 | –14,025 | –31.8 | –2.7 |
| Lithuania | 69,735 | 51,889 | –17,845 | –25.6 | –2.1 |
| Luxembourg | 2,630 | 2,493 | –137 | –5.2 | –0.4 |
| Malta | 1,172 | 819 | –353 | –30.1 | –2.5 |
| Netherlands | 188,084 | 169,639 | –18,445 | –9.8 | –0.7 |
| Poland | 1,579,836 | 1,232,406 | –347,430 | –22.0 | –1.8 |
| Portugal | 405,505 | 302,075 | –103,430 | –25.5 | –2.1 |
| Romania | 1,998,857 | 1,423,309 | –575,548 | –28.8 | –2.4 |
| Slovakia | 39,262 | 30,082 | –9,180 | –23.4 | –1.9 |
| Slovenia | 62,545 | 46,418 | –16,127 | –25.8 | –2.1 |
| Spain | 602,743 | 484,416 | –118,327 | –19.6 | –1.5 |
| Sweden | 53,735 | 46,425 | –7,310 | –13.6 | –1.0 |
| UK | 270,465 | 231,284 | –39,181 | –14.5 | –1.1 |
| **EU-28** | **8,640,109** | **6,702,797** | **–1,937,312** | **–22.4** | **–1.8** |
| **EU-15** | **4,204,194** | **3,425,086** | **–779,108** | **–18.5** | **–1.5** |
| **EU-13** | **4,435,915** | **3,277,712** | **–1,158,204** | **–26.1** | **–2.1** |

**TABLE 16:** EMPLOYMENT – AGRICULTURAL SECTOR
*Source:* Scenar 2030, MAGNET model.

[34] https://datam.jrc.ec.europa.eu/datam/mashup/BIOECONOMICS/index.html.

| | 2016 (FTE) | 2030 (FTE) | Absolute change (FTE) | Change (%) | Yearly change (%) |
|---|---|---|---|---|---|
| Austria | 80,036 | 67,006 | –13,029 | –16.3 | –1.3 |
| Belgium | 88,833 | 84,462 | –4,371 | –4.9 | –0.4 |
| Bulgaria | 94,208 | 74,360 | –19,848 | –21.1 | –1.7 |
| Croatia | 68,156 | 49,671 | –18,485 | –27.1 | –2.2 |
| Cyprus | 13,908 | 11,774 | –2,134 | –15.3 | –1.2 |
| Czech Republic | 112,461 | 94,000 | –18,461 | –16.4 | –1.3 |
| Denmark | 64,733 | 57,081 | –7,652 | –11.8 | –0.9 |
| Estonia | 10,825 | 8,338 | –2,488 | –23.0 | –1.8 |
| Finland | 40,063 | 35,498 | –4,565 | –11.4 | –0.9 |
| France | 620,016 | 539,754 | –80,262 | –12.9 | –1.0 |
| Germany | 920,958 | 685,651 | –235,307 | –25.6 | –2.1 |
| Greece | 90,380 | 71,732 | –18,648 | –20.6 | –1.6 |
| Hungary | 103,308 | 79,106 | –24,202 | –23.4 | –1.9 |
| Ireland | 38,203 | 34,968 | –3,235 | –8.5 | –0.6 |
| Italy | 427,316 | 383,761 | –43,556 | –10.2 | –0.8 |
| Latvia | 20,647 | 13,025 | –7,622 | –36.9 | -3.2 |
| Lithuania | 31,124 | 28,853 | –2,271 | –7.3 | –0.5 |
| Luxembourg | 5,266 | 5,105 | –161 | –3.1 | –0.2 |
| Malta | 3,419 | 2,562 | –857 | –25.1 | –2.0 |
| Netherlands | 132,374 | 126,807 | –5,567 | –4.2 | –0.3 |
| Poland | 372,305 | 288,727 | –83,578 | –22.4 | –1.8 |
| Portugal | 109,286 | 92,073 | –17,213 | –15.8 | –1.2 |
| Romania | 191,830 | 146,706 | –45,123 | –23.5 | –1.9 |
| Spain | 360,571 | 295,011 | –65,560 | –18.2 | –1.4 |
| Slovakia | 38,566 | 30,142 | –8,424 | –21.8 | –1.7 |
| Slovenia | 12,886 | 10,822 | –2,064 | –16.0 | –1.2 |
| Sweden | 63,375 | 59,866 | –3,509 | –5.5 | –0.4 |
| UK | 418,086 | 354,239 | –63,847 | –15.3 | –1.2 |
| **EU-28** | **4,533,139** | **3,731,101** | **–802,038** | **–17.7** | **–1.4** |
| **EU-15** | **3,459,496** | **2,893,016** | **–566,480** | **–16.4** | **–1.3** |
| **EU-13** | **1,073,642** | **838,085** | **–235,557** | **–21.9** | **–1.8** |

**TABLE 17:** EMPLOYMENT –FOOD INDUSTRY SECTOR.
*Source:* Scenar 2030. MAGNET model.

## 5.3 | Development of main agricultural sectors in EU

This section gives a brief overview of the major agricultural production and market developments in the reference scenario. The results of the reference scenario are generally in line with the major developments in the agricultural market outlook of the EU (DG AGRI, 2015). However, the following projections are derived using the CAPRI model and may differ slightly from DG AGRI's 2015 EU Agricultural Outlook because of differences in the model structure and input data. Moreover, the results of the 2030 projections are compared with the historical data which, in some cases, may also be slightly different to the various input data of CAPRI.

### 5.3.1 Arable crops

Cereal production in the EU is projected to increase by 6% by 2030, compared with the historical data for 2015 (Figure 13). This increase in EU cereal production is mainly driven by feed demand and favourable export prospects. The EU-15 accounts for about two thirds of total EU-28 cereal production, but while production is expected to increase only slightly in the EU-15 by 2030, most of the increase in cereal production is expected to take place in the EU-N13 countries (which are projected to increase production by 17%). This production increase in the EU-N13 can be explained mainly by productivity gains (i.e. yield increases). With a share of 21% of total production, France remains the largest cereal producer in the EU, followed by Germany (15%), Poland (10%), Spain (7%) and Romania (7%).

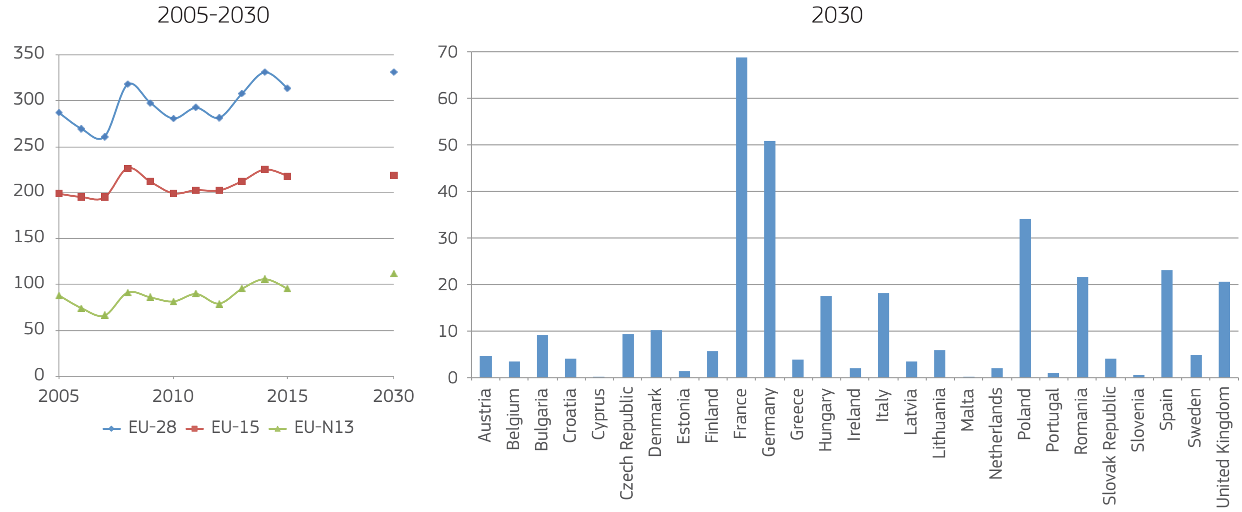



**FIGURE 13:** EU CEREAL PRODUCTION DEVELOPMENT (MILLION T).
*Note:* 2005-2015: historical data; 2030: CAPRI projection (Reference=REF).

For oilseeds, EU production is projected to increase by about 2% overall, compared with historical data for 2015 (Figure 14). Approximately 60% of oilseed production takes place in the EU-15, but most of the projected increase by 2030 is expected to take place in the EU-N13 (+4.5%). France (responsible for 20% of total EU oilseed production) and Germany (responsible for 17%) are the largest oilseed producers in the EU. While France produces considerable amounts of rapeseed, sunflower and soyaseed, rapeseed accounts for most oilseed production in Germany. Considerable increases in oilseed production are also projected for Bulgaria, Romania and Hungary (each accounting for 8% of total EU oilseed production), which are mainly related to sunflower production (and, in the case of Hungary and Romania, also soybean production). The cultivation of rapeseed accounts for most of Poland's oilseed production (7% of EU oilseed production).

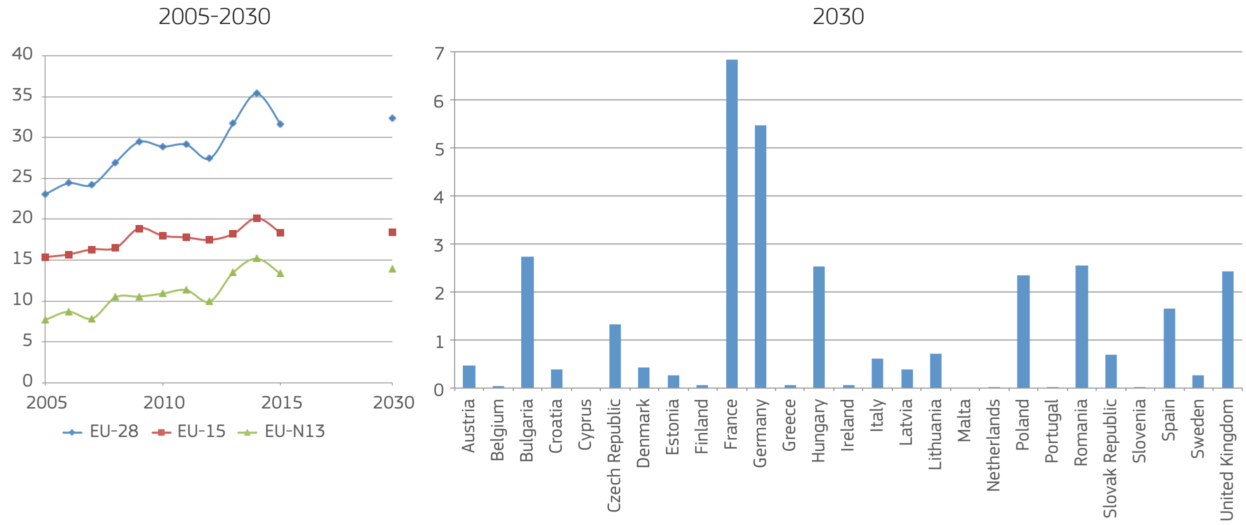



**FIGURE 14:** EU OILSEED PRODUCTION DEVELOPMENT (MILLION T).
*Note:* 2005-2015: historical data; 2030: CAPRI projection (REF).

Regarding the EU trade balance, the EU is projected to remain a net exporter of cereals, especially with respect to wheat and barley exports, whereas it is projected to be a net importer of grain maize and other cereals. The EU net trade balance for oilseeds is negative, which is mostly accounted for by net imports of soya (Figure 15).

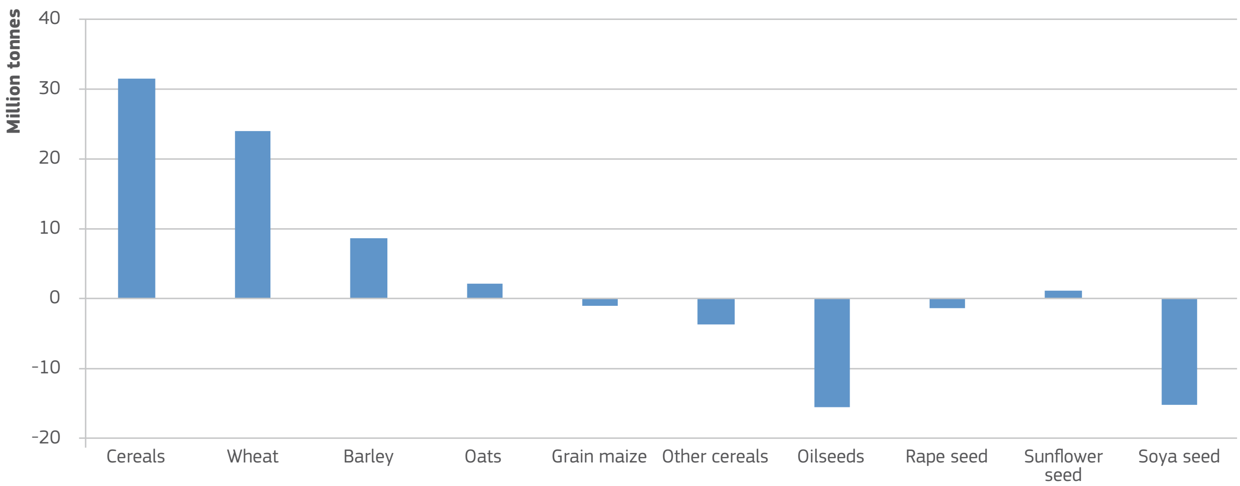



**FIGURE 15:** EU NET TRADE BALANCE FOR CEREALS AND OILSEEDS (MILLION T).
*Note:* net trade = exports – imports.

## 5.3.2 Milk and dairy

Milk is produced in every EU MS and milk production represents an important proportion of EU agricultural output value. With no production quota in place, the main drivers for increasing EU supply are market fundamentals, which show a favourable market environment for EU dairy exports. Accordingly, EU milk and dairy production is projected to further increase in the reference scenario, mainly driven by increases in world demand. EU milk production is projected to increase by about 9% between 2015 and 2030, with the EU-15 accounting for most of this increase, as production is expected to increase by 11% in the EU-15 but by only around 2% in the EU-N13 (Figure 16). Germany will keep its position as largest milk producer in the EU in 2030, producing about 20% of total EU milk, followed by France (16%), the UK (10%), Poland (8%) and the Netherlands (8%).

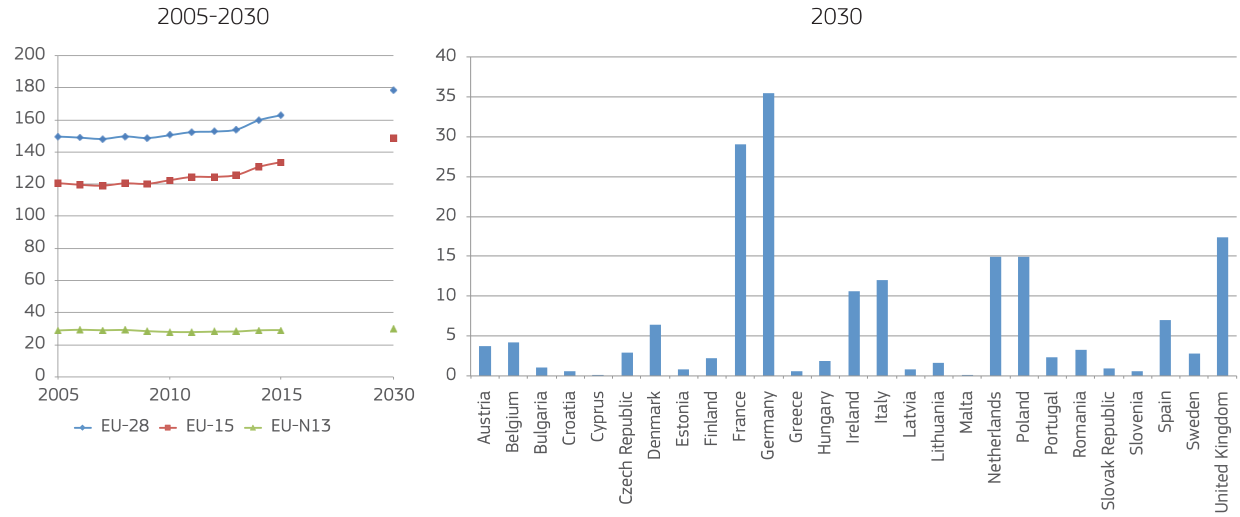



**FIGURE 16:** EU COW MILK PRODUCTION DEVELOPMENT (MILLION T).
*Note:* 2005-2015: historical data; 2030: CAPRI projection (REF).

The EU is expected to remain a considerable net exporter of dairy products (Figure 17), further increasing its exports over the projection period and becoming the leading supplier of dairy products on the world market. Despite the increase in exports, the EU domestic market remains the main outlet for EU dairy products, especially with respect to fresh dairy products, cheese and butter.

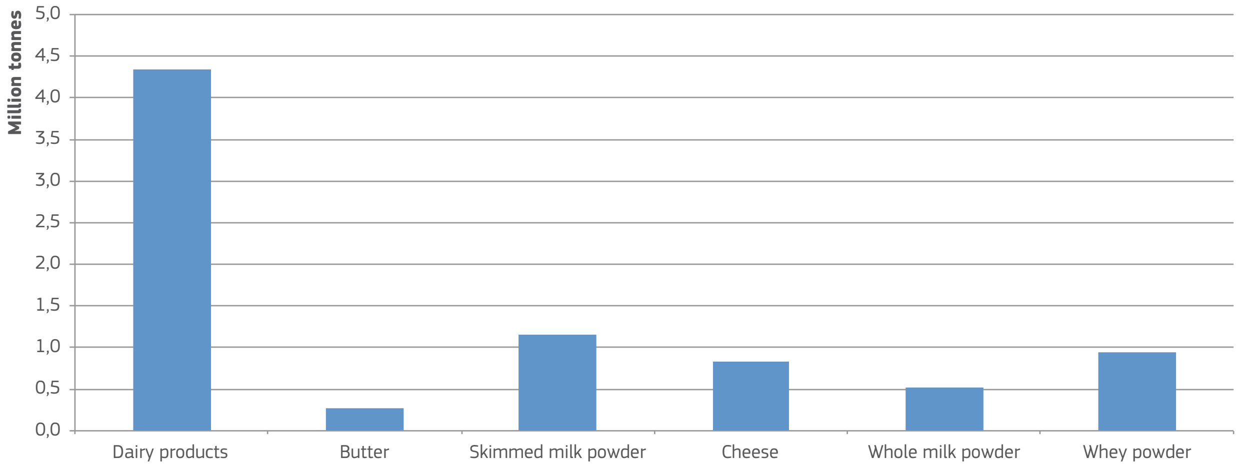



**FIGURE 17:** EU NET TRADE BALANCE (MILLION T).
*Note:* net trade = exports – imports.

## 5.3.3 Meat

World population and economic growth are expected to drive higher global meat demands and contribute to higher EU meat exports. As a result of the recent economic recovery and slightly lower meat prices, overall meat consumption per capita in the EU recovered by 2015. The increase in EU meat consumption is expected to continue, albeit at a slower pace than that observed in most recent years. By the end of the projection period (2030), per capita consumption is expected to be stable, with the market share for poultry taking small amounts of the market shares of other meats.

Considering that approximately two thirds of EU beef comes from the dairy herd, EU beef production is mainly driven by dairy herd developments. Furthermore, the beef sector is influenced by the implementation of VCS in many MSs, mainly in the form of payments linked to suckler cows. However, it also has to be mentioned that some MSs with large suckler cow herds did not opt for VCS in the beef sector, for example Germany and the UK (excluding Scotland). Moreover, specific ceilings (i.e. the maximum number of cattle that can be granted VCS) and specific implementation in the MSs limit the impact of VCS on cattle herd developments in the EU. VCS is assumed to remain implemented over the projection period in the reference scenario. The projections indicate that EU beef meat production will slightly decrease, by less than 1%, compared with the 2015 level. This small decrease can be accounted for by the EU-15, whereas beef meat production is expected to remain stable in the EU-N13 (Figure 18).

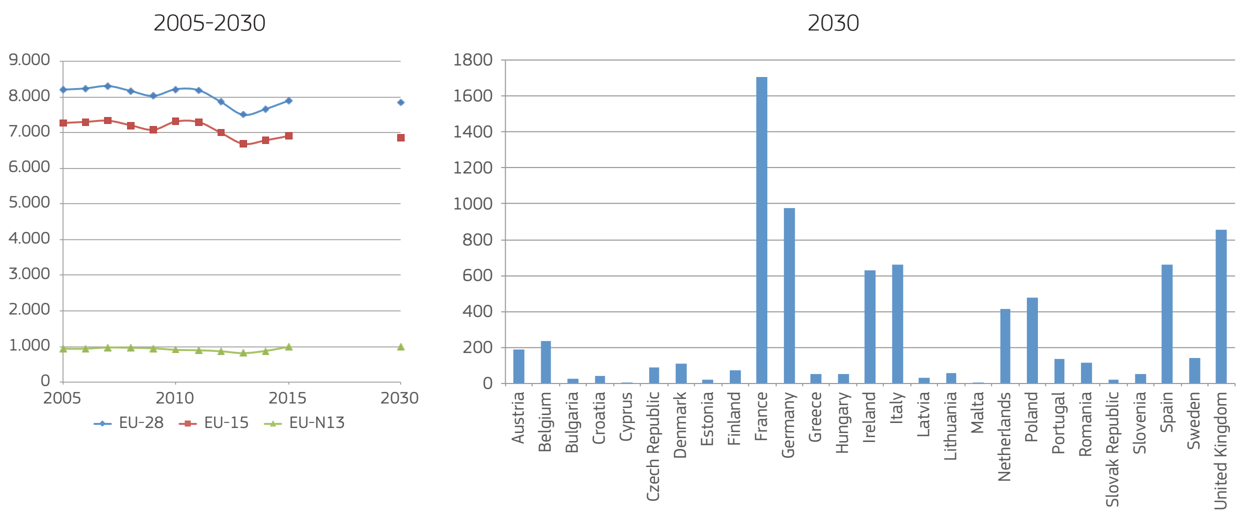



**FIGURE 18:** EU BEEF MEAT PRODUCTION (1,000 T).
*Note:* 2005-2015: historical data; 2030: CAPRI projection (REF).

The EU is the second largest producer of pig meat in the world (after China), and the largest exporter. EU pig meat production is projected to further increase by about 4% by 2030, compared with the already high levels of 2015, with most of this increase taking place in the EU-15 (Figure 19). As increases in domestic pig meat consumption are limited, EU pig meat exports are projected to grow steadily, particularly supported by sustained world demand and relatively low feed prices. Germany and Spain are the largest pig meat producers, with a share of 23% and 18%, respectively, of total EU pig meat production. With shares of between 9% and 7% in total EU production, Denmark, France, Poland, the Netherlands and Italy are also among the most important pig meat producers in the EU.

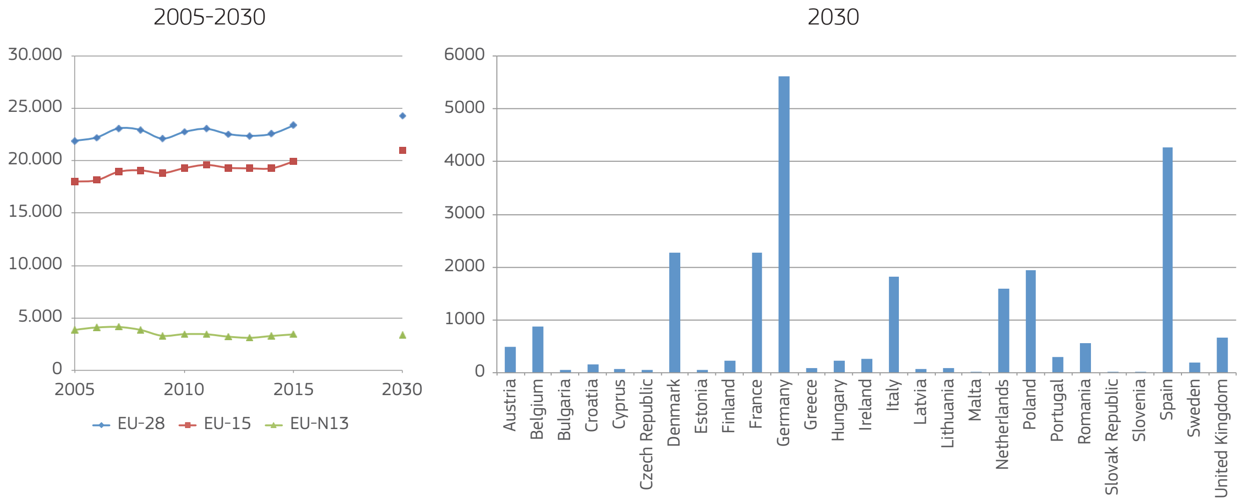



**FIGURE 19:** EU PIG MEAT PRODUCTION (1,000 T).
*Note:* 2005-2015: historical data; 2030: CAPRI projection (REF).

The EU is one of the world's largest producers of poultry meat and a net exporter of poultry products. EU poultry meat production projections suggest an increase of 9% by 2030 compared with 2015 levels (Figure 20). The increase is driven by consumption increases both inside and outside the EU. The promising growth in global demand will lead to increasing EU poultry meat exports, especially due to the expected valorisation of different cuts of poultry meat. The leading MSs in poultry meat production are Poland (17 %), Germany (14%) and France (13 %), closely followed by Italy (11%), the UK (10 %) and Spain (9%).

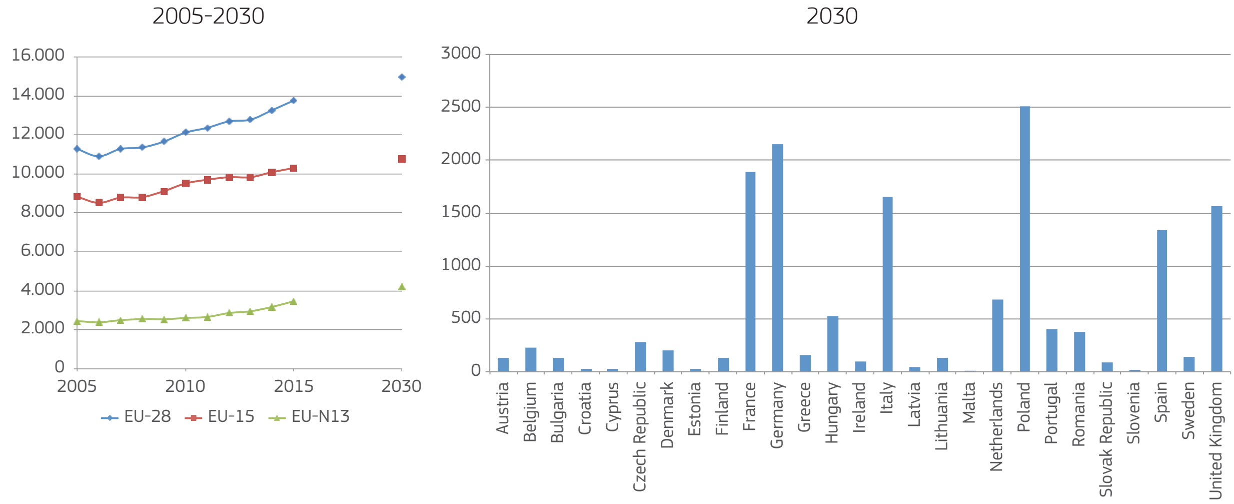



**FIGURE 20:** EU POULTRY MEAT PRODUCTION (1,000 T).
*Note:* 2005-2015: historical data; 2030: CAPRI projection (REF).

The EU is not self-sufficient in the sheep and goat meat sector, and imports considerable quantities of these meats, mainly from New Zealand and Australia. After several years of decrease, the EU production of sheep and goat meat is projected to stabilise and further increase over the projection period, especially in the EU-15 (Figure 21). The production increase is due to profitability increases and increased demand, but also because the majority of sheep-producing MSs decided to implement VCS for sheep farming, which is assumed to remain over the projection period.

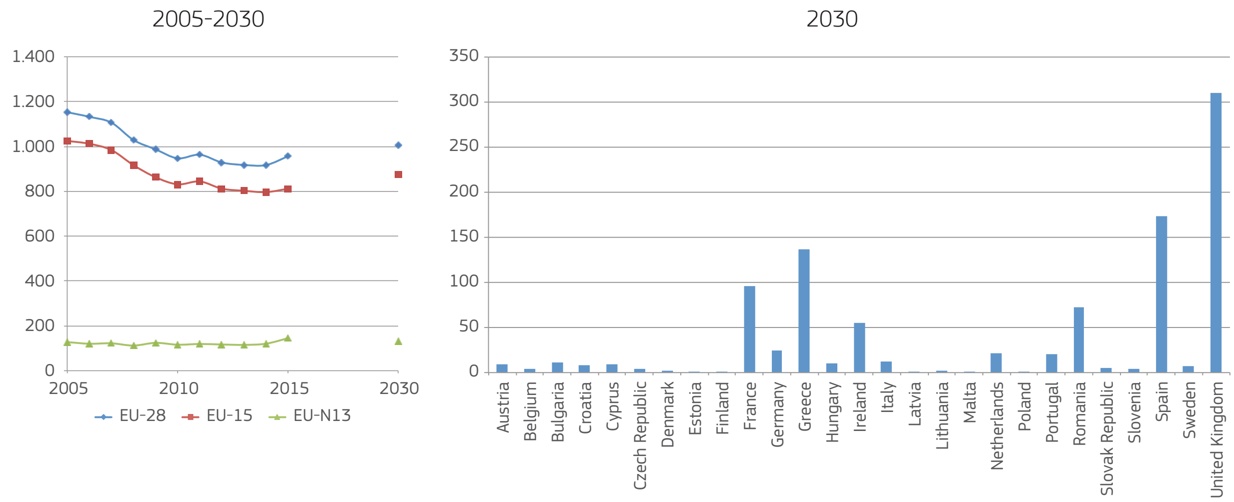



**FIGURE 21:** EU SHEEP AND GOAT MEAT PRODUCTION (1,000 T).
*Note:* 2005-2015: historical data; 2030: CAPRI projection (REF).

The EU net trade balance for meat is expected to remain positive until 2030 as a result of pig and poultry meat exports (Figure 22).

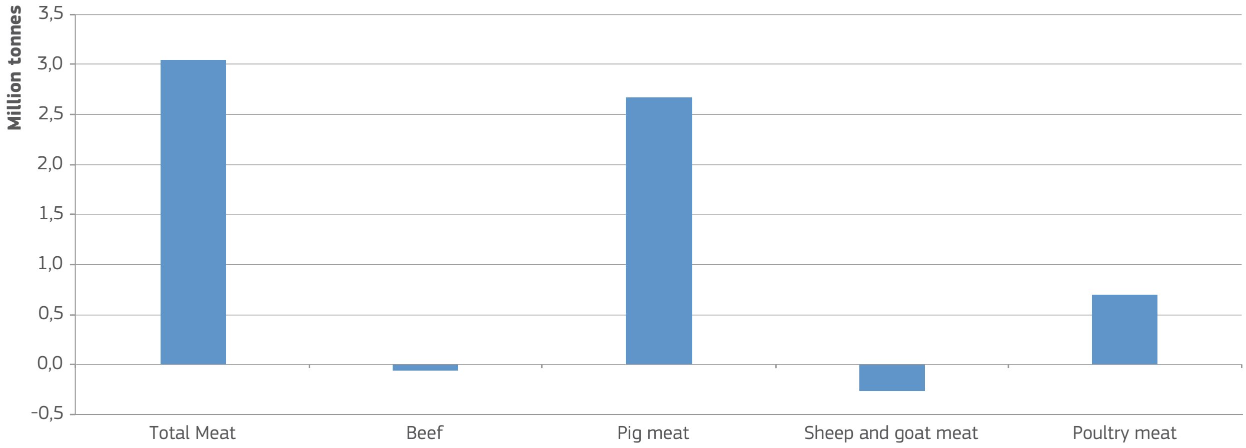



**FIGURE 22:** EU NET TRADE BALANCE FOR MEAT (MILLION T).
*Note:* net trade = exports – imports.

## 5.4 | The EU farm sector

### 5.4.1 Farm structures and land use

Table 18 and Table 19 show the structure of the farm population and land use by farm specialisation and economic farm size in the baseline for the EU-27. The farm population is split into 14 different production specialisations. Out of 4.8 million farms represented in the IFM-CAP model for the EU-27, in terms of numbers, the most abundant farm types are those specialised in mixed crops (14% of all farms), followed by specialist milk (12%) and specialist COP[35] (11%) farms. These three farm specialisations use around 50% of the total agricultural area of the EU-27. The remaining 11 farm specialisations represent individually between 3% and 8% of total farms in the EU-27. As expected, small farms dominate the EU agricultural sector. Farms with an economic size of less than EUR 25,000 standard output (SO)[36] represent 65% of all farms in the EU-27. Farms of medium economic size (between EUR 25,000 and EUR 100,000 SO) account for 22% of the total farm population, while remaining farms (13%) are of large economic size (more than EUR 100,000 SO).

The average farm utilises 34 ha of agricultural land in the EU-27. The largest farms are specialised in COP products, with an average area of 74 ha, followed by specialist cattle farms (51 ha/farm) and specialist sheep and goat farms (40 ha/farm). Farms specialised in horticulture and orchards and fruits are the smallest in the EU-27, cultivating on average less than 10 ha per farm. As expected, farms specialised in field crops (e.g. specialist COP, specialist other field crops) have a larger areas of arable land as a proportion of total UAA than farms specialised in livestock production (e.g. specialist sheep and goat farms, specialist cattle farms). In contrast, farms specialised in animal production (e.g. specialist sheep and goat, specialist cattle and specialist milk farms) have large areas of grassland as a proportion of total agricultural area (Table 18).

Farms of small economic size (smaller than EUR 25,000 SO) operate, on average, with less than 17 ha per farm, while farms of large economic size (more than EUR 100,000 SO) use more than 100 ha per farm. The medium-sized farms (between EUR 25,000 and EUR 100,000 SO) manage, on average, 45 ha per farm. Large farms use around 50% of the agricultural land in the EU-27, while medium-sized and small farms use 30% and 20%, respectively. Large farms tend to have larger areas of arable land as a proportion of total used area, whereas, for small and medium-sized farms, a higher proportion of their total land tends to be grassland (Table 19).

Table 20 and Table 21 describe the structure of livestock numbers by farm specialisation and economic farm size in the EU-27. The average farm in the EU-27 has 8 cows, 16 pigs, 26 sheep and goats, and 200 poultry animals. As expected, the vast majority of livestock animals are on farms specialised in livestock production (specialist milk, specialist sheep and goat, specialist cattle, specialist granivore farms) followed by mixed farms (mixed livestock, mixed crops and livestock farms). With the exception of sheep and goats, most livestock production is carried out by medium-sized farms (between EUR 25,000 and EUR 100,000 SO) and large farms (more than EUR 100,000 SO). These farm size classes account for more than 85% of total livestock numbers. Small farms (between EUR 2,000 and EUR 25,000 SO) account for a relatively large (37%) proportion of total animal numbers for only sheep and goats.

[35] COP crops: cereals, oilseed and protein crops.

[36] The SO is the average monetary value of the agricultural output at farm-gate price calculated by MSs per hectare or per head of livestock, by using data for a reference period of 5 successive years. The SO of the farm is calculated as the sum of the SO of each agricultural product present in the farm multiplied by the number of hectares or heads of livestock of the farm (FADN 2017).

| | Farm population | | UAA | | Arable land | | Grassland | |
|---|---|---|---|---|---|---|---|---|
| | No. farms | % of all farms | Average per farm (UAA/ farm) | % of UAA | Average per farm (arable area/farm) | % of total arable area | Average per farm (grassland/farm) | % of total grassland |
| Specialist COP | 530,964 | 11.1 | 74.2 | 24.7 | 70.8 | 32.5 | 3.4 | 4.1 |
| Specialist other field crops | 396,350 | 8.3 | 39.6 | 9.8 | 36.7 | 12.6 | 2.9 | 2.6 |
| Specialist horticulture | 171,106 | 3.6 | 6.3 | 0.7 | 5.5 | 0.8 | 0.8 | 0.3 |
| Specialist wine | 278,836 | 5.9 | 13.1 | 2.3 | 12.7 | 3.1 | 0.4 | 0.2 |
| Specialist orchards – fruits | 308,322 | 6.5 | 9.8 | 1.9 | 9.3 | 2.5 | 0.6 | 0.4 |
| Specialist olives | 248,741 | 5.2 | 11.1 | 1.7 | 10.8 | 2.3 | 0.4 | 0.2 |
| Permanent crops combined | 131,269 | 2.8 | 11.1 | 0.9 | 10.7 | 1.2 | 0.4 | 0.1 |
| Specialist milk | 588,310 | 12.3 | 37.2 | 13.7 | 21.0 | 10.7 | 16.3 | 21.7 |
| Specialist sheep and goats | 397,736 | 8.3 | 40.4 | 10.1 | 10.0 | 3.5 | 30.4 | 27.4 |
| Specialist cattle | 373,861 | 7.8 | 51.4 | 12.0 | 17.9 | 5.8 | 33.5 | 28.3 |
| Specialist granivores | 147,734 | 3.1 | 37.1 | 3.4 | 33.7 | 4.3 | 3.4 | 1.1 |
| Mixed crops | 191,239 | 4.0 | 22.5 | 2.7 | 21.0 | 3.5 | 1.5 | 0.7 |
| Mixed livestock | 350,960 | 7.4 | 14.4 | 3.2 | 9.9 | 3.0 | 4.5 | 3.6 |
| Mixed crops and livestock | 649,073 | 13.6 | 31.8 | 12.9 | 25.4 | 14.3 | 6.4 | 9.4 |
| EU-27 | 4,764,501 | 100.0 | 33.5 | 100.0 | 24.3 | 100.0 | 9.3 | 100.0 |

**TABLE 18:** FARM STRUCTURE AND AGRICULTURAL AREA BY FARM SPECIALISATION IN THE EU-27 IN THE REFERENCE SCENARIO.

| | Farm population | | UAA | | Arable land | | Grassland | |
|---|---|---|---|---|---|---|---|---|
| | No. farms | % of all farms | Average per farm (UAA/ ha) | % of UAA | Average per farm (arable area/ha) | % of total arable area | Average per farm (grassland/ ha) | % of total grassland |
| EUR 2,000 to < 8,000 | 1,664,756 | 34.9 | 5.6 | 5.9 | 4.2 | 6.1 | 1.4 | 5.3 |
| EUR 8,000 to < 25,000 | 1,454,196 | 30.5 | 16.2 | 14.8 | 11.7 | 14.8 | 4.5 | 14.8 |
| EUR 25,000 to < 100,000 | 1,045,201 | 21.9 | 45.5 | 29.8 | 28.7 | 26.0 | 16.8 | 39.6 |
| EUR 100,000 to < 500,000 | 535,065 | 11.2 | 106.9 | 35.8 | 78.6 | 36.4 | 28.3 | 34.2 |
| ≥ EUR 500,000 | 65,282 | 1.4 | 337.9 | 13.8 | 296.5 | 16.7 | 41.4 | 6.1 |
| EU-27 | 4,764,501 | 100 | 33.5 | 100.0 | 24.3 | 100.0 | 9.3 | 100.0 |

**TABLE 19:** FARM STRUCTURE AND AGRICULTURAL AREA BY ECONOMIC FARM SIZE IN THE EU-27 IN THE REFERENCE SCENARIO.

| | Cows | | Pigs | | Sheep and goats | | Poultry | |
|---|---|---|---|---|---|---|---|---|
| | Average per farm (heads/ farm) | % of all cows | Average per farm (heads/ farm) | % of all pigs | Average per farm (heads/ farm) | % of all sheep and goats | Average per farm (1000 heads/farm) | % of all poultry |
| Specialist COP | 0.8 | 1.1 | 1.0 | 0.7 | 2.8 | 1.2 | 0.0 | 1.6 |
| Specialist other field crops | 0.8 | 0.8 | 1.9 | 1.0 | 2.6 | 0.8 | 0.0 | 0.4 |
| Specialist horticulture | 0.1 | 0.0 | 0.6 | 0.1 | 0.8 | 0.1 | 0.0 | 0.1 |
| Specialist wine | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.0 | 0.0 | 0.0 |
| Specialist orchards – fruits | 0.0 | 0.0 | 0.2 | 0.1 | 0.5 | 0.1 | 0.0 | 0.0 |
| Specialist olives | 0.0 | 0.0 | 0.0 | 0.0 | 1.9 | 0.4 | 0.0 | 0.0 |
| Permanent crops combined | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 0.2 | 0.0 | 0.0 |
| Specialist milk | 35.9 | 55.7 | 1.3 | 0.9 | 3.0 | 1.4 | 0.0 | 0.7 |
| Specialist sheep and goats | 3.1 | 3.3 | 0.5 | 0.3 | 237.9 | 75.6 | 0.0 | 0.3 |
| Specialist cattle | 21.5 | 21.2 | 0.9 | 0.4 | 17.8 | 5.3 | 0.0 | 0.4 |
| Specialist granivores | 2.1 | 0.8 | 378.8 | 71.2 | 2.4 | 0.3 | 5.4 | 80.6 |
| Mixed crops | 0.6 | 0.3 | 1.0 | 0.3 | 2.8 | 0.4 | 0.1 | 1.1 |
| Mixed livestock | 6.3 | 5.8 | 25.8 | 11.5 | 15.9 | 4.5 | 0.2 | 7.4 |
| Mixed crops and livestock | 6.3 | 10.8 | 16.3 | 13.5 | 18.6 | 9.7 | 0.1 | 7.4 |
| EU-27 | 8.0 | 100.0 | 16.5 | 100.0 | 26.3 | 100.0 | 0.2 | 100.0 |

**TABLE 20:** THE STRUCTURE OF LIVESTOCK NUMBERS BY FARM SPECIALISATION IN THE EU-27 IN THE REFERENCE SCENARIO.

| | Cows | | Pigs | | Sheep and goats | | Poultry | |
|---|---|---|---|---|---|---|---|---|
| | Average per farm (heads/ farm) | % of all cows | Average per farm (heads/ farm) | % of all pigs | Average per farm (heads/ farm) | % of all sheep and goats | Average per farm (1000 heads/farm) | % of all poultry |
| EUR 2,000 to < 8,000 | 1 | 5.9 | 1.4 | 2.9 | 14.3 | 19.0 | 0.0 | 7.8 |
| EUR 8,000 to < 25,000 | 2 | 8.4 | 2.5 | 4.7 | 15.5 | 18.0 | 0.0 | 1.2 |
| EUR 25,000 to < EUR 100,000 | 10 | 27.5 | 6.4 | 8.5 | 43.5 | 36.3 | 0.0 | 3.9 |
| EUR 100,000 to < 500,000 | 32 | 45.6 | 53.9 | 36.7 | 59.8 | 25.5 | 0.6 | 31.0 |
| ≥ EUR 500,000 | 73 | 12.6 | 568.4 | 47.2 | 22.7 | 1.2 | 8.6 | 56.1 |
| EU-27 | 0 | 100 | 16.5 | 100.0 | 26.3 | 100.0 | 0.2 | 100.0 |

**TABLE 21:** THE STRUCTURE OF LIVESTOCK NUMBERS BY ECONOMIC FARM SIZE IN THE EU-27 IN THE REFERENCE SCENARIO.

## 5.4.2 Farm income

Table 22 and Table 23 show the per hectare farm income[37] and farm subsidies as a proportion of total farm income by farm specialisation and economic size class, respectively, for the reference scenario in the EU-27.

As shown in Tables 22 and 23, the farm income varies substantially among the different farm types in the EU. The average farm income is around EUR 2,115/ha in the EU-27. The highest income per ha (more than EUR 4,000/ha) is observed on farms specialised in horticulture, wine, orchards, fruits and mixed crops. These farm types usually produce high-value products and tend to be labour intensive. The lowest per hectare income (less than EUR 1,000/ha) is found on land-intensive farms such as farms specialised in COP crops and cattle. Farms with other types of specialisation have incomes ranging between EUR 1,200/ha and EUR 3,600/ha.

Regarding farm size, larger farms tend to have higher per hectare incomes than smaller farms (Table 23). Farms specialised in activities with high per hectare production value (e.g. horticulture and some animal activities) often have high production volumes and thus are included in the large economic size class which explains the differences in the per hectare income between small and large farms.

Figure 23 shows that most farms (52%) have incomes of between EUR 50/ha and EUR 2,000/ha. Only a small proportion of farms (2.7%) have a negative income in the reference scenario (Figure 24). This concerns farms whose revenue obtained from the sale of agricultural products and subsidies does not fully cover the costs of variables such as fertilisers, pesticides, seeds, feed, etc. These farms represent the most vulnerable group because they are not able to cover basic production-related expenses. These farms also have limited potential to guarantee the renovation of capital and machinery or farm growth or to pay labour costs, and thus many of the farmers in question might be under pressure to exit farming. This means that more farms would attain negative income when labour and capital costs are included in the income calculation. This also implies that the farms with negative incomes reported in Figure 24 are the most vulnerable farms from the economic viability point of view, and thus they represent a lower bound of the number of farms that are at risk of exiting farming. Figure 24 shows that the UAA of these negative-income farms represents 3.1% of total UAA in the EU-27.

The most subsidy-dependent farm types are those specialised in cattle, COP and olives, with their subsidies representing 32%, 26% and 23% of their total incomes, respectively. These farms are expected to be most affected by the CAP reforms, which aim to reduce agricultural support. The farms that are least dependent on subsidies (with subsidies accounting for less than 10% of their total incomes) are those specialised in horticulture, wine, mixed crops, and granivores (Table 22). Small farms are more dependent on subsidies than large farms. Subsidies represent between 15% and 20% of total farm income in small and medium-sized farms (less than EUR 100,000 SO). In large farms (larger than EUR 100,000 SO), subsidies

[37] Note that the farm income is calculated as the difference between farm revenues, including coupled and decoupled subsidies, and variable input costs (fertilisers, pesticides, feed, seeds and other specific costs). We do not explicitly model labour and capital in IFM-CAP, but they are captured by the quadratic terms of the behavioural activity function. Hence, wage costs are not included in the income calculation as well as other variable costs expenditures (e.g. rental costs) (for more details see Louhichi et al., 2017a, b).

account for between 9% and 10% of farm income (Table 23). At individual level, for many farms subsidies account for a substantial proportion of total income: around 37% of farms receive subsidies that account for more than 20% of their total incomes (Figure 25).

| | Farm income (EUR/ha) | Subsidy (% of farm income) |
|---|---|---|
| Specialist COP | 817 | 26.3 |
| Specialist other field crops | 2,237 | 12.6 |
| Specialist horticulture | 27,418 | 1.2 |
| Specialist wine | 4,515 | 4.9 |
| Specialist orchards – fruits | 4,401 | 8.0 |
| Specialist olives | 1,787 | 23.1 |
| Permanent crops combined | 2,705 | 10.1 |
| Specialist milk | 3,664 | 8.9 |
| Specialist sheep and goats | 1,284 | 17.0 |
| Specialist cattle | 975 | 31.8 |
| Specialist granivores | 3,316 | 8.0 |
| Mixed crops | 4,301 | 5.8 |
| Mixed livestock | 2,442 | 10.6 |
| Mixed crops and livestock | 1,637 | 15.7 |
| EU-27 | 2,115 | 12.5 |

**TABLE 22:** FARM INCOME AND SUBSIDIES BY FARM SPECIALISATION IN THE EU-27 IN THE REFERENCE SCENARIO.
*Source:* Scenar 2030. IFM-CAP model.

| | Farm income (EUR/ha) | Subsidy (% of farm income) |
|---|---|---|
| 2,000 to < 8,000 EUR | 1,594 | 15.6 |
| 8,000 to < 25,000 EUR | 1,346 | 19.5 |
| 25,000 to < 100,000 EUR | 1,692 | 16.0 |
| 100,000 to < 500,000 EUR | 2,542 | 10.5 |
| ≥ 500,000 EUR | 2,963 | 8.7 |
| EU-27 | 2,115 | 12.5 |

**TABLE 23:** FARM INCOME AND SUBSIDIES BY ECONOMIC FARM SIZE IN THE EU-27 IN THE REFERENCE SCENARIO.
*Source:* Scenar 2030. IFM-CAP model.

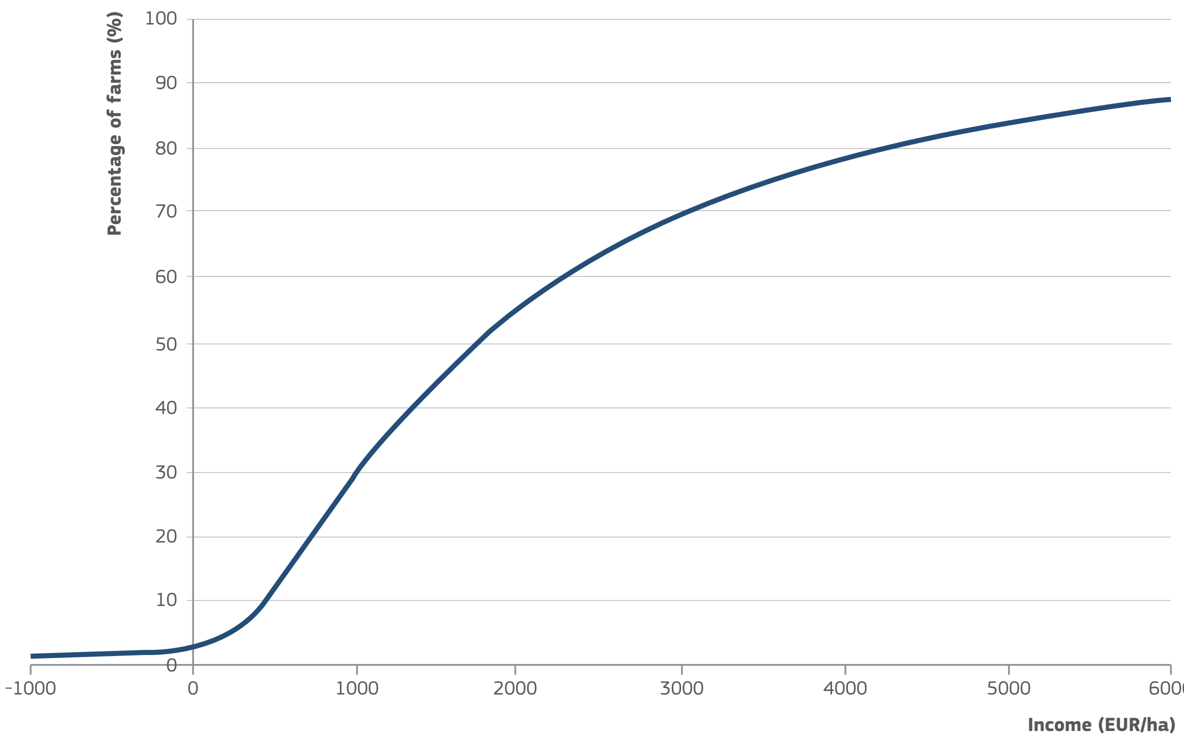



**FIGURE 23:** THE DISTRIBUTION OF FARM INCOME (EUR/HA) ACROSS THE FARM POPULATION IN THE EU-27 IN THE REFERENCE SCENARIO.
*Source:* Scenar 2030, IFM-CAP model.

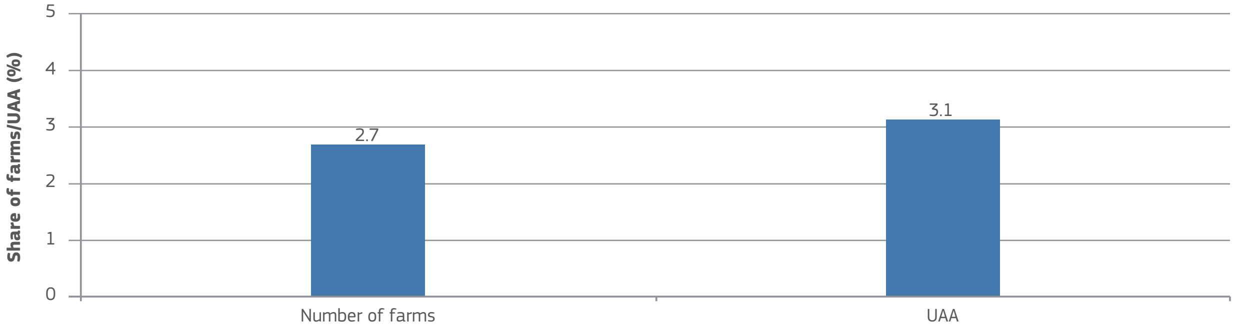



**FIGURE 24:** FARMS WITH NEGATIVE INCOME IN THE EU-27 IN THE REFERENCE SCENARIO (% OF ALL FARMS/UAA).
*Source:* Scenar 2030, IFM-CAP model.

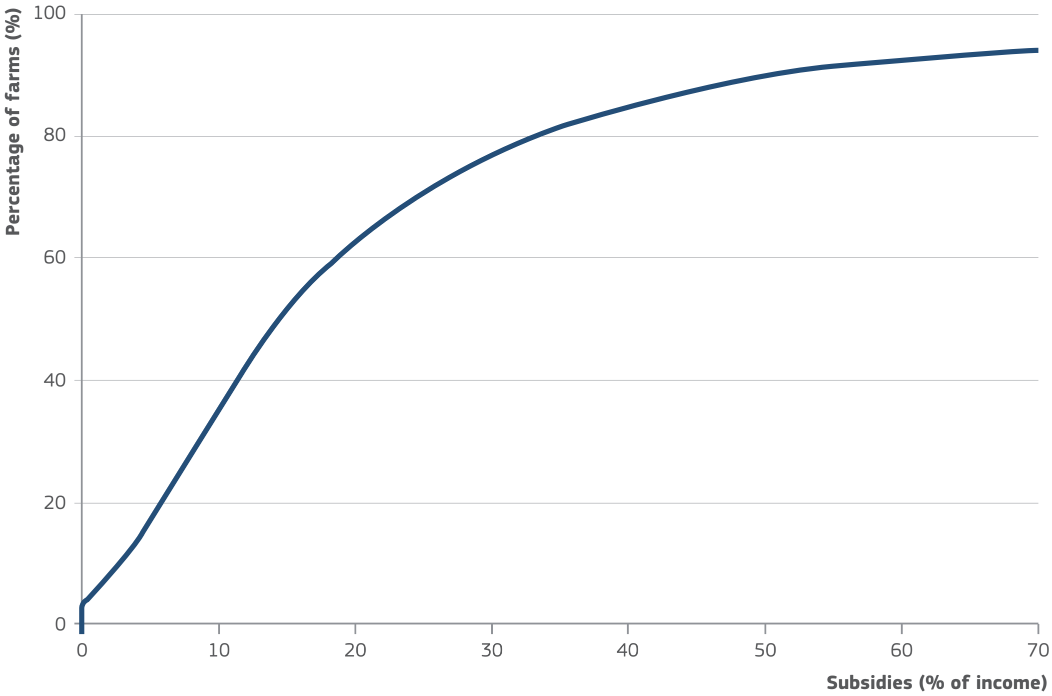



**FIGURE 25:** THE DISTRIBUTION OF SUBSIDIES (PERCENTAGE OF FARM INCOME) ACROSS THE FARM POPULATION IN THE EU-27 IN THE REFERENCE SCENARIO.
*Source:* Scenar 2030, IFM-CAP model.

## 5.5 | Environmental indicators

### 5.5.1 Nitrogen surplus

The N-surplus is the balance between inputs and outputs of nitrogen to and from the farm. It increases with mineral fertiliser application and also with manure brought from outside. High levels of N-surplus indicate higher losses of nitrogen to the atmosphere (through ammonia and $N_2O$ emissions) and the water (through nitrates and eutrophication). The average N-surplus in the reference scenario is indicated at about 62.9 kg N/ha UAA by 2030. This implies a slight decrease in average N-surplus compared with 2015, which is mostly related to some regional decreases in animal herd sizes. Figure 26 shows some regions with particularly high levels of N-surplus: north-western Germany, Belgium and the Netherlands, Brittany, Catalonia, Lombardy, Ireland and Northern Ireland.

### 5.5.2 Greenhouse gas emissions

Non-$CO_2$ GHG emissions of the EU agricultural sector are projected to amount to 433 million tonnes $CO_2$e by 2030 (Figure 27). Reflecting the absolute size of the agricultural sector, France (17%), Germany (15%) and the UK (11%) account for almost 45% of agricultural GHG emissions in the EU. Further considerable emissions are also projected for Spain (9% of EU agriculture emissions), Poland (7%), Italy and Ireland (6% each), and the Netherlands (5%).

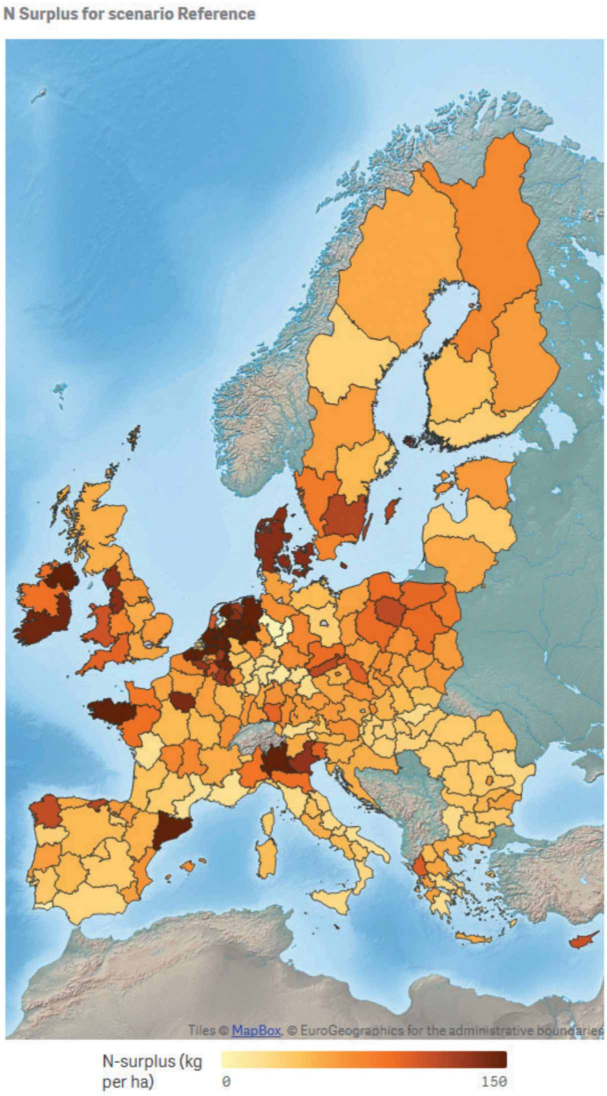



**FIGURE 26:** N-SURPLUS PROJECTED FOR 2030 (KG N/HA OF UAA).

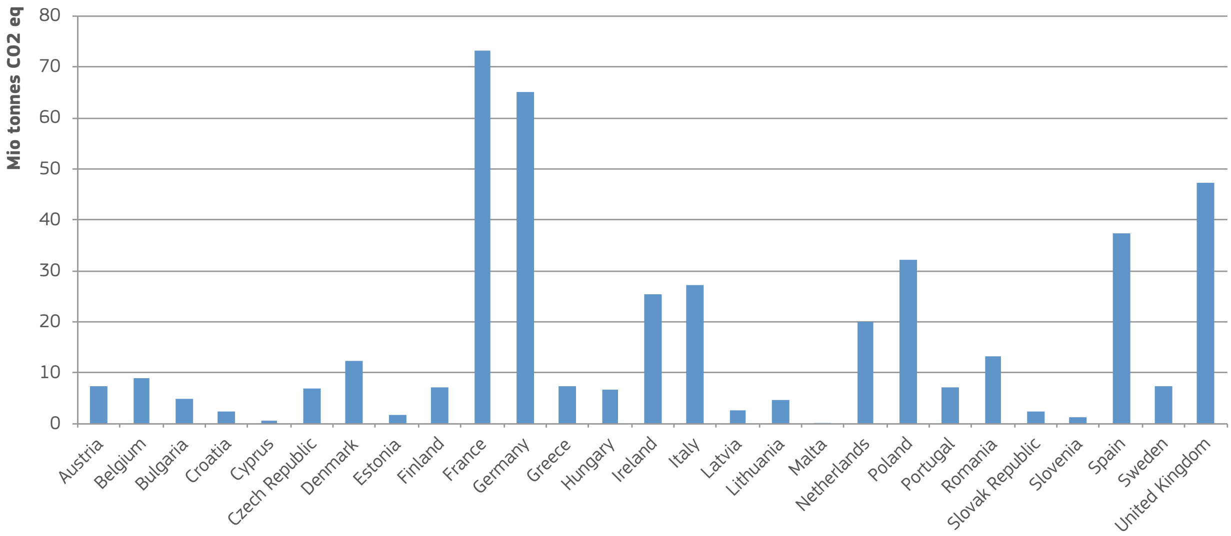



**FIGURE 27:** AGRICULTURAL NON-$CO_2$ EMISSIONS PROJECTED FOR 2030.
*Source:* Scenar 2030, CAPRI model.

6

# SCENARIOS: ECONOMIC **EFFECTS IN A GLOBAL CONTEXT**

# 6 Scenarios: economic effects in a global context

## 6.1 | The CAP budget

The description of the CAP budget and welfare impacts follow the methodology published by Boulanger & Philippidis (2014 and 2015). Table 24 presents the revenues and costs corresponding to the CAP budget in the reference scenario for the year 2016. The first row shows total CAP receipts of EUR 53,371 million accruing to the EU-28 MSs (EUR 38,947 million to the EU-15 and EUR 14,424 million to the EU-13). This total is split between the first and second pillars (Pillar 2 figures exclude nationally co-financed support) amounting to EUR 41,355 million and EUR 12,016 million, respectively. Of the former, decoupled payments total EUR 26,801 million, greening payments amount to EUR 11,322 million and remaining coupled payments sum to EUR 3,232 million. Contributions to the CAP budget are financed by tariff revenues and a uniform EU-wide percentage of each MS's GDP. The rebate row in Table 19 accounts for the net impacts on EU MSs from both UK rebate and additional corrective payments.

The 'net position' row shows that the 'old' EU-15 (except Greece, Ireland, Portugal and Spain) are net contributors to the CAP budget, while the newer MSs (as expected) are net beneficiaries. This observation underlies the redistributive nature of the CAP. A closer look reveals that France is the largest recipient of CAP funding, but makes significant payments to the CAP budget and the UK rebate, while receiving no special dispensation.

On the basis of these estimates, a CAP budget cut would benefit net contributors (or be of detriment to net beneficiaries) in the form of a taxpayer savings (or losses). In the model, income changes feedback to each economy as an increase (or decrease) in expenditure and savings. This effect is demonstrated in the lower part of Table 24 (parts C and D). As an initial observation, the results are consistent for all scenarios in terms of the comparative magnitudes across regions and whether or not the estimates are positive or negative.

For the Lib&Prod scenario, in comparison with the baseline, the following observations can be made with regard to the estimates for 2030. First, CAP budget cuts are expected to lead to strong reductions in the CAP receipts in all countries. Second, most of the net contributors are expected to be in a positive net position, i.e. the removal of the calculated CAP contribution is higher than the loss of CAP receipts. This is the case in particular for Belgium, Germany, Italy, the Netherlands, Sweden and the UK. Third, among the largest losers (losses of > EUR 400 million) are Bulgaria, Croatia, France, Greece, Hungary, Ireland, Poland, Romania and Spain.

The Inc&Env scenario predicts much smaller impacts on the CAP budget. Compared with the size of the payments, only Croatia would have a tangible reduction from its initial net position.

| A. CAP budget estimates in 2016 | EU-28 | EU-13 | EU-15 | AT | BE | BG | HR | CY | CZ | DK | EE | FI | FR | DE | EL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. CAP receipts | 53,371 | 14,424 | 38,947 | 1,204 | 565 | 1,091 | 786 | 72 | 1,120 | 899 | 218 | 806 | 8,426 | 5,771 | 2,285 |
| Pillar 1: decoupled | 26,801 | 6,862 | 19,939 | 420 | 292 | 526 | 510 | 34 | 556 | 560 | 78 | 319 | 4,396 | 3,277 | 1,122 |
| Pillar 1: coupled | 3,232 | 394 | 2,838 | 79 | 87 | 43 | 8 | 3 | 34 | 13 | 1 | 50 | 969 | 18 | 257 |
| Pillar 1: greening | 11,322 | 2,777 | 8,545 | 180 | 125 | 226 | 55 | 15 | 238 | 240 | 33 | 137 | 1,884 | 1,405 | 481 |
| *Pillar 1: total* | *41,355* | *10,033* | *31,322* | *678* | *504* | *795* | *573* | *51* | *829* | *814* | *112* | *506* | *7,249* | *4,700* | *1,860* |
| Pillar 2: ANC/LFA | 2,238 | 822 | 1,416 | 135 | 3 | 30 | 72 | 4 | 67 | 0 | 4 | 115 | 437 | 146 | 90 |
| Pillar 2: agri-environmental | 3,794 | 1,208 | 2,586 | 264 | 19 | 100 | 31 | 9 | 138 | 30 | 40 | 118 | 254 | 408 | 62 |
| Pillar 2: physical capital | 3,207 | 1,206 | 2,001 | 42 | 23 | 82 | 66 | 4 | 45 | 40 | 39 | 22 | 235 | 263 | 172 |
| Pillar 2: human capital | 1,763 | 767 | 996 | 37 | 10 | 41 | 24 | 3 | 23 | 10 | 15 | 32 | 178 | 103 | 87 |
| Pillar 2: wider development | 1,013 | 387 | 626 | 46 | 5 | 43 | 19 | 1 | 19 | 6 | 8 | 13 | 74 | 151 | 15 |
| *Pillar 2: total* | *12,016* | *4,391* | *7,625* | *525* | *61* | *295* | *212* | *21* | *292* | *85* | *106* | *300* | *1,177* | *1,071* | *426* |
| 2. CAP contribution | 53,371 | 4,624 | 48,748 | 1,182 | 1,901 | 166 | 227 | 81 | 666 | 1,006 | 84 | 703 | 8,152 | 11,168 | 749 |
| 3. Rebates | 0 | -507 | 507 | -45 | -172 | -18 | -20 | -8 | -73 | 39 | -8 | -82 | -916 | -403 | -85 |
| 4. Net position | 0 | 9,294 | -9,294 | -23 | -1,508 | 906 | 539 | -16 | 381 | -68 | 126 | 22 | -643 | -5,801 | 1,452 |

**TABLE 24:** CAP BUDGET (EUR MILLIONS, 2016 PRICES).

*TABLE CONTINUES ON NEXT PAGE →*

| B. CAP budget estimates in 2030 | EU-28 | EU-13 | EU-15 | AT | BE | BG | HR | CY | CZ | DK | EE | FI | FR | DE | EL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. CAP receipts | 45,475 | 12,076 | 33,399 | 1,008 | 482 | 924 | 911 | 55 | 962 | 792 | 231 | 693 | 7,335 | 5,051 | 2,053 |
| 2. CAP contribution | 45,475 | 4,407 | 41,068 | 997 | 1,535 | 166 | 213 | 84 | 609 | 868 | 83 | 602 | 6,745 | 9,344 | 661 |
| 3. Rebates | 0 | –517 | 517 | –38 | –152 | –20 | –22 | –9 | –71 | 14 | –9 | –75 | –802 | –335 | –80 |
| 4. Net position | 0 | 7,152 | –7,151 | –27 | –1,206 | 739 | 676 | –37 | 282 | –61 | 140 | 17 | –212 | –4,627 | 1,312 |
| **C. Lib&Prod vs. baseline in 2030** | **EU-28** | **EU-13** | **EU-15** | **AT** | **BE** | **BG** | **HR** | **CY** | **CZ** | **DK** | **EE** | **FI** | **FR** | **DE** | **EL** |
| 1. CAP receipts | 11,156 | 4,067 | 7,090 | 335 | 91 | 306 | 256 | 13 | 200 | 132 | 115 | 177 | 1,068 | 1,048 | 534 |
| 2. CAP contribution | 11,156 | 1,123 | 10,034 | 216 | 449 | 40 | 71 | 28 | 155 | 228 | 26 | 131 | 1,631 | 2,313 | 151 |
| 3. Rebates | 0 | –233 | 233 | –26 | –69 | –9 | –10 | –4 | –32 | 70 | –4 | –34 | –362 | –230 | –36 |
| 4. Net position | 0 | 2,711 | –2,711 | 93 | –427 | 257 | 175 | –19 | 13 | –27 | 84 | 13 | –926 | –1,495 | 347 |
| **D. Inc&Env vs. baseline in 2030** | **EU-28** | **EU-13** | **EU-15** | **AT** | **BE** | **BG** | **HR** | **CY** | **CZ** | **DK** | **EE** | **FI** | **FR** | **DE** | **EL** |
| 1. CAP receipts | 44,042 | 11,461 | 32,581 | 1,138 | 419 | 948 | 595 | 65 | 996 | 706 | 242 | 755 | 6,709 | 4,897 | 2,085 |
| 2. CAP contribution | 44,041 | 4,267 | 39,774 | 964 | 1,495 | 161 | 206 | 82 | 590 | 840 | 81 | 582 | 6,527 | 9,053 | 639 |
| 3. Rebates | 0 | –475 | 475 | –36 | –140 | –18 | –20 | –8 | –65 | 23 | –8 | –68 | –736 | –319 | –73 |
| 4. Net position | 1 | 6,719 | –6,718 | 137 | –1,215 | 769 | 369 | –25 | 340 | –111 | 153 | 104 | –554 | –4,475 | 1,373 |

**TABLE 24:** CAP BUDGET (EUR MILLIONS, 2016 PRICES).
*Source:* Scenar 2030. MAGNET model.

| A. CAP budget estimates in 2016 | HU | IE | IT | LV | LT | LU | MT | NL | PL | PT | RO | SK | SI | ES | SE | UK |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. CAP receipts | 1,769 | 1,485 | 5,017 | 331 | 613 | 43 | 14 | 810 | 4,672 | 1,178 | 2,885 | 603 | 250 | 5,819 | 912 | 3,727 |
| Pillar 1: decoupled | 893 | 818 | 2,474 | 137 | 297 | 22 | 4 | 487 | 2,254 | 281 | 1,198 | 288 | 88 | 2,894 | 467 | 2,109 |
| Pillar 1: coupled | 67 | 21 | 283 | 5 | 13 | 0 | 0 | 23 | 102 | 249 | 90 | 16 | 13 | 761 | 3 | 25 |
| Pillar 1: greening | 383 | 351 | 1,060 | 59 | 127 | 10 | 2 | 209 | 966 | 120 | 513 | 124 | 38 | 1,240 | 200 | 904 |
| *Pillar 1: total* | *1,342* | *1,190* | *3,817* | *200* | *437* | *32* | *5* | *719* | *3,321* | *650* | *1,801* | *428* | *138* | *4,896* | *670* | *3,038* |
| Pillar 2: ANC/LFA | 11 | 93 | 109 | 30 | 29 | 4 | 1 | 2 | 235 | 111 | 244 | 60 | 34 | 77 | 44 | 52 |
| Pillar 2: agri–environmental | 146 | 129 | 355 | 28 | 33 | 4 | 1 | 34 | 306 | 89 | 307 | 38 | 32 | 262 | 116 | 443 |
| Pillar 2: physical capital | 174 | 20 | 457 | 53 | 58 | 2 | 4 | 39 | 360 | 215 | 261 | 38 | 23 | 353 | 21 | 94 |
| Pillar 2: human capital | 65 | 21 | 175 | 12 | 33 | 1 | 2 | 10 | 321 | 73 | 193 | 17 | 17 | 172 | 33 | 56 |
| Pillar 2: wider development | 30 | 33 | 103 | 8 | 23 | 0 | 0 | 7 | 128 | 41 | 79 | 24 | 5 | 59 | 28 | 45 |
| *Pillar 2: total* | *427* | *295* | *1,200* | *130* | *176* | *11* | *9* | *91* | *1,350* | *529* | *1,084* | *175* | *112* | *923* | *242* | *689* |
| 2. CAP contribution | 410 | 747 | 5,875 | 97 | 159 | 175 | 58 | 2,478 | 1,636 | 649 | 571 | 308 | 160 | 4,261 | 1,632 | 8,071 |
| 3. Rebates | –47 | –84 | –674 | –10 | –16 | –21 | –4 | 648 | –185 | –75 | –67 | –34 | –16 | –482 | 156 | 2,703 |
| 4. Net position | 1,312 | 654 | –1,533 | 223 | 438 | –153 | –47 | –1,020 | 2,850 | 454 | 2,247 | 261 | 73 | 1,076 | –564 | –1,640 |
| **B. CAP budget estimates in 2030** | **HU** | **IE** | **IT** | **LV** | **LT** | **LU** | **MT** | **NL** | **PL** | **PT** | **RO** | **SK** | **SI** | **ES** | **SE** | **UK** |
| 1. CAP receipts | 1,418 | 1,230 | 4,147 | 361 | 585 | 38 | 15 | 675 | 3,417 | 954 | 2,508 | 485 | 203 | 4,816 | 758 | 3,368 |
| 2. CAP contribution | 381 | 640 | 4,423 | 98 | 139 | 158 | 55 | 2,029 | 1,572 | 545 | 563 | 291 | 153 | 3,764 | 1,363 | 7,393 |
| 3. Rebates | –46 | –77 | –534 | –11 | –15 | –20 | –4 | 495 | –189 | –67 | –71 | –34 | –17 | –451 | 117 | 2,521 |
| 4. Net position | 990 | 512 | –810 | 252 | 431 | –140 | –44 | –859 | 1,656 | 342 | 1,874 | 160 | 34 | 601 | –488 | –1,505 |
| **C. Lib&Prod vs. baseline in 2030** | **HU** | **IE** | **IT** | **LV** | **LT** | **LU** | **MT** | **NL** | **PL** | **PT** | **RO** | **SK** | **SI** | **ES** | **SE** | **UK** |
| 1. CAP receipts | 466 | 150 | 1,358 | 124 | 198 | 9 | 16 | 111 | 1,111 | 439 | 1,014 | 165 | 82 | 1,018 | 160 | 460 |
| 2. CAP contribution | 89 | 139 | 1,083 | 27 | 39 | 31 | 29 | 469 | 375 | 119 | 120 | 77 | 45 | 907 | 306 | 1,861 |
| 3. Rebates | –21 | –35 | –242 | –5 | –7 | –9 | –2 | 519 | –85 | –30 | –32 | –15 | –8 | –204 | 133 | 789 |
| 4. Net position | 356 | –24 | 33 | 92 | 152 | –30 | –15 | 161 | 651 | 289 | 862 | 73 | 30 | –93 | –13 | –612 |
| **D. Inc&Env vs. baseline in 2030** | **HU** | **IE** | **IT** | **LV** | **LT** | **LU** | **MT** | **NL** | **PL** | **PT** | **RO** | **SK** | **SI** | **ES** | **SE** | **UK** |
| 1. CAP receipts | 1,365 | 1,247 | 3,823 | 348 | 532 | 37 | 10 | 616 | 3,147 | 933 | 2,537 | 456 | 223 | 4,907 | 773 | 3,536 |
| 2. CAP contribution | 369 | 620 | 4,280 | 95 | 135 | 153 | 54 | 1,967 | 1,521 | 526 | 545 | 282 | 148 | 3,643 | 1,318 | 7,167 |
| 3. Rebates | –42 | –71 | –490 | –10 | –14 | –18 | –3 | 499 | –174 | –62 | –65 | –31 | –15 | –414 | 119 | 2,261 |
| 4. Net position | 953 | 557 | –947 | 243 | 384 | –135 | –48 | –852 | 1,453 | 345 | 1,927 | 143 | 59 | 850 | –426 | –1,371 |

**TABLE 25: CONT.:** CAP BUDGET (EUR MILLIONS, 2016 PRICES).
Source: Scenar 2030. MAGNET model.

## 6.2 | Growth and welfare

Effects on GDP are predicted to be very small (slightly negative) in the Inc&Env scenario, but more sizeable in both the Lib&Prod and NoCAP scenarios. By showing changes predicted for 2025 and 2030, Figure 28 takes advantage of the dynamic feature of MAGNET and predicts a better situation for almost all countries in 2030 than in 2025. Consistent with the CAP budget analysis and the redistributive nature of the policy, a consistent outcome is expected to be a negative impact on 'new' EU-13 MSs (and CAP budget net beneficiaries). The NoCAP scenario predicts a more negative impact on the EU-13 than the Lib&Prod scenario does. This latter scenario predicts an increase of EU-28 GDP by about 0.2% by 2030. As shown in Figure 29, countries such as Germany and Italy would have GDP increases of 0.3% and 0.5% compared with the baseline. The most-affected countries would be Greece (–0.7%) and, within the EU-13, Bulgaria and Lithuania, which would face 0.4% and 0.5% reductions in GDP, respectively. The NoCAP scenario predicts damages to EU-13 GDP but gains for the EU-15 MSs implies a positive change overall for the EU-28. GDP falls are elevated for Greece (–1.5%) and Cyprus (–1.7%).

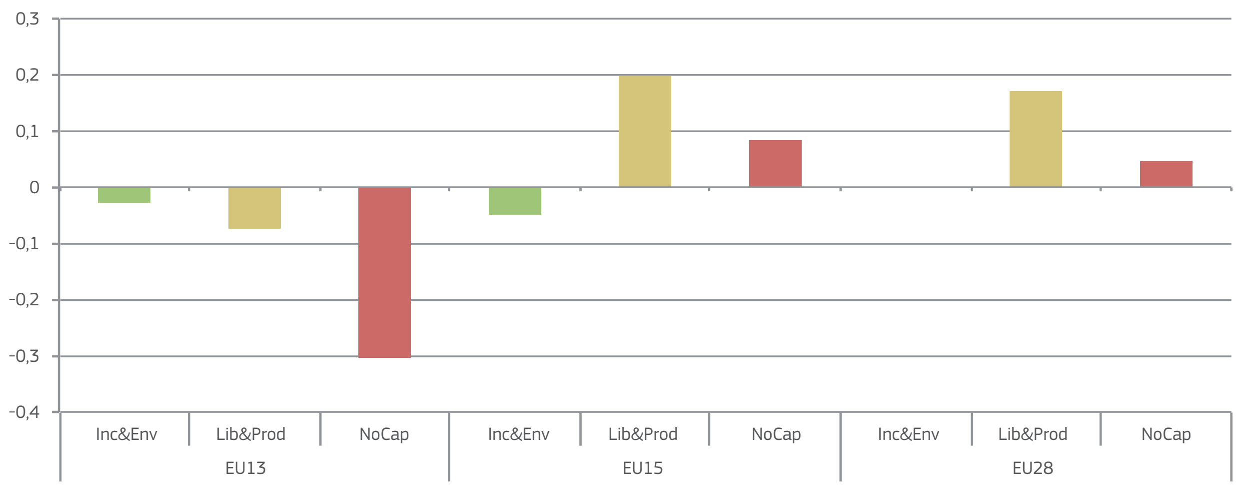



**FIGURE 28:** GDP, CHANGE FROM BASELINE (%), 2025 AND 2030.
*Source:* Scenar 2030, MAGNET model.

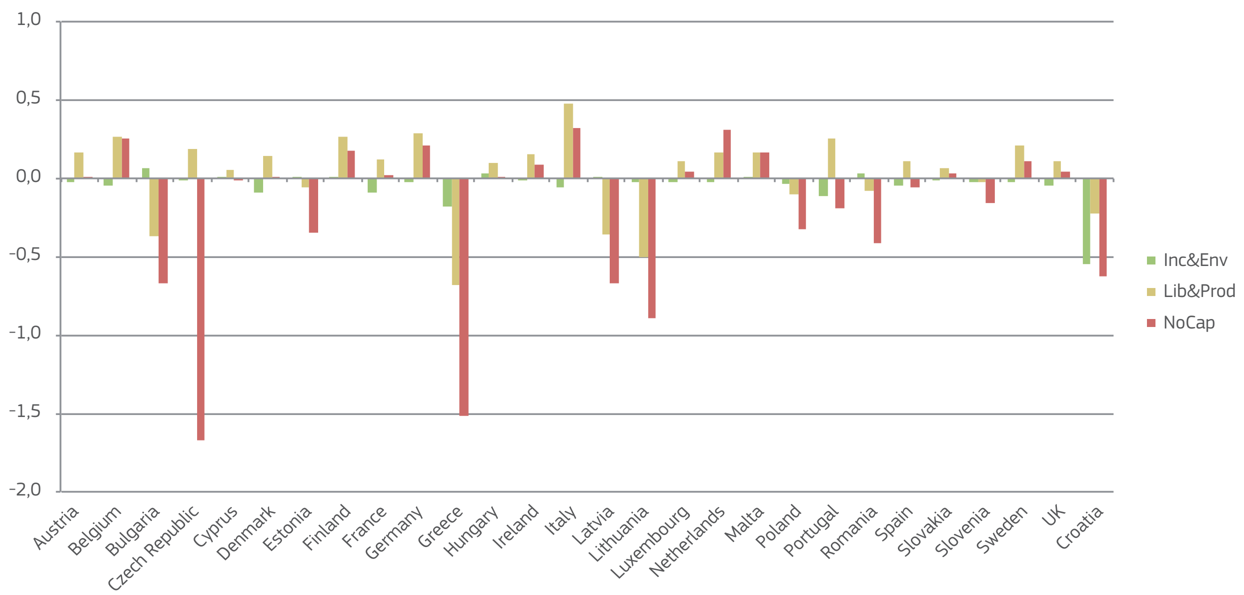



**FIGURE 29:** GDP, CHANGE FROM BASELINE (%), 2030.
*Source:* Scenar 2030, MAGNET model.

The description of the CAP budget is the exact accountancy of payments and receipts by MSs according to the current policies and the assumed changes in the scenarios. The welfare impacts instead take into account the impacts of the scenarios on the economy, presented as the real income or equivalent variation (EV) changes.

Figure 30 shows the change in welfare by EU aggregates and presents its decomposition to better understand where the impacts or changes come from.

The EV results in the Lib&Prod scenario, with a EUR 19.2 billion welfare gain, show losses accruing to the 'new' EU-13 states vis-à-vis EV gains of the 'old' EU-15 states. This result is driven by the CAP budget, but also changes in 'allocative efficiency' (i.e. efficiency gains that arise from changing resources or product usage in the presence of market distortions), and 'technology effects' (i.e. money metric equivalent from improvements in output or input augmenting technical change). Moreover, the 'terms of trade' effect (i.e. the unit price ratio of exchange between exports and imports) in the EU regions is the net result of (1) a change in agri-food prices resulting from adjustments in agricultural support, and (2) changes in the real exchange rate (i.e. factor prices). The Inc&Env scenario suggests a slightly negative EV of EUR 2.3 billion, with higher losses for the EU-15 than the Lib&Prod scenario. Remarkably, a NoCAP scenario would have a positive impact on EU-28 welfare, of EUR 2.3 billion, corresponding to a gain of EUR 15.9 billion for the 'old' EU-15 states and a loss of EUR 13.6 billion for the 'new' EU-13 states.

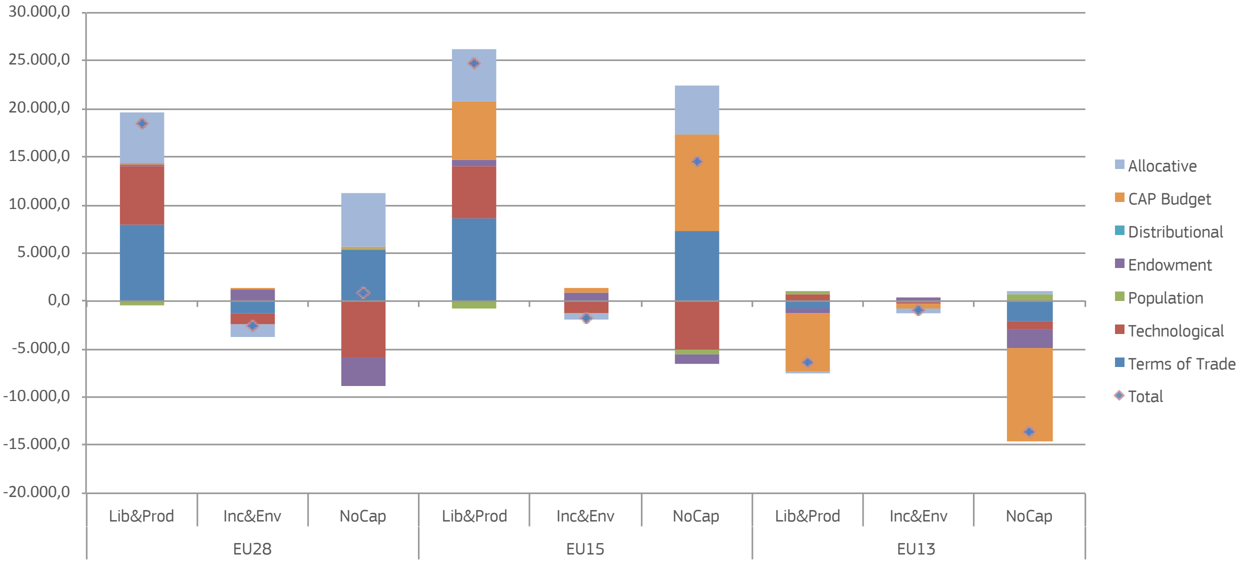



**FIGURE 30:** EV DECOMPOSITION BY EU AGGREGATES, 2030 (EUR MILLIONS, SCENARIOS VS. REFERENCE).
*Source:* Scenar 2030, MAGNET model.

## 6.3 | Market impacts (in terms of value)

Agri-food production will fall by about 1% under the Lib&Prod scenario while it remains stable under the Inc&Env scenario. The fall under the NoCAP scenario is even more pronounced, reaching almost 6% (Figure 31).[38]

From sectorial point of view, the most notable difference appears in the dairy sector which, under the Lib&Prod scenario, thanks to the increased market access in many third countries, increases production by about 1%, while, under the Inc&Env scenario, production decreases by more than 1% (Table 26 and Table 27).

Main differences between scenarios emerge when analysing the causes of the changes in production. Under the Lib&Prod scenario, the increase in imports (15% of agri-food imports) is one of the key factors accounting for the decrease in domestic production. Under the Inc&Env scenario, domestic policy changes are the main trigger for the change in production, while trade flows remain almost unchanged, with a limited decrease in exports and only a reduced increase in imports.

The policy measure with the highest impact on agriculture production is the removal of the first pillar. Based on analysis of the shock decomposition, the removal of decoupled payments will have a negative effect on agricultural production, decreasing production by about 4% compared with the baseline (the decrease would only be about 2% under the Inc&Env scenario). Under the NoCAP scenario, the removal of Pillar 2 has an effect (–4%) similar to the effect of removing Pillar 1 (Figure 31).

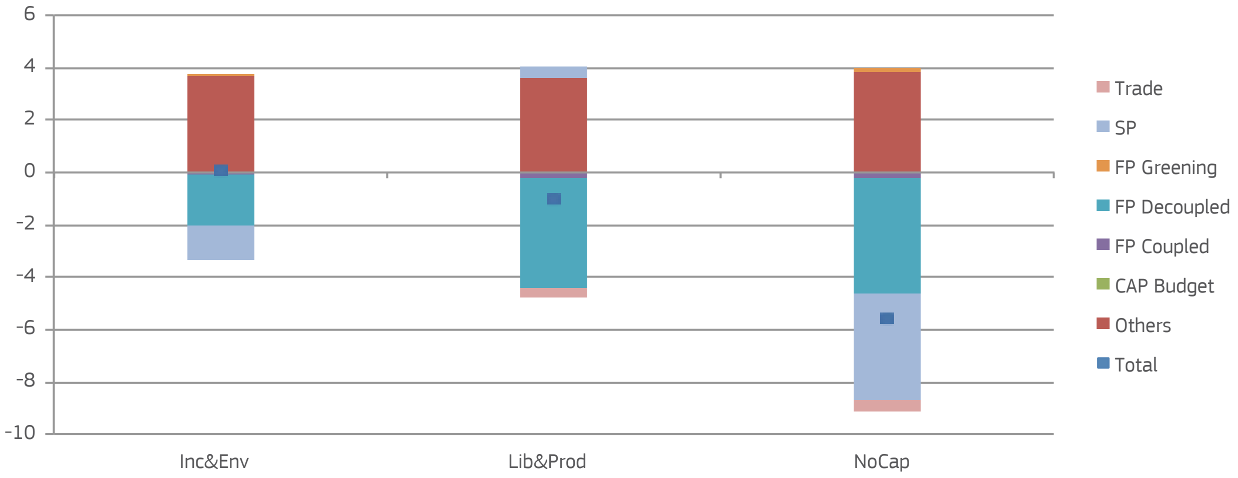



**FIGURE 31:** DECOMPOSITION OF POLICY MEASURES ON AGRICULTURAL OUTPUT COMPARED WITH BASELINE, 2030.
*Source:* Scenar 2030, MAGNET model.

| | Production | | | Import | | | Export | | | Use | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Wheat | 27,898 | 30,126 | 30,821 | 3,639 | 3,145 | 2,983 | 6,762 | 7,915 | 8,336 | 24,775 | 25,357 | 25,468 |
| Rice | 3,321 | 3,342 | 3,477 | 1,231 | 1,215 | 1,079 | 44 | 46 | 37 | 4,508 | 4,511 | 4,519 |
| Other cereals | 27,669 | 28,761 | 28,953 | 2,282 | 2,142 | 2,002 | 2,628 | 2,777 | 2,797 | 27,322 | 28,126 | 28,158 |
| Oilseeds | 14,306 | 15,531 | 15,731 | 9,773 | 9,557 | 9,450 | 2,068 | 2,139 | 1,924 | 22,011 | 22,949 | 23,257 |
| Oils & meals | 33,722 | 34,625 | 34,943 | 19,569 | 19,226 | 18,551 | 5,692 | 6,043 | 5,879 | 47,599 | 47,809 | 47,615 |
| Raw sugar | 3,508 | 3,601 | 3,589 | 98 | 91 | 82 | 0 | 0 | 0 | 3,606 | 3,691 | 3,670 |
| Sugar | 19,258 | 19,573 | 19,482 | 5,942 | 5,869 | 5,402 | 3,996 | 4,094 | 3,608 | 21,204 | 21,348 | 21,277 |
| Fruits & veg. | 58,477 | 61,287 | 61,740 | 14,871 | 13,007 | 12,592 | 1,177 | 1,428 | 1,382 | 72,171 | 72,866 | 72,950 |

**TABLE 26:** PRODUCTION, IMPORTS, EXPORTS AND DOMESTIC USE, 2030, EUR MILLION, 2011 PRICES, EU-28.
*TABLE CONTINUES ON NEXT PAGE →*

[38] The reader is reminded that results for a similar indicator can vary from one model to the other. The authors decided to provide a complete picture with a comprehensive result description.

| | Production | | | Import | | | Export | | | Use | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Other crops | 59,047 | 62,446 | 63,487 | 18,682 | 16,647 | 15,832 | 2,227 | 2,778 | 2,730 | 75,502 | 76,315 | 76,590 |
| Cattle | 28,714 | 29,329 | 29,966 | 1,224 | 1,176 | 1,089 | 1,359 | 1,369 | 951 | 28,578 | 29,135 | 30,103 |
| Beef & sheep meat | 46,519 | 47,356 | 49,702 | 9,648 | 9,253 | 5,508 | 2,856 | 3,092 | 1,818 | 53,310 | 53,516 | 53,392 |
| Pig & poultry | 63,981 | 66,948 | 67,947 | 1,657 | 1,514 | 1,505 | 1,836 | 2,109 | 2,084 | 63,802 | 66,353 | 67,367 |
| Pig & poultry meat | 134,778 | 139,520 | 141,395 | 9,318 | 8,097 | 4,930 | 9,643 | 11,394 | 9,789 | 134,453 | 136,222 | 136,536 |
| Raw milk | 57,647 | 60,524 | 59,492 | 0 | 0 | 0 | 1,650 | 2,639 | 2,609 | 55,998 | 57,886 | 56,884 |
| Dairy | 305,852 | 313,299 | 306,300 | 465 | 409 | 136 | 27,308 | 29,894 | 24,578 | 279,009 | 283,814 | 281,858 |
| Bev. & tobacco | 330,659 | 331,324 | 330,976 | 7,798 | 7,775 | 7,420 | 41,168 | 41,304 | 40,488 | 297,289 | 297,795 | 297,908 |
| Other food | 467,904 | 470,675 | 472,712 | 43,263 | 42,855 | 38,447 | 36,321 | 36,870 | 34,407 | 474,847 | 476,661 | 476,752 |

**TABLE 26:** PRODUCTION, IMPORTS, EXPORTS AND DOMESTIC USE, 2030, EUR MILLION, 2011 PRICES, EU-28.
*Source:* Scenar 2030, MAGNET model.

| | Production | | | Import | | | Export | | | Use | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Wheat | −12.90 | −5.94 | −3.77 | 31.86 | 13.98 | 8.10 | −25.18 | −12.42 | −7.76 | −3.79 | −1.53 | −1.10 |
| Rice | −4.86 | −4.25 | −0.39 | 15.09 | 13.53 | 0.87 | 18.85 | 22.60 | −1.80 | −0.34 | −0.26 | −0.08 |
| Other cereals | −6.34 | −2.64 | −1.99 | 18.45 | 11.15 | 3.90 | −10.09 | −5.01 | −4.34 | −4.28 | −1.47 | −1.35 |
| Oilseeds | −13.44 | −6.03 | −4.82 | 4.98 | 2.66 | 1.51 | 0.88 | 4.35 | −6.14 | −7.47 | −3.52 | −2.23 |
| Oils & meals | −4.78 | −2.23 | −1.33 | 6.79 | 4.92 | 1.24 | −6.30 | −0.52 | −3.22 | −0.14 | 0.30 | −0.10 |
| Raw sugar | −2.69 | −0.11 | −0.45 | 20.45 | 11.01 | −0.02 | −33.62 | −13.64 | −6.11 | −2.17 | 0.14 | −0.44 |
| Sugar | −1.28 | 0.33 | −0.13 | 10.16 | 8.82 | 0.15 | 11.25 | 13.99 | 0.45 | −0.50 | 0.18 | −0.16 |
| Fruits & veg. | −7.24 | −2.78 | −2.06 | 26.06 | 10.26 | 6.74 | −22.11 | −5.54 | −8.56 | −1.57 | −0.63 | −0.51 |
| Other crops | −8.96 | −3.71 | −2.11 | 23.53 | 10.08 | 4.69 | −25.93 | −7.62 | −9.20 | −1.91 | −0.85 | −0.50 |
| Cattle | −5.15 | −3.12 | −1.01 | 14.93 | 10.41 | 2.22 | 39.96 | 40.93 | −2.09 | −5.89 | −4.05 | −0.87 |
| Beef & sheep meat | −6.94 | −5.26 | −0.57 | 79.53 | 72.19 | 2.50 | 54.14 | 66.89 | −1.89 | −0.37 | 0.02 | −0.21 |
| Pig & poultry | −7.42 | −3.12 | −1.68 | 14.96 | 5.05 | 4.44 | −17.24 | −4.89 | −6.02 | −6.62 | −2.89 | −1.41 |
| Pig & poultry meat | −5.86 | −2.55 | −1.24 | 101.58 | 75.15 | 6.65 | −8.03 | 8.68 | −6.64 | −2.08 | −0.79 | −0.56 |
| Raw milk | −5.80 | −1.09 | −2.78 | 341.73 | 72.72 | 73.70 | −50.54 | −20.89 | −21.78 | −3.22 | 0.05 | −1.69 |
| Dairy | −1.32 | 1.08 | −1.18 | 267.16 | 223.46 | 7.21 | 5.72 | 15.73 | −4.85 | −1.84 | −0.15 | −0.84 |
| Bev. & tobacco | −0.17 | 0.03 | −0.08 | 5.24 | 4.94 | 0.13 | 1.54 | 1.87 | −0.14 | −0.27 | −0.10 | −0.06 |
| Other food | −1.25 | −0.66 | −0.23 | 13.04 | 11.97 | 0.45 | 4.88 | 6.47 | −0.64 | −0.55 | −0.17 | −0.15 |

**TABLE 27:** PRODUCTION, IMPORTS, EXPORTS AND DOMESTIC USE, 2030, EU-28, CHANGE (%) FOR SCENARIOS VS. BASELINE.
*Source:* Scenar 2030. MAGNET model.

Compared with 2016, the index of agricultural production for 2030 is slightly higher in the Inc&Env scenario, almost equal in the Lib&Prod scenario and significantly lower in the NoCAP scenario. The index of food industry production increases in all scenarios, although to a slightly lesser extent than in the baseline, with the lowest growth being in the NoCAP situation (Figure 32).

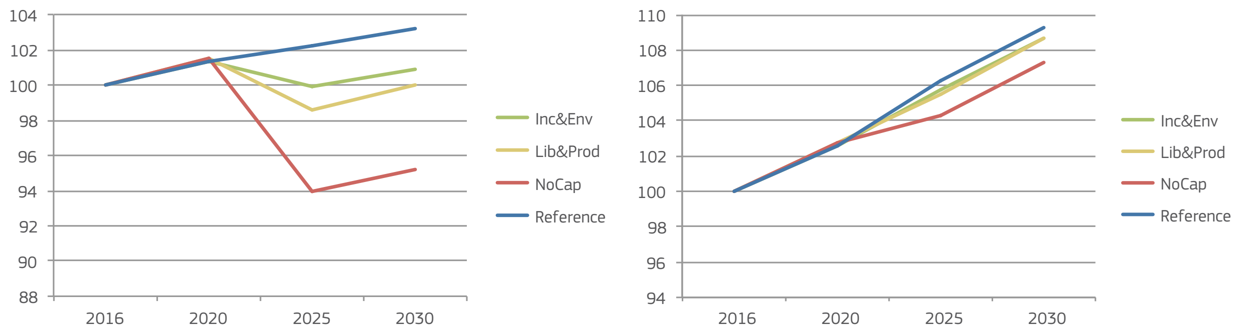
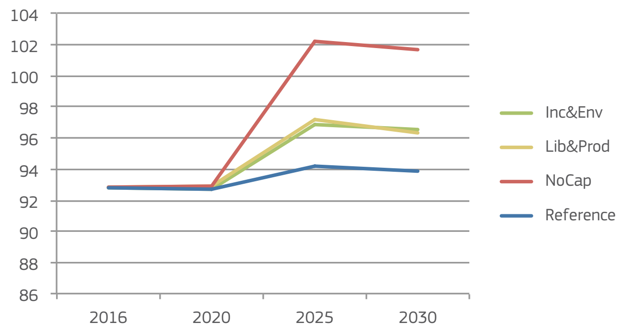



**FIGURE 32:** INDEX OF AGRICULTURAL (LEFT) AND FOOD INDUSTRY (RIGHT) PRODUCTION IN THE EU-28, 2016-2030 (2016 = 100).
*Source:* Scenar 2030, MAGNET model.

The market prices of agricultural products are slightly higher according to Lib&Prod scenario while NoCAP predicts a slight decrease of the price and Inc&Env a more pronounced fall. Food industry product prices show a declining trend, without notable differences between the scenarios and the baseline (Figure 33).



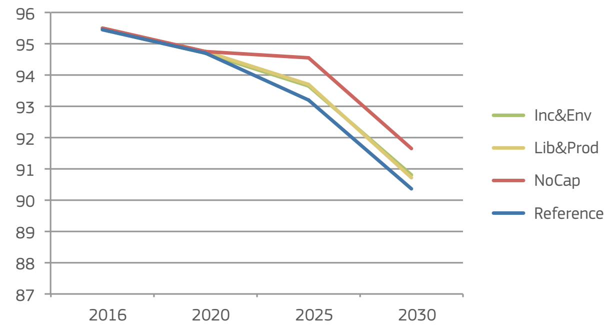




**FIGURE 33:** AGRICULTURE (LEFT) AND FOOD INDUSTRY (RIGHT) PRICES, 2016-2030, IN THE EU-28 (2011 = 100).
*Source:* Scenar 2030, MAGNET model.

The aggregated land price in the EU-28 is expected to show a clear pattern of change between 2011 and 2030 (Figure 34). In the baseline, the price is almost stable, while the changes to the CAP under the different scenarios are expected to have opposite effects on land price. Under the Lib&Prod scenario, both Pillar 1 and 2 shocks are causing a decrease in land price, whereas under the Inc&Env scenario, the reverse is true (Figure 35).

In the case of the Lib&Prod scenario, the decrease is due to the removal of Pillar 1 payments, which are (partially) capitalised into land.

In the case of the Inc&Env scenario, the redirection of payments into greening and agro-environmental payments, which are entirely capitalised into land, is the main force behind the land price increase in the EU.

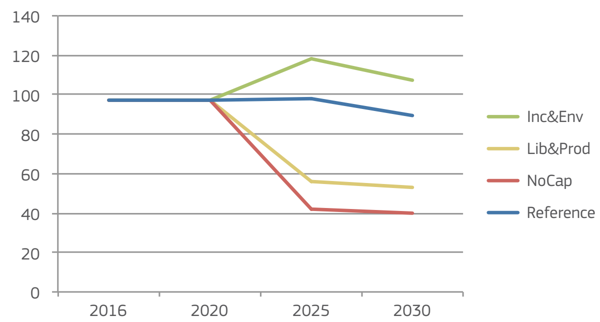



**FIGURE 34:** LAND PRICE (2011 = 100), BASELINE AND SCENARIOS.
*Source:* Scenar 2030, MAGNET model.

Looking at individual MSs, the pattern is similar (i.e. a decease under the Lib&Prod and an increase under the Inc&Enc scenarios) with very few exceptions (e.g. Malta and Luxembourg). Nevertheless, the magnitude of the shocks varies according to the MS, mainly depending on the initial level of capitalisation of Pillar 1 payments into land.

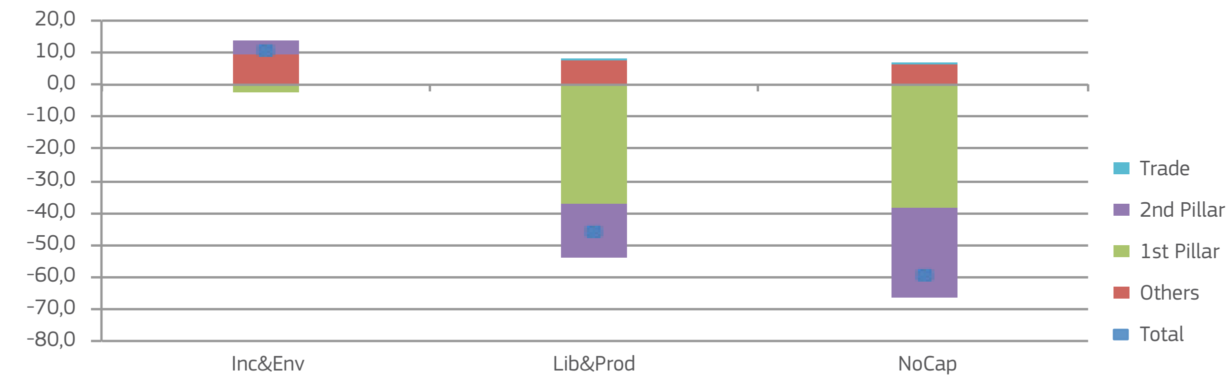



**FIGURE 35:** LAND PRICE DECOMPOSITION, 2011-2030, EU-28, DIFFERENCE (%) FROM BASELINE (DECOMPOSITION) AND TOTAL.
*Source:* Scenar 2030, MAGNET model.

# 6.4 | Trade

## 6.4.1 Trade balance

All three scenarios are detrimental in terms of the EU agri-food trade balance, which worsens by between EUR 30 billion under the Inc&Env scenario and EUR 53 billion under the NoCAP scenario. The combination of CAP removal or reduction and trade liberalisation policies causes a higher increase in imports than in exports (Table 28).

Again, sectoral differences highlight how the EU is highly competitive in high value-added food industry sectors, such as the dairy and beverages and tobacco sectors, where, under all three scenarios, the trade balance improves to very similar extents (Figure 36, Figure 37 and Figure 38).

As already underlined in Boulanger et al. (2016a), the region where trade competitiveness erodes the most is Mercosur, where trade policies have the strongest impacts, in particular on the beef meat sector. On the other hand, the Asian FTA region, which includes Japan, is the region where EU exports are gaining most momentum, under all scenarios (Table 28).

| | NAFTA | | | Mercosur | | | China | | | Australia & New Zealand | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Wheat | −1,762 | −1,510 | −1,469 | −34 | −28 | −29 | 2 | 3 | 4 | −122 | −101 | −95 |
| Rice | −67 | −66 | −47 | −19 | −19 | −15 | −7 | −6 | −7 | 0 | 0 | 0 |
| Other cereals | −492 | −458 | −427 | −537 | −510 | −446 | 201 | 215 | 228 | −35 | −32 | −18 |
| Oilseeds | −2,704 | −2,654 | −2,601 | −4,552 | −4,459 | −4,453 | −191 | −183 | −179 | −582 | −576 | −578 |
| Oils & meals | −216 | −164 | −85 | −6,722 | −6,646 | −6,808 | 32 | 45 | 47 | −2 | 6 | 117 |
| Raw sugar | −10 | −9 | −2 | −1 | −1 | 0 | −3 | −2 | −3 | 0 | 0 | 0 |
| Sugar | 298 | 324 | 159 | −2,155 | −2,149 | −1,495 | 8 | 9 | 8 | −71 | −68 | −30 |
| Fruits & veg. | −2,315 | −2,003 | −1,853 | −1,496 | −1,316 | −1,083 | −144 | −122 | −124 | −295 | −257 | −224 |
| Other crops | −414 | −266 | −180 | −8,112 | −7,227 | −6,636 | 122 | 202 | 208 | −208 | −177 | −171 |
| Cattle | −681 | −640 | −589 | −6 | −5 | −4 | 9 | 9 | 9 | 14 | 18 | 19 |
| Beef & sheep meat | −601 | −559 | −537 | −4,704 | −4,554 | −1,718 | 392 | 408 | 427 | −3,306 | −3,153 | −2,388 |
| Pig & poultry | −312 | −271 | −268 | −207 | −187 | −165 | 521 | 648 | 638 | −111 | −100 | −99 |
| Pig & poultry meat | −327 | −128 | 63 | −4,107 | −3,593 | −1,688 | 383 | 498 | 510 | −448 | −326 | 111 |
| Raw milk | 182 | 336 | 332 | 25 | 43 | 40 | 39 | 69 | 75 | 39 | 48 | 49 |
| Dairy | 6,513 | 7,164 | 4,109 | 583 | 636 | 272 | 815 | 926 | 960 | 608 | 706 | 686 |
| Bev. & tobacco | 11,449 | 11,501 | 11,576 | 614 | 611 | 453 | 2,251 | 2,260 | 2,272 | −58 | −54 | 13 |
| Other food | 414 | 584 | 1,789 | −2,434 | −2,434 | −1,129 | −3,902 | −3,829 | −3,918 | 1,100 | 1,127 | 1,121 |
| Feed | −170 | −166 | −165 | −103 | −102 | −103 | −171 | −162 | −156 | −2 | −2 | −1 |
| Total | 8,786 | 11,014 | 9,808 | −33,968 | −31,942 | −25,006 | 357 | 987 | 999 | −3,477 | −2,941 | −1,488 |

| | Asian FTA | | | LDCs | | | Rest of the World | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Wheat | −1,762 | −1,510 | −1,469 | −34 | −28 | −29 | 2 | 3 | 4 | −3,709 | −3,171 | −3,083 |
| Rice | −67 | −66 | −47 | −19 | −19 | −15 | −7 | −6 | −7 | −186 | −183 | −138 |
| Other cereals | −492 | −458 | −427 | −537 | −510 | −446 | 201 | 215 | 228 | −1,693 | −1,538 | −1,308 |
| Oilseeds | −2,704 | −2,654 | −2,601 | −4,552 | −4,459 | −4,453 | −191 | −183 | −179 | −15,475 | −15,168 | −15,044 |
| Oils & meals | −216 | −164 | −85 | −6,722 | −6,646 | −6,808 | 32 | 45 | 47 | −13,815 | −13,524 | −13,574 |
| Raw sugar | −10 | −9 | −2 | −1 | −1 | 0 | −3 | −2 | −3 | −27 | −25 | −11 |
| Sugar | 298 | 324 | 159 | −2,155 | −2,149 | −1,495 | 8 | 9 | 8 | −3,769 | −3,701 | −2,687 |
| Fruits & veg. | −2,315 | −2,003 | −1,853 | −1,496 | −1,316 | −1,083 | −144 | −122 | −124 | −8,205 | −7,140 | −6,343 |
| Other crops | −414 | −266 | −180 | −8,112 | −7,227 | −6,636 | 122 | 202 | 208 | −17,016 | −14,760 | −13,385 |
| Cattle | −681 | −640 | −589 | −6 | −5 | −4 | 9 | 9 | 9 | −1,341 | −1,253 | −1,147 |
| Beef & sheep meat | −601 | −559 | −537 | −4,704 | −4,554 | −1,718 | 392 | 408 | 427 | −13,132 | −12,563 | −6,042 |

**TABLE 28:** TRADE BALANCE, DIFFERENCE FROM BASELINE (REAL VALUES).

*TABLE CONTINUES ON NEXT PAGE →*

| | Asian FTA | | | LDCs | | | Rest of the World | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Pig & poultry | –312 | –271 | –268 | –207 | –187 | –165 | 521 | 648 | 638 | –107 | 278 | 313 |
| Pig & poultry meat | –327 | –128 | 63 | –4,107 | –3,593 | –1,688 | 383 | 498 | 510 | –8,550 | –6,773 | –2,118 |
| Raw milk | 182 | 336 | 332 | 25 | 43 | 40 | 39 | 69 | 75 | 534 | 943 | 945 |
| Dairy | 6,513 | 7,164 | 4,109 | 583 | 636 | 272 | 815 | 926 | 960 | 16,429 | 18,158 | 11,367 |
| Bev. & tobacco | 11,449 | 11,501 | 11,576 | 614 | 611 | 453 | 2,251 | 2,260 | 2,272 | 28,570 | 28,689 | 28,614 |
| Other food | 414 | 584 | 1,789 | –2,434 | –2,434 | –1,129 | –3,902 | –3,829 | –3,918 | –10,743 | –10,232 | –5,394 |
| Feed | –170 | –166 | –165 | –103 | –102 | –103 | –171 | –162 | –156 | –891 | –861 | –851 |
| Total | 8,786 | 11,014 | 9,808 | –33,968 | –31,942 | –25,006 | 357 | 987 | 999 | –53,127 | –42,823 | –29,887 |

**TABLE 28: CONT:** TRADE BALANCE, DIFFERENCE FROM BASELINE (REAL VALUES).
*Source:* Scenar 2030, MAGNET model.

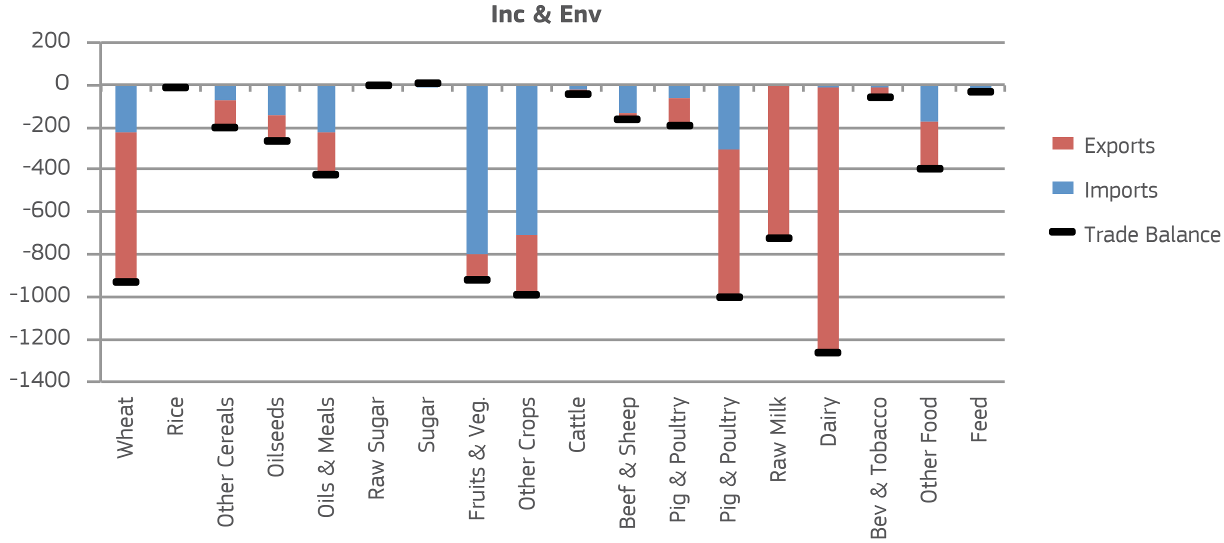



**FIGURE 36:** CHANGES IN IMPORTS, EXPORTS AND TRADE BALANCE IN DIFFERENCE FROM BASELINE (REAL VALUES), INC&ENV SCENARIO.
*Source:* Scenar 2030, MAGNET model.

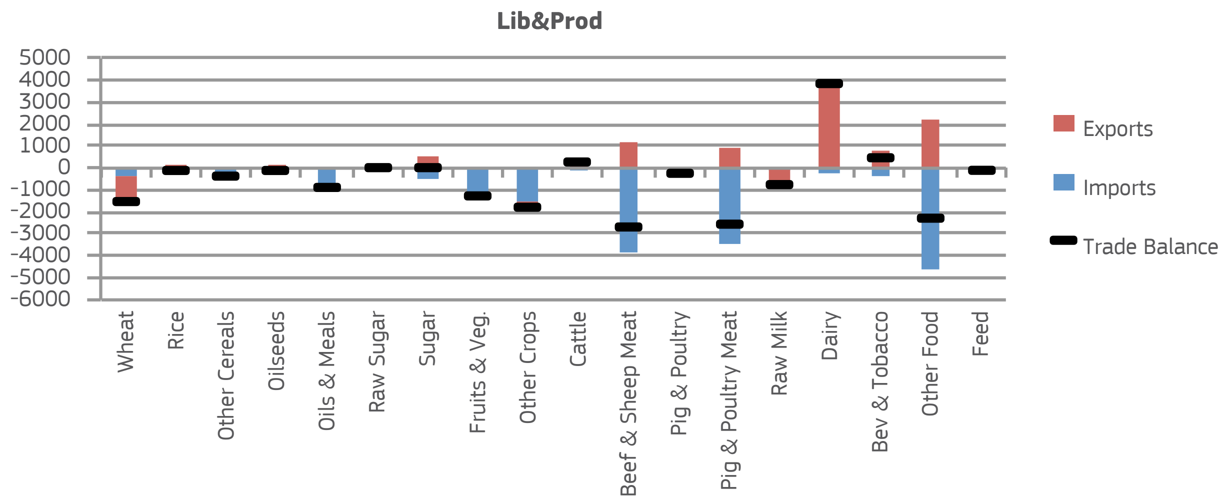



**FIGURE 37:** CHANGES IN IMPORTS, EXPORTS AND TRADE BALANCE IN DIFFERENCE FROM BASELINE (REAL VALUES), LIB&PROD SCENARIO.
*Source:* Scenar 2030, MAGNET model.

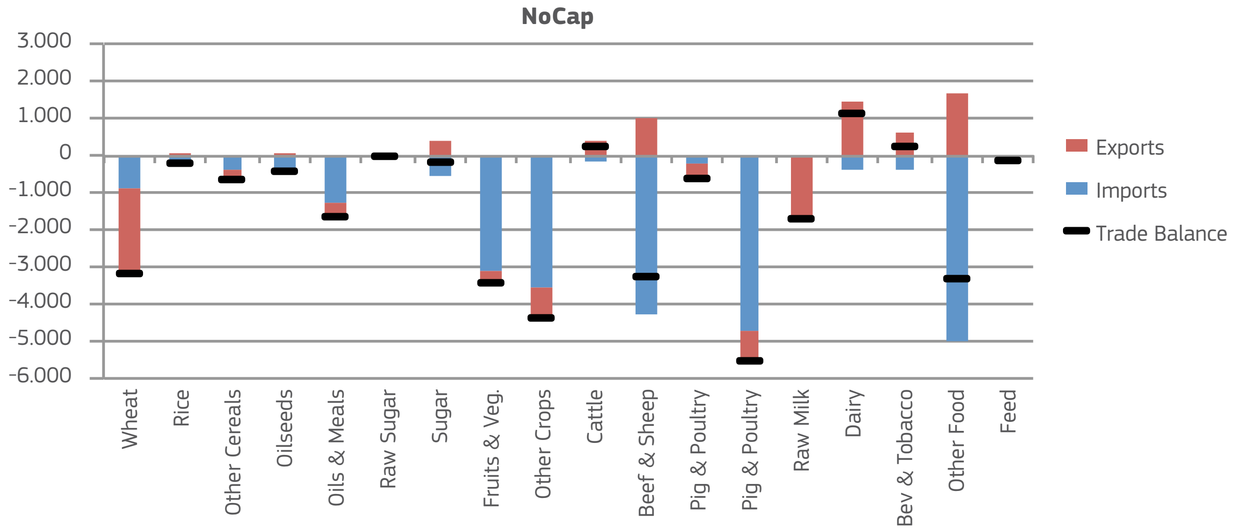



**FIGURE 38:** CHANGES IN IMPORTS, EXPORTS AND TRADE BALANCE IN DIFFERENCE FROM BASELINE (REAL VALUES), NOCAP SCENARIO.
*Source:* Scenar 2030, MAGNET model.

## 6.4.2 Self-sufficiency

An analysis of exports (and imports) as a share of production illustrates the state of self-sufficiency in the EU-28. For wheat, oils and meals, the ratio of exports to production is highest in the Inc&Env scenario. The ratios of exports to production are similar in both the NoCAP and Lib&Prod scenarios; under these scenarios, oilseeds, sugar, meat and dairy are the products that demonstrate the highest ratio of exports to production (Figure 39).

With regard to imports as a share of production, under the Inc&Env scenario, an improvement in self-sufficiency for all products is predicted, by contrast with both the NoCAP and Lib&Prod scenarios (Figure 40). As expected, the NoCAP scenario is associated with the lowest degree of self-sufficiency.

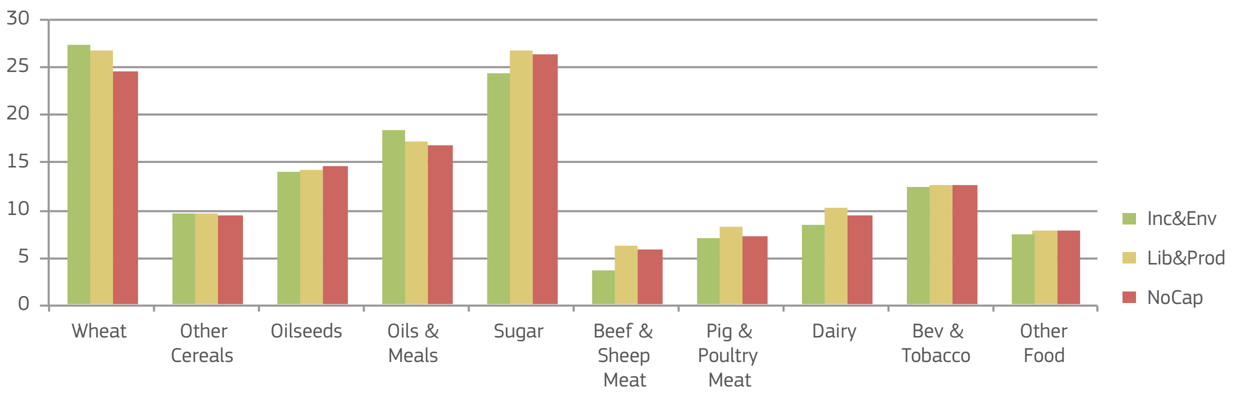



**FIGURE 39:** EXPORTS AS A SHARE OF PRODUCTION – SELECTED COMMODITIES.
*Source:* Scenar 2030, MAGNET model.

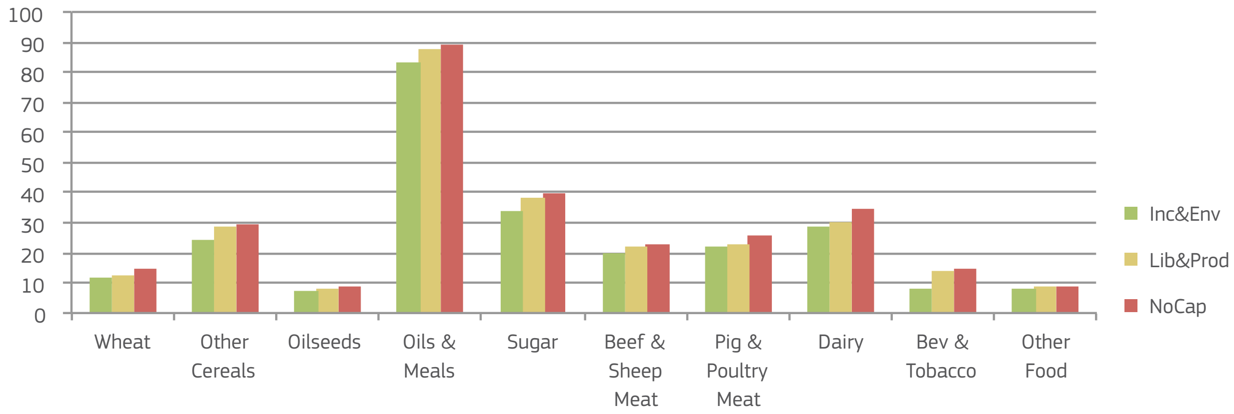



**FIGURE 40:** IMPORTS AS A SHARE OF PRODUCTION – SELECTED COMMODITIES.
*Source:* Scenar 2030, MAGNET model.

## 6.5 | Labour market

To determine the impact on the job market, a simplified approach was followed, i.e. the number of jobs (see also section 5.2) was assumed to change by the same percentage as that of changes in production in the individual sectors. This is a common approach in modelling; however, it does not incorporate the development of economies of scale, particularly for relatively high-skilled jobs.

The MAGNET model behaves according to the methodological assumptions; that is, depending on the specific impact of a policy/subsidy, job numbers are reduced or increased. There is no modelling for farms entering or leaving the sector (e.g. for small-farm, part-time farmers, which, anyway, would result in only a small overall change), but only aggregate results.

Agri-food sectors have different job multipliers; in general, they are higher in animal production. Within the EU, there is high diversity among the MSs with regard to value share between crop, animal and other food industry sectors (e.g. for the EU-13, the value shares for these sectors are 51%, 23% and 26%, respectively; for the EU-15, the value shares are 35%, 14% and 51%, respectively; see Figure 41).

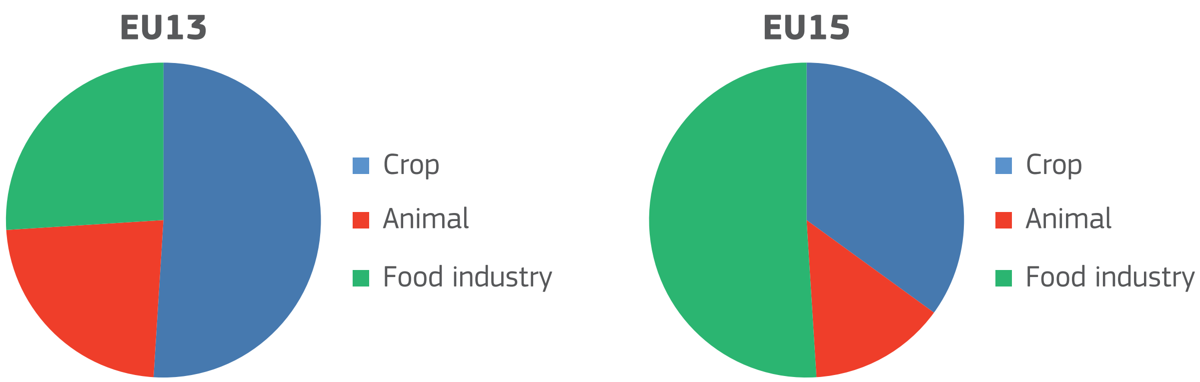



**FIGURE 41:** VALUE SHARE BETWEEN CROP, ANIMAL AND OTHER FOOD/FOOD INDUSTRY IN THE EU-13 AND EU-15.
*Source:* Scenar 2030, MAGNET model.

The levels of subsidies/payments per ha and category, as well their share in gross margin per ha, influence the resilience of farm activities and thus the number of jobs. In addition, the impact of subsidies on land and labour productivity is differently articulated. In the case of the NoCAP scenario, the main change (if compared with the Lib&Prod scenario) is the change in the Pillar 2 payments.

The different CAP payments influence productivity (see section 3.3.4) and employment in various ways: Pillar 1 payments increase land price/value and therefore make production more attractive (decoupled payments have a kind of coupling factor); Pillar 2 investments in human capital increase labour productivity (more output with less input, improvement of competitiveness). Pillar 2 investments in machinery increase capital, thus increase (capital) productivity, making production more competitive.

In short, improving productivity reduces, *ceteris paribus*, the number of jobs, but makes each job more productive and therefore competitive.

In addition to the 25% loss in the number of agricultural jobs in the EU in the next 15 years in the baseline, all three scenarios show further decreases in job numbers (Table 29 and Table 30). Under the Inc&Env scenario, employment in the agricultural sector decreases by 1.8 % at the EU-28 level.

The Lib&Prod scenario depicts a further job decrease of 4.7%, with jobs in downstream sectors being less affected (–0.3%) than agricultural jobs (–4.3%).

The NoCAP scenario shows a higher total job decrease (–5.6%), because of the higher impacts on the food industry (–1.3%) than in the other scenarios.

| | Level | | | Absolute change | | | Change (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Austria | 126,558 | 132,415 | 137,491 | −14,586 | −8,729 | −3,653 | −10.3 | −6.2 | −2.6 |
| Belgium | 42,580 | 41,811 | 43,136 | −769 | −1,537 | −213 | −1.8 | −3.5 | −0.5 |
| Bulgaria | 95,837 | 90,591 | 101,977 | −9,766 | −15,012 | −3,626 | −9.2 | −14.2 | −3.4 |
| Cyprus | 9,447 | 10,528 | 10,713 | −1,230 | −149 | 36 | −11.5 | −1.4 | 0.3 |
| Czech Republic | 74,904 | 72,026 | 75,087 | −1,224 | −4,102 | −1,040 | −1.6 | −5.4 | −1.4 |
| Denmark | 42,247 | 42,007 | 42,785 | −1,598 | −1,837 | −1,060 | −3.6 | −4.2 | −2.4 |
| Estonia | 9,276 | 9,959 | 10,596 | −1,782 | −1,098 | −461 | −16.1 | −9.9 | −4.2 |
| Finland | 51,636 | 52,423 | 53,160 | −2,418 | −1,632 | −895 | −4.5 | −3.0 | −1.7 |
| France | 502,641 | 498,156 | 522,242 | −33,180 | −37,664 | −13,579 | −6.2 | −7.0 | −2.5 |
| Germany | 355,926 | 362,340 | 380,525 | −29,665 | −23,250 | −5,065 | −7.7 | −6.0 | −1.3 |
| Greece | 293,330 | 302,047 | 306,510 | −26,787 | −18,070 | −13,607 | −8.4 | −5.6 | −4.3 |
| Hungary | 105,999 | 104,872 | 104,197 | −1,259 | −2,386 | −3,061 | −1.2 | −2.2 | −2.9 |
| Ireland | 53,361 | 54,410 | 59,028 | −7,502 | −6,454 | −1,835 | −12.3 | −10.6 | −3.0 |
| Italy | 571,243 | 584,285 | 591,096 | −32,727 | −19,685 | −12,873 | −5.4 | −3.3 | −2.1 |
| Latvia | 21,195 | 26,122 | 26,756 | −8,916 | −3,989 | −3,355 | −29.6 | −13.2 | −11.1 |
| Lithuania | 50,447 | 49,898 | 50,589 | −1,443 | −1,992 | −1,300 | −2.8 | −3.8 | −2.5 |
| Luxembourg | 2,322 | 2,352 | 2,419 | −171 | −141 | −74 | −6.9 | −5.7 | −3.0 |
| Malta | 841 | 838 | 818 | 22 | 19 | −1 | 2.7 | 2.3 | −0.1 |
| Netherlands | 176,830 | 168,762 | 171,262 | 7,191 | −877 | 1,624 | 4.2 | −0.5 | 1.0 |
| Poland | 1,165,425 | 1,169,407 | 1,206,844 | −66,981 | −63,000 | −25,562 | −5.4 | −5.1 | −2.1 |
| Portugal | 284,124 | 297,900 | 295,897 | −17,951 | −4,175 | −6,178 | −5.9 | −1.4 | −2.0 |
| Romania | 1,428,228 | 1,395,642 | 1,416,180 | 4,919 | −27,667 | −7,129 | 0.3 | −1.9 | −0.5 |
| Slovakia | 28,909 | 28,956 | 32,185 | −1,174 | −1,126 | 2,102 | −3.9 | −3.7 | 7.0 |
| Slovenia | 43,700 | 44,706 | 45,155 | −2,718 | −1,712 | −1,263 | −5.9 | −3.7 | −2.7 |
| Spain | 464,713 | 463,037 | 476,048 | −19,703 | −21,379 | −8,368 | −4.1 | −4.4 | −1.7 |
| Sweden | 40,806 | 43,968 | 44,996 | −5,619 | −2,456 | −1,429 | −12.1 | −5.3 | −3.1 |
| UK | 215,752 | 211,894 | 226,306 | −15,532 | −19,390 | −4,978 | −6.7 | −8.4 | −2.2 |
| Total | 6,258,277 | 6,261,352 | 6,433,998 | −292,569 | −289,490 | −116,843 | −4.5 | −4.4 | −1.8 |

**TABLE 29:** AGRICULTURAL JOBS, HEADS AND CHANGE (%) FROM BASELINE, 2030.
*Source:* Scenar 2030, MAGNET model.

| | Level | | | Absolute change | | | Change (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Austria | 64,682 | 66,823 | 66,472 | −2,324 | −183 | −535 | −3.5 | −0.3 | −0.8 |
| Belgium | 83,736 | 83,726 | 84,411 | −726 | −736 | −51 | −0.9 | −0.9 | −0.1 |
| Bulgaria | 75,453 | 73,796 | 74,690 | 1,093 | −564 | 330 | 1.5 | −0.8 | 0.4 |
| Cyprus | 8,737 | 11,790 | 11,792 | −3,037 | 16 | 18 | −25.8 | 0.1 | 0.2 |
| Czech Republic | 93,936 | 94,222 | 93,995 | −64 | 222 | −5 | −0.1 | 0.2 | 0 |
| Denmark | 55,876 | 57,042 | 56,360 | −1,205 | −39 | −722 | −2.1 | −0.1 | −1.3 |
| Estonia | 8,217 | 8,264 | 8,342 | −121 | −74 | 4 | −1.4 | −0.9 | 0.1 |
| Finland | 34,399 | 35,074 | 35,482 | −1,099 | −424 | −16 | −3.1 | −1.2 | 0 |
| France | 536,146 | 539,010 | 537,757 | −3,608 | −744 | −1,997 | −0.7 | −0.1 | −0.4 |
| Germany | 664,778 | 675,039 | 682,362 | −20,873 | −10,611 | −3,289 | −3 | −1.5 | −0.5 |
| Greece | 69,982 | 71,725 | 70,854 | −1,750 | −7 | −877 | −2.4 | 0 | −1.2 |
| Hungary | 77,602 | 78,413 | 78,557 | −1,504 | −693 | −549 | −1.9 | −0.9 | −0.7 |
| Ireland | 32,764 | 33,580 | 34,500 | −2,204 | −1,389 | −468 | −6.3 | −4 | −1.3 |
| Italy | 380,188 | 385,338 | 382,253 | −3,573 | 1,577 | −1,508 | −0.9 | 0.4 | −0.4 |
| Latvia | 13,141 | 13,071 | 13,066 | 116 | 46 | 41 | 0.9 | 0.4 | 0.3 |
| Lithuania | 29,009 | 28,638 | 29,079 | 156 | −215 | 226 | 0.5 | −0.7 | 0.8 |
| Luxembourg | 5,166 | 5,113 | 5,127 | 61 | 7 | 21 | 1.2 | 0.1 | 0.4 |
| Malta | 2,567 | 2,613 | 2,559 | 5 | 51 | −2 | 0.2 | 2 | −0.1 |

**TABLE 30:** FOOD INDUSTRY JOBS, HEADS AND CHANGE (%) FROM BASELINE, 2030.
*TABLE CONTINUES ON NEXT PAGE →*

| | Level | | | Absolute change | | | Change (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env | NoCAP | Lib&Prod | Inc&Env |
| Netherlands | 127,595 | 127,233 | 127,001 | 788 | 426 | 194 | 0.6 | 0.3 | 0.2 |
| Poland | 285,547 | 290,176 | 288,537 | –3,180 | 1,449 | –189 | –1.1 | 0.5 | –0.1 |
| Portugal | 90,440 | 92,339 | 91,441 | –1,633 | 265 | –632 | –1.8 | 0.3 | –0.7 |
| Romania | 146,066 | 146,571 | 146,944 | –640 | –135 | 237 | –0.4 | –0.1 | 0.2 |
| Slovakia | 30,049 | 30,188 | 30,198 | –93 | 46 | 57 | –0.3 | 0.2 | 0.2 |
| Slovenia | 11,046 | 10,891 | 10,885 | 224 | 69 | 63 | 2.1 | 0.6 | 0.6 |
| Spain | 290,766 | 293,128 | 293,484 | –4,246 | –1,884 | –1,527 | –1.4 | –0.6 | –0.5 |
| Sweden | 59,048 | 59,596 | 59,755 | –818 | –270 | –111 | –1.4 | –0.5 | –0.2 |
| UK | 349,262 | 350,530 | 353,200 | –4,977 | –3,710 | –1,040 | –1.4 | –1 | –0.3 |
| Total | 3,626,197 | 3,663,928 | 3,669,103 | –55,233 | –17,502 | –12,326 | –1.5 | –0.5 | –0.3 |

**TABLE 30:** FOOD INDUSTRY JOBS, HEADS AND CHANGE (%) FROM BASELINE, 2030.
*Source:* Scenar 2030. MAGNET model.

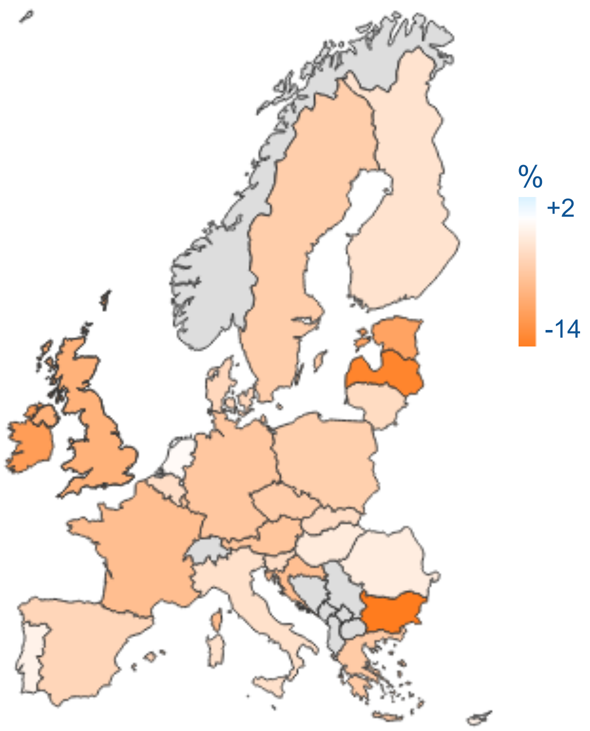



**FIGURE 42:** LIB&PROD SCENARIO AND JOBS IN THE AGRICULTURAL SECTOR BY MS, CHANGE (%) FROM BASELINE, 2030.
*Source:* Scenar 2030, MAGNET model.

Figure 42 distinguishes impacts in MSs according to the magnitude of agricultural job losses in the Lib&Prod scenario. Main results on agricultural job numbers according to the Lib&Prod scenario:

- more than a 10% decrease in job numbers in Bulgaria, Ireland, and Latvia;
- more than a 5% decrease in job numbers in Austria, Czech Republic, Estonia, France, Germany, Greece, Luxembourg, Poland, Sweden and United Kingdom;
- less than a 0% change in job numbers in Belgium, Croatia, Cyprus, Denmark, Finland, Hungary, Italy, Lithuania, The Netherlands, Portugal, Romania, Slovakia, Slovenia and Spain;
- a slight increase in job numbers in Malta.

Figure 43, decomposing agri-food employment, shows the adverse impact of the reduction in the Pillar 1 payment for employment, while the impacts of Pillar 2 policy changes are mixed. Changes in trade policy have a small, negative impact on jobs. The impact of polices on job creation is negative under all three scenarios.

The final number of job losses is the net result of a combination of different drivers/policies that decrease or increase the number of jobs. The removal of Pillar 1 is expected to have a direct negative impact on jobs in almost all countries (Latvia, –22%; Bulgaria, –14.7%; Estonia, –13%; other countries, between –5 and –10%). The removal of investment in capital/machinery would bring about an increased loss of employment in agriculture of about 2% (i.e. job numbers will be reduced by 25%). The removal of investment in human capital lowers productivity, thus causing an increase in labour demand to compensate, equal to 4% in agriculture in the EU-28. This explains the smaller number of job losses in the NoCAP scenario than in the Lib&Prod scenario.

The importance of the external drivers (general economic environment and the low opportunity costs in farming) also has to be stressed. As outlined in DG AGRI's agricultural market outlook (DG AGRI, 2015), for instance, if the pre-crisis trend had continued, the value in 2026 would be 6.1 million AWU (annual work units) rather than 7.9 million AWU under the current trend.

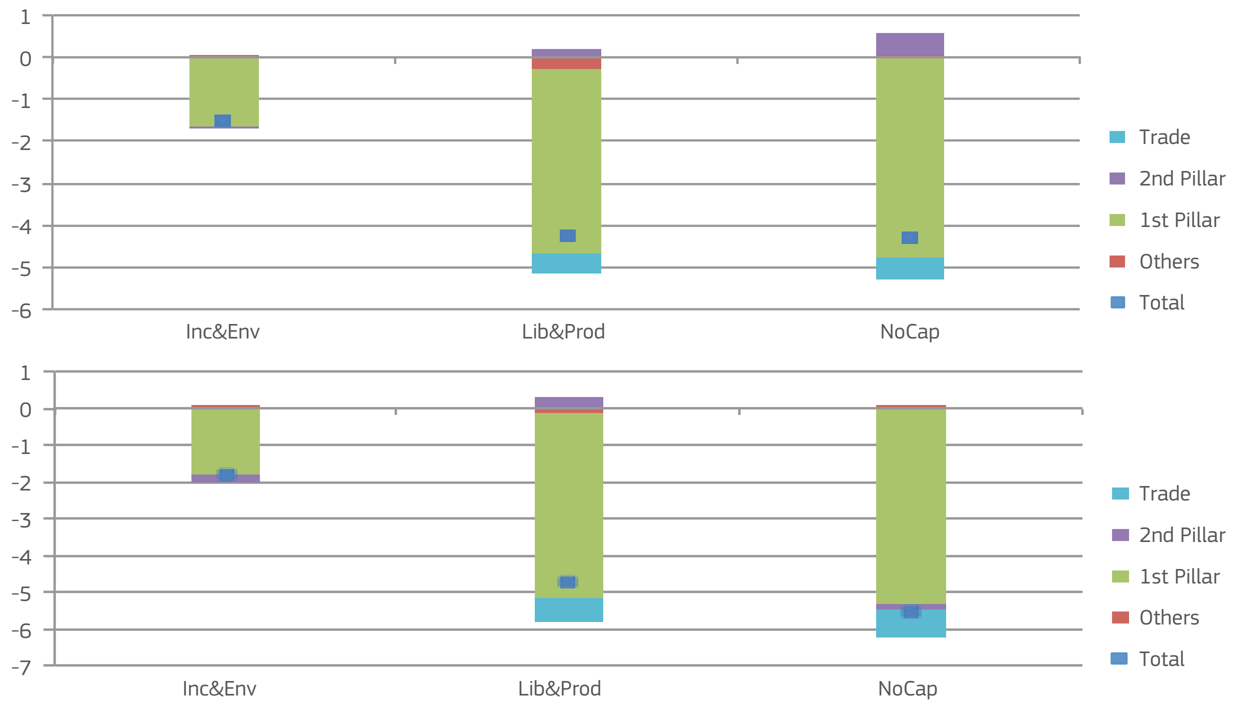



**FIGURE 43:** AGRI-FOOD EMPLOYMENT, 2016-2030, % DIFFERENCE FROM BASELINE (DECOMPOSITION) AND TOTAL FOR AGRICULTURE (TOP) AND FOOD INDUSTRY (BOTTOM).
*Source:* Scenar 2030, MAGNET model.

### Why are job numbers slightly increasing in the case of Romania in the NoCAP scenario?

Under the reference scenario, the absolute numbers indicate that Romania loses, between 2016 and 2030, almost 600,000 agricultural jobs (considering all persons active), which is a loss of 29%. Under the NoCAP scenario, Romania does not lose any more jobs than under the reference scenario, and, in fact, job numbers increase slightly, by 0.4%. At first sight, this is counterintuitive as the removal of all CAP payments should have a negative impact on job numbers.

The explanation is complex, as is linked to economic development as a whole and other factors.

First of all, under the NoCAP scenario, the whole Romanian economy grows less than in the reference scenario, with agricultural production shrinking. Given the overall reduction in economic growth, the market prices of production factors (wages, capital and land) decrease, including wages and salaries of skilled and unskilled workers in agriculture. Assuming a constant unemployment rate, workers have to be reallocated somewhere after market shocks. Typically, when an economy is shrinking, workers tend to remain in agriculture.

Second, the lack of Pillar 2 support (RDPs) slows down farm consolidation and labour productivity gains. This is illustrated by the subtotal analysis, showing the impacts of the different policy shocks on agricultural employment in Romania.

Consequently, the agricultural sector, in the NoCAP scenario, in Romania jobs decrease less than in the reference scenario, but these workers are less skilled.

Therefore, when looking at jobs, a differentiated view on the impacts of different policies has to be taken, acknowledging the trade-off between multiple objectives per single policy measure (e.g. it is difficult to increase productivity and keep jobs in the same sector with one measure).

7

# SCENARIOS: AGRICULTURAL PRODUCTION AND SECTOR **INCOME AT MS AND REGIONAL LEVEL**

# 7 Scenarios: agricultural production and sector income at MS and regional level

This chapter presents the most important scenario results with respect to agricultural production, land use, and sectoral income in the EU, focusing on the MS and regional levels.[39]

## 7.1 | Agricultural production

In the Inc&Env scenario, the increase in area payments maintains the profitability of agricultural activities, despite some negative productivity effects, while the combined nitrogen input and livestock density limitations effectively limit the output of intensive production systems. The assumption that the market would not be further liberalised prevents EU agriculture from increasing international competitiveness, and therefore agricultural producer prices are projected to increase on average by 1.3% and income is projected to increase by 4.2% on average at the aggregated EU-28 level.

The Lib&Prod scenario results show decreases in both cereal and meat production. These decreases are mainly driven by (1) the elimination of most area payments and coupled subsidies; and (2) by a negative price response of the domestic markets, induced by opening up the markets for international trade. The combination of these two drivers results in a considerable income loss for farmers (on average –20% at EU-28 level). Although equilibrium producer prices *ceteris paribus* should increase in parallel with decreasing supply, trade liberalisation opens up EU markets and generates decreasing overall domestic prices (on average –0.7% in the EU-28) for agricultural commodities.

The results of the NoCAP scenario show similar effects to the Lib&Prod scenario; however, the negative impact on EU production levels is more pronounced in the NoCAP scenario. The elimination of all direct payments, rural area development measures and price management tools, in combination with the further opening up of agricultural and food markets to the rest of the world, lead to significant decreases in cereal and meat production, and also result in a negative effect on EU dairy production levels. The drop in the EU's agricultural production cannot be completely compensated for by the increasing imports, and, as a consequence, EU producer prices increase for agricultural commodities by, on average, 5.3%. Nonetheless, the price effect does not compensate for the production effect, and total agricultural income decreases by 17.4% per ha of UAA at the aggregated EU-28 level.

| | Inc&Env | | | | Lib&Prod | | | | NoCAP | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ha or heads | Yield | Supply | Prod. price | Ha or heads | Yield | Supply | Prod. price | Ha or heads | Yield | Supply | Prod. price |
| UAA | 0.3% | na | na | na | –7.3% | na | na | na | –6.9% | na | na | na |
| Cereals | 0.6% | –1.4% | –0.9% | 1.1% | –8.0% | 0.1% | –7.9% | –3.8% | –8.4% | –2.9% | –11.0% | –0.4% |
| Oilseeds | –0.1% | –1.5% | –1.6% | 1.5% | –2.9% | 2.5% | –0.4% | 0.9% | –1.8% | –3.5% | –5.2% | 7.9% |
| Other arable crops | –3.3% | 0.6% | –2.8% | 2.7% | –10.5% | 9.9% | –1.7% | 2.0% | –12.2% | 10.0% | –3.4% | 3.7% |
| Vegs & Permanent crops | 0.1% | –0.8% | –0.7% | 1.2% | –0.5% | 0.9% | 0.4% | –1.9% | –0.2% | –2.5% | –2.8% | 3.4% |
| Pasture | 0.1% | na | na | na | –8.6% | na | na | na | –8.1% | na | na | na |
| Set-aside and fallow land | 7.8% | na | na | na | –15.6% | na | na | na | –16.9% | na | na | na |
| Dairy cows | 0.3% | –0.5% | –0.3% | 1.5% | –0.7% | 0.6% | –0.1% | –0.4% | 0.7% | –2.8% | –2.1% | 11.9% |
| Beef meat activities | –1.7% | –0.3% | –2.0% | 3.3% | –8.0% | 5.0% | –3.4% | –9.6% | –11.8% | 0.3% | –11.5% | –1.2% |
| Pig fattening | 0.1% | –0.6% | –0.5% | 1.3% | 0.2% | 0.4% | 0.6% | –2.3% | 0.2% | –3.4% | –3.2% | 6.6% |
| Sheep & goat fattening | 5.3% | –0.9% | 4.3% | –2.9% | –6.3% | 0.3% | –5.9% | –7.3% | –12.1% | –1.7% | –13.6% | –1.8% |
| Poultry fattening | –0.2% | –0.6% | –0.8% | 1.0% | –3.0% | 1.1% | –2.0% | –5.9% | –4.0% | –2.7% | –6.6% | –1.5% |

**TABLE 31:** OVERVIEW OF CHANGES IN AREA, HERD SIZE AND SUPPLY FOR THE EU-28 ACTIVITY AGGREGATES (CHANGE RELATIVE TO REF).
Note: Prod. price = producer price; na = not applicable.
*Source:* Scenar 2030. IFM-CAP model.

[39] More details can be found under this link: https://datam.jrc.ec.europa.eu/datam/mashup/SCENAR2030.

### 7.1.1 Cereals

With the increase of area payments and the nitrogen input limitations in the Inc&Env scenario, the intensity of cereal production decreases compared with the reference scenario. The average yield decreases in almost all MSs (–1.4% on average for the EU) and even though this is partially compensated for by an increase in area of 0.6% (314,000 ha), total EU cereal supply of about 1% (–1.9 million t). The most important increases in cereal area in absolute terms are indicated for Spain (+170,000 ha), followed by Finland (+86,000 ha), whereas Germany and France show the largest decreases in cereal area (–58,000 ha and –30,000 ha, respectively). Taking productivity (yield) changes into account, cereal supply increases are highest in Spain (+208,000 t), Latvia (+144,000 t), Lithuania and Estonia (both by about 130,000 t), while the largest drops are indicated for France (–750,000 t), Poland (–600,000 t), Germany (–495,000 t) and Bulgaria (–470,000 t).

Under the Lib&Prod scenario, the combined effect of eliminating area payments and pressure from increased competition from the world market lead to strong decreases in EU cereal production compared with the reference scenario. Average EU cereal productivity per hectare is not really affected, but cereal area (–4.5 million ha) and supply (–26 million t) both decrease by about 8%. In absolute terms, the production decreases are strongest for Germany (–6.7 million t; –825,000 ha), France (–3.3 million t, –360,000 ha), Poland (–3 million t; –650,000 ha), Spain (–2.3 million t; –450,000 ha), Italy (1.8 million t; almost –430,000 ha), Finland (–1.5 million t; –388,000 ha) and Hungary (–1.5 million t; –194,000 ha).

The strong decreases in EU cereal area (–8.4%; –4.7 million ha) and supply (–11%; –36 million t) in the NoCAP scenario compared with the reference scenario, are mainly due to the removal of direct payments that affect the income of EU crop producers and to a decrease in EU feed demand, but also to an increase in market competition due to further liberalisation of the EU market. The effects on production levels would, in almost all MSs, be more pronounced under the NoCAP scenario than under the Lib&Prod scenario, especially with respect to supply levels.

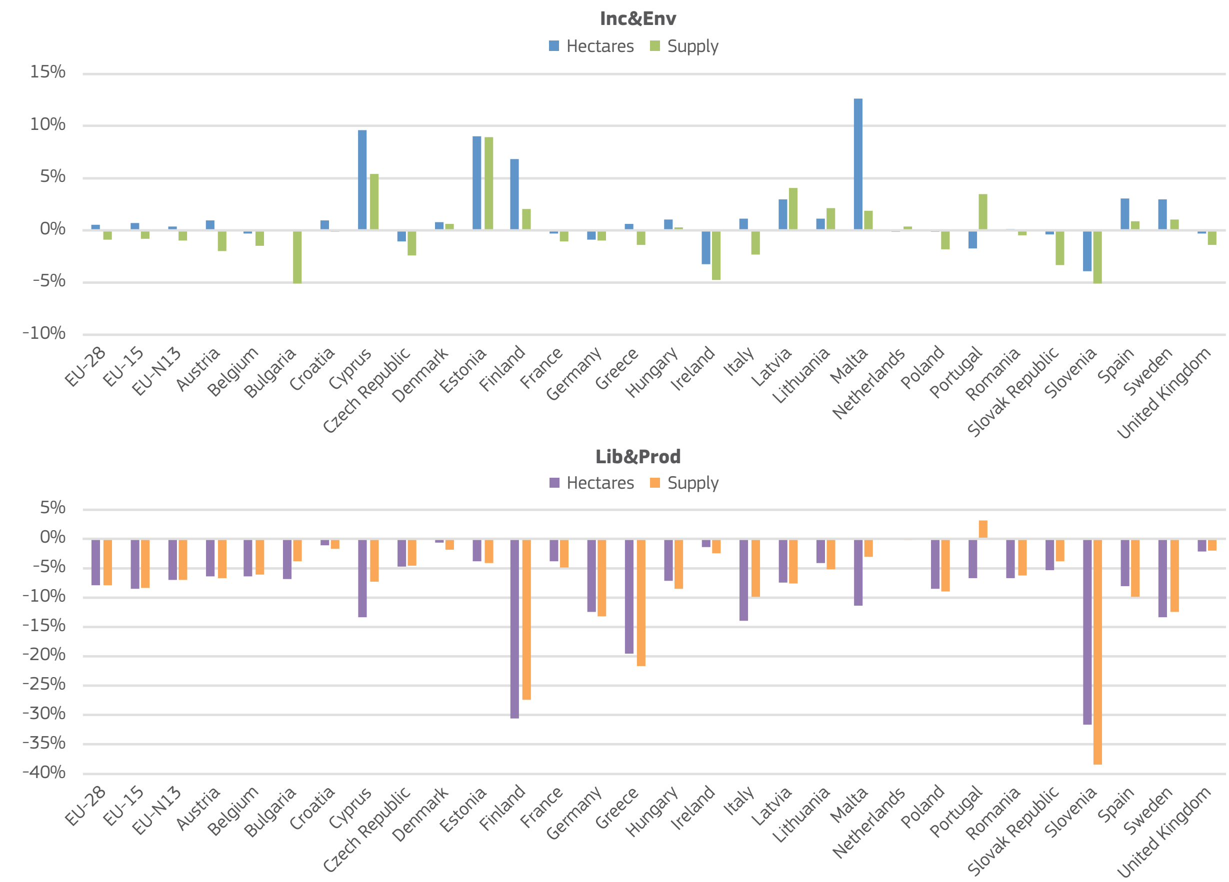



**FIGURE 44:** CHANGES IN CEREAL AREA AND SUPPLY IN THE THREE POLICY SCENARIOS (% CHANGE RELATIVE TO REF).
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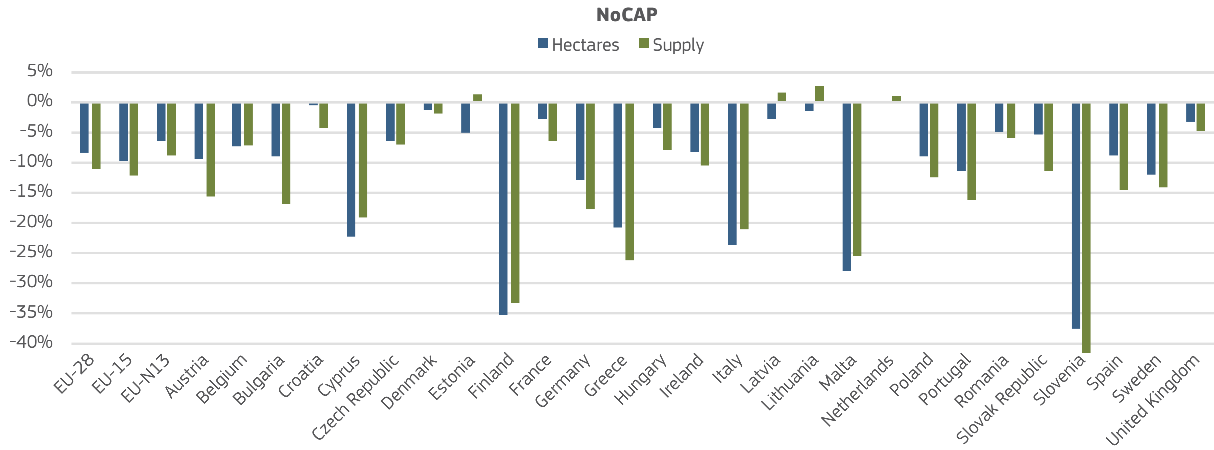


**FIGURE 44:** CHANGES IN CEREAL AREA AND SUPPLY IN THE THREE POLICY SCENARIOS (% CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

Figure 44 gives an overview of the percentage changes of cereal production in each EU MS and each scenario, and Figure 45 presents the production changes per region. Regions where the production of cereals is already low in the baseline and where mixed livestock and crop producers are located tend to have stronger decreases in cereal area in the Lib&Prod and NoCAP scenarios. Moreover, in both scenarios cereal production is also reduced in more productive regions, such as Picardie and Ile de France, due to the large decrease in income.

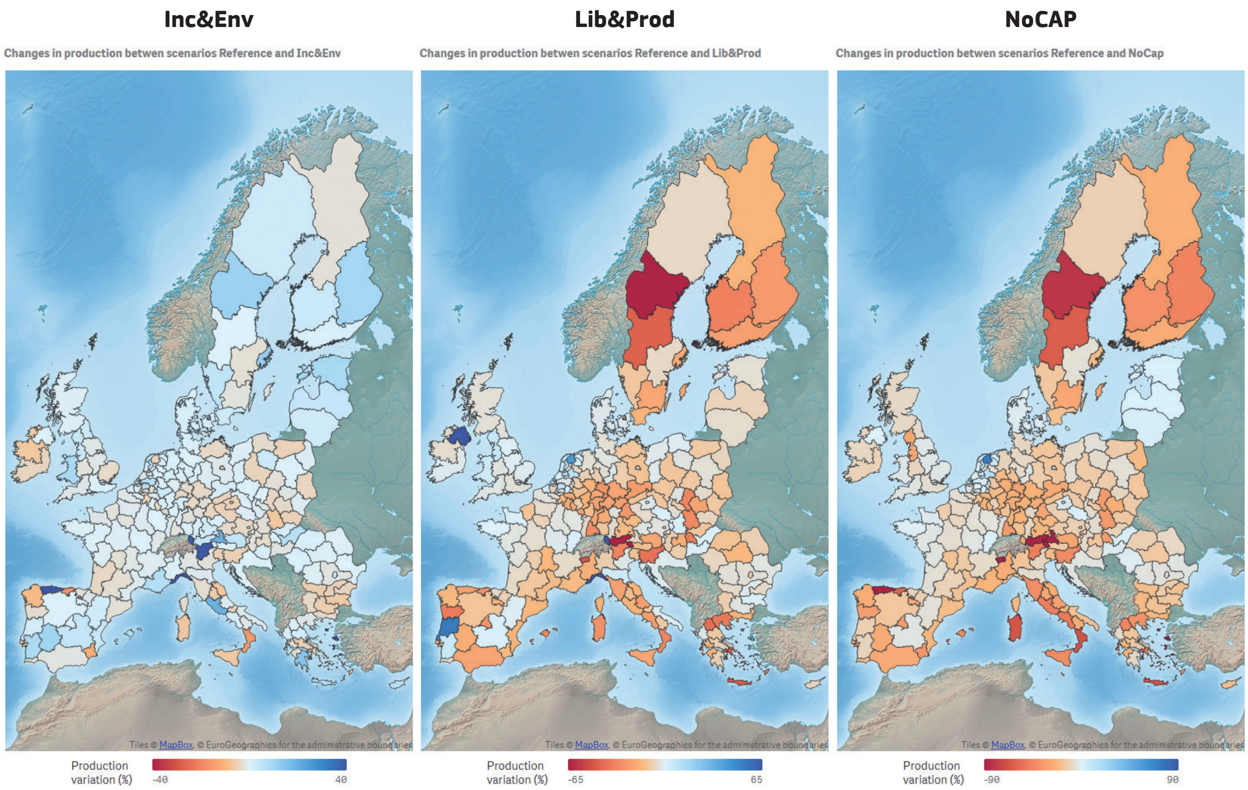


**FIGURE 45:** REGIONAL SUPPLY OF CEREALS (% CHANGE RELATIVE TO REF).
Source: Scenar 2030. CAPRI model.

## 7.1.2 Oilseeds

Figure 46 presents an overview of the percentage changes of cereal production in each EU MS and each scenario, and Figure 47 shows the production changes per region. Similar to the developments in the cereals sector, the nitrogen input restriction in the Inc&Env scenario lead to an average oilseed yield decline of 1.5% at EU-28 level compared with the reference scenario. As oilseed area changes only slightly (–0.1%), the decrease in production intensity leads to an EU oilseed supply reduction of 1.6%. The percentage changes in oilseed area and supply are shown in Figure 46. In absolute terms, the production decreases are most important in Bulgaria (–169,000 t, mostly sunflower), France (–102,000 t, mainly rapeseed, but also soya, whereas sunflower increases), Spain (–84,000 t, mainly sunflower) and Hungary (–61,000 t, mainly rapeseed, but also sunflower and soya), whereas the largest production increases are projected for the Czech Republic (+29, 000 t, mainly rapeseed) and Poland (+24,000 t, rapeseed).

In the Lib&Prod and NoCAP scenarios, oilseed production is less affected than EU cereal production, and some switches between the production of rapeseed, sunflower and soybeans are projected. Even though EU oilseed area decreases by almost 3% in the Lib&Prod scenario, production intensity and hence yields increase by 2.5%, resulting in a moderate EU supply decrease of 0.4% compared with the reference scenario. A closer examination of the results shows that the aggregated EU oilseed result can be explained by decreases in rapeseed and soybean production, whereas sunflower supply in fact increases, by almost 2%. The most important absolute increases in sunflower production are reported for Romania (+122,000 t) and France (+71,000 t). France also shows the most important absolute increase in rapeseed supply (+220,000 t), followed by Poland (+102,000 t), whereas the supply drop is by far the largest in Germany (–264,000 t). The developments in soya supply are quite different in the MSs, ranging from decreases of 98,000 t in France to increases of 34,000 t in Italy.

Negative oilseed production developments are more pronounced in the NoCAP scenario than in the Lib&Prod scenario. Although total EU area for oilseeds decreases by only 2%, supply declines by more than 5% compared with the reference scenario, as yields per hectare decrease by 3.5%. The production decline is greatest for rapeseed, followed by soya, and the decline is lowest (but still negative) for sunflower production. Rapeseed supply is the most negatively affected oilseed supply, in absolute terms, in Germany (–570,000 t), France


**FIGURE 46:** CHANGES IN OILSEED AREA AND SUPPLY IN THE THREE POLICY SCENARIOS (% CHANGE RELATIVE TO REF).
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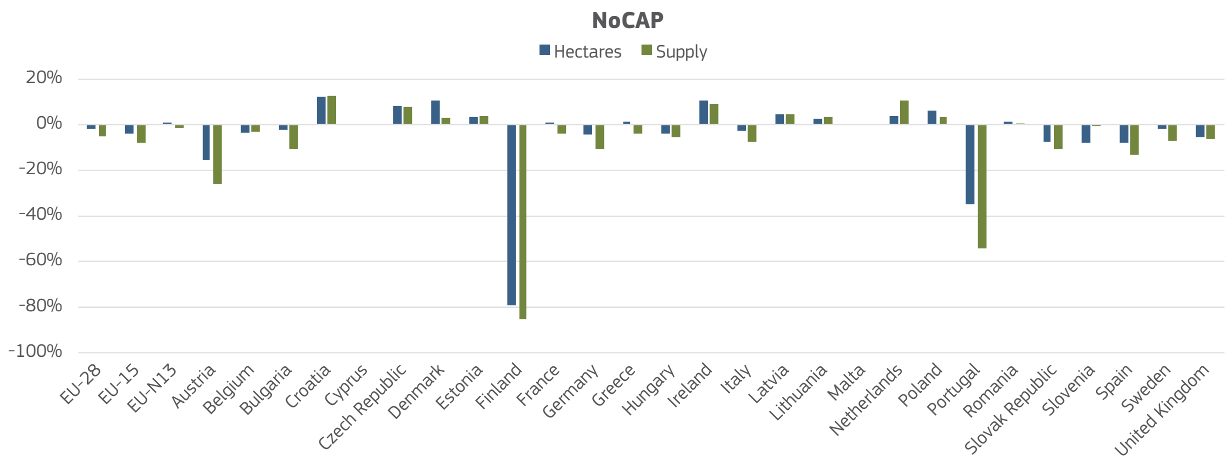


**FIGURE 46:** CHANGES IN OILSEED AREA AND SUPPLY IN THE THREE POLICY SCENARIOS (% CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

(–174,000 t) and the UK ( 151,000), whereas several EU-N13 MSs show some increase in supply (largest in Poland, +76,000 t). Considerable decreases in soybean production are projected for Romania (–176,000 t) and France (–146,000 t), and sunflower supply declines most in Bulgaria (–225,000 t), Spain (–184,000 t) and, especially, Romania (+197,000 t, switching from soya); France also shows increases in production (+43,000 t).

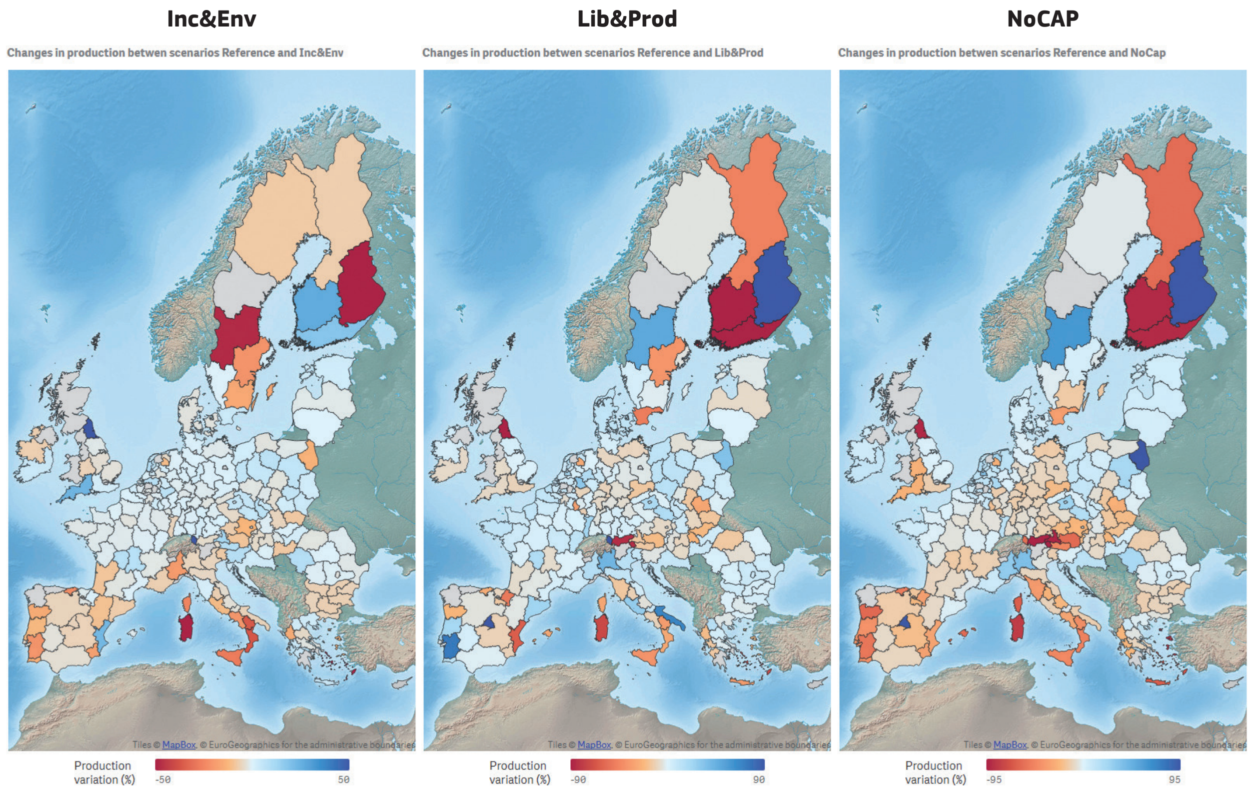


**FIGURE 47:** REGIONAL SUPPLY OF OILSEEDS (%-CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

## Trade balance for cereals and oilseeds

With decreases in EU production, the EU trade balance also worsens compared with the reference scenario (Figure 48). The EU, one of the largest cereal producers in the world in the REF scenario, loses its position as an important cereal net exporter in the Lib&Prod and NoCAP scenarios. In the case of wheat, this is not because of decreasing exports (which in fact increase), but because of substantially increased imports, especially in the NoCAP scenario. For grain maize, substantial increases in imports are projected in the Lib&Prod and NoCAP scenarios, whereas the EU slightly increases its barley net exports in both scenarios. For oilseeds, the EU position as a net importer is not much affected, and is, as in the reference scenario, dominated by soybean imports.

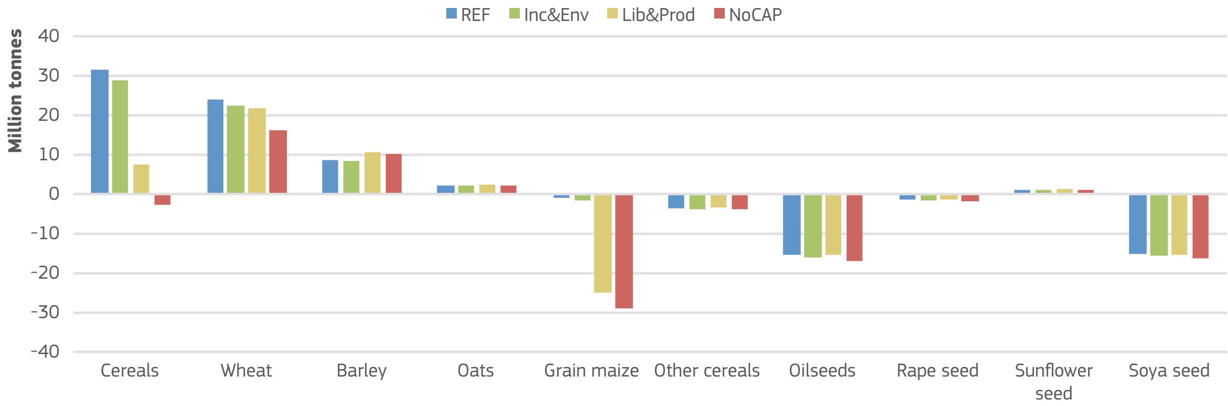


**FIGURE 48:** EU TRADE BALANCE FOR CEREALS AND OILSEEDS.
*Note:* trade balance = exports – imports;
*Source:* Scenar 2030, CAPRI model.

## 7.1.3 Milk and dairy

Changes in milk production in the three policy scenarios are presented in Figure 49 and Figure 50. The total impact on EU milk production is rather low in the Inc&Env scenario. Compared with the reference scenario, the number of dairy cows slightly increases in most MSs, but because of decreases in average milk yields, total EU milk supply drops slightly, by 0.3%. In the EU-N13 both animal numbers (–0.4%) and supply (–0.6%) decrease, whereas the animal herd increases in the EU-15 (+0.4%); however, average yields decrease and supply is reduced by –0.2%. At MS level, the effect on cow milk supply varies between –2.2% in Bulgaria and +2.5% in Austria.

The elimination of coupled subsidies and the further opening up of the market for international trade do not have a large impact on total EU cow milk production in the Lib&Prod scenario. The decrease in the number of dairy cows (–0.7%) is compensated for by a slight intensification of milk production, with increases in average milk yields, resulting in almost no change in EU milk supply (–0.1%). Cow milk production is more negatively affected in the EU-N13, with a decrease of –1%, whereas in the EU-15 milk supply increases by a mere +0.1%. At MS level, milk supply changes vary between –2% in Latvia and +1.7% in Greece.

Compared with the reference scenario, the EU dairy sector is most negatively affected under the NoCAP scenario, especially because of the elimination of price management tools. EU cow milk supply decreases by –2.1% under this scenario, mainly because of a decrease in average milk yield (–2.8%), as cow numbers increase by

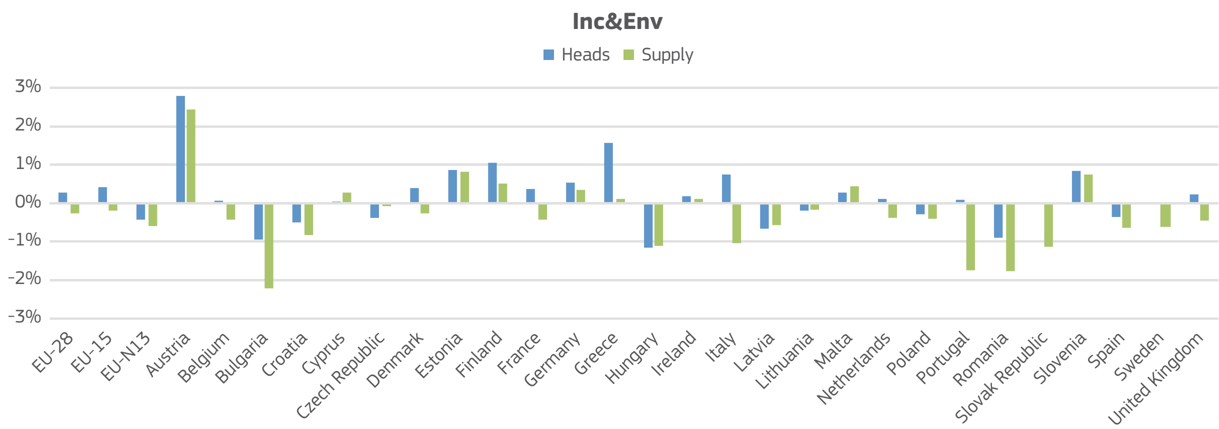


**FIGURE 49:** CHANGES IN DAIRY COW NUMBERS AND MILK SUPPLY IN THE THREE POLICY SCENARIOS (CHANGE RELATIVE TO REF).
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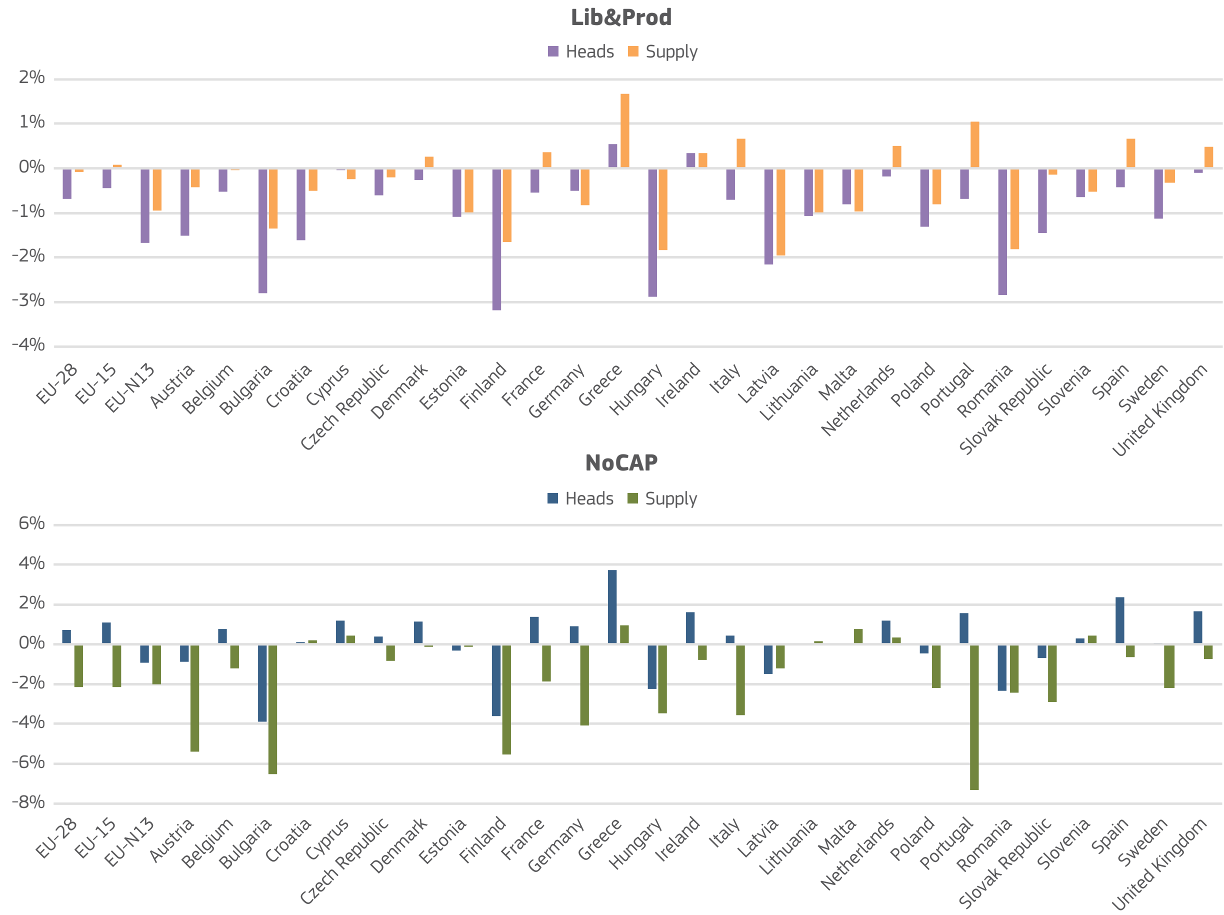


**FIGURE 49:** CHANGES IN DAIRY COW NUMBERS AND MILK SUPPLY IN THE THREE POLICY SCENARIOS (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

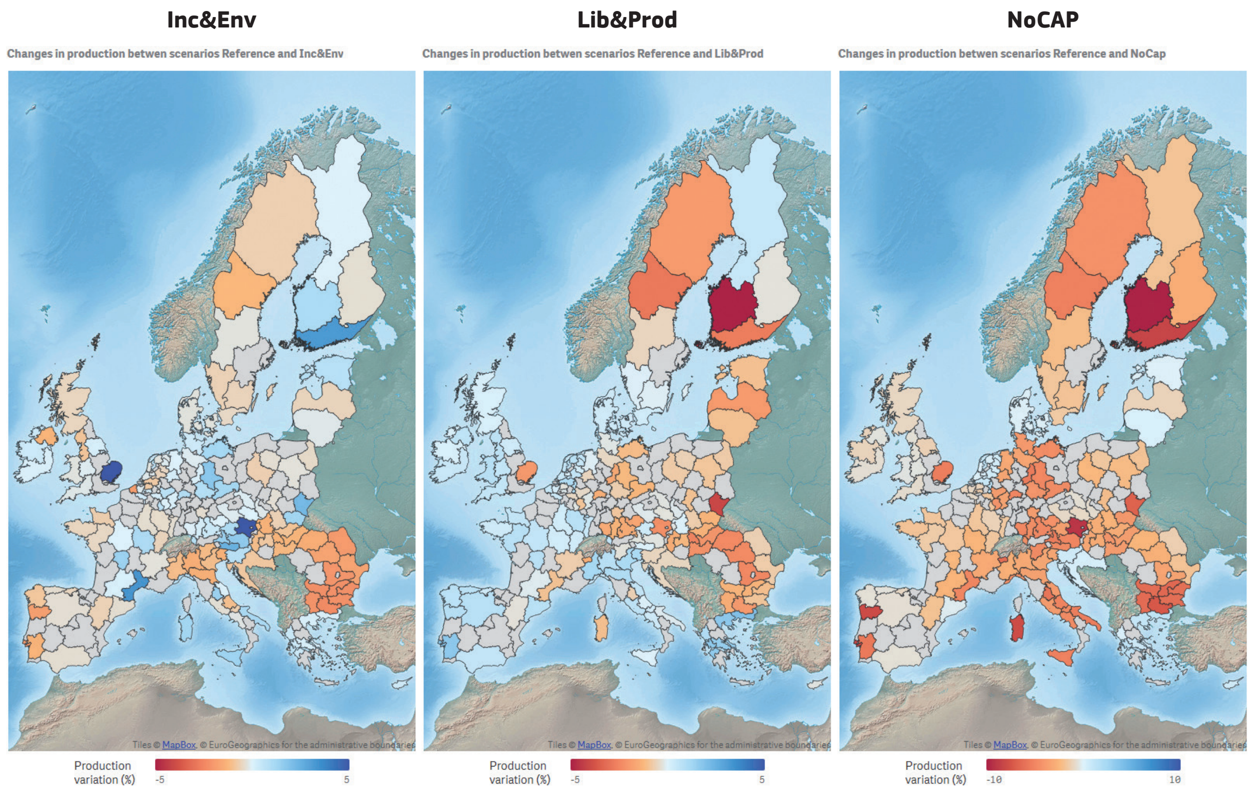


**FIGURE 50:** REGIONAL SUPPLY OF COW MILK (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030. CAPRI model.

0.7%. While the cow herd increases by 1.1% in the EU-15, it decreases in the EU-N13. Milk supply is most negatively affected in Bulgaria (–6.5%) and Austria (–5.4%), whereas milk production increases the most (in relative terms) in Greece (+1%) because of an increase in the number of dairy cows.

The decrease in EU milk production leads to reductions in the EU supply of dairy products in all three policy scenarios compared with the reference scenario (Figure 51). Following the decreases in EU milk and dairy production, the EU trade balance for dairy products decreases in all policy scenarios, and is most affected in the NoCAP scenario. Nonetheless, the EU would remain a substantial net exporter in dairy products in all scenarios (Figure 52).

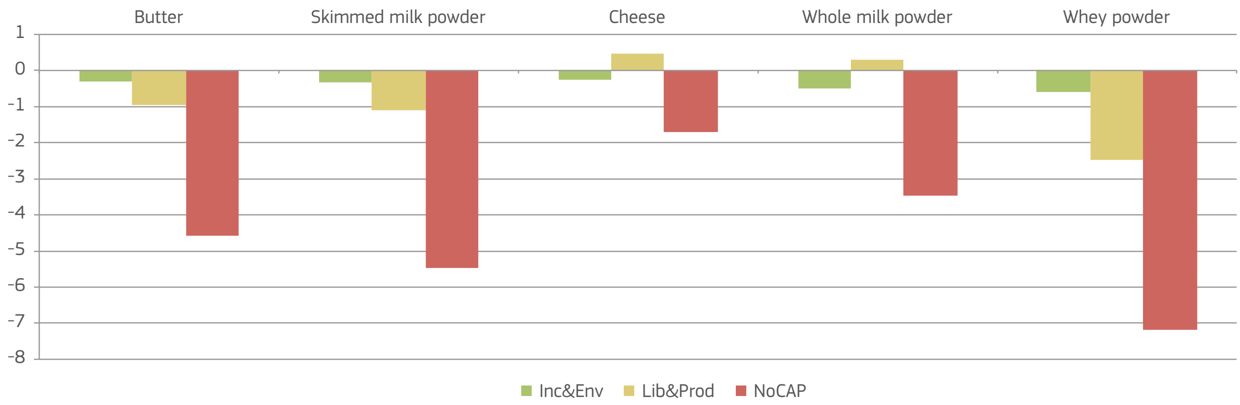


**FIGURE 51:** EU SUPPLY OF DAIRY PRODUCTS (% CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

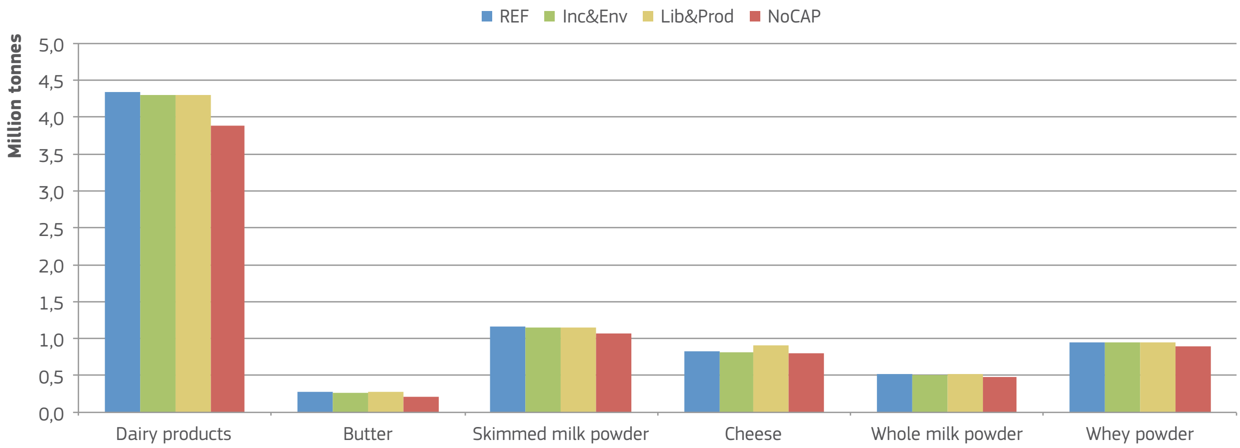


**FIGURE 52:** EU TRADE BALANCE FOR SELECTED DAIRY PRODUCTS.
*Note:* trade balance = exports – imports.
*Source:* Scenar 2030, CAPRI model.

## 7.1.4 Meat

Figure 53 gives an overview of the relative changes in EU meat supply in the scenarios compared with the reference scenario. EU meat production in the Inc&Env scenario is affected mainly by stocking density restrictions, leading to a decrease in total EU meat supply, most pronounced for beef meat (–2%), but sheep and goat meat increase by 4% (although from a rather low level). In the Lib&Prod scenario, the removal of almost all direct payments in combination with trade liberalisation leads to production decreases for all meats except pork, which benefits slightly (+0.6%) from the trade liberalisation. The elimination of all CAP support in combination with trade liberalisation leads to significant production decreases for all meats in the NoCAP scenario. This further decrease, compared with the Lib&Prod scenario, is mainly due to the removal of all remaining CAP premiums, as, even though not directly related to meat production, they have a positive impact on income, and their removal further decreases the small income margins of EU meat production.

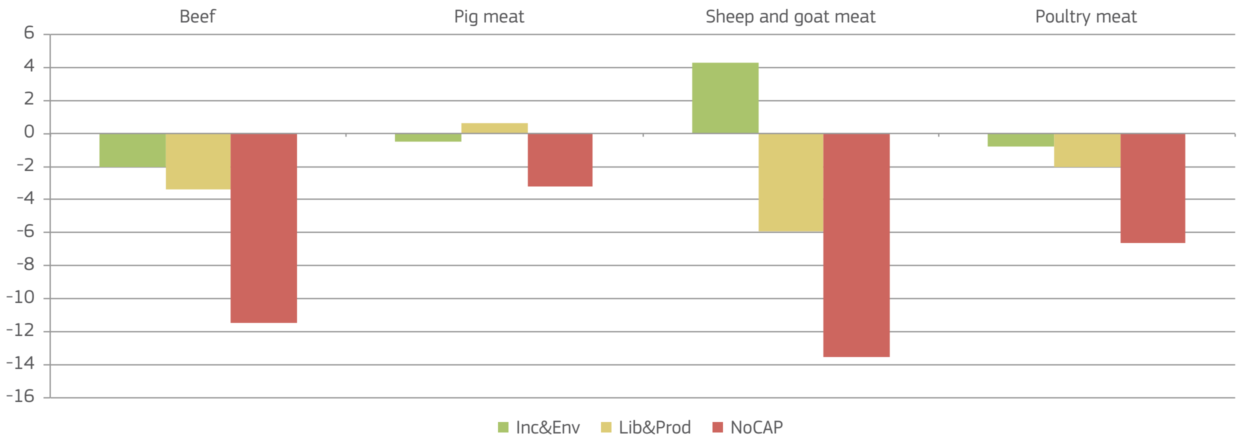


**FIGURE 53:** EU MEAT SUPPLY VARIATION (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

Figure 54 and Figure 55 present the changes in beef meat production at MS and regional level, respectively. In the Inc&Env scenario, beef meat supply is affected more than any of the other meat categories, mainly because of the restrictions on stocking densities. Supply in the EU-15 is generally more affected (–2.1%) than in the EU-N13 (–1.5), leading to a total decrease of 2% in the EU-28 compared with the reference scenario. In general, the decrease in beef meat cattle numbers is only partially compensated for by an increase in production intensity. The number of beef cattle decreases most in France (–152,600 heads), whereas an increase is indicated for Germany (+19,300 heads). Beef meat supply decreases in almost all MSs, i.e. also in Germany (–5.6%), with the largest supply decrease in absolute terms being reported for France (–36,100 t; –2.1%).

The beef herd decreases in almost all EU MSs under the Lib&Prod scenario (EU-28: –8%; –1.5 million cattle), and even though production intensity and hence yields increase (+5%), total EU beef supply declines by –3.4% (266,000 t). In absolute terms, the number of beef cattle decreases most in France (–545,000 cattle), followed by Spain (–280,000 cattle), whereas Ireland and Cyprus are the only countries where increases, although very small, in cattle numbers are noted (+0.2% and +0.6%, respectively). In terms of beef supply, the decreases are largest (in absolute terms) in France (–85,000 t), followed by Germany (–30,000 t), Spain and the UK (–22,000 t each).

In the NoCAP scenario, the beef cattle herd decreases substantially, by almost 12% (–2.2 million cattle), and, as beef yields only slightly increase (+0.3%), the net effect is a decline in EU beef meat supply of –11.5% (–0.9 million t) compared with the reference scenario. The decrease in cattle numbers is more pronounced in the EU-N13 (–15.1%) than in the EU-15 (–11.3%), but as yields increase in the former (+3.6%), the net effect is a decrease in EU-N13 beef supply of –12%. In absolute terms, the

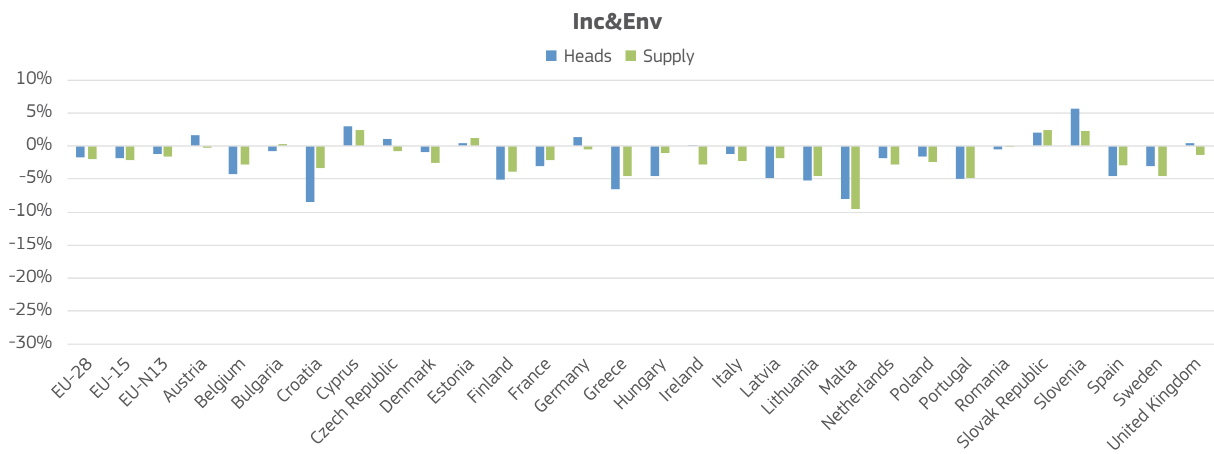


**FIGURE 54:** CHANGES IN BEEF CATTLE NUMBERS AND SUPPLY IN ALL POLICY SCENARIOS (CHANGE RELATIVE TO REF).
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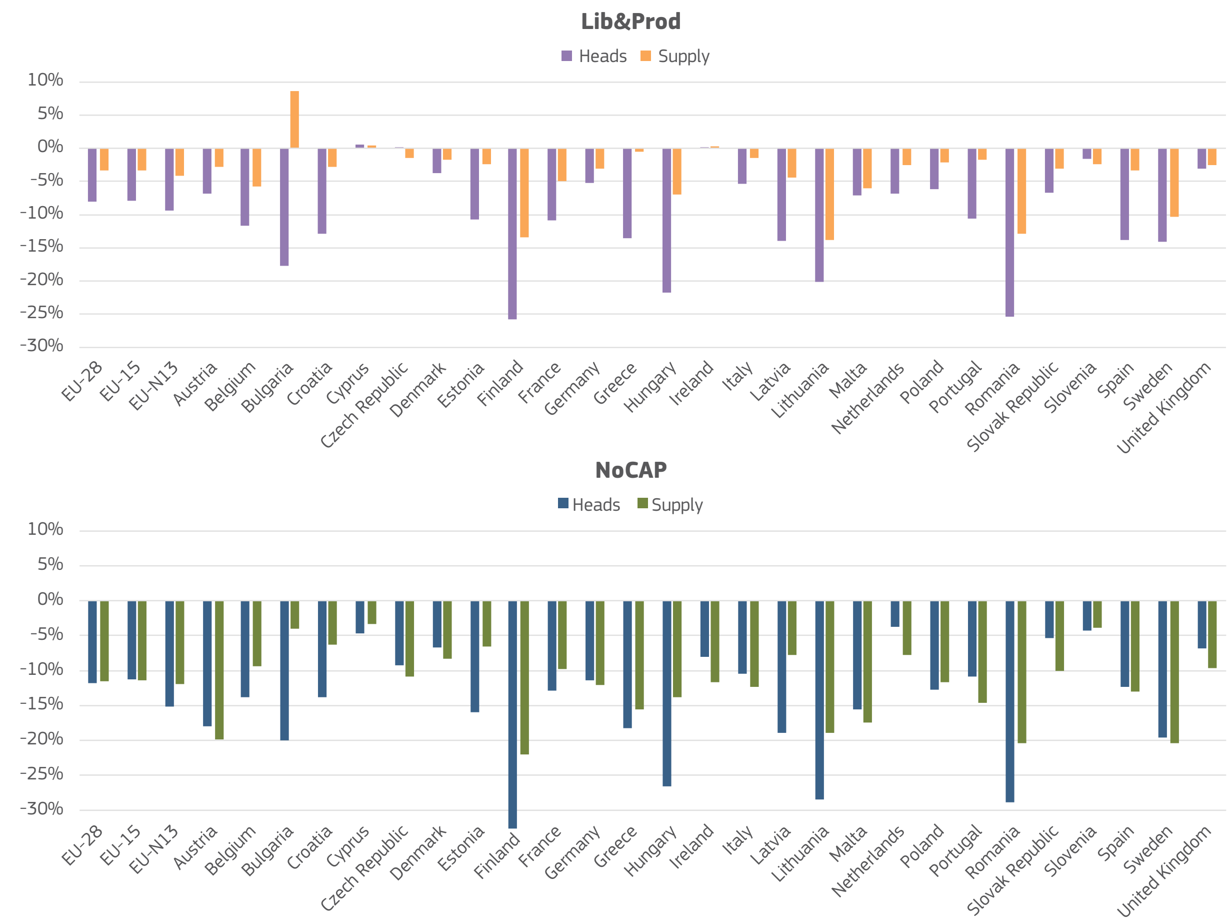


**FIGURE 54:** CHANGES IN BEEF CATTLE NUMBERS AND SUPPLY IN ALL POLICY SCENARIOS (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

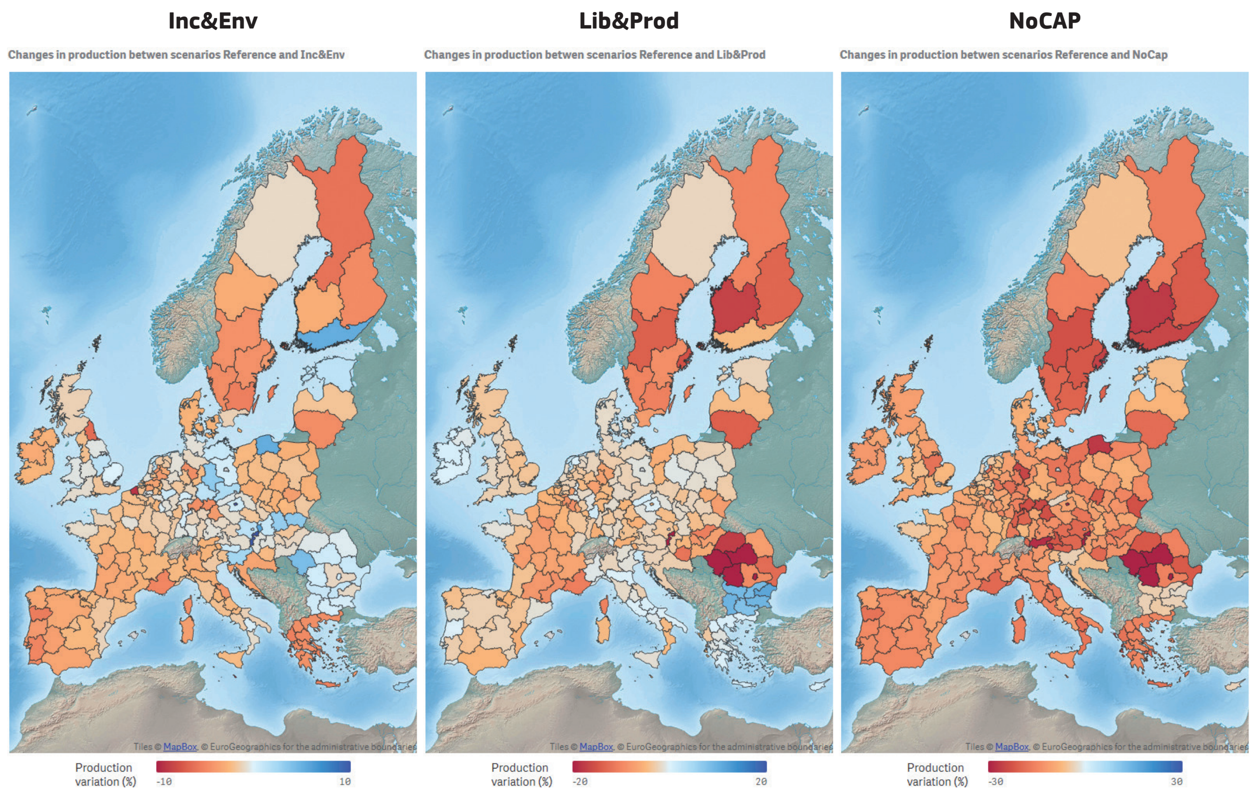


**FIGURE 55:** REGIONAL SUPPLY OF BEEF MEAT (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030. CAPRI model.

decrease in the cattle herd is largest in France (–650,000 cattle), Spain (–248,000 cattle) and the UK (–181,000 cattle), and the supply decrease is highest in France (–166,000 t) and Germany (–119,000 t).

Total EU pig meat production decreases slightly by 0.5% in the Env&Prod scenario compared with the reference scenario. Due to the restrictions on stocking densities, the production decreases occur mostly in EU-15 regions and are most pronounced in Belgium (–90,000 t supply), the Netherlands (–57,000 t), and Spain and Denmark (around –34,000 t each). Conversely, some regions in Germany (+69,000 t) and Poland (+34,000 t) show the largest absolute increases in pig meat production. In the Lib&Prod scenario, pig meat production increases slightly, by 0.6%, at aggregated EU-28 level. While production declines most in Germany (–179,000 t) and Poland (–14,000 t), several other regions experience production opportunities, leading to supply increases. The largest increases occur in Spain (+151,000 t), Italy (+69,000 t) and Denmark (+45,000 t). The removal of all CAP measures in the NoCAP scenario provokes an aggregated pig meat production decrease

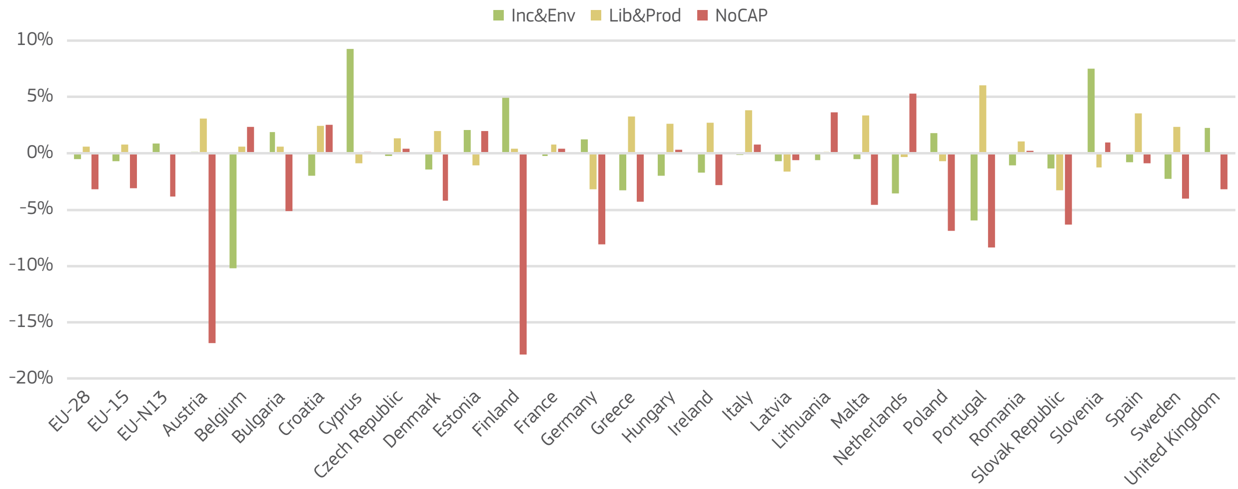


**FIGURE 56:** CHANGES IN PIG MEAT SUPPLY IN THE POLICY SCENARIOS (CHANGE RELATIVE TO REF).

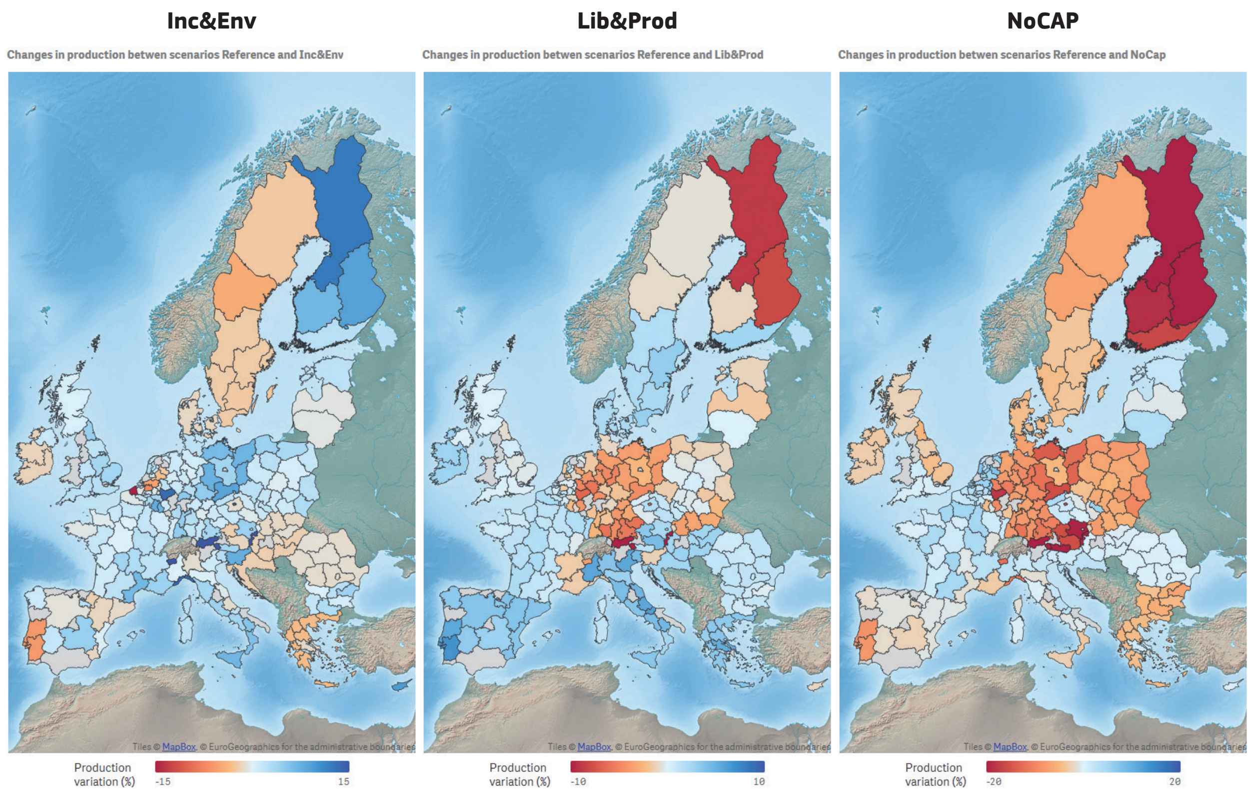


**FIGURE 57:** REGIONAL SUPPLY OF PIG MEAT (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030. CAPRI model.

of 3.2% in the EU. This affects almost all MSs, but the absolute production decline is by far the largest in Germany (–454,000 t), followed by Poland (–134,000 t), Denmark (–97,000 t) and Austria (–84,000 t). In contrast, increases in pig meat production are highest in the Netherlands (+84,000 t) and Belgium (+21,000 t). The changes in pig meat production are shown at MS level in Figure 56 and at regional level in Figure 57.

EU poultry meat production declines in all policy scenarios (Figure 58). EU poultry supply decreases moderately, by 0.8%, in the Inc&Env scenario, which is mainly due to stocking density restrictions, and is most pronounced, in absolute terms, in Italy (–26,000 t), Spain (–23,000 t) and Portugal (–21,000 t). In contrast, Germany, the second largest EU poultry meat-producing country, slightly increases poultry meat supply (+18,000 t). In the Lib&Prod scenario, total

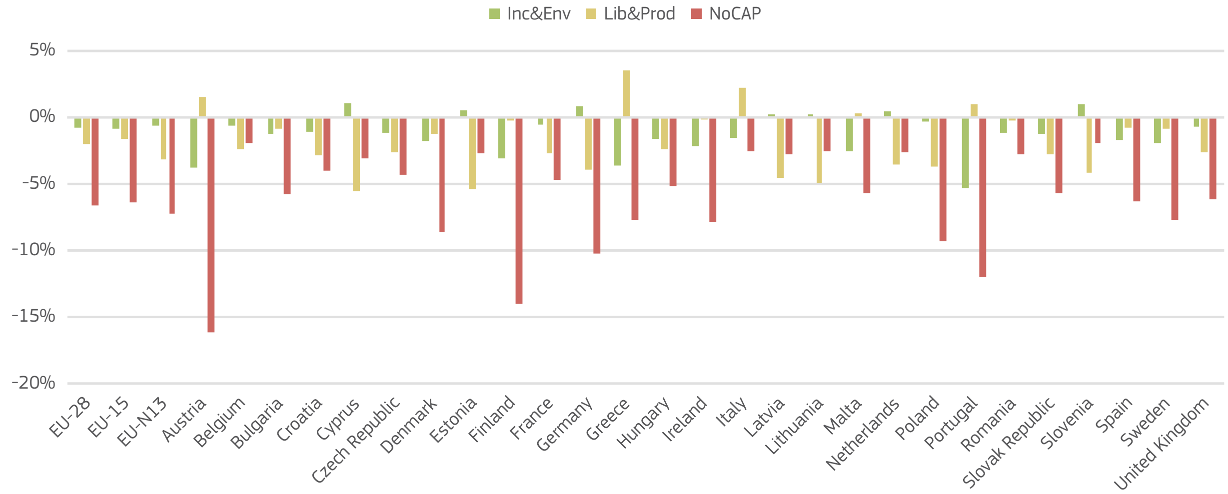


**FIGURE 58:** CHANGES IN POULTRY SUPPLY IN THE POLICY SCENARIOS (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

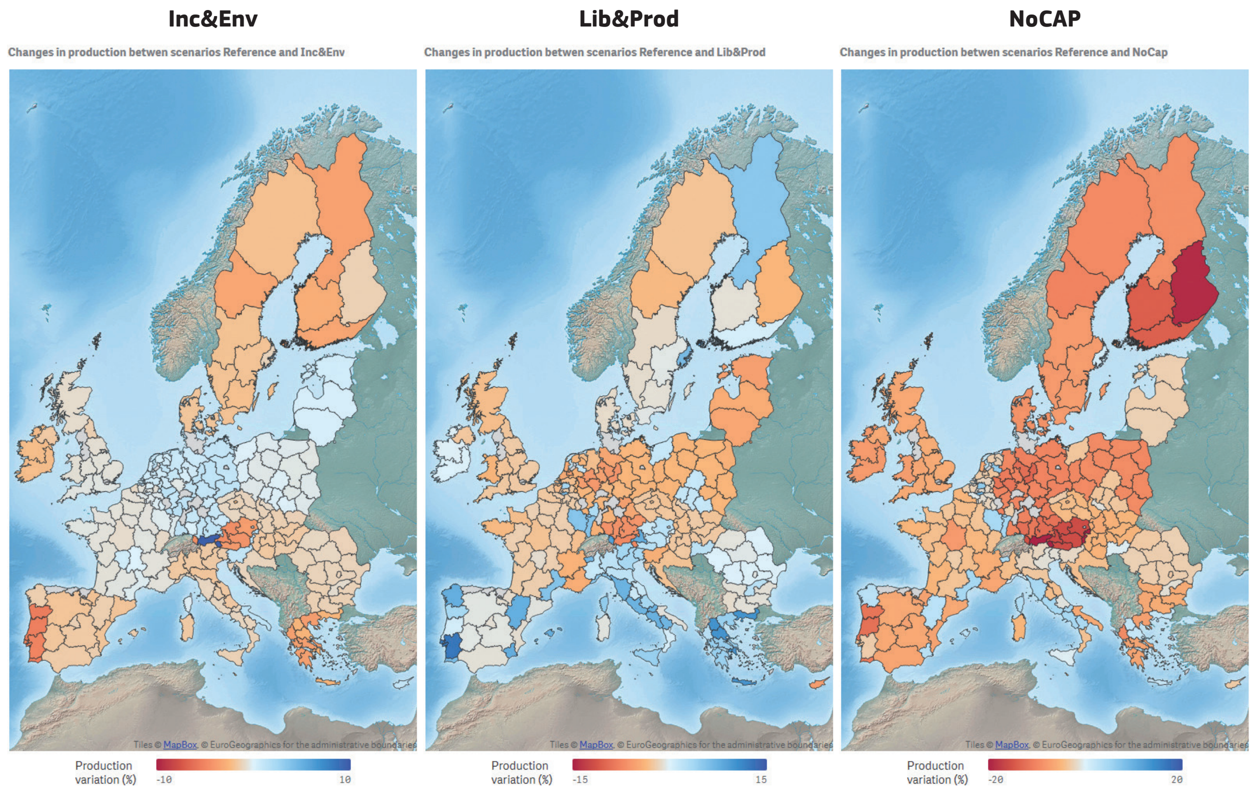


**FIGURE 59:** REGIONAL SUPPLY OF POULTRY MEAT (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

EU poultry supply declines by 2%, with somewhat larger decreases in the EU-N13 (–3.1%) than in the EU-15 (–1.6%). The absolute production decreases are highest in the two largest poultry meat-producing MSs: Poland (–94,000 t) and Germany (–85,000 t). In the NoCAP scenario, poultry production is projected to decline most, by –6.6% in the EU-28, again with the largest decreases in Poland (–234,000 t) and Germany (–219,000 t), but other important EU poultry meat producers are also negatively affected, especially the UK (–96,000 t), France (89,000 t) and Spain (–85,000 t). The regional scenario results are shown in Figure 59.

EU sheep and goat meat production benefits from the Inc&Env scenario (Figure 60). In particular, because of the decreases in EU beef meat production related to density restrictions, EU sheep and goat meat production increases by 4.3% (43,000 t) compared with the reference scenario. Almost half of this increase takes place in the UK (+21,000 t), which further improves its position as the largest sheep and goat meat producer in the EU-28. Apart from the UK, only Spain, the second largest EU producer of sheep and goat meat, (+7,400 t), Greece (+3,800 t) and France (+3,400 t) show somewhat considerable production increases.

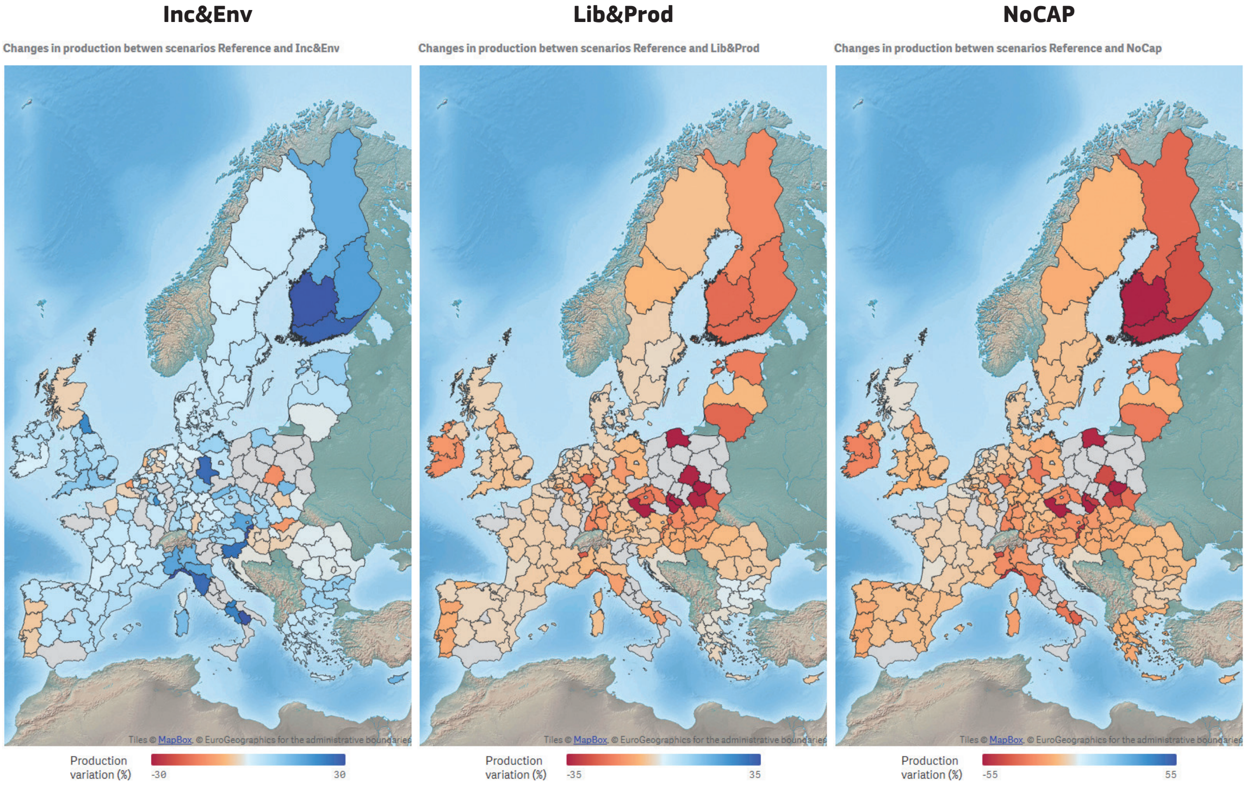


**FIGURE 60:** REGIONAL SUPPLY OF SHEEP AND GOAT MEAT (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030. CAPRI model.

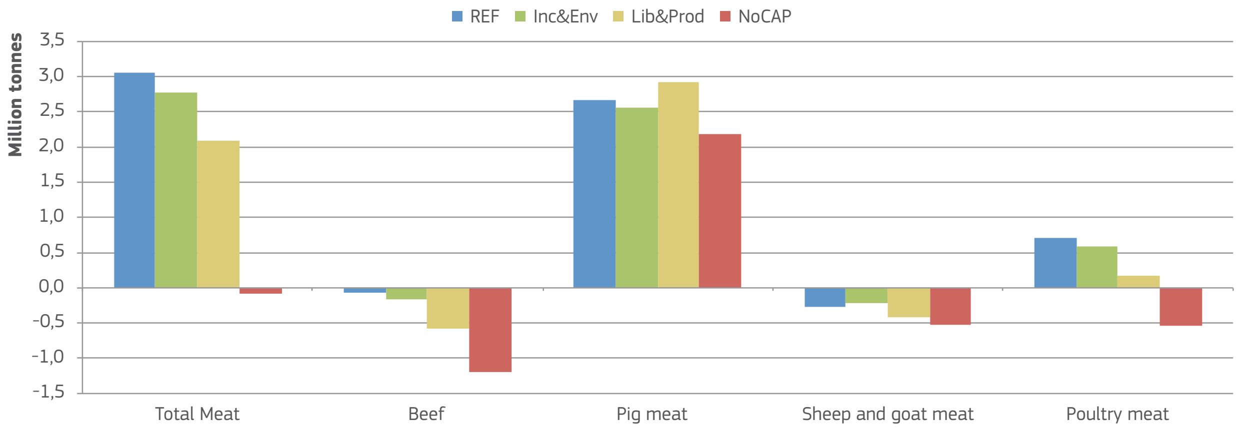


**FIGURE 61:** EU TRADE BALANCE FOR MEAT.
*Note:* trade balance = exports – imports.
*Source:* Scenar 2030, CAPRI model.

As a result of production decreases, the EU-28 trade balance for meat worsens in all scenarios, and while the EU remains a net meat exporter in the Inc&Env and Lib&Prod scenarios (particularly because of the net exports in pig meat), the EU becomes a net importer of meat in the No-CAP scenario (Figure 61).

## 7.2 | Land use

### 7.2.1 Utilised agricultural area

Under the Inc&Env scenario, UAA increases by 0.3% (+0.6 million ha) compared with the reference scenario, whereas UAA substantially declines, by 7.3% (–13.1 million ha), in the Lib&Prod scenario and by about 6.9% (–12.4 million ha) in the NoCAP scenario (Figure 62). The decreases in UAA in the Lib&Prod and NoCAP scenarios are directly linked to (1) the removal of direct payments, which immediately affects the profitability of all crop production activities, and (2) the decreases in EU production levels, especially to the declines in cereal production and pasture, i.e. part of the land is taken out as economic returns decrease.

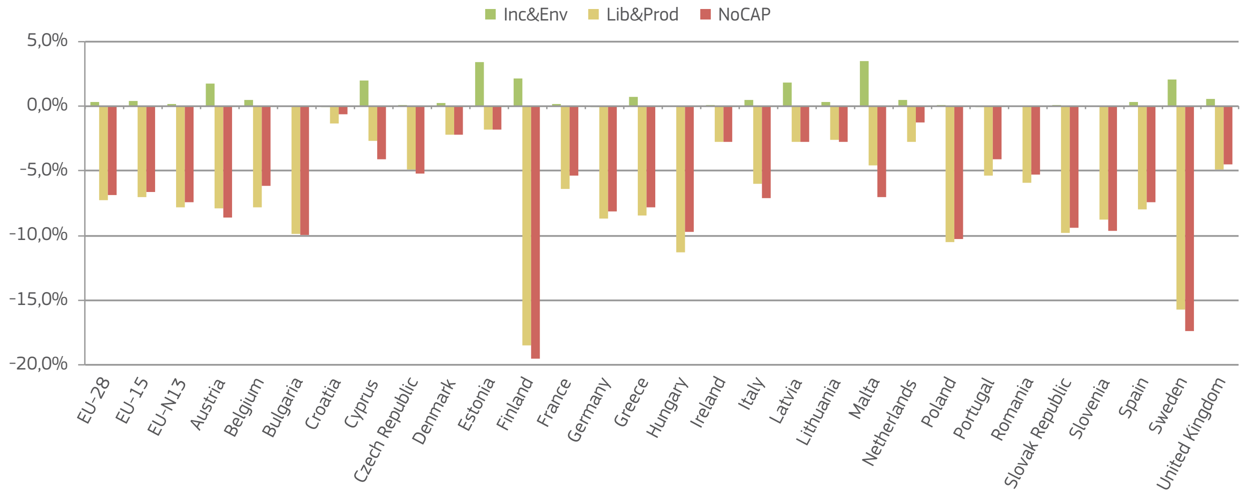


**FIGURE 62:** CHANGE IN UAA PER MS (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

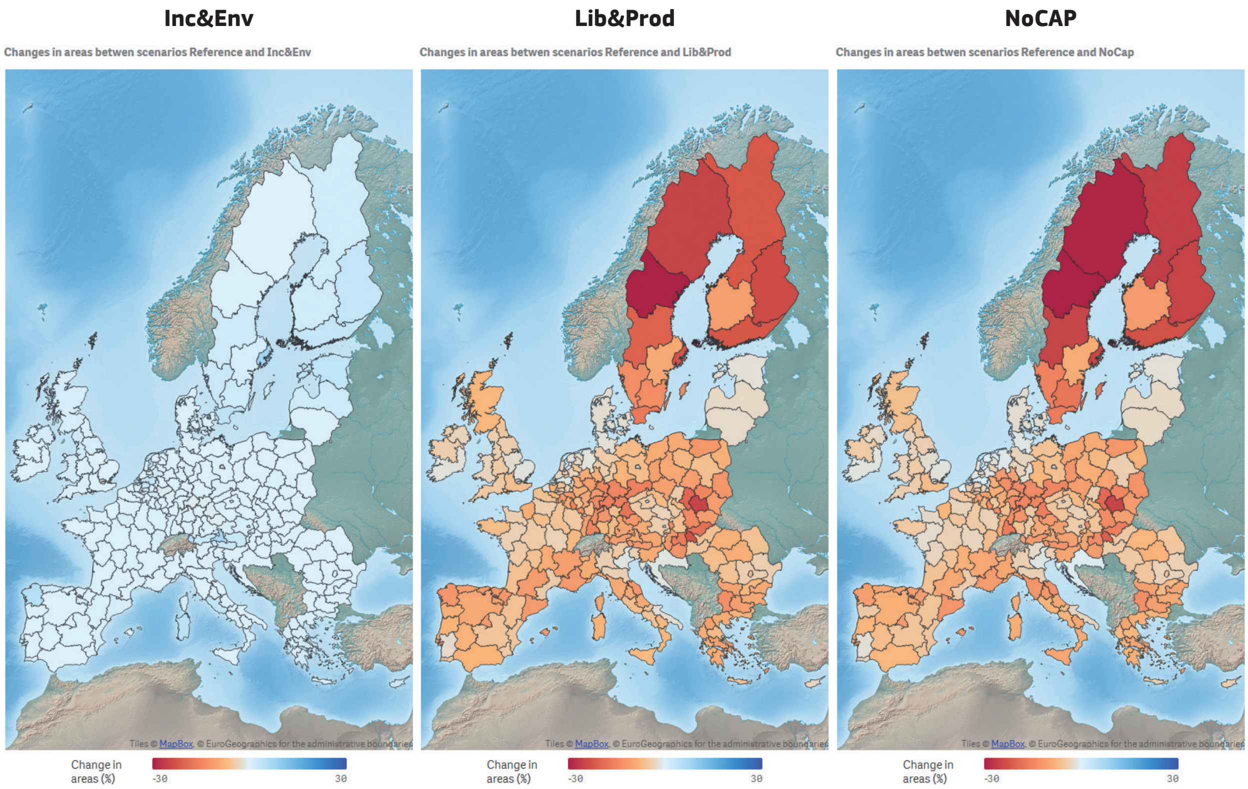


**FIGURE 63:** REGIONAL CHANGES IN UAA (CHANGE RELATIVE TO BASELINE).
*Source:* Scenar 2030. CAPRI model.

The regional changes in UAA compared with the reference scenario are shown inFigure 53. This figure shows that land abandonment in the Lib&Prod and NoCAP scenarios also takes place in areas with relatively good land quality (e.g. in France). In this context, it has to be mentioned that land quality in the CAPRI modelling approach is only captured through the inputs and outputs of the activities. Crop activities in regions with good land quality have a profitability that is above average (i.e. above the country or EU average), but the removal of direct payments immediately affects the profitability of crop production, leading to an income drop for all crop activities (as all crop activities receive direct payments in the REF scenario), and related reductions in total area. However, the income decline is generally smaller for regions where soil quality (and therefore potentially profitability of the crop activities) is high.

### 7.2.2 Grassland

In the Inc&Env scenario, there is almost no change in grassland area at aggregate EU-28 level compared with the reference scenario, but impacts in the individual MSs vary slightly, from the decreases of –3.5% in Cyprus (very low in absolute terms) and –0.5% in Spain to the increase of 2% in Austria. Both the Lib&Prod and NoCAP scenarios show a substantial decrease in EU-28 grassland area, with decreases of 8.6% (5.2 million ha) and 8.1% (4.9 million ha), respectively. In absolute terms, the decline in grassland is largest in France (around –1 million ha in both scenarios) and Spain (–0.9 million ha in Lib&Pro; –0.7 million ha in NoCAP). These substantial decreases in grassland area are driven mainly by the removal of direct payments and the absence of a CAP measure targeting the maintenance of permanent grassland. Grassland receives subsidies from both pillars that are a significant share of the grassland income, and without direct payments the grassland income becomes negative in most MSs. Moreover, the decrease of ruminant production and the related drop in feed demand amplify the negative effect on grassland area (Figure 64).

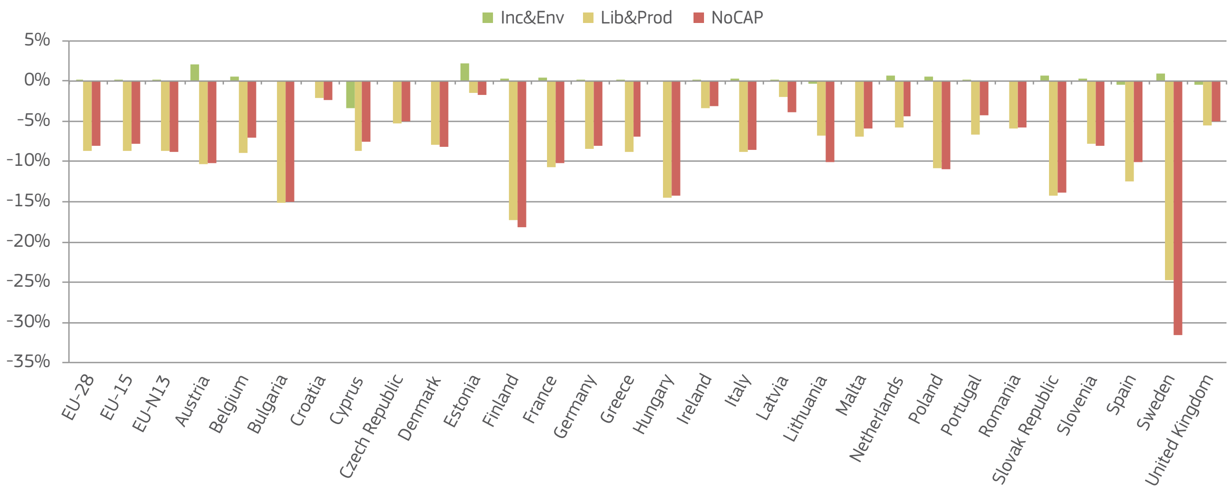


**FIGURE 64:** CHANGE IN GRASSLAND AREA PER MS (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

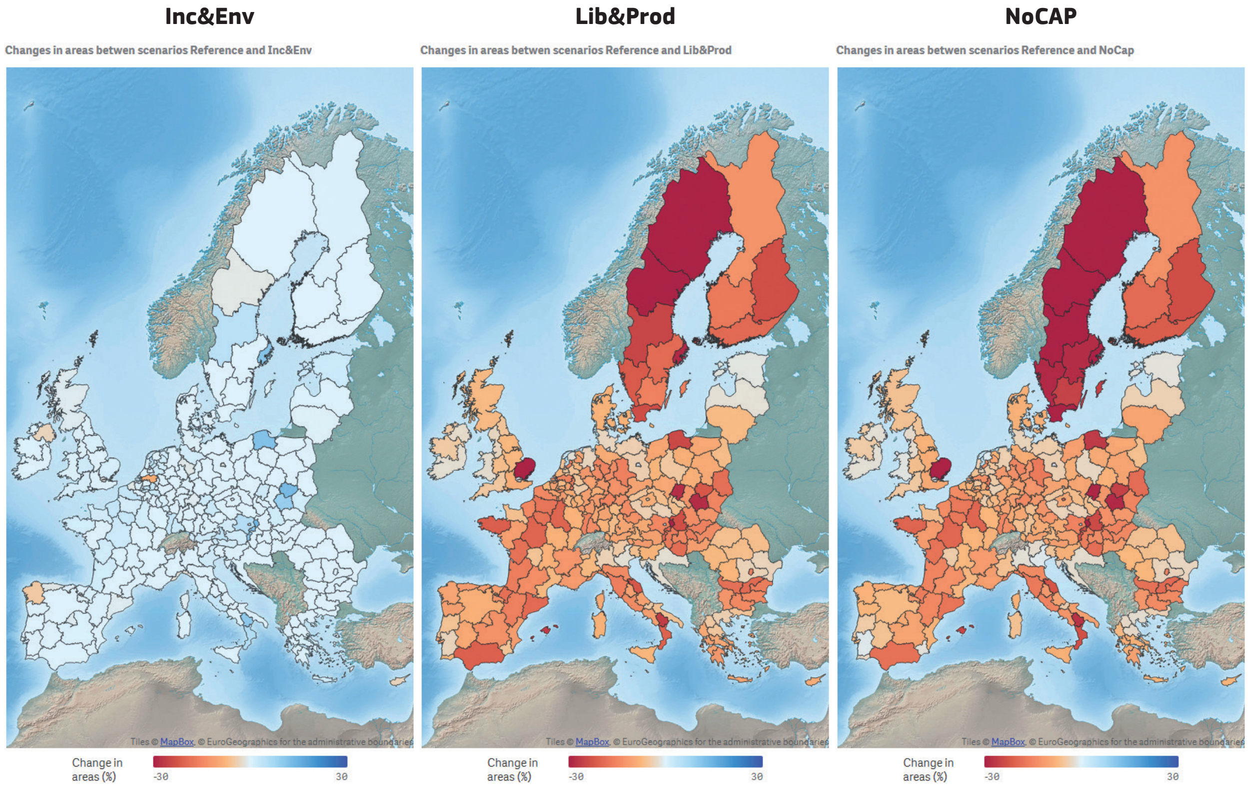


**FIGURE 65:** REGIONAL CHANGE IN GRASSLAND AREA (% CHANGE RELATIVE TO BASELINE).
*Source:* Scenar 2030. CAPRI model.

## 7.3 | Sectoral income per region

The market developments in the Inc&Env scenario, together with the direct payments and other agricultural support, lead to an increase of 4.2% in gross farm income for all agricultural activities in the EU-28 compared with the reference scenario. The income increase is similar in the EU-15 and EU-N13 (4.1% and 4.5%, respectively). In contrast, in the Lib&Prod scenario, income decreases by 20% in the EU-28, with a decrease of about 18% in the EU-15 and a decrease of 32% in the EU-N13. The income decrease is a combination of the elimination of most support payments and a decrease in most producer prices due to increased international competition and related EU production decline. As the negative EU production effects are less pronounced in the NoCAP scenario than in the Lib&Prod, scenario, producer prices actually decrease less in the NoCAP scenario (as the EU production decrease is not compensated for by increased imports). Accordingly, income decreases less in the NoCAP scenario than in the Lib&Prod scenario. Nonetheless, total EU-28 agricultural income decreases by more than 17% in the EU-28 under the NoCAP scenario, with decreases of almost 16% in the EU-15 and 29% in the EU-N13. Relative income changes are bigger in EU-N13 in all three scenarios because the relative proportion of support payments to total income is generally higher in the EU-N13 than in the EU-15.

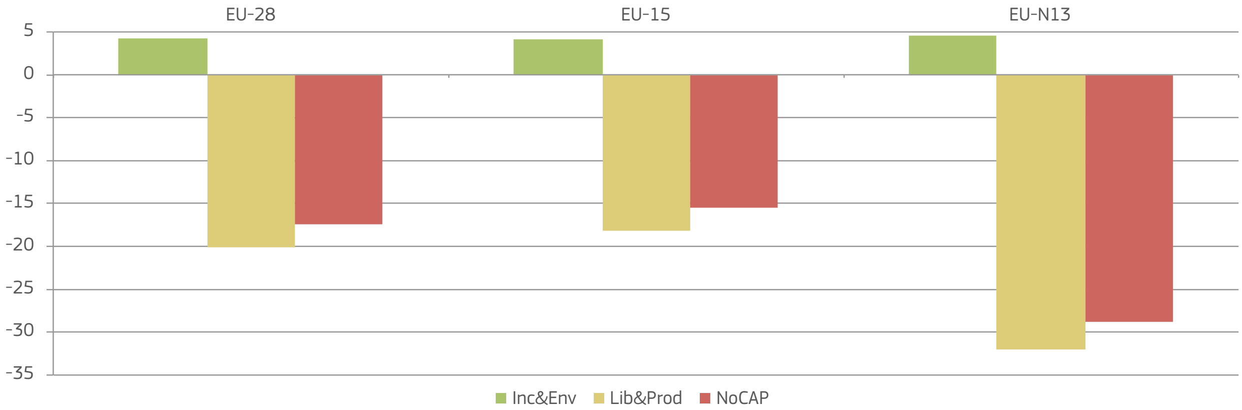


**FIGURE 66:** GROSS FARM INCOME, ALL AGRICULTURAL ACTIVITIES (% CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

Figure 67 shows that in the Lib&Prod and NoCAP scenarios, the impacts on income per UAA are lower in regions with a high proportion of sectors not receiving payments, e.g. Andalusia, other southern MSs and the Netherlands, where horticulture accounts for a very high proportion of value-added. Conversely, the reduction in income per UAA is above 30% in regions where cattle, dairy and crop production is very high (e.g. cattle and dairy farms in Asturias, Scotland, Tyrol and Slovenia).

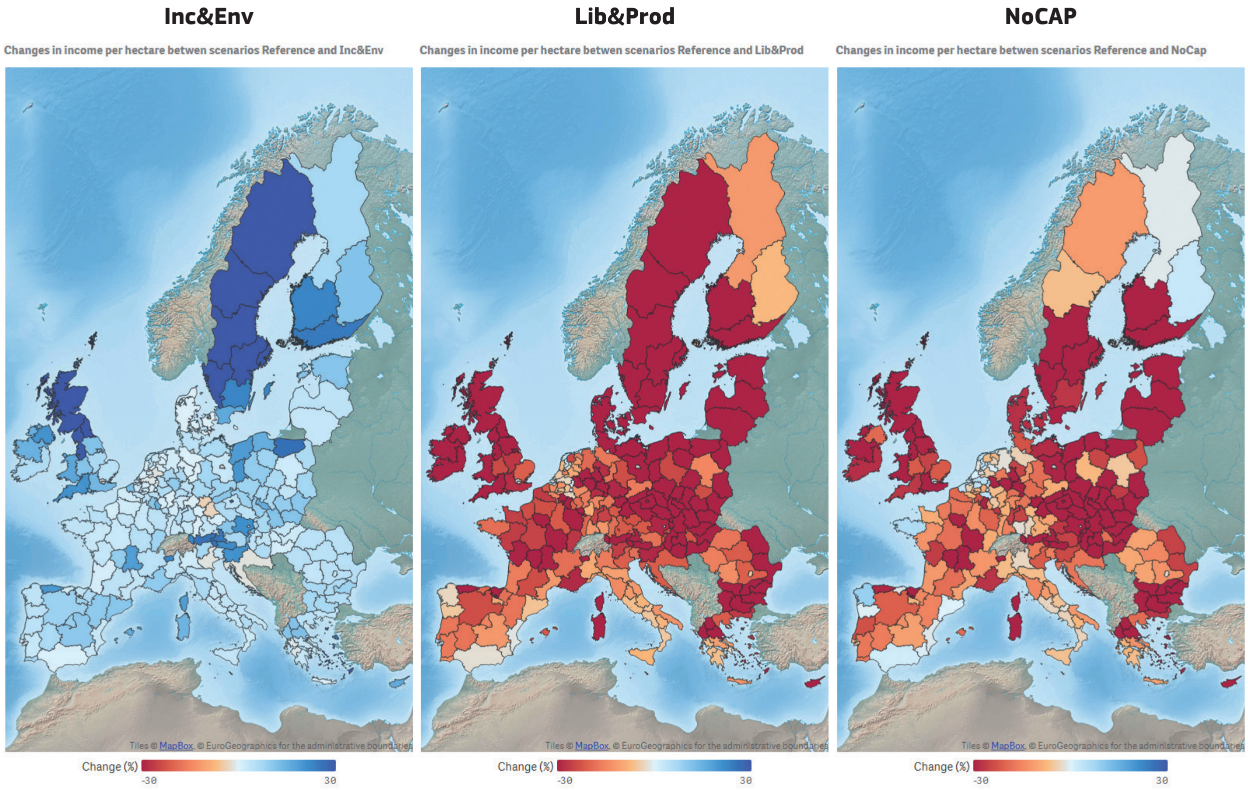


**FIGURE 67:** GROSS FARM INCOME PER UAA AT REGIONAL LEVEL (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030. CAPRI model.

# 8

# SCENARIOS: IMPACTS **AT FARM LEVEL**

# 8 Scenarios: impacts at farm level

## 8.1 | Farm structure change

Table 32 and Table 33 show the impact of the simulated policy scenarios on crop area and animal numbers for key activity groups by farm specialisation and economic farm size in the EU-27.[40] The simulation results show that the impacts are of a greater magnitude in the Lib&Prod and NoCAP scenarios than in the Inc&Env scenario. In general, in all three scenarios, supported activities (e.g. cattle, cereals) are more negatively affected than less supported activities (e.g. oilseeds, vegetables and permanent crops) across different farm specialisations and economic size classes.[41]

Under the Inc&Env scenario, cereal area decreases between 0.5% and 7% across farm specialisations and between 1.4% and 3% across farm size classes compared with the reference scenario because of the elimination of coupled crop subsidies. Cereals tend to be more supported than other crop activities in the reference scenario, while crop payments are eliminated in the Inc&Env scenario. The cereal area is relocated to, among others, oilseed and fodder production. Oilseed area increases because of a lower level of coupled support in the reference scenario and a better relative price for oilseeds than cereals in the Inc&Env scenario. Cattle activities increase by up to 5% across most farm specialisations in the Inc&Env scenario, compared with the reference scenario, because of price rises, while they are also less adversely affected by coupled payment reduction. However, livestock farms (specialist milk; specialist cattle) experience a small reduction in cattle numbers, in contrast to the increases indicated for other farm specialisations. This effect is caused by the limits on stocking density per hectare imposed as an eligibility condition for receiving coupled livestock payments in the Inc&Env scenario. This limit constrains livestock farms more than farms specialised in other activities because of the greater livestock intensity on livestock farm than on other farms. Livestock farms account for the main bulk of cattle numbers; hence, they drive the overall results causing a small reduction in cattle numbers across most economic size classes (Table 32 and Table 33).

The reduction of support in the Lib&Prod and NoCAP scenarios leads to a substantial restructuring of farming activities across farm types and sectors in the EU-27 (Table 32). The resulting impacts under these two scenarios are much greater than under the Inc&Env scenario. The direction of the simulated activity changes for cereals, oilseeds and vegetables, and permanent crops are the same for the Inc&Env and the Lib&Prod and NoCAP scenarios, but the magnitudes of these changes are significantly larger under the Lib&Prod and NoCAP scenarios across most farm specialisations and farm size classes. The exception is cattle numbers, which decrease in the Lib&Prod and NoCAP scenarios compared with the reference scenario for all farm specialisations and size classes, but show rather mixed effects in the Inc&Env scenario. The main cause for the reduction in cattle activities in the Lib&Prod and NoCAP scenarios is the elimination of coupled payments, as these farms receive the main bulk of this type of subsidy in the reference scenario. For other animal activities, the effects are mixed across farm specialisations and size classes in the Lib&Prod and NoCAP scenarios, as they include different livestock types which are affected heterogeneously by the subsidy changes and price effects applied under the simulated scenarios. Overall, the magnitudes of the effects for other animal activities are similar for the Lib&Prod and NoCAP scenarios and the Inc&Env scenario.

The results reveal that there is substantial heterogeneity in the changes in crop area and animal numbers between different farm specialisations in the three simulated scenarios. In general, farms experience greater changes in minor activities in which they are not specialised (e.g. cereal and animal activities for permanent crop farms; vegetables and permanent crops for field cropping farms and livestock farms; oilseeds for livestock farms) than in their core activities. This effect is largely due to relatively low levels of minor activities in the reference scenario. It could be also explained by lower adjustment costs and lower opportunity costs for minor activities than for core

[40] The EU-27 includes all EU Member States except for Croatia. Croatia is not considered because, in 2012, it was not part of the EU (FADN data for the base year are not available).

[41] More details can be found under this link: https://datam.jrc.ec.europa.eu/datam/mashup/SCENAR2030.

activities. This indirectly implies that when subsidies are reduced (particularly coupled ones) farms adjust minor activities to a larger extent than core activities, which remain less affected (Table 32).

The simulated effects are less heterogeneous between economic sizes classes than they are across farm specialisations (Table 32 and Table 33). However, there is a relatively consistent pattern indicating an inverse relationship between the magnitude of the simulated impacts and economic farm size in all three simulated scenarios. The exceptions to this are vegetables and permanent crops in the Lib&Prod and NoCAP scenarios, where the reverse pattern is observed. The main explanation for this inverse relationship is the greater subsidy dependence of small farms, which are, therefore, affected more than large farms when subsidies are reduced. In addition, as explained above, because, by construction, small farms have fewer farm activities in the reference scenario than large farms, there are larger changes in relative magnitudes.

| | Cereals | | | Oilseeds | | | Vegetables and permanent crops | | | All cattle activities | | | Other animals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP |
| Specialist COP | −1.96 | −4.15 | −3.63 | 3.89 | 19.20 | 21.24 | 9.44 | −6.21 | 27.37 | 1.50 | −9.79 | −5.09 | −2.05 | −1.80 | 2.42 |
| Specialist other field crops | −4.00 | −7.48 | −5.99 | 3.44 | 34.38 | 33.09 | 3.40 | 7.54 | 17.00 | 0.48 | −9.13 | −5.40 | −0.72 | −0.13 | 2.22 |
| Specialist horticulture | −1.90 | −9.67 | −13.26 | 2.70 | 25.38 | 10.54 | −1.14 | 4.37 | 8.76 | 2.91 | −15.03 | −9.34 | −0.26 | −0.30 | 1.30 |
| Specialist olives | −7.48 | −10.51 | −13.01 | 17.48 | 46.85 | −5.56 | 0.73 | 0.87 | 3.04 | 2.30 | −12.86 | −7.34 | 0.42 | 0.70 | 1.55 |
| Specialist wine | −3.41 | −8.74 | −6.05 | −5.13 | 36.11 | 18.38 | 0.43 | −1.44 | −0.39 | 0.27 | −6.79 | −3.86 | −2.19 | −2.11 | −1.21 |
| Specialist orchards – fruits | −6.41 | −8.94 | −6.12 | −0.14 | 40.15 | 38.30 | 0.04 | −2.06 | −2.09 | 4.84 | −20.01 | −8.80 | −1.03 | −1.45 | −0.79 |
| Permanent crops combined | −5.85 | −6.34 | −6.69 | −2.62 | 30.97 | 13.74 | 0.74 | −1.09 | 0.52 | −0.61 | −6.50 | −3.56 | 0.40 | 1.69 | 2.95 |
| Specialist milk | −1.39 | −4.99 | −0.98 | 4.76 | 40.16 | 42.16 | 8.01 | 3.07 | 37.36 | −0.24 | −3.54 | −0.52 | −0.45 | −1.57 | 0.25 |
| Specialist sheep and goats | −5.85 | 8.03 | 11.03 | 13.65 | 192.30 | 220.30 | 1.08 | −4.26 | 2.53 | 1.63 | −7.76 | −3.47 | −0.50 | −0.49 | −0.08 |
| Specialist cattle | −2.55 | 1.22 | 4.79 | −3.06 | 29.15 | 30.48 | 1.11 | −1.34 | 6.61 | −0.76 | −7.39 | −4.10 | −0.50 | −0.72 | −0.87 |
| Specialist granivores | −0.68 | −3.46 | −2.72 | 0.12 | 16.03 | 14.30 | 6.85 | 3.52 | 27.47 | 1.13 | −6.49 | −2.08 | −0.05 | 0.02 | 0.04 |
| Mixed crops | −3.53 | −5.83 | −6.12 | 1.70 | 34.38 | 32.62 | 0.75 | −0.86 | 3.25 | 0.83 | −9.81 | −5.57 | −0.74 | −0.97 | 0.56 |
| Mixed livestock | −0.51 | −1.86 | −1.69 | 8.13 | 74.06 | 97.80 | 0.89 | 11.94 | 16.39 | 0.33 | −7.89 | −4.45 | −0.45 | −1.86 | −1.12 |
| Mixed crops and livestock | −0.81 | −1.77 | −1.17 | 1.64 | 23.24 | 27.24 | 1.55 | 1.81 | 11.15 | 0.18 | −7.49 | −3.96 | −1.22 | −1.45 | 0.30 |

**TABLE 32:** THE STRUCTURE OF CROP AREA AND ANIMAL NUMBERS FOR KEY ACTIVITY GROUPS BY FARM SPECIALISATION IN THE EU-27 (% CHANGE RELATIVE TO REFERENCE).
*Source:* Scenar 2030, IFM-CAP model.

| | Cereals | | | Oilseeds | | | Vegetables and permanent crops | | | All cattle activities | | | Other animals | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP | Inc&Env | Lib&Prod | NoCAP |
| 2,000 to < 8,000 EUR | −2.94 | −7.09 | −7.48 | 27.71 | 162.22 | 199.46 | 1.55 | −1.32 | 0.89 | −0.05 | −15.97 | −11.02 | −0.33 | −3.12 | −5.19 |
| 8,000 to < 25,000 EUR | −2.83 | −1.86 | −0.24 | 8.77 | 61.21 | 55.66 | 1.30 | −1.21 | 2.30 | −1.07 | −13.04 | −8.66 | −0.77 | −0.59 | 0.95 |
| 25,000 to < 100,000 EUR | −2.44 | −3.53 | −1.90 | 3.46 | 30.31 | 29.59 | 1.49 | −0.61 | 4.79 | −0.24 | −7.17 | −3.14 | −0.92 | −0.37 | 0.98 |
| 100,000 to < 500,000 EUR | −1.68 | −4.83 | −3.90 | 0.99 | 14.47 | 16.12 | 0.67 | 3.42 | 7.91 | −0.05 | −3.67 | −0.67 | −0.26 | −0.03 | 0.48 |
| ≥ 500,000 EUR | −1.46 | −1.85 | −1.42 | 0.40 | 8.14 | 8.94 | 0.07 | 2.82 | 7.10 | 0.03 | −1.27 | 0.06 | −0.08 | −0.03 | 0.55 |

**TABLE 33:** THE STRUCTURE OF CROP AREA AND ANIMAL NUMBERS FOR KEY ACTIVITY GROUPS BY ECONOMIC FARM SIZE IN THE EU-27 (% CHANGE RELATIVE TO REFERENCE).
*Source:* Scenar 2030, IFM-CAP model.

## 8.2 | Farm income

Table 34 and Table 35 show the percentage income change, relative to the reference scenario, for the three simulated scenarios (Inc&Env, Lib&Prod and NoCAP) by farm specialisation and economic farm size in the EU-27, respectively.

Across farm specialisations, income changes vary from –12% to +2% in the Inc&Env scenario; from –37% to +2% in the Lib&Prod scenario; and from –32% to +4% in the NoCAP scenario. The income change variation is much smaller across the different economic size classes: from –1% to +2% for the Inc&Env scenario; from –16% to –6% for the Lib&Prod scenario; and from –15% to –2% for the NoCAP scenario. This is because sector-specific effects are diluted among different farm specialisations belonging to the same economic size class.

These income changes are largely driven by changes to subsidies, particularly for the Lib&Prod and NoCAP scenarios. The correlation ratio between the subsidy as a proportion of total income in the reference scenario and the income change in the Lib&Prod and NoCAP scenarios for both farm specialisations and economic size classes is greater than 90%. Subsidy-dependent farms experience a significant reduction in income in these two scenarios, such as specialist cattle, specialist COP and specialist olive farms, with income reductions of 20% or more. In addition significantly affected farms under the Lib&Prod and NoCAP scenarios are specialist sheep and goat, mixed crop and livestock and mixed livestock farms. In the Inc&Env scenario, only specialist olive farms are significantly affected (–12%) because of the direct payment reduction caused by the introduction of flat-rate decoupled payments. Most of the other farm specialisations experience an income change of between –2% and +2% in the Inc&Env scenario.

Small economic size farms seem to gain (in relative terms) in the Inc&Env scenario. Small farms experience greater income losses than large farms under the Lib&Prod and NoCAP scenarios because of the subsidy cuts. However, under the Inc&Env scenario, small farms seem to be less affected by the restrictive greening measures and benefit from the redistribution of payments (homogenisation of direct payments, higher share of the greening envelope and HNV payments). Under the Lib&Prod and NoCAP scenarios, small farms are adversely affected by the removal of direct payments because of their higher subsidy dependency in the reference scenario.

| | Inc&Env | Lib&Prod | NoCAP |
|---|---|---|---|
| Specialist COP | 1.2 | –23.5 | –22.6 |
| Specialist other field crops | 0.4 | –2.1 | –0.2 |
| Specialist horticulture | –0.9 | 1.9 | 0.8 |
| Specialist wine | 0.4 | –7.1 | –7.6 |
| Specialist orchards – fruits | –2.7 | –4.0 | –6.2 |
| Specialist olives | –11.6 | –20.6 | –19.9 |
| Permanent crops combined | –1.5 | –7.7 | –9.2 |
| Specialist milk | –0.1 | –8.7 | 2.6 |
| Specialist sheep and goats | –0.5 | –12.1 | –11.9 |
| Specialist cattle | –2.3 | –36.7 | –31.8 |
| Specialist granivores | 1.0 | –3.7 | 3.6 |
| Mixed crops | –0.3 | –2.8 | –3.6 |
| Mixed livestock | 1.8 | –12.0 | –3.0 |
| Mixed crops and livestock | 0.2 | –14.8 | –9.7 |

**TABLE 34:** INCOME VARIATION BY FARM SPECIALISATION IN THE EU-27 (% CHANGE RELATIVE TO REFERENCE).
*Source:* Scenar 2030. IFM-CAP model.

| | Inc&Env | Lib&Prod | NoCAP |
|---|---|---|---|
| EUR 2,000 to < 8,000 | 1.9 | –14.5 | –10.2 |
| EUR 8,000 to < 25,000 | –0.5 | –16.3 | –14.6 |
| EUR 25,000 to < 100,000 | –0.7 | –13.8 | –10.2 |
| EUR 100,000 to < 500,000 | –0.2 | –8.5 | –3.3 |
| ≥ EUR 500,000 | –0.2 | –6.1 | –2.2 |

**TABLE 35:** INCOME VARIATION BY ECONOMIC FARM SIZE IN THE EU-27 (% CHANGE RELATIVE TO REFERENCE).
*Source:* Scenar 2030. IFM-CAP model.

Figure 68 reveals that there are heterogeneous effects with regard to income in all three simulated scenarios. However, the proportion of farmers with negative income change is significantly larger in the Lib&Prod and NoCAP scenarios than in the Inc&Env scenario. In the Lib&Prod and NoCAP scenarios, most farms (around 88% and 78% of all farms, respectively) lose relative to the reference situation, whereas in the Inc&Env scenario the reverse holds true, with most (around 54%) farms gaining relative to the reference.

In the Lib&Prod and NoCAP scenarios, farmers lose mainly because of the abolishment of direct payments. Most farms (83% and 73% of all farms, respectively) lose between EUR 10/ha and EUR 1,000/ha in these two scenarios. In the Inc&Env scenario, most farms that gain income (45% of all farms) increase their income by between EUR 10/ha and EUR 500/ha (Figure 68). These farms gain income mainly because of an increase in output prices. Some specific farms are positively affected by the increase in direct payments with the introduction of MS flat-rate decoupled payments (i.e. those that have lower per hectare payments in the reference scenario) and/or because they are located in Natura 2000 areas. Most income-losing farms (37% of all farms) in the Inc&Env scenario experience an income reduction of between EUR 10/ha and EUR 500/ha (Figure 68).

Figure 69 shows that the proportion of farms with a negative income is 2.7% of the total number of farms in the reference scenario but 4.2% and 4.4% of farms in the Lib&Prod and NoCAP scenarios, respectively. In the Inc&Env scenario, the proportion of farms with a negative income is the same as in the reference scenario. In terms of the UAA, the proportion of UAA of farms with a negative income is 3.1% of total UAA in the reference scenario but 5.8% and 6.2%, respectively, in the Lib&Prod and NoCAP scenarios.

At the EU-27 level, as represented by the Gini coefficient, the Lib&Prod and NoCAP scenarios increase farm income inequality among farms to 0.75 and 0.76, respectively, from 0.71 in the reference scenario. This implies that CAP subsidies play an income equalisation role among farms in the EU. Farm income inequality is the same in the Inc&Env and reference scenarios; that is, the Gini coefficient is around 0.71 in both of these scenarios (Figure 70).

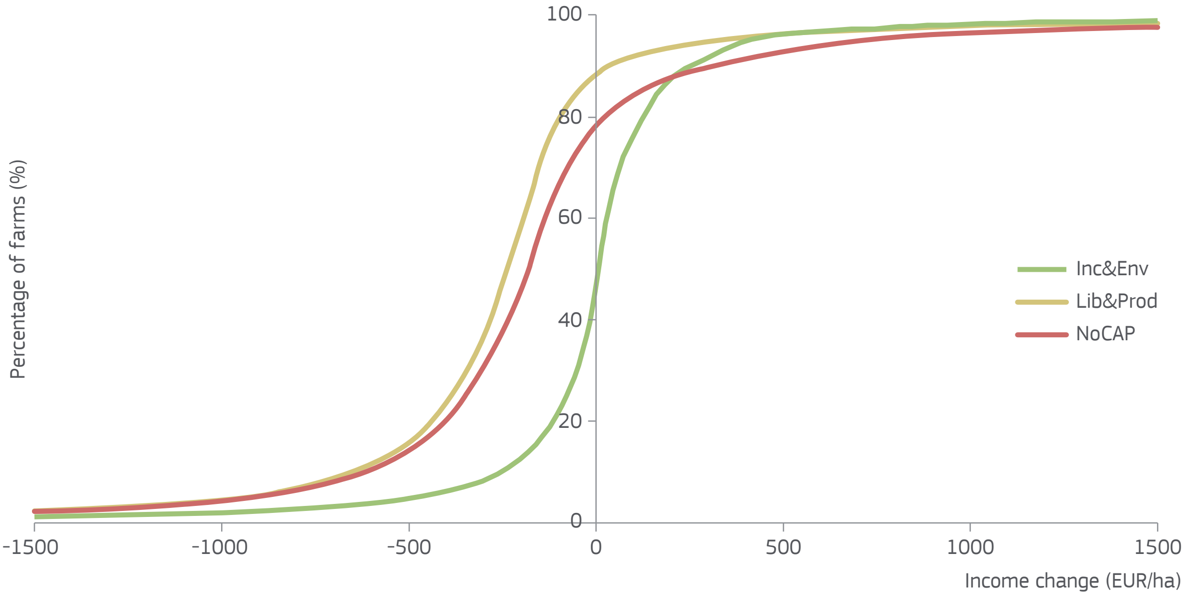


**FIGURE 68:** THE DISTRIBUTION OF FARM INCOME RELATIVE TO THE REFERENCE SCENARIO ACROSS THE FARM POPULATION IN THE EU-27 (EUR/HA).
*Source:* Scenar 2030, IFM-CAP model.

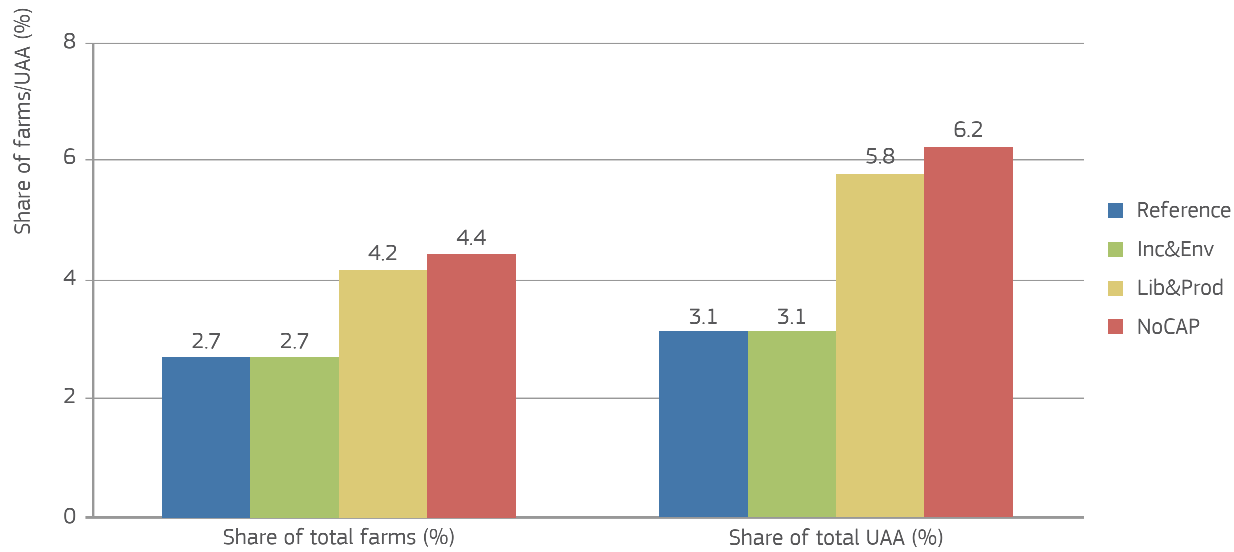


**FIGURE 69:** FARMS WITH NEGATIVE INCOME IN THE EU-27 (% OF ALL FARMS/UAA).
*Source:* Scenar 2030, IFM-CAP model.

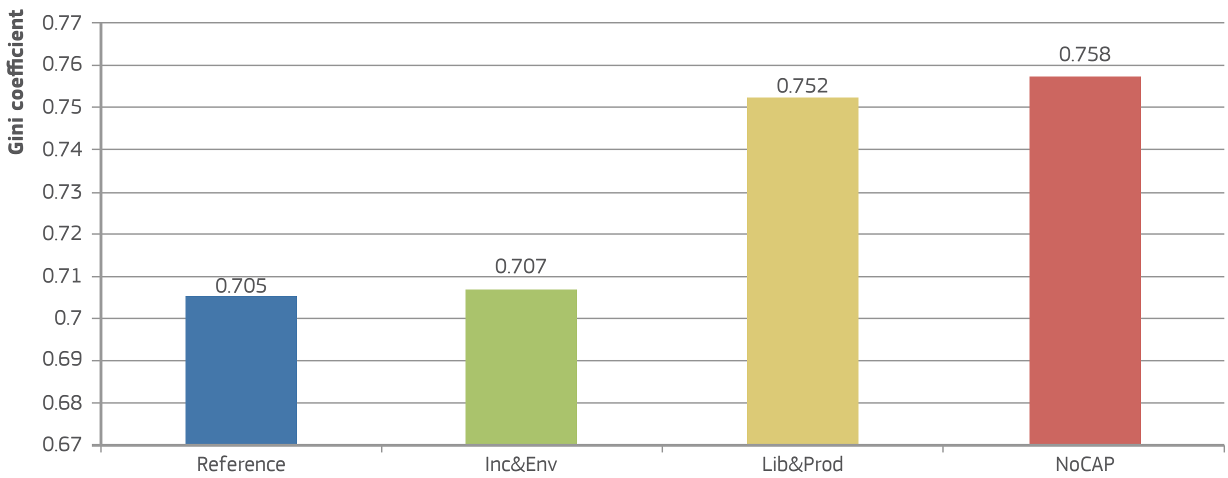


**FIGURE 70:** GINI COEFFICIENT FOR FARM INCOME DISTRIBUTION IN THE EU-27.
*Source:* Scenar 2030, IFM-CAP model.

9

# SCENARIOS: ENVIRONMENTAL ASPECTS IN THE EU

# 9 Scenarios: environmental aspects

## 9.1 | Nitrogen surplus

The limitation in animal stocking density and the restriction on nitrogen use lead to a decrease in the N-surplus of 0.8 kg N/ha UAA under the Inc&Env scenario. A considerable reduction is reported in particular in Member States and regions with a high N-surplus in the reference scenario, such as Belgium and the Netherlands, mostly related to reductions in stocking densities. In contrast, under the Lib&Prod and NoCAP scenarios, the N-surplus increases by 2 and 0.5 kg N/ha UAA, respectively (Figure 71 and Figure 72). The increase in N-surplus is, on the one hand, driven by the decrease in UAA and, on the other hand, the intensification of livestock and crop production on the remaining UAA. The rise in N-surplus per ha is more pronounced in the Lib&Prod than in the NoCAP scenario because the overall decline in intensity and production levels is greater in the NoCAP scenario, while the decrease in total UAA is greater in the Lib&Prod scenario. In both scenarios, more substantial increases in N-surplus are indicated for regions that already have the highest N-surplus in the reference scenario, as these are among the most competitive regions (Figure 73).[41]

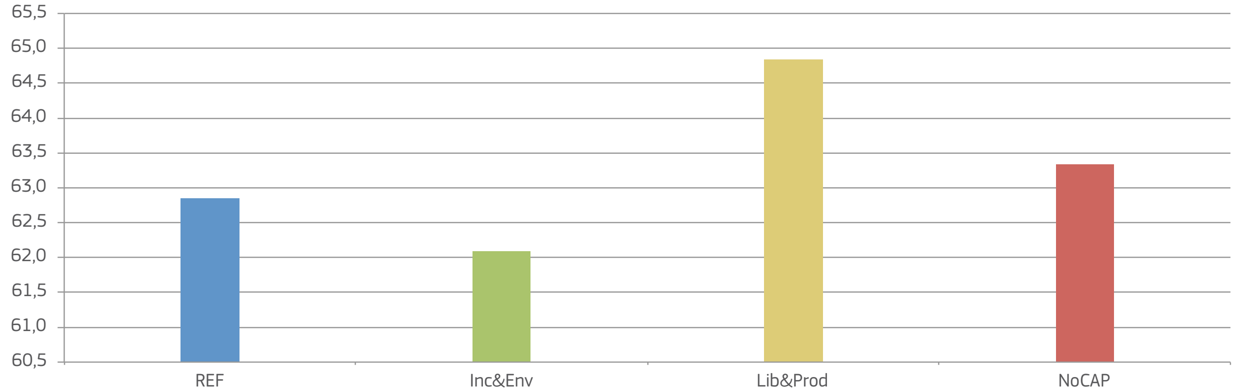


**FIGURE 71:** N-SURPLUS, EU-28 (KG N/HA UAA).
*Source:* Scenar 2030, CAPRI model.

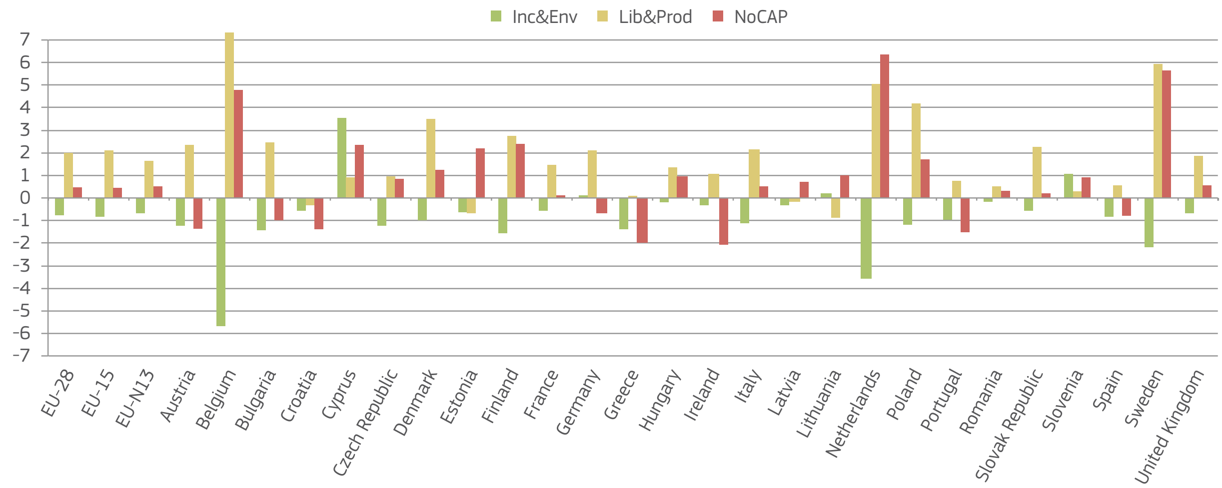


**FIGURE 72:** CHANGE IN N-SURPLUS PER MS (ABSOLUTE CHANGE IN KG N/HA UAA RELATIVE TO REF).
*Note:* Malta has been removed from the graph to improve the readability. The values for Malta are: Inc&Env -14%, Lib&Prod +17%, NoCAP +12%".
*Source:* Scenar 2030, CAPRI model.

[41] More details can be found under this link: https://datam.jrc.ec.europa.eu/datam/mashup/SCENAR2030.

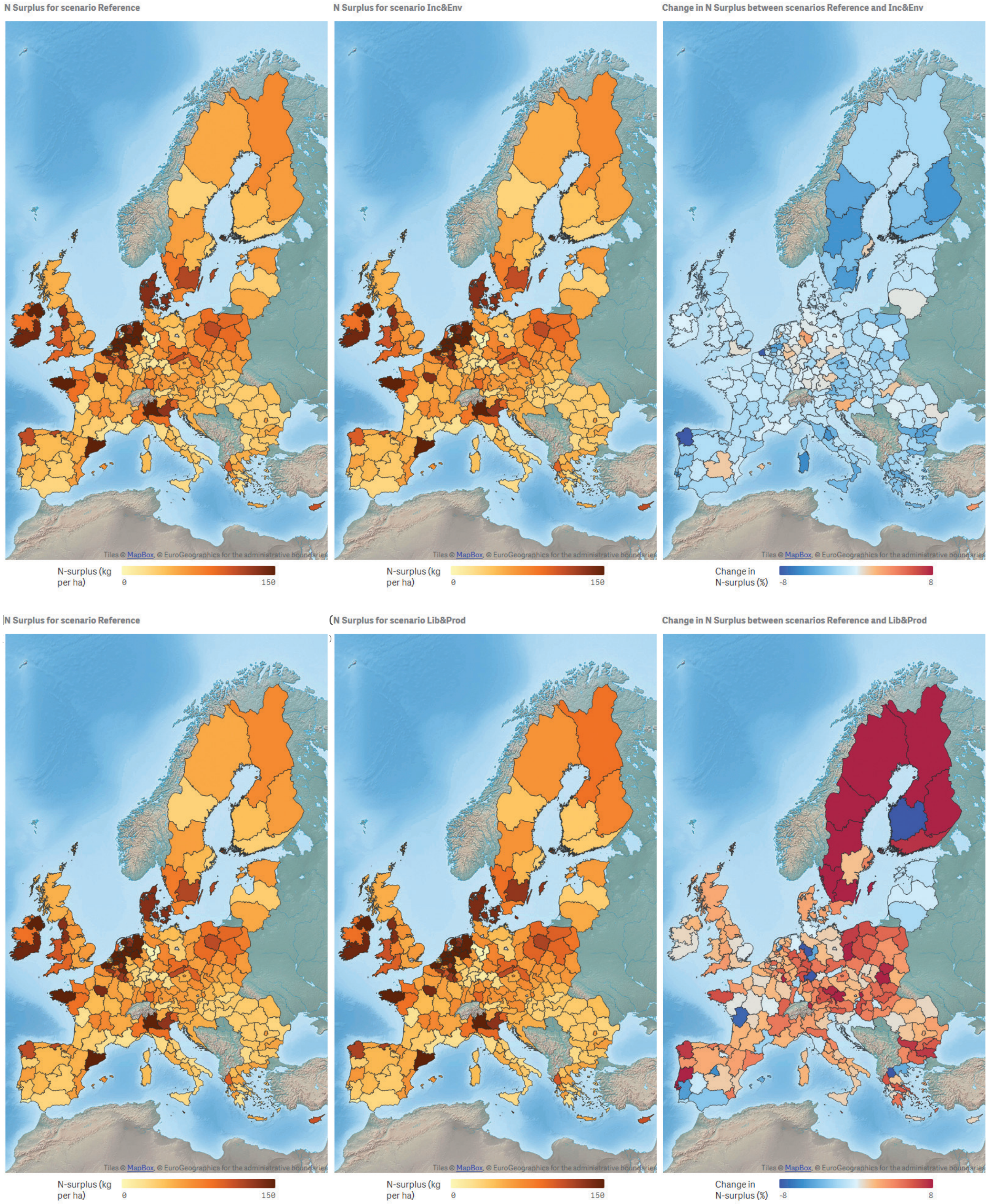


**FIGURE 73:** N-SURPLUS IN 2030 IN REF AND EACH SCENARIO, AND CHANGE IN N-SURPLUS UNDER EACH SCENARIO RELATIVE TO REF (KG N/HA UAA).

*FIGURE CONTINUES ON NEXT PAGE →*

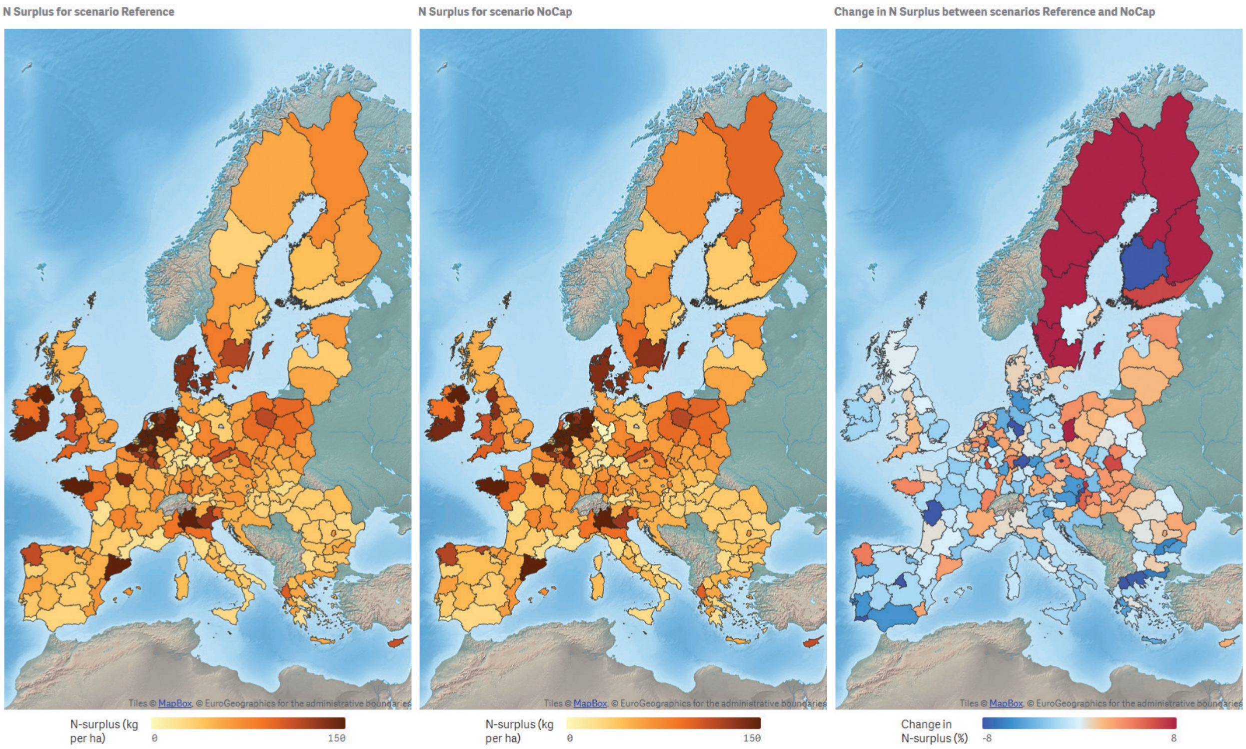


**FIGURE 73:** N-SURPLUS IN 2030 IN REF AND EACH SCENARIO, AND CHANGE IN N-SURPLUS UNDER EACH SCENARIO RELATIVE TO REF (KG N/HA UAA).
Source: Scenar 2030. CAPRI model.

## 9.2 | Agricultural greenhouse gas emissions

Changes in agricultural non-$CO_2$ GHG emissions follow directly from production developments. Therefore, changes are rather limited in the Inc&Env scenario, with a decrease of 0.5% in EU-28 emissions; however, considerably larger decreases are indicated under the Lib&Prod scenario (–4.2%) and NoCAP scenario (–5.8%) (Figure 74). It should be mentioned that the consideration of the impact of technological GHG mitigation options is very limited in the scenario setting (i.e. the technologies are not widely applied), which is why the predicted GHG

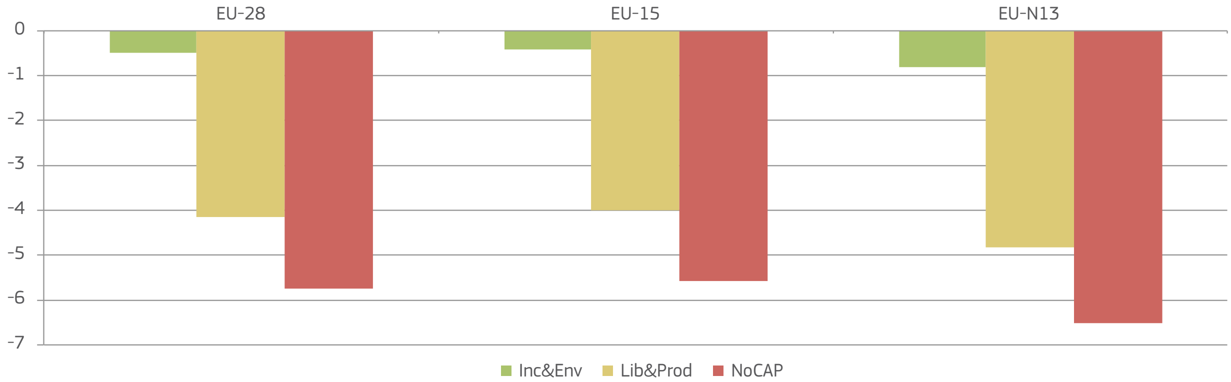


**FIGURE 74:** CHANGE IN AGRICULTURAL NON-$CO_2$ GHG EMISSIONS (% CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

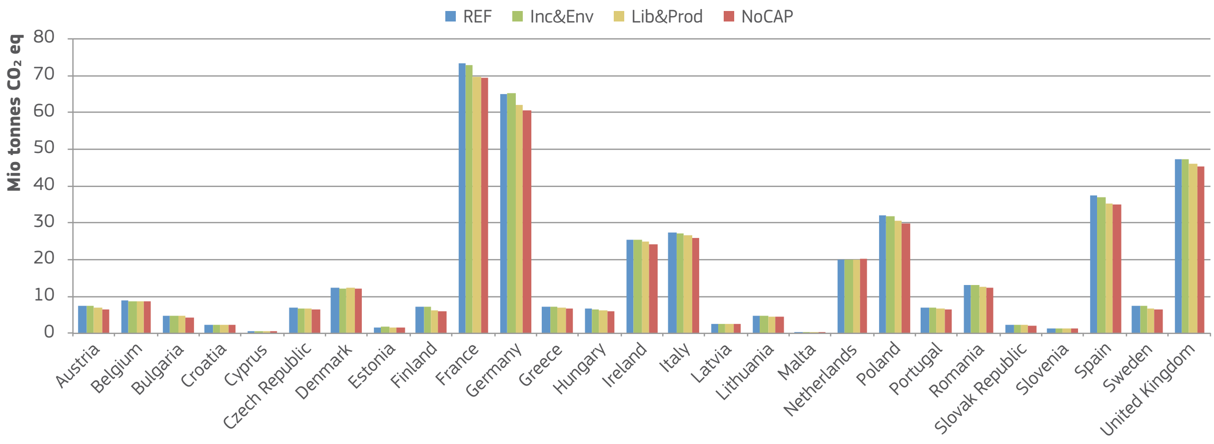


**FIGURE 75:** AGRICULTURAL NON-$CO_2$ GHG EMISSIONS IN THE EU MSs.
*Source:* Scenar 2030, CAPRI model.

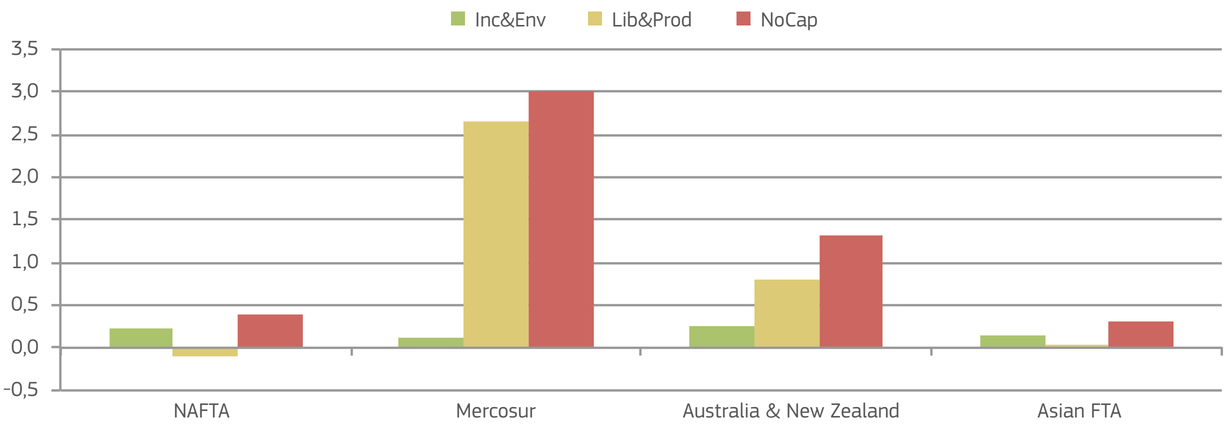


**FIGURE 76:** GHG EMISSIONS IN AGRICULTURE, EU-28 AND OTHER COUNTRIES, 2030 (% DIFFERENCE FROM BASE).
*Source:* Scenar 2030, MAGNET model.

changes mirror production changes so closely. At the MS level, the changes in agricultural non-$CO_2$ GHG emissions also reflect the corresponding production changes in the scenarios (Figure 75).

Taking a worldwide perspective, the increase of GHG emissions in agriculture for Mercosur or Australia-New-Zealand in the NoCAP scenario illustrates the leakage effect, mainly due to the reduction of support and to a lesser extent to market opening (Figure 76).

10

# CONSOLIDATED ANALYSIS **AND OUTLOOK**

# 10 Consolidated analysis and outlook

## 10.1 | The Scenar 2030 approach

The CAP is evolving into a multifunctional policy that can respond to the constantly changing needs of society. The CAP must meet market-efficiency and competitiveness criteria; be a motor of job creation and 'smart' growth; continue to aid the fight against climate change as an environmentally accountable policy measure; act (in tandem with other policies) as a custodian of responsible and sustainable biologically renewable resource management; and still respect its initial aim of ensuring sufficient amounts of food for all citizens at affordable prices.

Given the above, the design of post-2020 farm policy is once again under consultation and a wide range of policy options are being considered, from retaining the status quo to radical reform.

The present report, in the tradition of the 'Scenar 2020' studies, contributes to the analysis of selected scenarios and provides a framework for further exploration of the process of designing the future CAP.[42] It complements recent, more qualitative, forward-looking studies with a well-elaborated baseline and multiple perspectives through the use of different models.

This analysis of the social, economic and environmental impacts of several options for the next CAP employs models of the iMAP platform hosted by the JRC. This suite of economic models ranges from one that models macroeconomic aspects (a CGE model, i.e. MAGNET[43]) to those that model more sectoral economic aspects (a PE model, i.e. CAPRI[44]) and microeconomic aspects related to the impact on individual farms (IFM-CAP[45]).

MAGNET, CAPRI and IFM-CAP are run in an integrated manner on different spatial scales (global, EU, MS, NUTS 2, individual farm), having as a common reference the EU Agricultural Outlook published at the end of 2015 (DG AGRI, 2015), generated with the AGLINK-COSIMO[46] PE model.

The reader is reminded that the general caveats that apply to all modelling exercises (i.e. a simplified representation of reality, no forecasting models, high uncertainty, etc.) apply here. Furthermore, using three different models and their (soft) linkages adds complexity and a certain degree of inconsistency (e.g. different commodity categories).

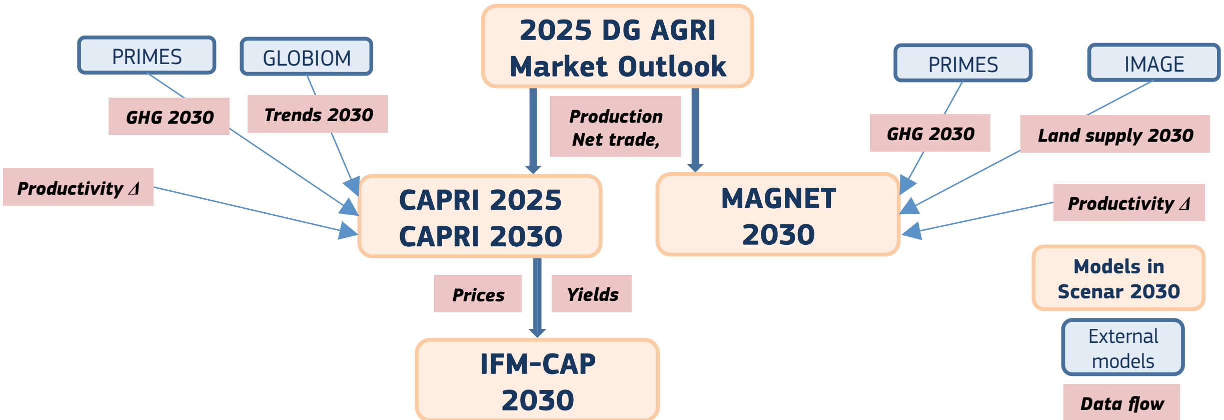


**FIGURE 77:** MODEL CHAIN.
*Source:* own presentation.

[42] See http://ec.europa.eu/smart-regulation/roadmaps/docs/2017_agri_001_cap_modernisation_en.pdf.
[43] Modular Applied GeNeral Equilibrium Tool (MAGNET).
[44] Common Agricultural Policy Regionalised Impact (CAPRI) model; http://www.capri-model.org/docs/capri_documentation.pdf.
[45] Individual Farm Model for Common Agricultural Policy Analysis (IFM-CAP).
[46] AGLINK-COSIMO; http://publications.jrc.ec.europa.eu/repository/bitstream/JRC92618/jrc92618%20online.pdf.

## 10.2 | The scenarios

Scenar 2030 looks at three scenarios, designed beginning of 2016, that take polar paths, against a reference scenario (the baseline), to characterise different visions for the CAP.

The baseline, or reference scenario (or the business-as-usual scenario), was generated on the basis of the latest available reference at the time of the study, i.e. the 2015 EU Agricultural Outlook[47], with a perspective up to 2025. The baseline was extended up to 2030 in order to cover the timeline of the Scenar 2030 study.

The first scenario (Inc&Env) assumes a more restrictive compliance with agri-environmental objectives needed for direct payment eligibility while maintaining the EU's CAP budget at its current nominal level.

The second scenario (Lib&Prod) assumes a strong reduction in subsidies (the removal of Pillar 1 direct payments, which are returned to tax payers), with a shift to productivity-increasing measures and further trade liberalisation.

The third scenario (NoCAP) is a variant of the Lib&Prod scenario, but it also eliminates Pillar 2 payments, and is basically intended to represent a step away from the EU CAP.

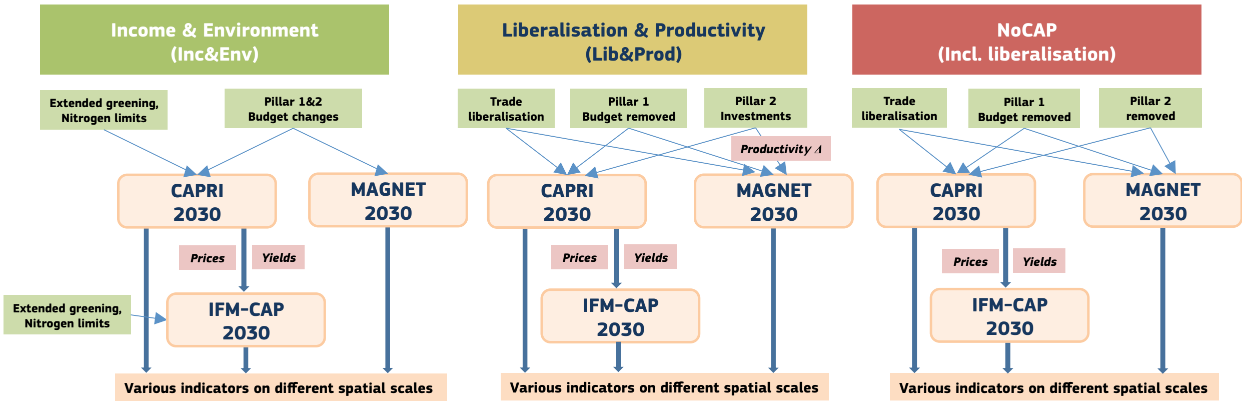


**FIGURE 78:** OVERVIEW OF THE SCENARIOS.
*Source:* own presentation.

The policy scenarios are assessed with regard to their impact on markets (production, demand, trade and prices), land use, environment and farmer income from the global to the farm level. In the following section, the key results are presented in relation to their economic, social and environmental dimensions.

[47] *EU Agricultural Outlook: Prospects for EU agricultural markets and income 2015-2025.* Directorate-General for Agriculture and Rural Development, European Commission.

## 10.3 | EU agri-food sector towards 2030 (reference scenario)

The reference scenario in Scenar 2030 is based on 'EU Agricultural Outlook: Prospects for EU agricultural markets and income 2015-2025', published in December 2015 (DG AGRI, 2015). It assumes the implementation of the 2013 CAP reforms, as well as the ratified FTAs. By extending the horizon to 2030 and complementing it with the outcome of the three models used, a plausible/potential pathway of the EU in the global agri-food system can be described as follows:[48]

- **Annual GDP growth** between 2016 and 2030 is anticipated to be 1.8% on average in the EU, significantly below that in the rest of the world. However, economic growth among the EU MSs is quite diverse; the EU-N13 (2.7% on average) far exceeds that in the EU-15, where it is expected to be 1.7%.

- **EU production and consumption** is growing slower than in rest of the world. The EU will increase the production of all products apart from rice and beef. A substantial increase of about 20% over the 15-year horizon is observed in the dairy sector, following the expansion of world dairy demand. The increase in the production and use of the main cereals is mainly driven by feed use.

- The **trade surplus** with the non-EU countries rises to about EUR 40 billion by 2030. The trade balance of the EU improves for all products but rice, oilseeds and meals, 'other products' and feed. The evolution of the beverages and dairy sectors appears to be particularly positive. The main improvements in the trade balance are in relation to NAFTA, China, the LDCs and Rest of the World, but there is a negative trend with regard to Mercosur and Australia and New Zealand.

- **Land use change** is slightly negative in the EU over the 15-year horizon, whereas increases reaching almost 10% are apparent for Mercosur, Asian FTA and the LDCs over the same period. Land prices show a negative trend in the EU, but rise substantially in China and the LDCs.

- **GHG emissions** from agriculture in the EU increase by 7.9% over the time horizon, which is in line with the increase in production. However, the GHG emissions increase is much lower than in the other countries and regions considered. The **N-surplus** is expected to be larger where livestock density is already high, reaching, on average, 63 kg/ha UAA.

- **Employment** in the agricultural sector decreases by 1.9% yearly, reaching 7.3 million in 2030. Employment in the food industry is decreasing at a slower pace, by 1.3% yearly.

- The **farm structure** of today is extrapolated to 2030. Out of the 4.7 million farms, the 13% largest farms (economic size > EUR 100,000) cultivate 50% of the UAA.

- The net positions of the EU MSs remain similar to those of today's budget, with the **CAP budget** showing an important economic contribution to many of the EU-13 and Mediterranean countries.

- The most **subsidy-dependent farm types** are those specialised in cattle, COP and olives, with subsidies representing 32%, 26% and 23% of their total incomes, respectively. Subsidies as a proportion represent between 15% and 20% of total income in small and medium-sized farms (> EUR 100,000 SO). In large farms (> EUR 100,000 SO), subsidies account for between 9% and 10% of farm income. The Gini coefficient for income distribution is estimated at 0.7% (ESTAT calculates a Gini coefficient of equalised disposable income of 0.3%).

This perspective of the agri-food sector in a broadly unchanged socioeconomic and political environment must also be placed in the context of public opinion. EU citizens identified, in the 'Modernising and Simplifying the Common Agricultural Policy' public consultation (2017), the following as the most important challenges for EU agriculture and rural areas: (1) pressures on the environment and on natural resources; (2) climate change (mitigation and adaptation); and (3) a fair standard of living for farmers.[49]

[48] More details can be found under this link: https://datam.jrc.ec.europa.eu/datam/mashup/SCENAR2030.

[49] https://ec.europa.eu/agriculture/sites/agriculture/files/consultations/cap-modernising/highlights-public-consul_en.pdf.

# 10.4 | The EU agri-food system between markets and societal challenges (scenarios)

In the following section, the key results of the three scenarios are described according to the economic, social and environmental dimensions. The results are presented in terms of changes with respect to the results given by the baseline (reference or business as usual scenario).[50]

## 10.4.1 Economic dimension

### Agricultural production is declining, but not disappearing, in most extreme scenarios

The results show a small negative impact on agricultural production under the Inc&Env scenario, whereas under the Lib&Prod and NoCAP scenarios production decreases by 4% and 6%, respectively. The differences between EU-15 and EU-13 are negligible, and the variability between EU MSs is greatest under the NoCAP scenario.

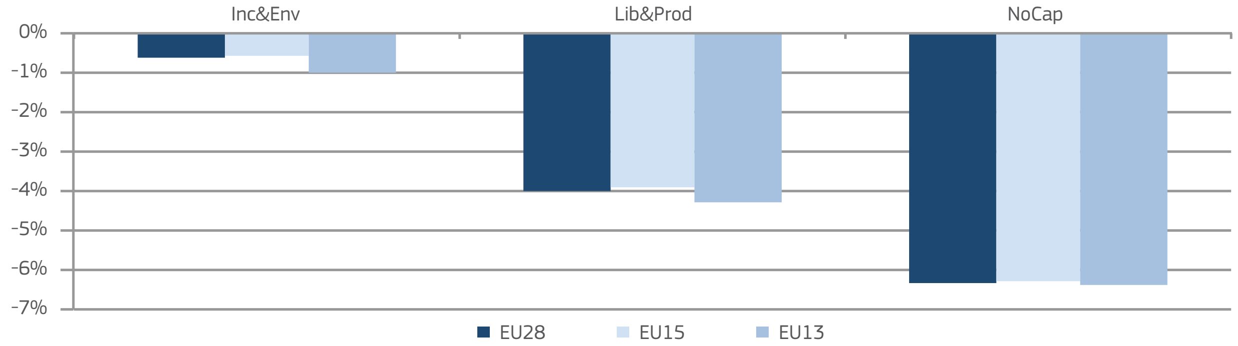


**FIGURE 79:** AGRICULTURAL PRODUCTION, EU-28, TOTAL QUANTITY CHANGES COMPARED WITH REFERENCE (%).
*Source:* Scenar 2030, CAPRI model.

### Producer prices increase if the CAP is eliminated

Following the small decreases in agricultural production under the Inc&Env scenario, aggregated EU producer prices increase by about 1%. In the Lib&Prod scenario, EU producer prices drop by almost 1%, as EU production decreases are compensated by cheaper imports. With the elimination of all CAP payments, the stronger EU production declines cannot be fully compensated by imports, leading to increased aggregated EU producer prices of about 5% in the NoCAP scenario.

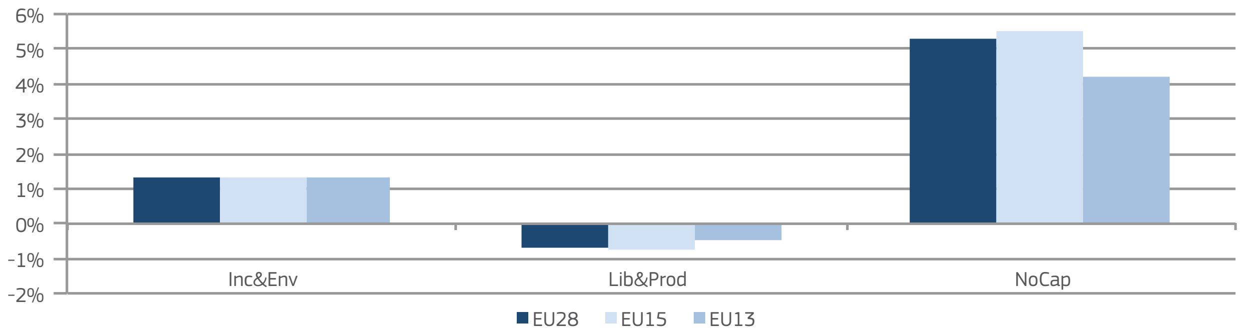


**FIGURE 80:** PRODUCER PRICE, EU-28, CHANGES COMPARED WITH REFERENCE (%).
*Source:* Scenar 2030, CAPRI model.

[50] More details can be found under this link: https://datam.jrc.ec.europa.eu/datam/mashup/SCENAR2030.

## More imports than exports

Imports increase in all scenarios, leading to a decrease in the EU trade balance. Although exports in the Lib&Prod scenario grow substantially, also thanks to the ambitious trade agenda pursued by the EU, they cannot compensate for the higher level of imports. In the NoCAP scenario, the trade balance is reduced by about EUR 25 billion, billion trade surplus in 2030 under the reference scenario, bringing back the EU to net importer status.

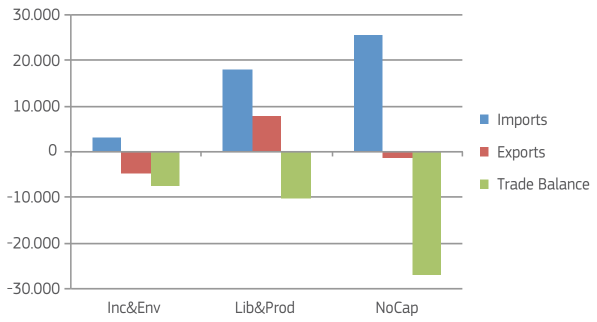


**FIGURE 81:** EU IMPORTS, EXPORTS AND TRADE BALANCE CHANGES (EUR MILLION) COMPARED WITH REFERENCE, 2030.
*Source:* Scenar 2030, MAGNET model.

## Income of farms decreases strongly when the CAP is abolished

Under the Inc&Env scenario, gross farm income increases by around 4.5%, mainly through higher prices, with the CAP budget remaining stable. The negative effects in the Lib&Prod scenario (–20%) mean that there is a slightly larger income decrease than under the NoCAP scenario, following the larger decreases in EU production. Again, the EU-13 farming sector experiences a stronger negative impact on income than the EU-15, reflecting a generally higher importance of CAP payments in total income..

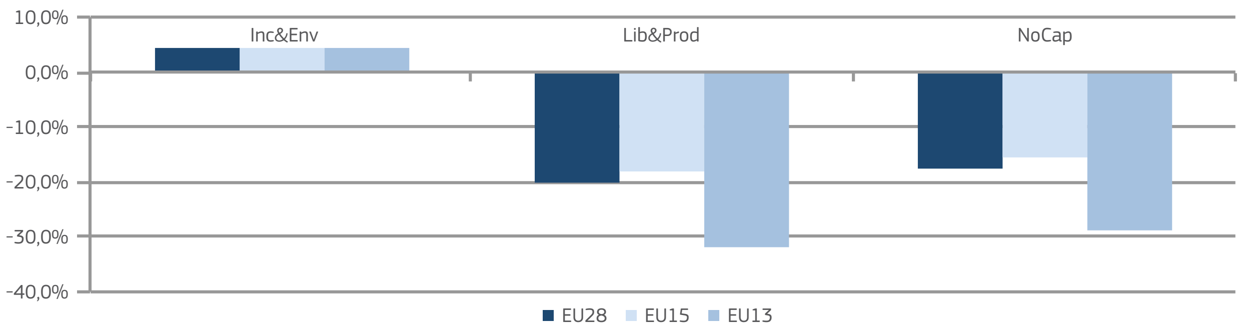


**FIGURE 82:** GROSS FARM INCOME (% CHANGE RELATIVE TO REFERENCE).
*Source:* Scenar 2030, CAPRI model.

| | Inc&Env | Lib&Prod | NoCAP |
|---|---|---|---|
| Specialist COP | 1.2 | –23.5 | –22.6 |
| Specialist other field crops | 0.4 | –2.1 | –0.2 |
| Specialist horticulture | –0.9 | 1.9 | 0.8 |
| Specialist wine | 0.4 | –7.1 | –7.6 |
| Specialist orchards – fruits | –2.7 | –4.0 | –6.2 |
| Specialist olives | –11.6 | –20.6 | –19.9 |
| Permanent crops combined | –1.5 | –7.7 | –9.2 |
| Specialist milk | –0.1 | –8.7 | 2.6 |
| Specialist sheep and goats | –0.5 | –12.1 | –11.9 |
| Specialist cattle | –2.3 | –36.7 | –31.8 |
| Specialist granivores | 1.0 | –3.7 | 3.6 |
| Mixed crops | –0.3 | –2.8 | –3.6 |
| Mixed livestock | 1.8 | –12.0 | –3.0 |
| Mixed crops and livestock | 0.2 | –14.8 | –9.7 |

**TABLE 36:** INCOME VARIATION BY FARM SPECIALISATION IN THE EU-27 (% CHANGE RELATIVE TO REFERENCE).
*Source:* Scenar2030. IFM-CAP.

The simulated effects are less heterogeneous between economic sizes classes than they are across farm specialisations. However, there is a relatively consistent pattern indicating an inverse relationship between the magnitude of the simulated impacts and economic farm size in all three simulated scenarios. Among the most affected farm specialisations, mainly in the Lib&Prod and NoCAP scenarios, are the specialists cattle, COP (cereals, oilseeds and protein), and olives.

## Overall, economic growth effects are small, but are substantial for some Member States

The CAP has an important role to play in territorial cohesion. The effect of the scenarios on GDP is very small (maximum –0.3% in the NoCAP scenario for the EU-13); however, under all scenarios, changes in GDP are negative for the EU-13. In general, the gains observed in the scenarios with a large or complete reduction in CAP payments for the EU-15 countries drive the EU-28 GDP to a small but positive value.

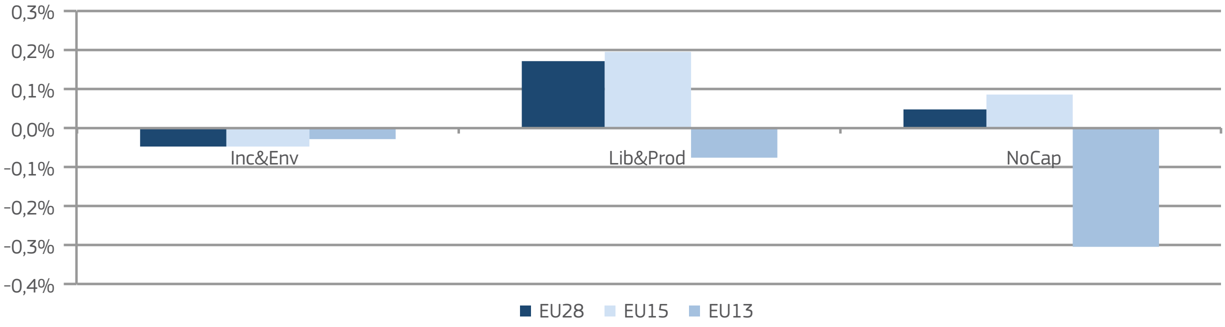


**FIGURE 83:** GDP, CHANGE FROM REFERENCE (%), 2030.
*Source:* Scenar 2030, MAGNET model.

When looking at the individual MS results, sizeable impacts are observed for Croatia, Cyprus, Greece, Latvia and Lithuania, who lose up to 1.7% of their GDP compared with the reference scenario.

One can observe that most of the EU-13 and some EU-15 countries not only experience a high absolute per capita welfare loss, but even more in relative terms (here in % change of household expenditure).

## Small increase of prosperity, but only for richer EU-15 countries

Using so-called Equivalent variation (EV) as a welfare measure, i.e. the real income change, we observe a similar pattern as that observed for GDP, namely that the scenarios have only small impacts on welfare. Compared with the reference scenario in 2030, the Inc&Env scenario for the EU-28 results in a slightly negative EV of EUR 2.6 billion (–0.08%), the Lib&Prod scenario shows a EUR 18.4 billion welfare gain (+0.15%) and, finally, the NoCAP scenario shows a EUR 0.1 billion welfare gain (+0.01%).

The welfare decomposition highlights the reasons behind these developments. The EV results in, for instance, the Lib&Prod scenario show losses for the 'new' EU-13 MSs vis-à-vis EV gains for the 'old' EU-15 MSs. For the EU-13 MSs this result is mainly driven by changes to the CAP budget, whereas efficiency gains and improving terms of trade occur in the EU-15 MSs and lead to an overall positive welfare effect in the Lib&Prod scenario.

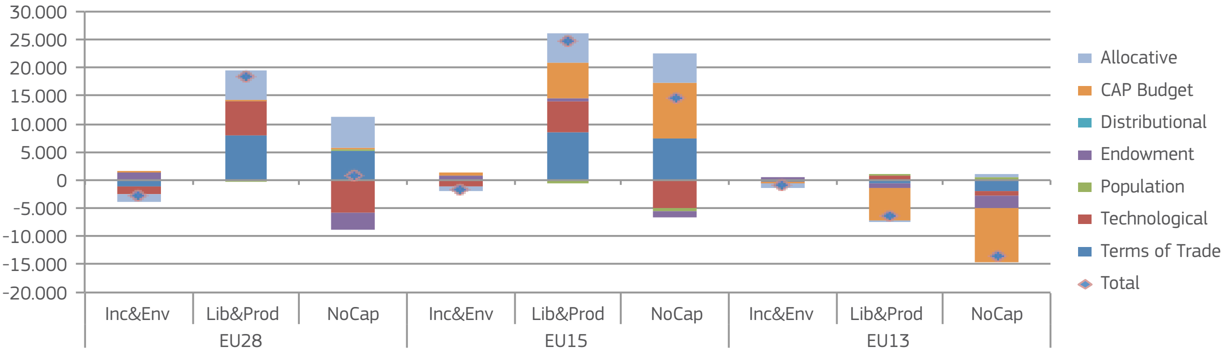


**FIGURE 84:** WELFARE (EV) DECOMPOSITION IN THE EU-28, EU-15 AND EU-13, 2030, EUR MILLIONS, SCENARIOS VS. REFERENCE.
*Source:* Scenar 2030, MAGNET model.

## The time dimension of scenario shocks matters for welfare

The dynamics of the scenarios' impacts on welfare (and other indicators) have to be closely observed, on the one hand to anticipate temporary hardships and the necessary accompanying measures, on the other hand to monitor the recovering of an economy after a (structural) adjustment.

In the Lib&Prod scenario, and even more so in the NoCAP scenario, EU-13 welfare growth shows a substantial decline in 2025 after the policy change in 2020, but recovers in the period from 2025 to 2030 due to the market evolution and structural adjustment of the economy.

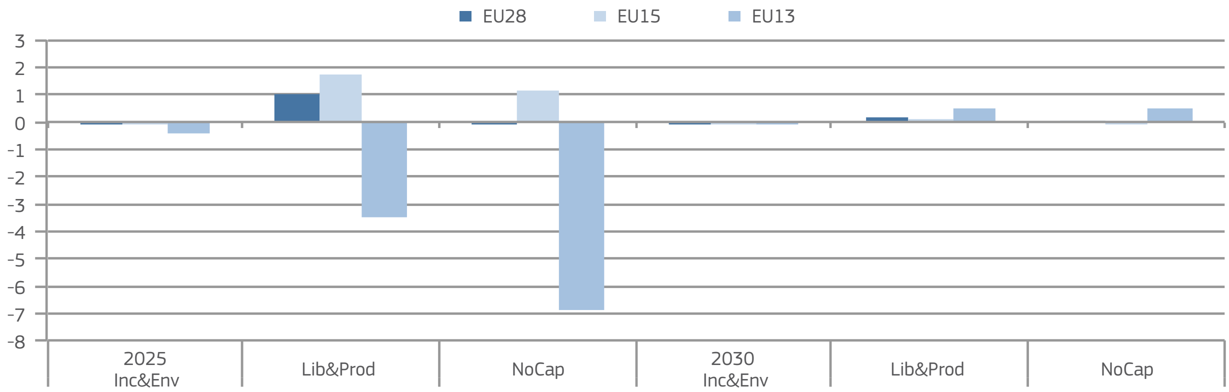


**FIGURE 85:** WELFARE GROWTH, CHANGES (%) FROM BASELINE FROM ONE PERIOD TO THE NEXT WITHIN A SCENARIO, IN EUR BILLION.
*Source:* Scenar 2030, MAGNET model.

## 10.4.2 Social dimension

In this subsection, the income distribution among farms and the impacts on jobs are analysed.

## Small farms lose a higher proportion of their incomes than larger farms

With the exception of the smallest farms in the Inc&Env scenario, all farm sizes lose income under all scenarios. The smaller farms are generally more affected because the share of subsidies in their total income is usually higher than for larger farms. It should be noted that the income calculation on the farm level is slightly different from the gross farm income calculation.

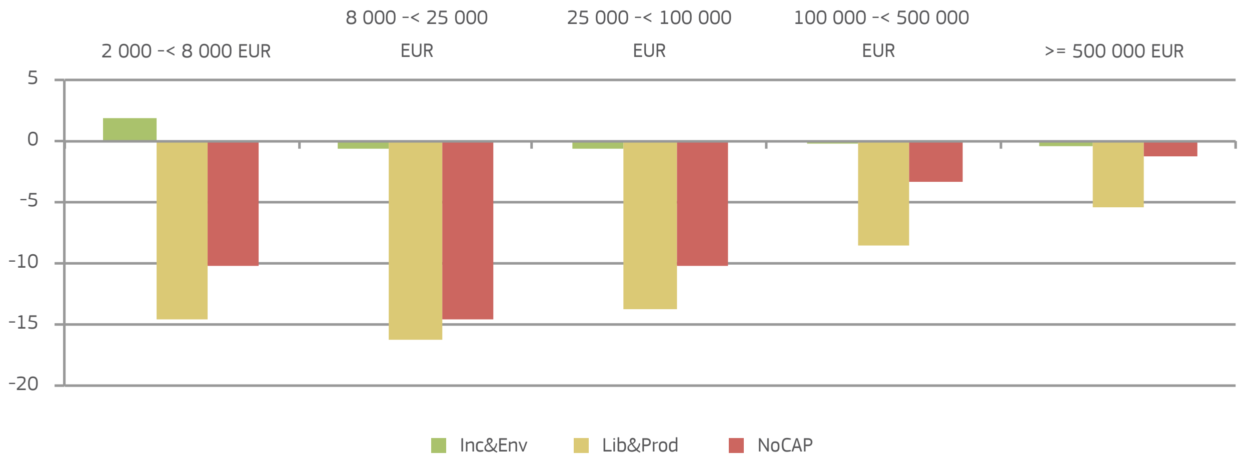


**FIGURE 86:** INCOME VARIATION BY ECONOMIC FARM SIZE IN THE EU-28 (% CHANGE RELATIVE TO REFERENCE).
*Source:* Scenar 2030, IFM-CAP model.

CAP subsidies play an income equalisation role among farms in the EU. Decreasing or cutting payments increases inequality, where a higher Gini coefficient indicates higher inequality.

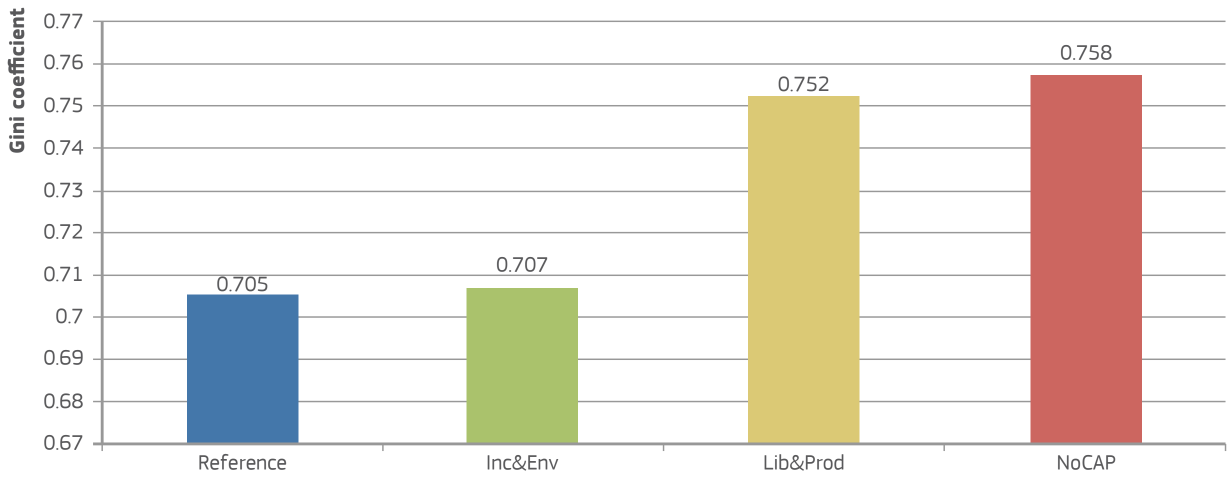


**FIGURE 87:** GINI COEFFICIENT FOR INCOME DISTRIBUTION IN THE EU-27.
*Source:* Scenar 2030, IFM-CAP.

## Job numbers decrease

Under all three scenarios, in addition to the job decline of about 25% in the reference scenario, there is a negative effect on jobs in the agricultural sector. The decrease in agricultural jobs is more pronounced in the Lib&Prod and NoCAP scenarios (–5%) than in the Inc&Env scenario (–1.8%). Decreases in employment in the food industry are less noticeable.

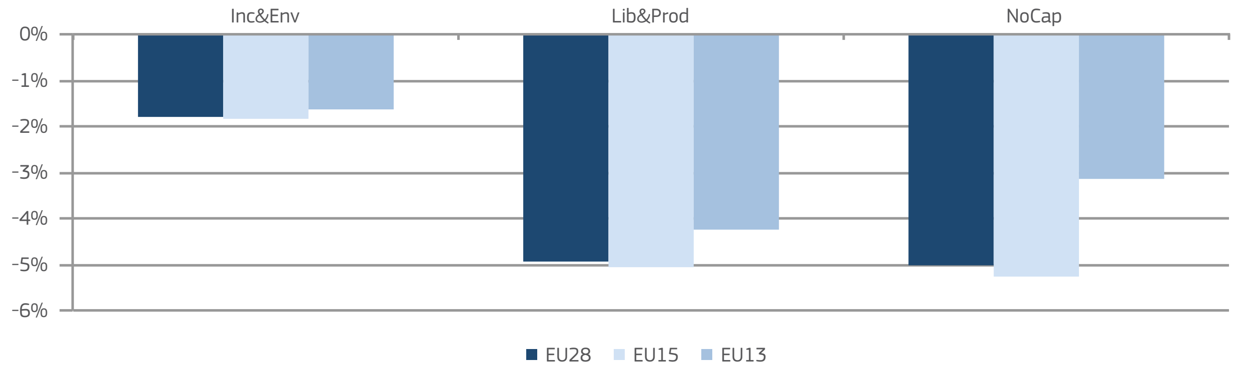


**FIGURE 88:** IMPACT OF SCENARIOS ON EMPLOYMENT NUMBERS, 2030.
*Source:* Scenar 2030, MAGNET model.

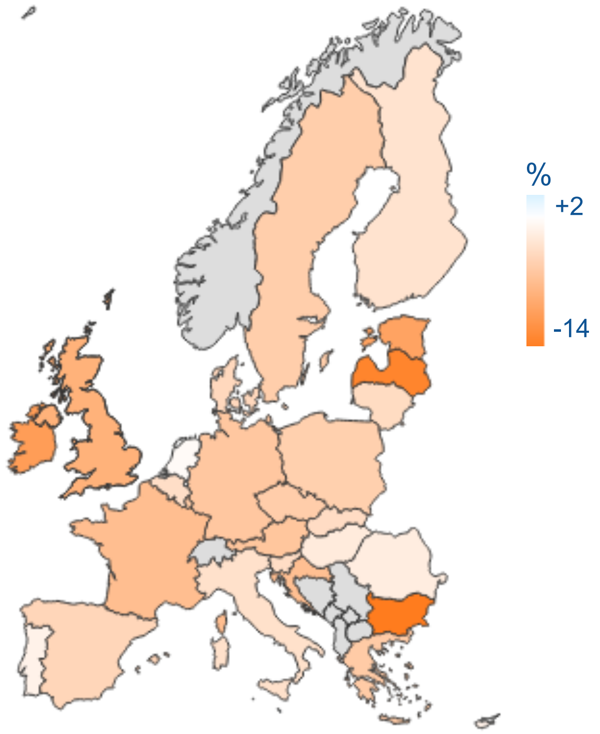


**FIGURE 89:** IMPACT OF LIB&PROD SCENARIO ON EMPLOYMENT NUMBERS (IN % CHANGE), 2030.
*Source:* Scenar 2030, MAGNET model.

### 10.4.3 Environmental dimension

With regard to the environmental dimension, the results are considered in the context of land use, nitrogen surplus and GHG emissions.

#### More land is abandoned with diverse impacts

The slight increase in UAA in the Inc&Env scenario of 0.3% (+0.6 million ha) contrasts with the substantial decreases of 7.3% (–13.1 million ha) in the Lib&Prod scenario and about 6.9% (–12.4 million ha) in the NoCAP scenario. The decreases in UAA in the Lib&Prod and NoCAP scenarios are directly linked to the removal of direct payments, which immediately affect the profitability of all crop production activities, and the decreases in EU production levels, especially the decline in cereal production and pasture, i.e. part of the land is taken out as economic returns decrease.

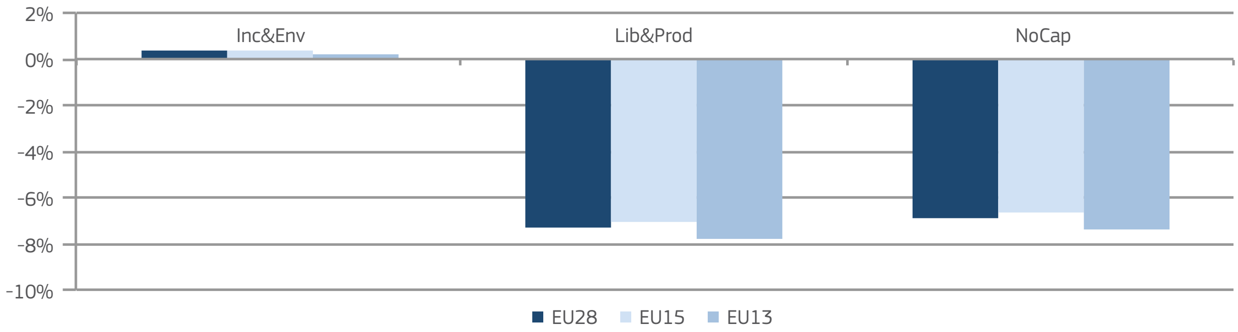


**FIGURE 90:** UAA, % CHANGE.
*Source:* Scenar 2030, CAPRI model.

Under the Inc&Env scenario, UAA increases by 0.3% (+0.6 million ha) compared with the reference scenario, whereas UAA substantially declines, by 7.3% (–13.1 million ha), in the Lib&Prod scenario and by about 6.9% (–12.4 million ha) in the NoCAP scenario.

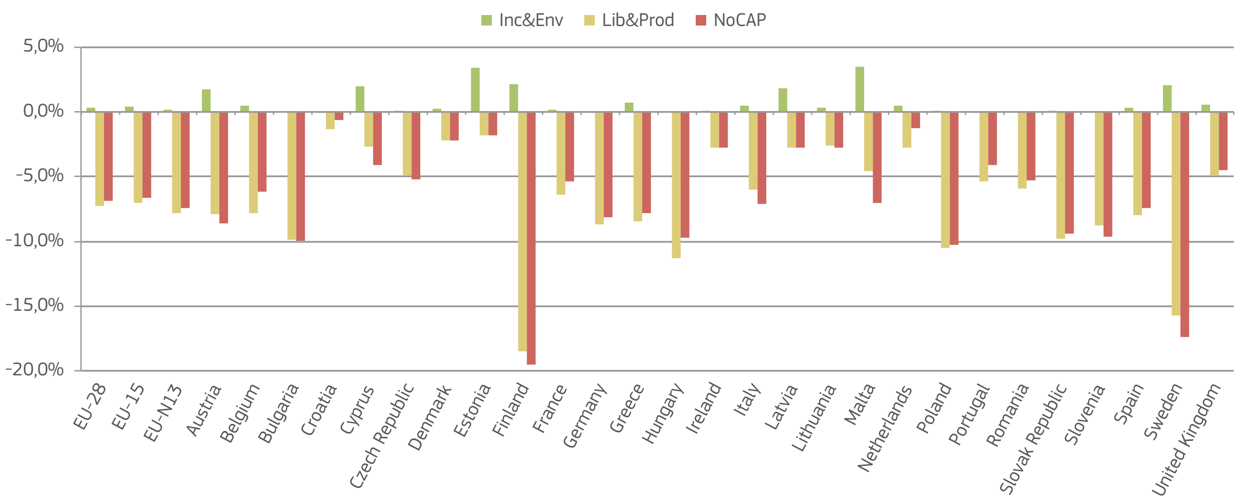


**FIGURE 91:** CHANGE IN UAA PER MS (CHANGE RELATIVE TO REF).
*Source:* Scenar 2030, CAPRI model.

A similar decrease in grassland area (–8.8%) can be observed, driven by the removal of direct payments and by the absence of any CAP measure targeting the maintenance of (permanent) grassland. This is relevant from a public goods point of view (e.g. landscape, tourism).

## Nitrogen – a particular challenge

High concentrations of nitrates in the soil and water constitute a widespread problem caused by nitrogen surplus. Nitrogen surplus per ha decreases under only the Inc&Env scenario, by 1%. The increase of 3% in the Lib&Prod scenario illustrates the challenge of sustainable intensification.

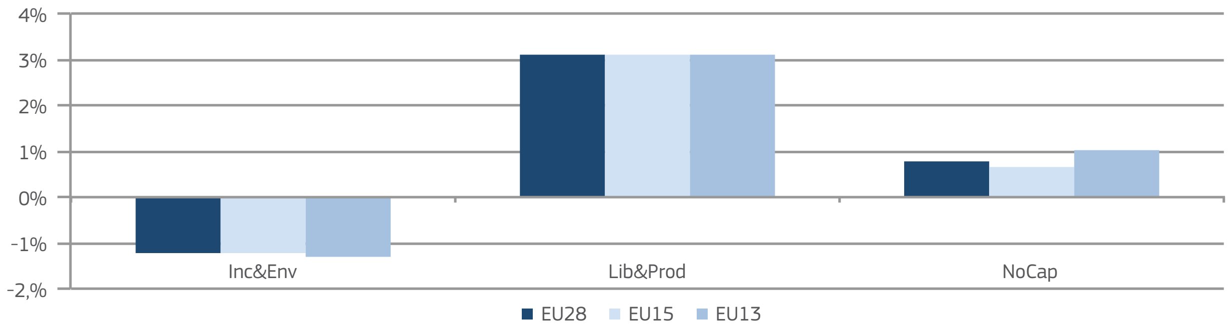


**FIGURE 92:** NITROGEN SURPLUS PER HA.
*Source:* Scenar 2030, CAPRI model.

The limitation in animal stocking density and the restriction on nitrogen use lead to a decrease in the N-surplus of 0.8 kg N/ha UAA. A considerable reduction is reported in particular in Member States and regions with a high N-surplus in the reference scenario, such as Belgium and the Netherlands, mostly related to reductions in stocking densities. In contrast, under the Lib&Prod and NoCAP scenarios, the N-surplus increases by 2 and 0.5 kg N/ha UAA, respectively. The increase in N-surplus is, on the one hand, driven by the decrease in UAA and, on the other hand, the intensification of livestock and crop production on the remaining UAA. In both scenarios, more substantial increases in N-surplus are indicated for regions that already have the highest N-surplus in the reference scenario, as these are among the most competitive regions.

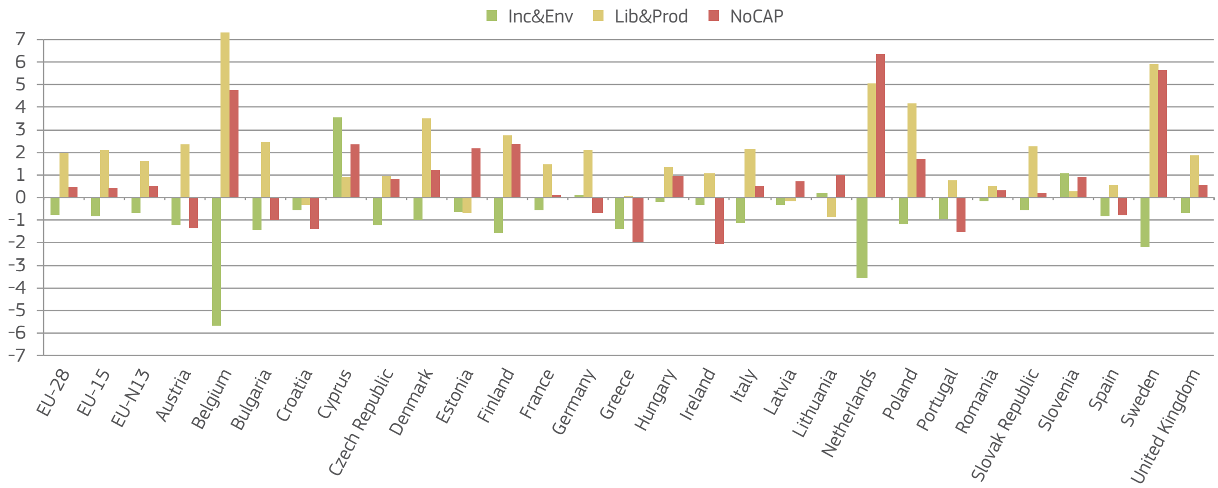


**FIGURE 93:** CHANGE IN N-SURPLUS PER MS (ABSOLUTE CHANGE IN KG N/HA UAA RELATIVE TO REF).
*Note:* Malta has been removed from the graph to improve the readability. The values for Malta are: Inc&Env -14%, Lib&Prod +17%, NoCAP +12%".
*Source:* Scenar2030, CAPRI.

Looking at the regional distribution of the N-surplus the increase is concentrated in productive areas that already have high N-surplus in the reference scenario.

## GHG emissions – a question of leakage?

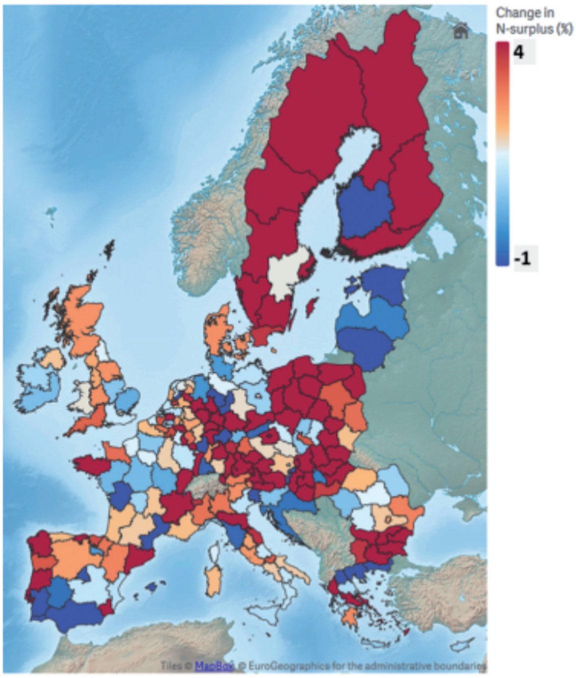


**FIGURE 94:** NITROGEN SURPLUS PER HA, % CHANGES IN THE LIB&PROD SCENARIO.
*Source:* Scenar 2030, CAPRI model.

The GHG emissions of EU agriculture follow directly the production developments. Therefore, changes are rather limited in the Inc&Env scenario, with a decrease of 0.5% in EU-28 emissions; however, considerably larger decreases are indicated under the Lib&Prod scenario (–4.2%) and NoCAP scenario (–5.8%). The impact of technological GHG mitigation options is very limited in the scenarios (i.e. the technologies are not widely applied), which is why the predicted GHG changes mirror production changes so closely. Moreover, the GHG emission analysis does not take into account that the land taken out of EU production could be used for afforestation and therefore as a carbon sink. At the MS level, the changes in agricultural non CO2 GHG emissions also reflect the corresponding production changes in the scenarios.

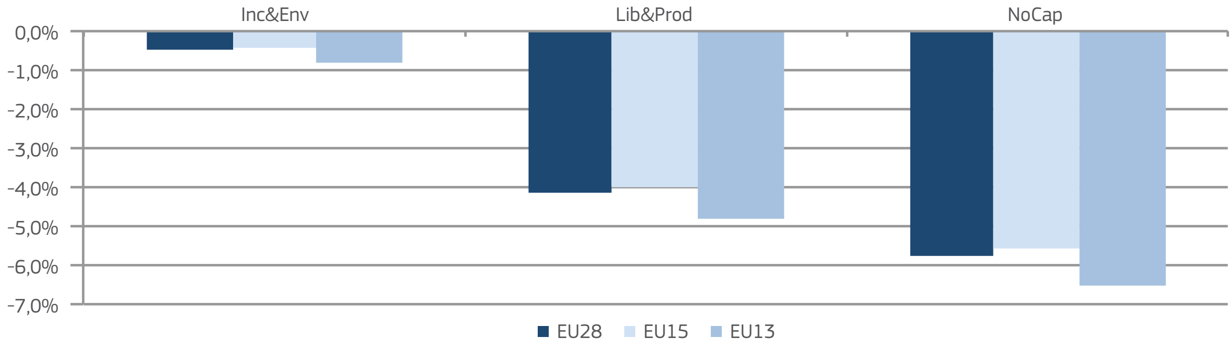


**FIGURE 95:** CHANGE IN AGRICULTURAL NON-CO2 GHG EMISSIONS (%).
*Source:* Scenar 2030, CAPRI model.

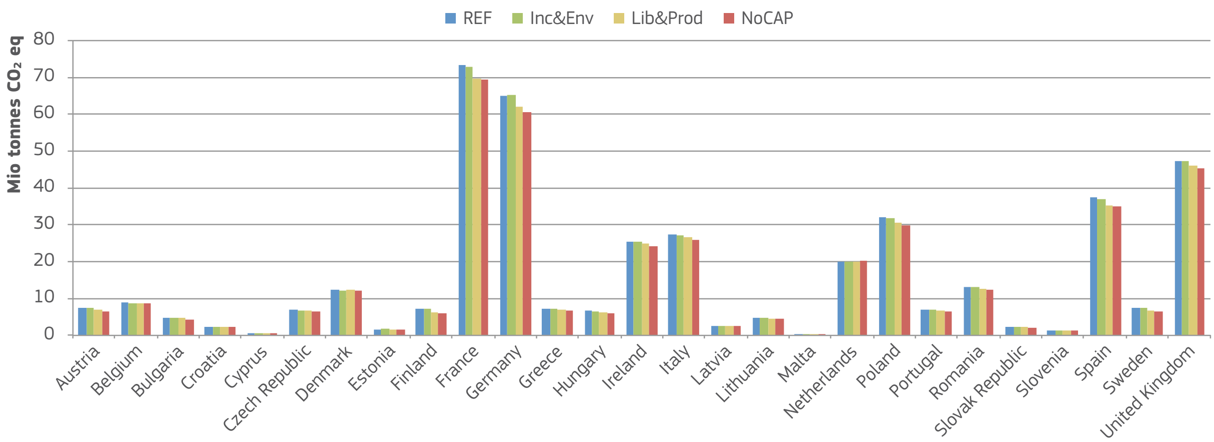


**FIGURE 96:** AGRICULTURAL NON-$CO_2$ GHG EMISSIONS IN THE EU MSs (IN MIO TONNES $CO_2$ EQ).
*Source:* Scenar 2030, CAPRI model.

From a worldwide perspective, the emission reductions in the EU are widely compensated by emission increases in non-EU countries, mainly due to increased production and exports of agricultural commodities to the EU. This emission leakage effect is for example illustrated by the increase of agricultural GHG emissions in Mercosur or Australia & New Zealand. As a result of emission leakage, the net benefit of EU emission reductions on global agricultural GHG emissions is minimal.

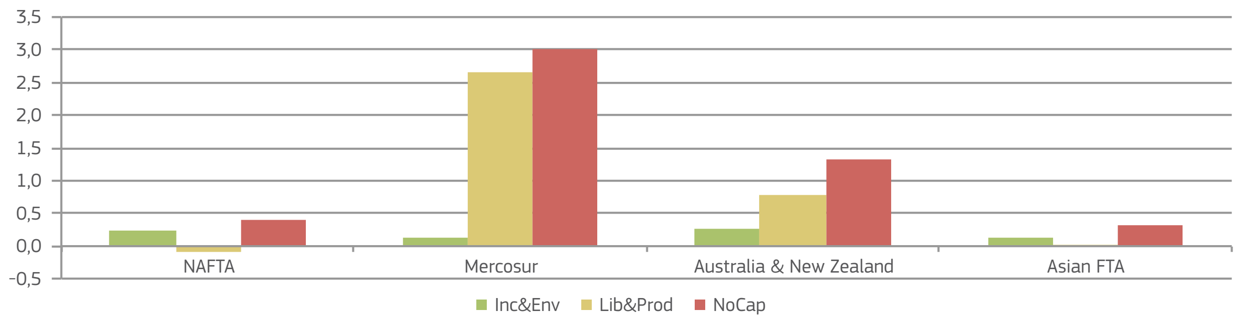


**FIGURE 97:** GHG EMISSIONS IN AGRICULTURE, DIFFERENT REGIONS, 2030, DIFFERENCE (%) FROM REFERENCE.
*Note:* Asian FTA means bilateral trade agreements between the EU and Japan, Vietnam, Thailand, Philippines and Indonesia respectively.
*Source:* Scenar 2030, MAGNET model.

The main caveat in relation to the scenarios' consideration of GHG emissions is that only a rough estimation of GHG emissions is possible. However, the main message is the importance of GHG emission leakage through increased EU imports.

## 10.4.4 Synthesis of scenario results

Figure 98 summarises the indicators presented at a glance.

The **Inc&Env scenario** shows only marginal changes for production, land use and emissions. The more pronounced focus on the environment, implemented through extended greening measures and a limit on nitrogen use, is associated with a small, economy-wide cost, but contributes to the improving trend of the agricultural nitrogen balance. However, the reduction of about 1% nitrogen in the scenario compared with the reference is not sufficient to address the nitrogen balance problem in areas already in surplus. Under this scenario, farm income distribution in the EU, as measured by a Gini coefficient, does not improve. Thus, the key challenges related to the environment and a fair standard of living for farmers are only partly addressed.

The **Lib&Prod scenario** and its even extremer variant, the **NoCAP scenario**, have, by default, a much stronger impact on farm income, land use, production and emissions. The decrease in agricultural production, leading to price increases in the NoCAP scenario, is within the limit of interannual variation, but is associated with a pronounced reduction in land use. This affects the territorial balance, with marginal areas being further marginalised, with fewer jobs, and intensive agricultural areas being further concentrated. Less production, in principle, reduces the overall use of resources and thus the environmental impacts. At least in the EU, GHG emissions would also be reduced; however, these reductions could be levelled out through a leakage effect. Releasing land from agricultural uses could also provide an opportunity for the creation of $CO_2$ sinks, such as forests and other ecological areas, with important benefits for biodiversity.

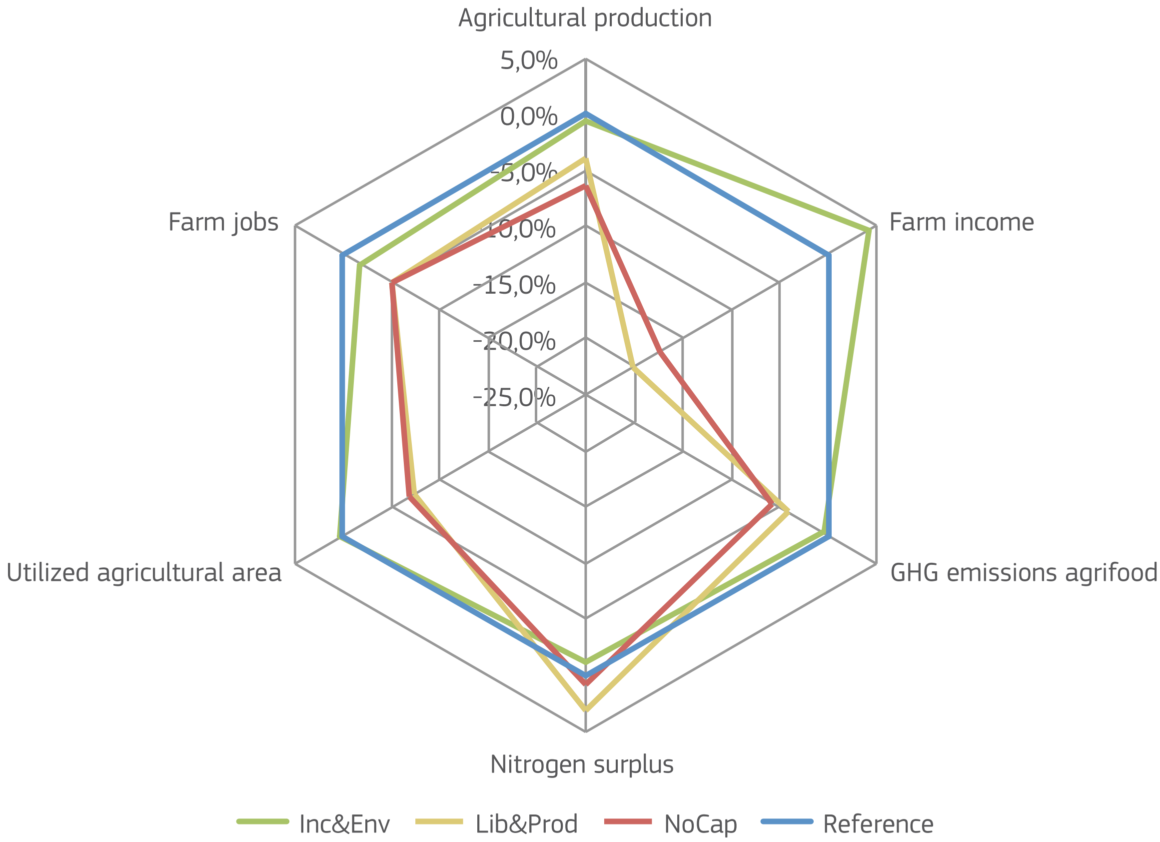


**FIGURE 98:** OVERVIEW OF KEY IMPACTS.
*Source:* Scenar 2030, CAPRI and MAGNET model.

The mixed picture with regard to production and the environment for these scenarios is opposed by a strongly negative impact on the social dimension. Most of the burden, at least in percentage terms, is on the small farms in the net beneficiary countries, and would increase farm income inequality even more and put the resilience of many farms at risk. The scenarios show, also as a consequence of further liberalisation, an increase in the vulnerability of, in particular, crop and cattle/beef farmers. The trade balance is very negative under these scenarios, giving rise to questions about a general leakage of positive and negative externalities. In this context, the widely demanded inclusion of the consumer side (see obesity and other problems related to unhealthy food consumption) in a food systems approach could provide further insights.

A further element to consider is the increase in aggregated welfare through the released budget being used in more (economically) productive sectors.

The presented and discussed scenarios do not represent real policy options. However, they underline the potential for changes to the current agri-food policies to address societal challenges and demands.

The vulnerability of small farms, in particular in the southern and eastern parts of the EU, where agriculture (and its subsidies) have a far more important economic weight has to be emphasised. The trade liberalisation scenarios reveal opportunities for some but risks for even more agri-food sectors. Special attention must be paid to the complex relations, incentives and trade-offs of the different instruments, in particular regarding the environmental dimension. For direct payments to be effective in achieving their objectives and improving existing the inequality, the target population needs to be well defined.

## 10.5 | Scenar 2030 and the long road ahead: achievements and remaining challenges

The present study offers a well-established, model-based agro-economic analysis enriched with new features, providing a framework for future policy analysis. In particular, an attempt has been made to deliver a fully transparent study report, linked to an interactive visualisation of the results.

The scenarios chosen are instructive and show the existence of trade-offs.

In particular, the combination of different types of models allows the analysis of the scenarios from all three sustainability perspectives and on different spatial scales, i.e. from the global market to the individual farm level.

During the course of this study, experiences have revealed repeatedly that the linkage of models is a challenge. Furthermore, the assumptions on the impact of policies on productivity are of particular importance, pointing to the need for more research.

At the time of finalising this report, many uncertainties about the future of the agricultural sector remain. They include the early stage of discussions on the Multiannual Financial Framework (MFF) 2021-2027, the Brexit, the ongoing free trade negotiations, the implementation of COP21 and SDGs, the Renewable Energy Directive, and the evolving bioeconomy among others.

APPENDIX

- DECOMPOSITION METHOD
- PILLAR 2
- MAIN ASSUMPTIONS FOR THE IFM-CAP MODEL

# 11 Appendix

## 11.1 | Annex: decomposition method

As an additional tool of analysis, this study draws on the use of a **decomposition method** known as '**subtotals'** based on the pioneering work of Harrison et al. (2000). More specifically, on running a complex scenario with an array of shocks (i.e. endowments, tariffs, technology changes, etc.), it is possible to calculate the part-worth of the resulting endogenous variable change that corresponds to a specific exogenous shock, or pre-specified group of exogenous shocks. Thus, when comparing each of the scenarios with the reference scenario, the comparative 'part-worth' importance of the four policy indicators is evaluated in order to better understand the role that policy has to play (if any) in shaping bio-based market trends.

Employing the terminology of Harrison et al. (2000), for a simplistic function Z = F(X,Y), where Z is endogenous and X and Y are exogenous, GEMPACK calculates the change in the separate values of the first derivatives corresponding to X and Y within the total derivative dZ, accumulated over all the steps specified within the model algorithm. Furthermore, the part-worths of each exogenous variable are calculated based on the GEMPACK assumption that the rate of progression in the set of exogenous shocks along the path is proportionally linear.

It is expected that, as a direct consequence of changes in exogenous policy shocks, their respective part-worths will change compared with the reference scenario. What is perhaps less obvious is that when changing the policy conditions of the experiment, the deviation in the solution path of the model from the reference scenario can also alter the part-worths of unchanged exogenous shocks (i.e. projections and fossil fuel world prices). For example, steeper GHG emissions cuts in the EU in would affect the entire macroeconomy, which implies additional impacts on (inter alia) factor prices. Thus, the set of unchanged projection shocks, with a different vector of factor prices, will also now have a different part-worth.

## 11.2 | Annex: Pillar 2

| Axes | # | Measure title | Invest-ment in physical capital | Invest-ment in human capital | Wider rural devlpt. schemes | Support to LFAs | Agri-environ. measures |
|---|---|---|---|---|---|---|---|
| 1 | 111 | Vocational training and information actions | | X | | | |
| | 112 | Setting up of young farmers | | X | | | |
| | 113 | Early retirement | | X | | | |
| | 114 | Use of advisory services | | X | | | |
| | 115 | Setting up of management, relief and advisory services | | X | | | |
| | 121 | Modernisation of agricultural holdings | X | | | | |
| | 122 | Improvement of the economic value of forests | X | | | | |
| | 123 | Adding value to agricultural and forestry products | X | | | | |
| | 124 | Cooperation for development of new products | X | | | | |
| | 125 | Infrastructure related to the development and adaptation… | X | | | | |
| | 126 | Restoring agricultural production potential | X | | | | |
| | 131 | Meeting standards based on Community legislation | | X | | | |
| | 132 | Participation of farmers in food quality schemes | | X | | | |
| | 133 | Information and promotion activities | | X | | | |
| | 141 | Semi-subsistence farming | | X | | | |
| | 142 | Producer groups | | X | | | |
| | 143 | Provision of farm advisory and extension services in BG and RO | | X | | | |
| 2 | 211 | Natural handicap payments to farmers in mountain areas | | | | X | |
| | 212 | Payments to farmers in areas with h., other than mountain… | | | | X | |
| | 213 | Natura 2000 AND Directive 2000/60/EC payments | | | | | X |
| | 214 | Agri-environment payments | | | | | X |
| | 215 | Animal welfare payments | | | | | X |
| | 216 | Non-productive investments | | | | | X |
| | 221 | First afforestation of agricultural land | | | | | X |
| | 222 | First establishment of agroforestry systems on… | | | | | X |
| | 223 | First afforestation of non-agricultural land | | | | | X |
| | 224 | Natura 2000 payments | | | | | X |
| | 225 | Forest-environment payments | | | | | X |
| | 226 | Restoring forestry potential and introducing prevention… | | | | | X |
| | 227 | Non-productive investments | | | | | X |
| 3 | 311 | Diversification into non-agricultural activities | | | X | | |
| | 312 | Support for business creation and development | | | X | | |
| | 313 | Encouragement of tourism activities | | | X | | |
| | 321 | Basic services for the economy and rural population | | | X | | |
| | 322 | Village renewal and development | | | X | | |
| | 323 | Conservation and upgrading of the rural heritage | | | X | | |
| | 331 | Training and information | | | X | | |
| | 341 | Skills acquisition, animation and implementation of … | | | X | | |
| 4 | 411 | Implementing local development strategies. Competitiveness | X | | | | |
| | 412 | Implementing local development strategies. Environment/land | | | | | X |
| | 413 | Implementing local development strategies. Quality of life | | | X | | |
| | 421 | Implementing cooperation projects | | | X | | |
| | 431 | Running the local action group, acquiring skills and … | | | X | | |
| 5 | 511 | Technical Assistance | | | X | | |

**TABLE A.1.** TREATMENT OF PILLAR 2 MEASURES BY MAGNET CATEGORIES (2007-2013).
Source: Boulanger & Philippidis (2014).

| Rural development measures | Payment type | | | |
|---|---|---|---|---|
| | SCT | GCT | ACT | OTP |
| 111. Vocational training and information actions | | | OBS | |
| 112. Setting up of young farmers | | | Labour | |
| 113. Early retirement | | | | Land |
| 114. Use of advisory services | | | OBS | |
| 115. Setting up of management, relief and advisory services | | | OBS | |
| 121. Modernisation of agricultural holdings | | | Capital | |
| 122. Improvement of the economic value of forests | Capital F | | | |
| 123. Adding value to agricultural and forestry products | | | Capital F+PA | |
| 124. Cooperation for development of new products, processes and technologies in the agriculture and food sector and the forestry sector | | | Capital F+PA | |
| 125. Infrastructure related to the development and adaptation of agriculture and forestry | | | Capital F+PA | |
| 126. Restoring agricultural production potential damaged by natural disasters and introducing appropriate prevention actions | | | Capital | |
| 131. Meeting standards based on Community legislation | | | OBS | |
| 132. Participation of farmers in food quality schemes | | | OBS | |
| 133. Information and promotion activities | | | OBS | |
| 141. Semi-subsistence farming | | | | Land |
| 142. Producer groups | | | | Land |
| 143. Provision of farm advisory and extension services in Bulgaria and Romania | | | OBS | |
| 144. Holdings undergoing restructuring due to a reform of a common market organisation | | | Capital | |
| 211. Natural handicap payments to farmers in mountain areas | | | | Land |
| 212. Payments to farmers in areas with handicaps, other than mountain areas | | | | Land |
| 213. Natura 2000 payments and payments linked to Directive 2000/60/EC (WFD) | | | | Land |
| 214. Agri-environment payments | | | | Land |
| 215. Animal welfare payments | | Capital | | |
| 216. Non-productive investments | | | | Land |
| 221. First afforestation of agricultural land | Capital F | | | |
| 222. First establishment of agroforestry systems on agricultural land | Capital PA | | | |
| 223. First afforestation of non-agricultural land | Capital F | | | |
| 224. Natura 2000 payments | Capital F | | | |
| 225. Forest-environment payments | Capital F | | | |
| 226. Restoring forestry potential and introducing prevention actions | Capital F | | | |
| 227. Non-productive investments | Capital F | | | |
| 311. Diversification into non-agricultural activities | | | | Land |
| 411. Implementing local development strategies. Competitiveness | | | Mix | |
| 412. Implementing local development strategies. Environment/land management | | | Mix | |
| 413. Implementing local development strategies. Quality of life/diversification | | | Mix | |
| 611. Complement to direct payment | | | | Land |

**TABLE A.2.** TREATMENT OF PILLAR 2 MEASURES IN MAGNET BY GTAP SUBSIDY WEDGES AND PAYMENT CLASSIFICATIONS (2007-2013).

*Notes:* SCT, single commodity transfers; ACT, all commodity transfers (ACT); GCT, group commodity transfers; OTP, and other transfer payments; F, forestry sector; PA, primary agricultural sector (e.g. measure #123 is allocated to capital of both F and PA sectors).; OBS, other business services. For measures #411 #412 #413 (LEADER measures or support granted to local action groups to implement local development strategies), expenditures are redistributed to other measures between #111 and #311, weighted by measure expenditures.

*Source:* Boulanger & Philippidis (2015).

| # | Measure title | Invest-ment in physical capital | Invest-ment in human capital | wider rural devlpt. schemes | Support to LFAs | Agri-environ. measures |
|---|---|---|---|---|---|---|
| 1 | Knowledge transfer and information actions (Article 14) | | X | | | |
| 2 | Advisory services, farm management and farm relief services (Article 15) | | X | | | |
| 3 | Quality schemes for agricultural products and food-stuffs (Article 16) | | X | | | |
| 4 | Investments in physical assets (Article 17) | X | | | | |
| 5 | Restoring agricultural production potential damaged by natural disasters and introduction of appropriate prevention (Article 18) | X | | | | |
| 6 | Farm and business development (Article 19) | | X | | | |
| 7 | Basic services and village renewal in rural areas (Article 20) | | | X | | |
| 8 | Investments in forest area development and improvement of the viability of forests (Article 21) | X | | | | |
| 9 | Setting up of producer groups and organisations (Article 27) | | X | | | |
| 10 | Agri-environment-climate (AEC) (Article 28) | | | | | X |
| 11 | Organic farming (Article 29) | | | | | X |
| 12 | Natura 2000 and Water Framework Directive payments (Article 30) | | | | | X |
| 13 | Payments to areas facing natural or other specific constraints (Article 31) | | | | X | |
| 14 | Animal welfare (Article 33) | | | | | X |
| 15 | Forest-environmental and climate services and forest conservation (Article 34) | X | | | | |
| 16 | Cooperation (Article 35) | | X | | | |
| 17 | Risk management (Article 36) | | | | | |
| 18 | Financing of complementary national direct payments for Croatia (Article 40) | | | | | |
| 19 | Technical Assistance (Articles 51-54). | | X | | | |
| 20 | Support for Leader local development (CLLD) (Article 35 of Regulation (EU) No 1303/2013); | | | X | | |

**TABLE A.3.** TREATMENT OF PILLAR 2 MEASURES BY MAGNET CATEGORIES (2014-2020).

*Source:* Expert opinion based on Boulanger & Philippidis (2014) together with:

- REGULATION (EU) No 1305/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1305&from=en.
- COMMISSION DELEGATED REGULATION (EU) No 807/2014 of 11 March 2014 supplementing Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and introducing transitional provisions http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0807&from=en.

| Rural development measures | Payment type | | | |
|---|---|---|---|---|
| | SCT | GCT | ACT | OTP |
| 1. Knowledge transfer and information actions (Article 14) | | | OBS | |
| 2. Advisory services, farm management and farm relief services (Article 15) | | | OBS | |
| 3. Quality schemes for agricultural products and food-stuffs (Article 16) | | | OBS | |
| 4. Investments in physical assets (Article 17) | | | Capital | |
| 5. Restoring agricultural production potential damaged by natural disasters and introduction of appropriate prevention (Article 18) | | | Capital | |
| 6. Farm and business development (Article 19) | | | | Land |
| 7. Basic services and village renewal in rural areas (Article 20) | | | | Land |
| 8. Investments in forest area development and improvement of the viability of forests (Article 21) | Capital F | | | |
| 9. Setting up of producer groups and organisations (Article 27) | | | | Land |
| 10. Agri-environment-climate (AEC) (Article 28) | | | | Land |
| 11. Organic farming (Article 29) | | | | Land |
| 12. Natura 2000 and Water Framework Directive payments (Article 30) | | | | Land |
| 13. Payments to areas facing natural or other specific constraints (Article 31) | | | | Land |
| 14. Animal welfare (Article 33) | | Capital GCT8 | | |
| 15. Forest-environmental and climate services and forest conservation (Article 34) | Capital F | | | |
| 16. Cooperation (Article 35) | | | OBS | |
| 17. Risk management (Article 36) | | | | |
| 18. Financing of complementary national direct payments for Croatia (Article 40) | | | | |
| 19. Technical Assistance (Articles 51-54). | | | OBS | |
| 20. Support for Leader local development (CLLD) (Article 35 of Regulation (EU) No 1303/2013); | | | Mix | |

**TABLE A.4.** TREATMENT OF PILLAR 2 MEASURES IN MAGNET BY GTAP SUBSIDY WEDGES AND PAYMENT CLASSIFICATIONS (2014-2020).

*Notes:* OBS, other business services; F, forestry sector; GCT8, Ruminant Group Commodity Transfer; 'Input all' means uniform input subsidy on all agriculture; 'mix' means that expenditures are redistributed to measures 1-16, weighted by measure expenditures.

Source: Expert opinion based on Boulanger & Philippidis (2015) together with:

- REGULATION (EU) No 1305/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R1305&from=en.
- COMMISSION DELEGATED REGULATION (EU) No 807/2014 of 11 March 2014 supplementing Regulation (EU) No 1305/2013 of the European Parliament and of the Council on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and introducing transitional provisions http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0807&from=en.

## 11.3 | Annex: Main assumptions for the IFM-CAP model

The IFM-CAP relies on expected utility maximising behaviour and attempts to find the optimal land allocation among production activities, taking into account resource (arable and grass land and feed requirements) and policy constraints such as greening requirements and environmental obligations. Land constraints are used to match the available land that can be used in a production operation and the possible use by the different agricultural activities. Constraints relating to feed availability and feed requirements of animal activities are used to ensure that the total energy, protein and fibre requirements are met by farm-grown and/or purchased feed.

Farmers' expected utility is defined following the mean-variance approach (Markowitz, 2014) with a constant absolute risk aversion (CARA) specification (Pratt, 1964). According to this approach, expected utility is defined as expected income and the associated income variance. The expected income is defined as the sum of gross margins minus a non-linear (quadratic) activity-specific function. The gross margin is the total revenue including sales from agricultural products and compensation payments (coupled and decoupled payments) minus the accounting variable costs of production activities. The accounting costs include the costs of seeds, fertilisers, crop protection, feeding and other specific costs. The quadratic activity-specific function is a behavioural function introduced to calibrate the farm model to an observed base year situation, as is usually done in positive programming models. This function intends to capture the effects of factors that are not explicitly included in the model, such as farmers' perceived costs of capital and labour, or model misspecification (Paris and Howitt, 1998; Heckelei, 2002; de Frahan et al., 2007).

The IFM-CAP is calibrated to the base year 2012 using cross-sectional analysis (i.e. multiple observations) and a highest posterior density (HPD) approach with prior information on NUTS 2 supply elasticities and dual values of resources (e.g. land rental prices). The calibration to the exogenous supply elasticities is performed in a non-myopic way, i.e. (for more details see Louhichi et al., 2017b).

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# List of abbreviations and definitions

| | |
|---|---|
| ANC | Area with natural constraints. |
| AVE | Ad valorem equivalents. |
| AWU | Annual work units. |
| BPS | Basic Payment Scheme. |
| CAP | Common Agricultural Policy. |
| CAPRI | Common Agricultural Policy Regionalised Impact. |
| CATS | Clearance Audit Trail System. |
| CES | Constant elasticity of substitution. |
| CGE | Computable general equilibrium. |
| CIF | Cost, insurance and freight. |
| CNDP | Complementary national direct payment. |
| $CO_2$ | Carbon dioxide. |
| $CO_2e$ | Carbon dioxide equivalent. |
| COP | Cereals, oilseeds and protein. |
| DG AGRI | Directorate-General for Agriculture and Rural Development. |
| EU | European Union. |
| EAFRD | European Agricultural Fund for Rural Development. |
| EAGF | European Agricultural Guarantee Fund. |
| EFA | Ecological focus area. |
| ESTAT | EUROSTAT. |
| ETS | Emissions Trading Scheme. |
| EV | Equivalent variation. |
| FADN | Farm Accountancy Data Network. |
| FAO | Food and Agriculture Organization of the United Nations. |
| FSS | Farm Structure Survey. |
| FTA | Free trade agreement. |
| FTE | Full-time equivalents. |
| GDP | Gross domestic product. |
| GTAP | Global Trade Analysis Project. |
| GHG | Greenhouse gas. |
| GMO | Genetically modified organism. |
| HNV | High nature value. |
| IFM-CAP | Individual Farm Model for Common Agricultural Policy Analysis. |
| IIA | Inception Impact Assessment. |
| Inc&Env | Income & Environment. |
| JRC | Joint Research Centre. |
| LDC | Least developed country. |
| LFA | Less favoured area. |
| LFS | Labour Force Survey. |
| Lib&Prod | Liberalisation & Productivity. |
| MAGNET | Modular Applied GeNeral Equilibrium Tool. |
| MS | Member State. |
| NAFTA | North America Free Trade Agreement. |
| NoCAP | No Policy. |
| N-surplus | Nitrogen surplus. |
| NTM | Non-tariff measure. |
| NUTS | Nomenclature of Territorial Units for Statistics. |

| | |
|---|---|
| OECD | Organisation for Economic Co-operation and Development. |
| PE | Partial equilibrium. |
| PMP | Positive mathematical programming. |
| RDP | Rural development programme. |
| SAPS | Single Area Payment Scheme. |
| SDG | Sustainable Development Goal. |
| SFP | Single Farm Payment. |
| SO | Standard output. |
| SPS | Single Payment Scheme. |
| TRQ | Tariff-rate quota. |
| UAA | Utilised agricultural area. |
| VCS | Voluntary coupled support. |
| WTO | World Trade Organization. |

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## JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

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