The Green Deal: An assessment of impacts of the Farm to Fork and Biodiversity Strategies on the EU livestock sector

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This report was commissioned by associations along the EU livestock value chain: COPA-COGECA, FEFAC, FEFANA, AVEC, UECBV, CLITRAVI, Animal Health Europe, EFFAB and EDA

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Dit rapport behandelt de verwachte effecten en wisselwerkingen van de Van boer tot bord-strategie en de biodiversiteitstrategie (onderdelen van de Green Deal van de EU) voor de veehouderijsector in de EU. Hierbij is aandacht voor de mogelijkheden en uitdagingen om de doelstellingen te halen. Op basis van een beoordeling van de schaarse huidige studies wordt geconcludeerd dat het bereiken van de Green Deal-doelstellingen van de EU kan leiden tot een vermindering van de veehouderijproductie met 10 tot 15%. De kortetermijneffecten op het inkomen van de landbouwbedrijven zijn divers (er zijn zowel winnaars als verliezers) en worden beïnvloed door verschillende factoren, zoals prijzen, regiospecifieke gevolgen van milieueisen, veranderingen in de rechtstreekse GLB-betalingen, de ontwikkeling van de kosten en subsidies ter compensatie van de kosten die gepaard gaan met specifieke maatregelen.

Trefwoorden: EU veehouderij, klimaat, meststoffen, pesticiden, antibiotica, dierenwelzijn, biologische landbouw, biodiversiteit, landbouwinkomen

This policy paper discusses the expected effects and trade-offs of the EU's Farm to Fork and Biodiversity Strategies (parts of the Green Deal) for the EU livestock sector, with a view to the possibilities and challenges to reach the targets. Based on an assessment of the sparse current studies, it is concluded that achieving the EU's Green Deal objectives may lead to a reduction of livestock production in the order of 10 to 15%. The short-term impacts on farm net income are diverse (gainers as well as losers) and influenced by various factors such as prices, region-specific impact of environmental constraints, changes in CAP direct payments, development of costs and subsidies compensating for costs associated with the adoption of specific measures.

Keywords: EU livestock, climate, fertilisers, pesticides, antimicrobials, animal welfare, organic agriculture, biodiversity, farm income

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Preface

The European Commission launched an ambitious Green Deal Roadmap aimed at making agriculture more environmentally sustainable, nature-inclusive and making it contribute to the mitigation of greenhouse gas emissions. This roadmap and the Farm to Fork and Biodiversity Strategies related to this will have a major impact on European food value chains and may define how the food system will be reshaped. At the same time, several specific elements and implications of the strategy documents are unknown (policy measures, targets and national implementation) as well as their impacts on many parts on the European (and also global) food value chains.

This policy paper of Wageningen Economic Research discusses the expected effects and trade-offs of the Green Deal for the EU livestock sector, with a view to the possibilities and challenges to reach the targets. The study is commissioned by COPA-COGECA, the farmers and agri-cooperatives organisation in the EU, and other associations along the livestock value chain: FEFAC, FEFANA, AVEC, UECBV, CLITRAVI, Animal Health Europe, EFFAB and EDA.

The study included desk research on selected issues: climate, fertilisers, pesticides, antimicrobials, animal welfare, organic agriculture and biodiversity. The WUR study on the impacts of the F2F and BD strategies on EU crop sectors issued by Crop Life Europe (Bremmer et al., 2021) provided useful insights. The findings of the study by JRC (Barreiro-Hurle et al., 2021) and other studies were taking into account in a set of assumptions for farm income simulations. Based on an assessment of the sparse current studies, stylised farm income impact calculations were made for different farm cases, illustrating the heterogeneity in farming and Member State conditions.

The authors consulted several WUR sector and theme experts. The contributions from Ron Bergevoet, Nico Bondt, Allard Jellema, Willem Ruster, and René Schils are gratefully acknowledged.

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Summary

S.1 Introduction

The EU's Green Deal will have a major impact on European food value chains and define how the food system will be reshaped. At the same time, several specific elements and implications of the underlying policy documents are unknown (policy measures, targets and national implementation) while for some objectives (e.g. change in consumer diets) no concrete instruments are yet foreseen. Also the implications of the Farm to Fork Strategy (F2F) and the Biodiversity (BD) Strategy on many parts of the European (and also global) food value chains are still unknown (Beckman et al, 2020). In this policy paper, the expected effects and trade-offs of the Green Deal are discussed for the EU livestock sector, with a view to the possibilities and challenges to reach the targets. In terms of methodology, the paper is based on a literature review and consultations with sector and theme experts. It also integrates the relevant results of the Green Deal study commissioned by CropLife Europe (Bremmer et al., 2021), while the market impacts are largely based on a recent study by JRC (Barreiro-Hurle et al., 2021). In addition, this paper includes a number of farm type and case-specific income assessments. The stylised calculations take into account the heterogeneity in farming and Member State conditions and rely on information from the FADN data. Note that the focus of this research is on potential impacts of the F2F and BD strategies on primary agriculture and does not provide information on impacts for the sectors related to animal farming (e.g. feed compounders, meat processors), while it also excludes impacts on demand (e.g. changes in diets, reduction in food waste).

S.2 Main results

- Based on an assessment of the sparse current studies, it is concluded that achieving the EU's Green Deal objectives may lead to a reduction of livestock production in the order of 10 to 15%. This is mainly driven by the objective to halve nutrient losses (e.g. reducing Gross Nitrogen Balance (GNB) surpluses). Part of this has to be realised by lowering manure production and herd size. In some cases the decrease in production volume would lead to more than proportional price increases.
- Agricultural product market conditions are of key importance in determining the impacts on revenues and farm income. Costs (notably related to feed) as well as product prices are likely to increase, although it is difficult to quantify these with any precision. Partly this is due to uncertainties with regard to world market responses and partly due to the incomplete coverage of F2F and BD measures in the impact assessments; e.g. unknown impact of reductions in food waste and shifts in diets.
- The short-term impacts on farm net income are diverse and influenced by various factors such as prices, region-specific impact of environmental constraints, changes in CAP direct payments, development of costs (e.g. purchased feed, fertiliser, etc.), and subsidies compensating for costs associated with the adoption of specific measures. In some cases, i.e. beef and pigs, the projected price increases play a strong role in making the estimated income impacts strongly positive. However, these projected price increases may be overstated.
- Without incentive payments there are serious extra negative impacts on net farm income foreseeable due to the increase in costs associated with the set of different measures that farmers would need to take. Under a voluntary policy regime this would probably lead to low degrees of measure adoption. Under an obligatory measure adoption policy regime, the exercise shows the need for additional income support and/or innovation if one wishes to counteract the negative income effects.
- As the environmental problems and biodiversity challenges are spatially differentiated, regionalised tailored policy approaches are recommended. A targeted policy approach, both by and within Member States, will be important to deal with the local particularities. The new delivery model of the

CAP will be helpful in this regard as it facilitates such a tailored policy implementation approach. But in addition to this also more budget may be needed when the wish is to simultaneously achieve all objectives while compensating farmers for the efforts they have to make.
- To the extent a tailored policy approach will not be realised, one may expect a regional divergence of production and associated net farm income impacts. In particular, regions where there is a high pressure on the environment (as for example measured by the gross nitrate surplus per hectare) and where stronger adjustments will be needed, will face a competitive disadvantage and declines in the volume of production.
- More generally the competitive position of EU farmers relative to those outside the EU is likely to worsen. Here the degree to which border measures (e.g. existing TRQ and import tariff structure) will protect EU farmers (thereby sustaining price increases as a response to a decline in EU domestic production) will be important. As regards the climate objective, adjustments in trade may also negatively affect the effective realisation of the objective (leakage).

S.3 Other outcomes

- The fertiliser (sales -20%) and nutrient loss reduction (-50%) objectives are the most restrictive ones. Alongside the need to apply a set of technical measures, it also leads to herd reduction, necessary to achieve the nutrient loss reduction objective. In addition these measures contribute to a reduction of crop production and feed supply, with an expected negative impact on the cost structure (competitiveness) of EU livestock farmers.
- Until 2030 achieving the climate objective can go together with achieving the GNB surplus reduction. Although this will require the adoption of a significant number of measures, this will not lead to climate-driven herd reductions.
- The pesticides reduction objective negatively affects EU feed production (volume) and quality (mycotoxins), which may induce some feed price increase, with a negative impact on the margins of livestock farmers.
- The objective to reduce antimicrobials (-50%) will require specific farm management measures, but there are empirical cases suggesting that it will be feasible to achieve this objective, without lasting negative impacts on production.
- With respect to animal welfare two cases have been identified that could negatively affect farm incomes of involved farms: the objective of ending the use of cages in poultry and potential welfare regulation impacts on animal transport for the veal sector.
- The organic production (25% of land area) objective cannot easily be translated into the impacts that it is likely to have on livestock production activities per se. In general, the impact of an increase in organic cropping area is expected to have a negative impact on total crop and feed availability in the EU.
- The impact of achieving the biodiversity objectives may be serious. There is a high share of habitats at an unfavourable status (more than 70%), this share has to be reduced to about 50% by 2030. Achieving this goal is likely to require higher ammonia emission reductions from the livestock sector, but these reductions would have additional consequences (measures, costs, herd reductions) to be taken into account.

S.4 Highlight of the report – Estimated impacts on net farm incomes

A main contribution of this policy paper is the assessment of the potential impacts of the F2F and BD strategies on livestock farm incomes. The consequences on farm net income have been analysed for thirteen farm cases, taking into account market conditions as these have been projected by the JRC technical report, and assumptions with respect to the CAP subsidies to facilitate voluntary adoption of environmental and climate measures by farmers. The farms were chosen in such a way to reflect the heterogeneity of EU agriculture with respect to sectors, production systems and soil conditions. The simulated impacts on net farm income show a large variation between cases (Figure S.1).

- The average income loss for the dairy cases is 32%. In particular, relatively high income reductions are expected for the two Dutch cases, which is driven by on the one hand the relatively strong production decline that has been projected, while also the production adjustments that are enforced in the peat area (*Zuid-Holland*) have a strong negative income impact. The results obtained in these cases may be typical for intensive dairy production systems also elsewhere within the dairy belt region (EU Commission, 2015).
- The income impacts for the cattle cases (*Pay de la Loire, Galicia*) are positive. This is mainly driven by the significant beef price increases that have been used as an input to the simulations.
- The income impacts for intensive livestock productions (granivores) are in all cases positive (especially for the Denmark and Hungary cases, followed by *Aquitaine*). This result is driven by the strong market impact (following the JRC study a projected pork price increase of more than 40% is assumed). For the granivore farms, the feed costs have an important share in the intermediate costs (this also holds for the veal farms). As such, these types of farms are relatively sensitive to changes in their feed costs.

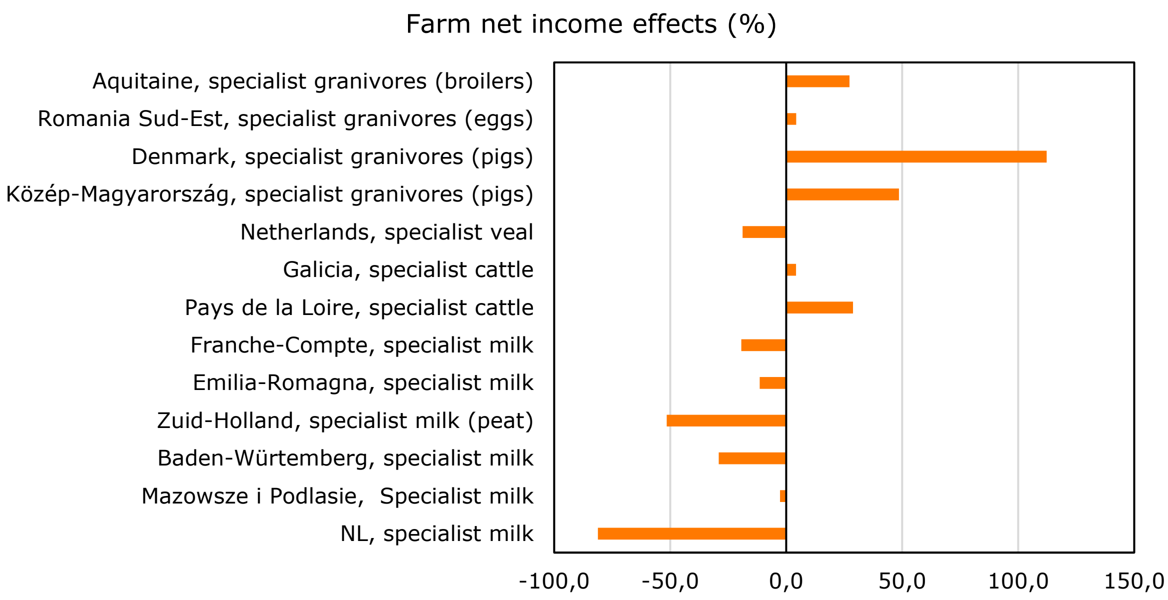


Figure S.1 *Potential impacts of F2F and BD strategies on farm income (percentage changes) for selected farm cases*
Source: Authors.

- For those cases where the projected market price increases were found to be rather extreme, i.e. beef and pork, a sensitivity analysis has been done. In this analysis the income effects for the dairy, beef and pork cases were calculated, assuming price increases of 15% for all three products, rather than 2% (dairy), 24% (beef) and 41% (pork).
  - The most notable effects are observed for intensive livestock production (granivores, pigs). In these cases, the lower price leads to clearly negative net income effects for both the Denmark and Hungarian granivore farm cases, with the Aquitaine broiler case being an exception.
  - For the beef and veal cases, which now face lower price increases, the impact on farm net income is also negative (on average a decline of 18 percentage points). In the extensive beef production case (Galicia) the income effect becomes slightly negative.
  - On the other hand, the dairy farms' income improves (on average farm net income increases by 33 percentage points and becomes positive for the *Baden-Würtemberg* and *Mazowsze i Podlasie* and *Emilia Romagna* cases).
- A second sensitivity analysis provides further insight as to what would happen to farm incomes, when farmers have to bear the burden of the costs of measures that have to be taken and no or limited policy support/budget would be available. The impacts on the net farm income of the considered cases would be worse (on average 28 percentage points lower than in the baseline case

with compensatory payments). This shows that without compensatory payments, voluntary adoption of measures could be a problem, as it would go at the cost of farm profitability and farmer incomes.

S.5 Method

The study includes the following research steps:

- Desk research on selected issues: climate, fertilisers, pesticides, antimicrobials, animal welfare, organic agriculture and biodiversity
- Consultation of WUR sector and theme experts (poultry, pig sector, dairy, antibiotics, climate change, nitrogen & biodiversity)
- Assessment of the relevant results of the WUR study on the impacts of the F2F and BD strategies on EU crop sectors issued by Crop Life Europe, the study done by JRC (Barreiro-Hurle et al., 2021) and other studies, and taking their findings into account in a set of assumptions to be used for farm income simulations
- Pursuing stylised farm income impact calculations for thirteen different farm cases, based on the assumptions described in the previous step having been made and taking into account the heterogeneity in farming and Member State conditions
- Feedback from
- Taking into account feedback from an EU webinar, joined by more than 380 registered persons and
- Taking into account the comments from an internal quality review organised by Wageningen Economic Research.

Samenvatting

S.1 Inleiding

De Green Deal van de EU zal een grote impact hebben op de Europese voedselwaardeketens en bepalend zijn voor de hervorming van het voedselsysteem. Tegelijkertijd zijn verschillende specifieke elementen en implicaties van de onderliggende beleidsdocumenten onbekend (beleidsmaatregelen, streefcijfers en nationale uitvoering), terwijl voor sommige doelstellingen (bijvoorbeeld verandering in de voedingsgewoonten van de consument) geen concrete instrumenten zijn voorzien. Ook zijn de implicaties van de 'van boer tot bord'-strategie (F2F) en de biodiversiteitsstrategie (BD) voor veel onderdelen van de Europese (en ook mondiale) voedselwaardeketens nog onbekend (Beckman et al., 2020). In dit rapport worden de verwachte effecten en trade-offs van de Green Deal voor de veehouderijsector in de EU besproken, met aandacht voor de mogelijkheden en uitdagingen om de doelstellingen te halen. Wat de methode betreft, is het document gebaseerd op een literatuurstudie en informatie van sector- en themadeskundigen. Het integreert ook de relevante resultaten van de Green Deal-studie die in opdracht van CropLife Europe is uitgevoerd (Bremmer et al., 2021), terwijl de markteffecten grotendeels zijn gebaseerd op een recente studie van JRC (Barreiro-Hurle et al., 2021). Daarnaast bevat dit rapport een aantal inkomensberekeningen. De gestileerde berekeningen tonen de heterogeniteit van de omstandigheden in de landbouw van de lidstaten en zijn gebaseerd op informatie van het landbouwboekhoudnet (FADN). De focus van dit onderzoek ligt op potentiële effecten van de F2F- en BD-strategieën voor de primaire landbouw. Het verschaft geen informatie over effecten voor de sectoren die verband houden met de veehouderij (bij voorbeeld diervoederindustrie, slachterijen), terwijl het ook effecten op de vraag uitsluit (bij voorbeeld veranderingen in diëten, vermindering van voedselverspilling).

S.2 Voornaamste resultaten

- Op basis van een beoordeling van de schaarse huidige studies wordt geconcludeerd dat het bereiken van de Green Deal-doelstellingen van de EU kan leiden tot een vermindering van de dierlijke productie in de orde van grootte van 10 tot 15%. Dit wordt voornamelijk ingegeven door de doelstelling om de verliezen aan nutriënten te halveren (bijvoorbeeld door het terugdringen van de overschotten van de brutostikstofbalans (GNB)). Een deel hiervan moet worden gerealiseerd door de mestproductie en de omvang van de veestapel te verminderen. In sommige gevallen zou de daling van het productievolume leiden tot meer dan evenredige prijsstijgingen.
- De marktomstandigheden voor landbouwproducten zijn van groot belang voor het bepalen van de gevolgen voor de inkomsten en het bedrijfsinkomen. Zowel de kosten (met name voor diervoeder) als de prijzen van de producten zullen waarschijnlijk stijgen, hoewel het moeilijk is deze nauwkeurig te kwantificeren. Deels is dit te wijten aan onzekerheden met betrekking tot de reacties op de wereldmarkt en deels aan de onvolledige dekking van F2F- en BD-maatregelen in de effectbeoordelingen; bijvoorbeeld onbekend effect van verminderingen in voedselverspilling en verschuivingen in diëten.
- De kortetermijneffecten op het netto-inkomen van de landbouwbedrijven zijn divers en worden beïnvloed door diverse factoren zoals prijzen, regiospecifieke impact van milieubeperkingen, veranderingen in de rechtstreekse GLB-betalingen, de ontwikkeling van de kosten (bijvoorbeeld aangekocht voeder, meststoffen, enz.), en subsidies ter compensatie van de kosten in verband met de goedkeuring van specifieke maatregelen. In sommige gevallen, dat wil zeggen rundvlees en varkensvlees, spelen de geraamde prijsstijgingen een grote rol bij de positieve inkomenseffecten. Deze prijsstijgingen kunnen echter overdreven zijn.
- Zonder stimulerende betalingen zijn er ernstige extra negatieve effecten op het netto-inkomen van de landbouwbedrijven te verwachten als gevolg van de stijging van de kosten in verband met de reeks verschillende maatregelen die de landbouwers zouden moeten nemen. Bij een op vrijwilligheid

gebaseerde beleidsregeling zou dit waarschijnlijk leiden tot een lage mate van toepassing van de maatregelen. In het geval het nemen van maatregelen verplicht wordt gesteld, blijkt uit de evaluatie dat extra inkomenssteun en/of innovatie nodig zijn om de negatieve inkomenseffecten tegen te gaan.

- Aangezien de milieuproblemen en de biodiversiteitsuitdagingen ruimtelijk gedifferentieerd zijn, wordt een geregionaliseerde beleidsaanpak op maat aanbevolen. Een gerichte beleidsaanpak, zowel door als binnen de lidstaten, zal belangrijk zijn om de plaatselijke bijzonderheden aan te pakken. Het nieuwe uitvoeringsmodel van het GLB zal in dit verband nuttig zijn omdat het een dergelijke op maat gesneden beleidsuitvoering mogelijk maakt. Maar daarnaast kan ook meer budget nodig zijn wanneer het de bedoeling is alle doelstellingen tegelijk te bereiken en tegelijk de landbouwers te compenseren voor de inspanningen die zij moeten leveren.
- In de mate dat een op maat gesneden beleidsaanpak niet zal worden gerealiseerd, mag worden verwacht dat de productie en de daarmee samenhangende nettogevolgen voor het landbouwinkomen regionaal zullen uiteenlopen. Met name regio's waar de druk op het milieu groot is (zoals bijvoorbeeld gemeten aan de hand van het brutonitraatoverschot per hectare) en waar sterkere aanpassingen nodig zullen zijn, zullen te maken krijgen met een concurrentienadeel en met een daling van het productievolume.
- Meer in het algemeen zal de concurrentiepositie van de landbouwers in de EU ten opzichte van die buiten de EU waarschijnlijk verslechteren. In dit verband zal het van belang zijn in hoeverre grensmaatregelen (bijvoorbeeld de bestaande tariefcontingenten en de structuur van de invoertarieven) de landbouwers in de EU zullen beschermen (en zo prijsstijgingen in stand zullen houden als reactie op een daling van de binnenlandse productie in de EU). Wat de klimaatdoelstelling betreft, kunnen aanpassingen in de handel ook een negatieve invloed hebben op de daadwerkelijke verwezenlijking van de doelstelling (weglekeffect).

S.3 Andere resultaten

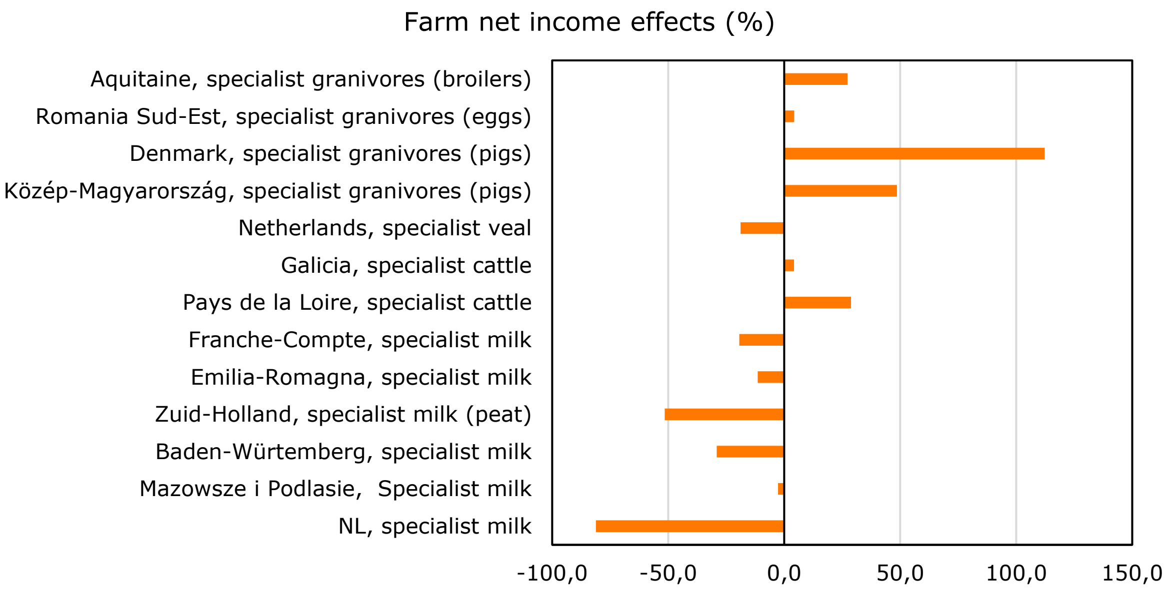
- De doelstellingen inzake vermindering van meststoffen (-20%) en vermindering van nutriëntenverlies (-50%) zijn de meest restrictieve. Naast de noodzaak om een reeks technische maatregelen toe te passen, leidt dit ook tot een inkrimping van de veestapel, die nodig is om de doelstelling inzake vermindering van het verlies aan voedingsstoffen te bereiken. Bovendien dragen deze maatregelen bij tot een vermindering van de plantaardige productie en het voederaanbod, met naar verwachting een negatief effect op de kostenstructuur (concurrentievermogen) van de veehouders in de EU.
- Tot 2030 kan de verwezenlijking van de klimaatdoelstelling samengaan met de vermindering van het GNB-overschot. Hoewel dit de vaststelling van een aanzienlijk aantal maatregelen zal vergen, zal dit niet leiden tot een klimaatgedreven inkrimping van de veestapel.
- De doelstelling om het gebruik van bestrijdingsmiddelen te verminderen heeft een negatieve invloed op de voederproductie (volume) en -kwaliteit (mycotoxinen) in de EU, wat tot een zekere stijging van de voederprijzen kan leiden, met een negatief effect op de marges van de veehouders.
- De doelstelling om het gebruik van antimicrobiële stoffen te verminderen (-50%) zal specifieke maatregelen op het gebied van bedrijfsbeheer vereisen, maar er zijn empirische gevallen die erop wijzen dat het haalbaar zal zijn deze doelstelling te verwezenlijken, zonder blijvende negatieve gevolgen voor de productie.
- Wat dierenwelzijn betreft, zijn er twee gevallen geconstateerd die negatieve gevolgen kunnen hebben voor het bedrijfsinkomen van de betrokken landbouwbedrijven: de doelstelling om het gebruik van kooien bij pluimvee te beëindigen en mogelijke gevolgen van de welzijnsverordening voor het transport van dieren in de kalfsvleessector.
- De doelstelling van biologische productie (25% van het landbouwareaal) kan niet gemakkelijk worden vertaald in de gevolgen die deze doelstelling waarschijnlijk zal hebben voor de veehouderijactiviteiten als zodanig. In het algemeen wordt verwacht dat het effect van een toename van het biologische bouwland een negatief effect zal hebben op de totale beschikbaarheid van gewassen en diervoeders in de EU.
- De gevolgen voor het bereiken van de biodiversiteitsdoelstellingen kunnen ernstig zijn. Er is een groot aandeel habitats in een ongunstige toestand (meer dan 70%); dit aandeel moet tegen 2030 zijn teruggebracht tot ongeveer 50%. Om dit doel te bereiken is waarschijnlijk een grotere reductie

van de ammoniakemissie door de veehouderijsector nodig, maar deze reducties zouden extra gevolgen hebben (maatregelen, kosten, inkrimping van de veestapel) waarmee rekening moet worden gehouden.

S.4 Kernpunt van het rapport - Geraamde effecten op de netto-inkomens van de landbouwbedrijven

Een belangrijk onderdeel van dit rapport is de beoordeling van de potentiële effecten van de F2F- en BD-strategieën op de inkomens van veehouderijbedrijven. De gevolgen voor het netto-inkomen van de landbouwbedrijven zijn geanalyseerd voor dertien gevallen, rekening houdend met de marktomstandigheden zoals die in het technisch verslag van het JRC zijn berekend, en met de veronderstellingen betreffende de GLB-subsidies om de vrijwillige toepassing van milieu- en klimaatmaatregelen door landbouwers te vergemakkelijken. De landbouwbedrijven zijn zo gekozen dat zij de heterogeniteit van de EU-landbouw met betrekking tot sectoren, productiesystemen en bodemgesteldheid weerspiegelen. De gesimuleerde effecten op het netto-inkomen van de landbouwbedrijven verschillen sterk van geval tot geval (figuur S.1).

- Het gemiddelde inkomensverlies voor de zuivelsector bedraagt 32%. Met name voor de twee Nederlandse gevallen worden relatief grote inkomensdalingen verwacht, wat enerzijds komt door de relatief sterke productiedaling die is voorspeld, terwijl anderzijds ook de productieaanpassingen die in het veengebied (Zuid-Holland) worden opgelegd, een sterk negatief inkomenseffect hebben. De resultaten die in deze gevallen worden verkregen, zijn mogelijk typerend voor intensieve melkproductiesystemen ook elders binnen de zuivelgordelregio (EU Commissie, 2015).
- De inkomenseffecten voor de rundveehouderij (Pay de la Loire, Galicië) zijn positief. Dit is voornamelijk het gevolg van de aanzienlijke prijsstijgingen van rundvlees die als input voor de simulaties zijn gebruikt.
- De inkomenseffecten voor de intensieve veehouderij zijn in alle gevallen positief (vooral voor Denemarken en Hongarije, gevolgd door Aquitaine). Dit resultaat is toe te schrijven aan de sterke marktimpact (in navolging van de studie van het JRC wordt uitgegaan van een verwachte prijsstijging voor varkensvlees met meer dan 40%). Voor de bedrijven hebben de voederkosten een belangrijk aandeel in de intermediaire kosten (dit geldt ook voor de kalfsvleesbedrijven). Dit soort bedrijven is dus relatief gevoelig voor veranderingen in hun voederkosten.



Figuur S.1 *Potentiële effecten van F2F- en BD-strategieën op het landbouwinkomen (procentuele veranderingen) voor geselecteerde landbouwbedrijfssituaties*
Bron: Auteurs.

- Voor de gevallen waarin de verwachte marktprijsstijgingen nogal extreem bleken te zijn, dat wil zeggen rund- en varkensvlees, is een gevoeligheidsanalyse uitgevoerd. In deze analyse zijn de inkomenseffecten voor de gevallen zuivel, rundvlees en varkensvlees berekend, uitgaande van prijsstijgingen van 15% voor alle drie de producten, in plaats van 2% (zuivel), 24% (rundvlees) en 41% (varkensvlees).
  - De meest opvallende effecten worden waargenomen bij de intensieve veehouderij (pluimvee, varkens). In deze gevallen leidt de lagere prijs tot duidelijk negatieve netto-inkomenseffecten voor zowel het Deense als het Hongaarse bedrijf, waarbij het vleeskuikenbedrijf in Aquitaine een uitzondering vormt.
  - Voor de gevallen rund- en kalfsvlees, die nu met lagere prijsstijgingen worden geconfronteerd, is het effect op het netto-inkomen van de landbouwbedrijven eveneens negatief (gemiddeld een daling met 18 procentpunten). In het geval van extensieve rundvleesproductie (Galicië) wordt het inkomenseffect licht negatief.
  - Daartegenover staat dat het inkomen van de melkveehouderijen verbetert (gemiddeld stijgt het netto-inkomen van de landbouwbedrijven met 33 procentpunten en wordt het positief voor de gevallen Baden-Würtemberg en Mazowsze i Podlasie en Emilia Romagna).
- Een tweede gevoeligheidsanalyse geeft meer inzicht in wat er met de landbouwinkomens zou gebeuren wanneer de landbouwers de kosten van de te nemen maatregelen zouden moeten dragen en er geen of slechts beperkte beleidssteun/budget beschikbaar zou zijn. De gevolgen voor het nettolandbouwinkomen zouden in de onderzochte gevallen slechter zijn (gemiddeld 28 procentpunten lager dan in het basisscenario met compenserende betalingen). Hieruit blijkt dat zonder compenserende betalingen de vrijwillige toepassing van maatregelen een probleem zou kunnen vormen, aangezien dit ten koste zou gaan van de rendabiliteit van de landbouwbedrijven en het inkomen van de landbouwers.

S.5 Methode

Het onderzoek omvat de volgende stappen:
- Deskresearch naar geselecteerde thema’s: klimaat, meststoffen, bestrijdingsmiddelen, antimicrobiële stoffen, dierenwelzijn, biologische landbouw en biodiversiteit;
- Raadpleging van WUR-sector- en themadeskundigen (pluimvee, varkens, zuivel, antibiotica, klimaatverandering, stikstof & biodiversiteit);
- Beoordeling van de relevante resultaten van de WUR-studie over de effecten van de F2F- en BD-strategieën op de plantaardige sectoren in de EU, die is uitgevoerd door Crop Life Europe (Bremmer et al., 2021), de studie van het JRC (Barreiro-Hurle et al., 2021) en andere studies, en rekening houden met hun bevindingen in een reeks aannames die moeten worden gebruikt voor landbouwinkomenssimulaties;
- Gestileerde berekeningen van de gevolgen voor het bedrijfsinkomen voor dertien verschillende gevallen van landbouwbedrijven, op basis van de in de vorige stap beschreven veronderstellingen;
- Verwerking van feedback van Copa-Cogeca, EFFAB, AnimalHealthEurope, AVECC, FEFAC en EDA;
- Verwerking van de feedback van een EU-webinar waaraan meer dan 380 geregistreerde personen hebben deelgenomen; en
- Verwerking van opmerkingen en suggesties van de door Wageningen Economic Research georganiseerde interne kwaliteitsevaluatie.

1 Introduction

1.1 The European Union's Green Deal

The European Union's (EU) Green Deal is the growth strategy of the European Commission to transition the EU economy to a sustainable economic model. Presented in December 2019, the overarching objective of the Green Deal is for the EU to become a climate neutral continent by 2050 (European Commission, 2019a). This should result in a cleaner environment, more affordable energy, smarter transport, new jobs and an overall better quality of life.

The Green Deal covers actions in the fields of Climate, Environment and Oceans, Energy, Transport, Agriculture, Finance and Regional Development, Industry and Research and Development.

The main parts of the EU's Green Deal for food and agriculture are: Climate action, Farm to Fork strategy and the Biodiversity strategy. Selected ambitions and targets for agriculture are as follows:

- Climate: 35% reduction of GHG emissions between 2015-2030
- Fertilisers: 50% reduction in nutrient losses, no deterioration of soil fertility; 20% reduction in the use of fertilisers by 2030
- Pesticides: 50% reduction in use and risk of (hazardous) pesticides by 2030
- Antimicrobials: 50% reduction in sales by 2030
- Organic: 25% of land under organic farm management in 2030
- Biodiversity: 10% of agricultural area to be set aside for high diversity landscape features + additional habitat and species protection

1.2 Objective of this report

The EU's Green Deal may have a major impact on European food value chains and may define how the food system will be reshaped. At the same time, several specific elements and implications of the strategy documents are unknown (policy measures, targets and national implementation) as well as their impacts on many parts on the European (and also global) food value chains. In this policy paper the expected effects and trade-offs of the Green Deal are discussed for the EU livestock sector, with a view at the possibilities and challenges to reach the targets.

1.3 Approach

1.3.1 Desk research

Four documents are used as starting points and building blocks for the analysis:

- European Commission (2020a): *EU agricultural outlook for markets, income and environment, 2020-2030.*
- Guyomard, H., Bureau J.-C. et al. (2020): *Research for AGRI Committee – The Green Deal and the CAP: policy implications to adapt farming practices and to preserve the EU's natural resources.*
- Peyraud, J-L. and MacLeod, M. (2020): *Future of EU livestock: how to contribute to a sustainable agricultural sector?*
- Barreiro-Hurle, J. et al. (2021): *Modelling environmental and climate ambition in the agricultural sector with the CAPRI model. Exploring the potential effects of selected Farm to Fork and Biodiversity strategies targets in the framework of the 2030 Climate targets and the post 2020 Common Agricultural Policy.*

Next to an additional literature review on the issues (see References), WUR sector and theme experts (poultry, pig sector, dairy, antibiotics, climate change, nitrogen & biodiversity) have been consulted.

Relevant results of the Green Deal study for Crop Life Europe have been integrated.

1.3.2 Impact analysis

A schematic overview of the impact pathways of the Farm to Fork-strategy with respect to the livestock sector is presented in Figure 1.1. There are two main 'channels':

1. measures that directly affect the livestock sectors (e.g. the use or availability of antimicrobials), and
2. measures that affect the availability and price of feed which operate through the crop sector impacts of the F2F strategy.

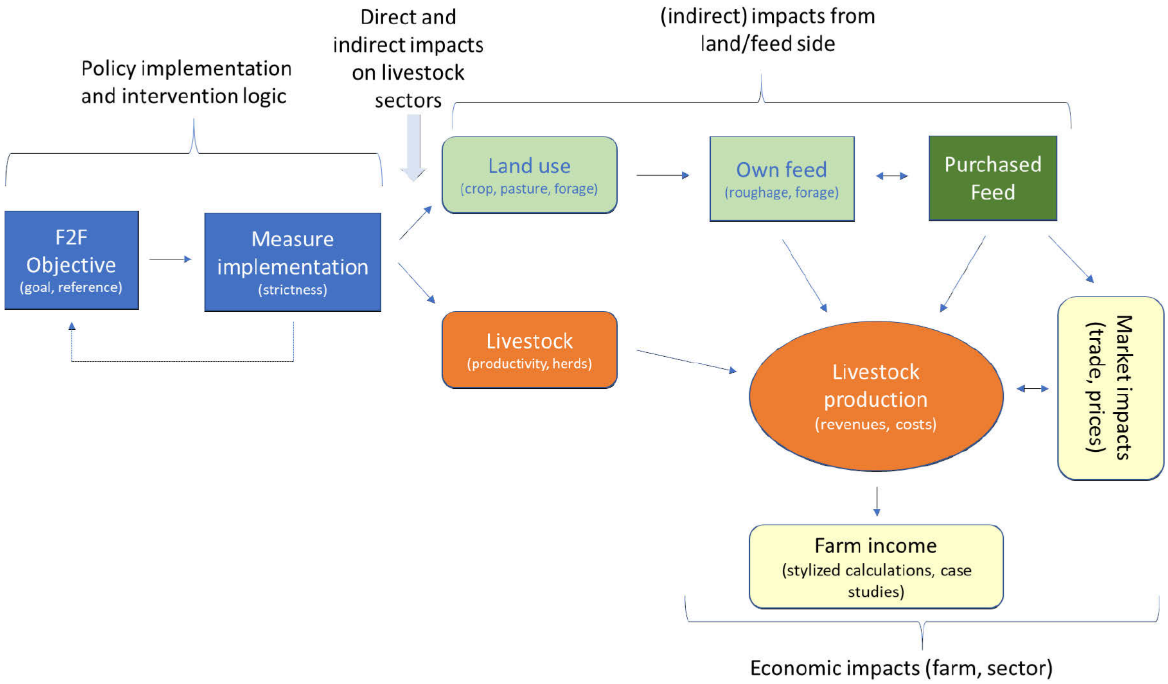


Figure 1.1 *Pathway F2F and livestock*
Source: Authors.

For the impact evaluation it is important to have specific information on the policy measures that will be implemented in order to achieve the objectives. The Strategy document provides some indications on this but in general does not contain very specific information. Moreover, under the new CAP, implementation of policy measures will be to a large extent at the discretion of EU Member States. Before the end of this year the Member States will have to present their National Strategic Plans, which will have to be approved by the European Commission. As such it may be expected that measure implementation will vary depending on the specific characteristics of the livestock and crop sectors as well as on national priorities/preferences. Finally, it is not clear in advance whether the available CAP budgets will allow all nine CAP objectives and Farm to Fork-objectives to be simultaneously achieved. When this is not feasible further priority choices may be unavoidable. In order to pursue the assessment and taking into account the described lack of information and uncertainties with respect to individual Member State approaches, in this study a number of simplifying assumptions are made.

Figure 1.1 illustrates that, when measures are known, the next step is to assess their impacts on the livestock and feed sectors. These impacts (e.g. declining feed availability) may be partly mitigated by changes in purchased feed. However, such changes will usually come at a cost and may induce different market impacts (e.g. increase in feed prices). Such market impacts will affect the profitability of livestock production, especially when these cannot be transferred as additional costs to end-users (e.g. due to competitive pressure from competing imports of livestock products). As feed costs are an important cost item, especially in intensive livestock production, this could be a driver of farm income impacts of the Farm to Fork strategy in those sectors. As it is beyond the scope of this research to execute model simulations a qualitative assessment has been made based on existing research and expert opinions.

Figure 1.2 further elaborates on how the impact of the various objectives will be accounted for in an integrated assessment of farmer income. The seven selected targets are linked to the key variables which will be impacted. As shown in Figure 1.1 this relates both to the feed channel (indirect effect) and to the direct impacts on animal herds, yields and livestock product sales (e.g. a premium price for organic products). Note that objectives can interact: the reduction of N-fertiliser will, for example, also contribute to reduce GHG emissions (climate) since it will reduce N_2O emissions. Also policy linkages are taken into account (e.g. eco-schemes to support climate action, biodiversity, environment, climate action and integrated pest management).

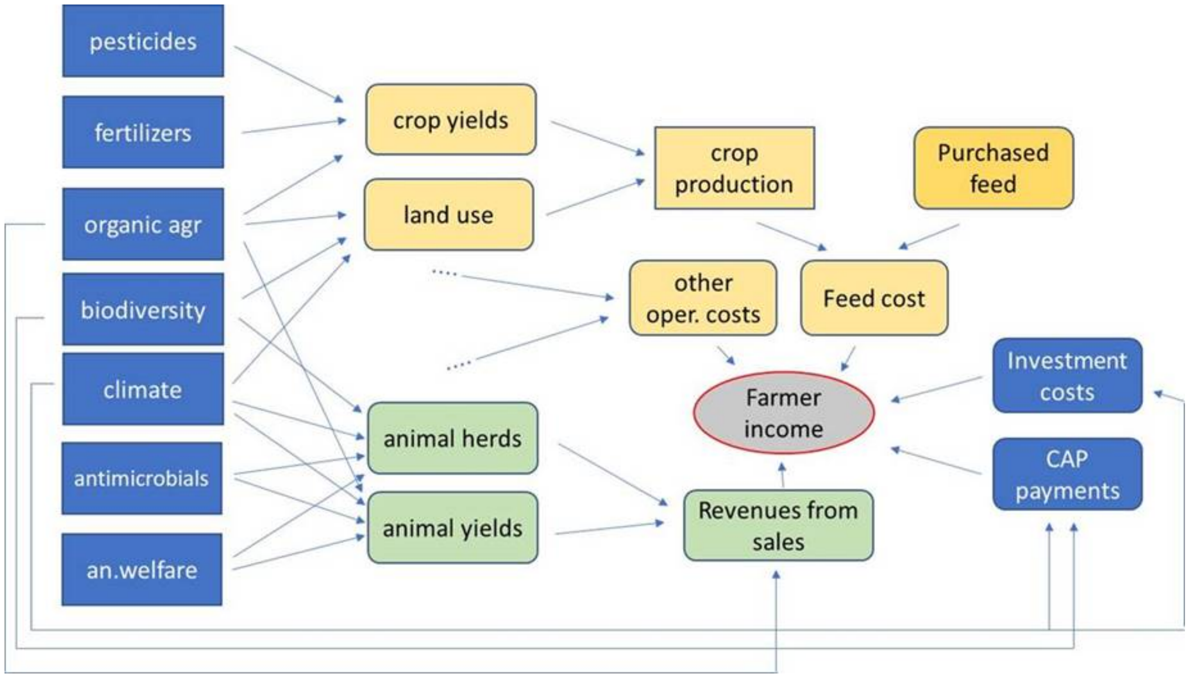


Figure 1.2 *An integrated livestock farmer income impact perspective of the F2F and BD objectives*
Source: Authors.

Some stylised farm income impact calculations have been made, in order to indicate potential impacts, taking into account the heterogeneity in farming and Member State conditions. Aside from the qualitative assessment about synergies and trade-offs between objectives, the 'integrated view' will be focused both on the agricultural production and prices and on the farmer income.

Note that the focus of this research is on potential impacts of the F2F and BD strategies on primary agriculture and does not provide information on impacts for the sectors related to animal farming (e.g. feed compounders, meat processors), while it also excludes impacts on demand (e.g. changes in diets, reduction in food waste).

1.4 Structure of this report

This introductory chapter is followed by analyses of the selected issues: climate, fertilisers, pesticides, antimicrobials, animal welfare, organic agriculture and biodiversity. These sections deal with the gaps between the Green Deal targets and projections, with the policy measures and with their impact (Chapter 2). Next, the combined effects of the targets on production, trade, prices and income are discussed on the basis of the recent impact study by the Joint Research Centre of the EU Commission (Chapter 3). This is followed by calculations on the income effects for certain farm types (Chapter 4) and the conclusions of the report (Chapter 5). Background information on the livestock sector is presented in the appendices.

2 Targets, measures and impact

2.1 Introduction

Against the background of the projections for the EU's livestock sector in 2030 (Appendix 1), this chapter focuses on the relevant policy targets of the EU's Green Deal. The selected issues are climate, fertilisers, pesticides, antimicrobials, animal welfare, organic agriculture and biodiversity. Table 2.1 introduces the issues by confronting the strategy targets with the current situation and the trends of the variables. This information is based on Guyomard, Bureau et al. (2020) and more detailed in Appendix 2.

Table 2.1 *Gaps between Green Deal targets and trends*

Issue	Green Deal target 2030	Current situation/ trend
Climate	35% reduction of GHG emissions between 2015-2030: reducing these emissions by at least 55% compared to levels in 1990	EU agricultural GHG emissions declined by 24% between 1990 and 2013, but increased by 4% between 2013 and 2017. Emissions fell slightly by 1.3% between 2017 and 2018
Fertilisers	50% reduction in nutrient losses, no deterioration of soil fertility; 20% reduction in the use of fertilisers by 2030	The prolongation of the 2009-2015 trend, which hardly shows any nitrogen balance surplus decline for the coming period will lead to a nitrogen surplus far away from the target
Pesticides	Reducing by 50% the use and risk of pesticides, together with a 50% reduction in the use of hazardous pesticides	EU-27 sales of pesticides are roughly constant; a prolongation of the 2011-2018 trend will clearly be at odds with the 50% reduction target
Antimicrobials	50% reduction of the EU sales of antimicrobials for farmed animals and in aquaculture	Significant progress has been made over the two last decades in the reduction of sales of antimicrobials in agriculture; the EU as a whole could be on track to reach the reduction target by 2030
Animal welfare	Stricter animal welfare standards	Concern for animals is growing throughout the EU, with animal welfare increasingly appearing as a global public good
Organic agriculture	At least 25% of agricultural land should be under organic farming management, with a significant increase in the uptake of agro-ecological practices	In 2018, the share at the EU-27 level was 8% (compared to 5.9% in 2012). The linear prolongation of the 2012-2018 trend would allow the EU to reach a share of 12.3% by 2030
Biodiversity	Legally protect a minimum of 30% of the EU's land area and 30% of the EU's sea area and integrate ecological corridors, as part of a true Trans-European Nature Network Strictly protect at least a third of the EU's protected areas, including all remaining EU primary and old-growth forests At least 10% of agricultural area is under high-diversity landscape features	Habitats at an unfavourable status have increased from 68.7% in 2007-2012 to 72.1% in 2013-2018. This percentage should decrease to 50.5% by 2030. Species at an unfavourable status were globally constant between 2007-2012 and 2013-2018, but should decline to 38.5% by 2030, which is a challenging task.

Source: Guyomard, Bureau et al. (2020).

2.2 Climate

2.2.1 Introduction

The three major GHG in agriculture are methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2), with the share of livestock sector in total GHG emissions being 50% (Figure 2.1). CH_4 emissions from livestock originate mainly from ruminant species (enteric fermentation) (80.7%) and manure management (17.4%) (European Commission, 2020g). Methane is special in that it is an aggressive GHG (34 times more powerful than CO_2), while when emitted it halves in the atmosphere in just over 8 years (short carbon cycle) (Vellinga, 2021). Emissions from beef and dairy cattle account for about 75% of livestock emissions (European Court of Auditors, 2021, 17).

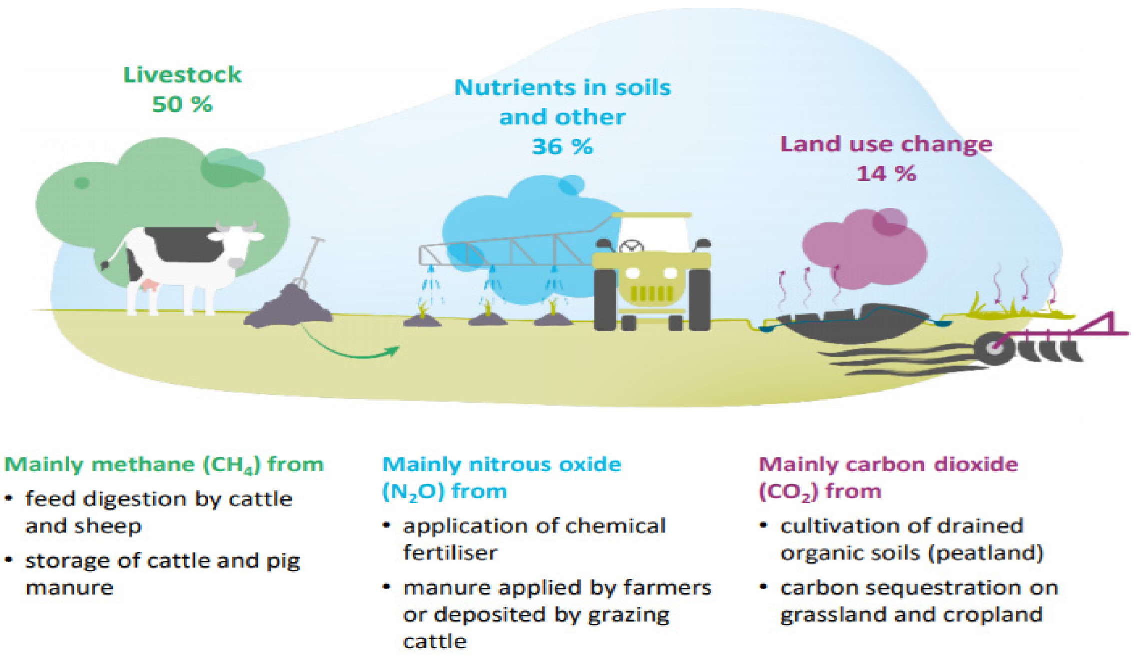


Figure 2.1 *Key sources of greenhouse gas emissions (in CO_2eq) and the share of the livestock sector*
Source: European Court of Auditors (2021, 6).

The Regulation on binding annual emission reductions by Member States from 2021 to 2030 (Effort Sharing Regulation) was adopted in 2018. It sets national emission reduction targets for 2030 for all Member States, ranging from 0% to -40% from 2005 levels. These targets also apply to agriculture, and correspond to a reduction of 30% by 2030 from 2005 at the EU level (Guyomard, Bureau et al., 2020).

2.2.2 Targets and measures

The Commission has proposed a new, more strict, EU target for 2030 of reducing greenhouse gas emissions by at least 55% compared to levels in 1990 and would like to include the new EU 2030 target in the EU Climate Law. This is a step-up to climate neutrality in 2050, implying achieving net zero greenhouse gas emissions for EU Member States as a whole, mainly by cutting emissions, investing in green technologies and by protecting the natural environment.

The 2030 climate target plan’s impact study concluded that stepping up the level of ambition for reductions in GHG emissions would also require an accelerated effort to tackle methane emissions. Projections indicated the need for 35% to 37% methane emission reductions by 2030 compared to 2005.

The measurement-system GHG emissions covered by the 30% quantitative target of the Effort Sharing Regulation includes only those linked to agricultural inputs and outputs (manure and fertiliser-related emissions, methane emissions, etc.), and the measures concerned essentially deal with cropland management, livestock management and fertiliser use.

Net effects on climate change will depend on the sum of contributions to emissions (e.g. methane) and efforts to reduce or capture emissions (e.g. carbon sequestration). It is currently not clear what implications the EC 2050 climate neutral target has specifically on the EU livestock sector, but as the livestock sector is an important emitter it is likely to be more strongly affected than crop sectors.

At EU level an additional 25 percentage point reduction will be needed in the current decade to achieve the 55% reduction target. The challenges at Member State level vary a lot. Figure 2.2 indicates the reduction that has been made to achieve the 2020 target. For 13 out of the 27 EU Member States the 2020 targets under the Effort Sharing legislation (including agriculture) have been more than achieved and these Member States have even space for increasing their GHG emissions. This group includes mainly the Middle and Eastern Member States of the EU and Portugal. For the other Member States, mainly from the EU-15, it holds that the 2020 objective has not been achieved, with further emission reductions up to an additional 20% needed (Ireland, Denmark).

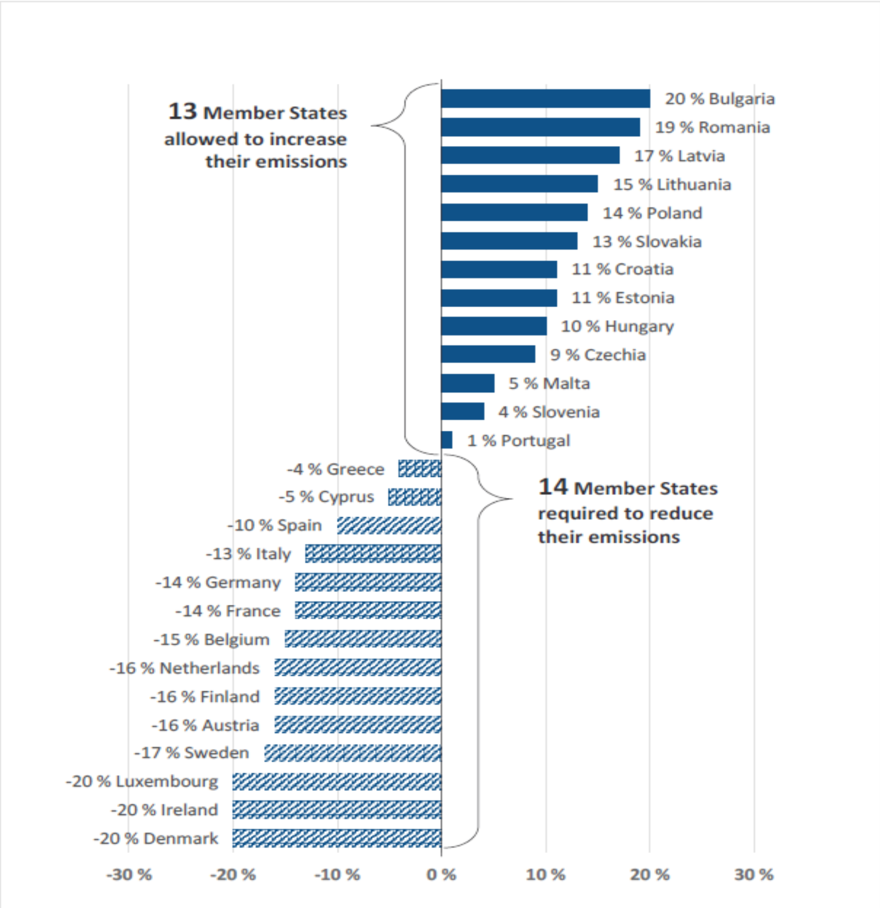


Figure 2.3 *The 2020 Member State targets under effort sharing legislation, compared to 2005 emissions*
Source: European Court of Auditors (2021, 9).

To achieve the 2030 targets more GHG emission reduction efforts have to be made in nearly all Member States (Romania, Greece and Hungary could be exceptions). For a number of Member States (e.g. Slovenia, Slovakia) the ‘autonomous developments’ as projected in the medium term Market Outlook may already be sufficient to achieve the 2030 objective (see also text below), while for others the reduction to be still achieved may approximate about 30% (e.g. Germany, France, Ireland, Austria, Luxembourg, Malta, Cyprus) (European Court of Auditors, 2021, 11).

When looking at the expected evolution in livestock numbers, as these are reported in the EU's mid-term outlook, dairy cattle is expected to decline by about 9% and beef by 8.5%. For the intensive livestock sector production is expected to decline for pigs by 3%, while for poultry (broilers +6%, laying hens +9%) increases are expected. This will translate in changes in livestock numbers, after correcting for animal productivity increases. It is expected that these changes in livestock populations will contribute to a reduction of the associated greenhouse gas emissions at EU level, while different developments may take place at Member State level. To grasp the impact of expected changes in animal numbers on GHG emission, Figure 2.4 shows the share of different livestock sectors into total livestock GHG emissions at Member State level. Manure management, soils and enteric fermentation are the most important sources of GHG emissions. In most EU Member States, the CH_4 emitted through enteric fermentation is highest, followed by the N_2O emitted by the soil.

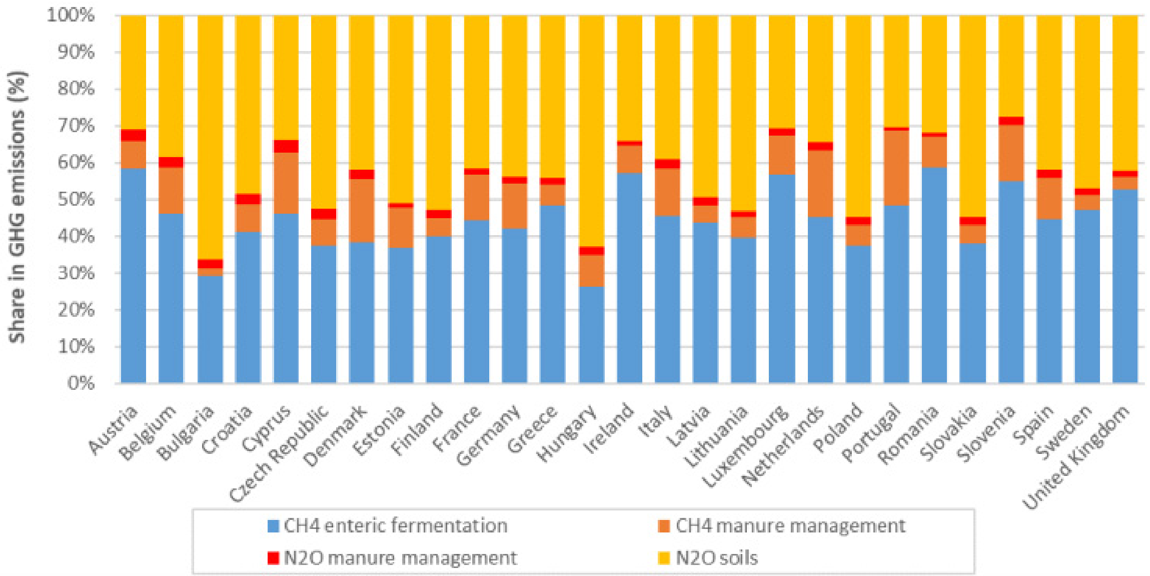


Figure 2.4 *Share in agricultural GHG emission sources per EU member state (only the emission sources reported in the UNFCCC emission sector Agriculture are included)*
Source: Duan et al. (2021).

GHGs from etheric fermentation are linked to ruminant animals (dairy cattle, beef cattle, sheep and goat), while CH_4 emissions from manure management can be significant, especially in countries with liquid manure systems and pig production. Manure management and soils contribute to the direct and indirect emission of N_2O. The projected autonomous herd declines for dairy, beef and pigs will contribute to a further reduction of CH_4 emissions, while the increase in poultry will partly counteract this. The F2F objective to reduce the N-fertiliser use by 20% will contribute to a reduction of N_2O emissions.

Member States need to take further actions to achieve the GHG reduction targets for agriculture. A range of mitigation technologies and practices are available that have the potential to deliver emission reductions decoupled from production. These mitigation options are mainly related to improvement of animal diets, herd management, manure management (notably its use in fertilisers and biogas generation), animal and plant breeding, herd health and animal welfare. The F2F strategy identifies different technical solutions and mitigation practices to be implemented in agriculture, among which precision agriculture, nitrogen management, organic farming, agroforestry.

As regards livestock, reducing CH_4 emissions is important for achieving the overall target. The most effective ways of reducing emissions from enteric fermentation include improving the health and fertility of the herds, improving animal diets (mix of feed materials), the use of feed additives, and application of specific feeding techniques. Approximately 7-10% of the energy in the feed of ruminants is metabolised into methane (EC, 2020). Feed digestion accounts for 78% of livestock emissions while manure storage is responsible for the remaining 22% (European Court of Auditors, 2021).

According to the F2F strategy, the biggest potential for reducing emission intensity is in novel approaches. Certain feed additives may be effective, but are still in need for getting regulatory approval, before they can be applied. Many practices concerned with animal breeding, feeding, health and fertility management offer only a slow and marginal mitigation potential (European Court of Auditors, 2021). Some of the mentioned practices could encourage production expansion (rebound effect), and may then even lead to an increase net emissions. In breeding, short-term solutions don't exist, but breeding strategies may reduce GHG in the longer term.

Policies can support mitigation practices. The greening policy of the CAP has been argued to have contributed to the reduction of GHG emissions, although this effect is likely to have been limited to only a few percentage points (Solazzo et al., 2016). In the new CAP the past greening criteria will be included in the enhanced conditionality, while Member States are obliged to offer eco-schemes to their farmers, to support and incentivise climate friendly actions (e.g. carbon farming). Moreover, Pillar 2 of the CAP includes a large variety of measures, among which Agri-environment-climate Measures (AECM) are clearly the most important from a climatic and environmental point of view. Designing and implementing AECM is mandatory for MSs. AECMS, just like eco-schemes, are voluntary for farmers. Pillar 2 encompasses a host of other measures, such as payments supporting investment for productivity improvement or income support aids for farmers in areas facing natural or specific constraints, which can impact on GHG emissions and the environment. The measures taken to achieve the GHG reduction objective will be left to the Member States. There is a safeguard in that it has been agreed that for the 2021-2027 period 30% of the CAP budget will have to be spent on climate action.

The European Commission presented a strategy to reduce methane emissions in October 2020. This strategy calls for monitoring of agricultural emissions, including carbon equivalent balance calculations at the farm level. It also intends to develop research and the dissemination of best practices (European Commission, 2020g). There are currently no obligatory policy measures enforcing specific Member State actions. Apart from 'technical measures' and depending on the mitigation strategies chosen by Member States with respect to agriculture, herd size reductions may be necessary, especially for achieving the longer run objective of climate neutrality.

2.2.3 Impact

In the JRC study (Barreiro-Hurle et al., 2021) several measures aimed at reducing CO_2 and non-CO_2 emissions have been considered, and their impact on the climate objective has been assessed. According to their assessment focusing on four key measures of the F2F and BD strategies (fertilisers, pesticides, organic agriculture, and biodiversity), they expect that, relative to the 2030 baseline, the non-CO_2 emissions could decline by about 19% and total GHG emissions by 28% to 264 t CO_2eq (Barreiro-Hurle et al., 2021, 56). This would imply that the climate objective will be roughly achieved.

The climate measures will impact the livestock as well as the crop sectors, but their net impact is difficult to quantify from the available studies. As an example, the fallowing of histosols-measure is identified as a big contributor to reducing non-CO_2 emissions (Barreiro-Hurle et al., 2021). Since these soils are currently to an important extent in use by the livestock sector, it will negatively impact especially dairy and beef production. Another important measure contributing to the reduction of greenhouse gas emissions is the extended use of winter cover crops, which mostly affects the crop sector and mixed farms. A third contributor is mineral fertiliser application technologies, including precision farming and variable rate technology, which affect both crop production as well as land-tied animal productions. As the (endogenous) adoption of measures in the JRC assessment is driven by financial policy incentives, the impacts on farm income are likely to be limited since adoption only takes place when the compensation covers additional costs. It should be further noted that climate also benefits from the F2F objective to reduce the N-fertiliser use by 20% as this will contribute to a reduction of non-CO_2 (N_2O) emissions.

Two additional observations:

1. The measures taken to reduce nutrient loss (gross nitrate surplus) in high density regions create a synergy for achieving the climate objective, especially to the extent nitrate/ammonia emission reduction measures lead to a decline in animal production (which according to the JRC assessment lies in the range of 10 to 15%; see Chapter 4 below).
2. There is evidence from the literature that in the longer run, achieving the climate objective (climate neutrality) will impose further restrictions on livestock herds than the intermediate objectives as for the medium-run the nitrate-related measures are the most important drivers of change in agricultural activities (Jongeneel and Gonzalez-Martinez, 2021).

2.3 Fertilisers

2.3.1 Introduction

The excess of nutrients (especially nitrogen and phosphorus) in the environment, stemming from excess use and the fact that not all nutrients used in agriculture are effectively absorbed by plants, is considered as a major source of air, soil and water pollution. It has reduced biodiversity in rivers, lakes, wetlands and seas. Use of nitrogen in agriculture also leads to the emissions of nitrous oxide to the atmosphere.

2.3.2 Targets and measures

The achievement of the targets for fertilisers will need a significant effort at EU level (Guyomard, Bureau et al., 2020). However the commitments that will be required from the different MS can differ substantially since there is a diverse 'picture' when looking at their current use within the EU. This is further illustrated by Figure 2.5 which provides an overview of the nitrate balance per hectare at MS level (see net balance lines) and the different underlying factors.

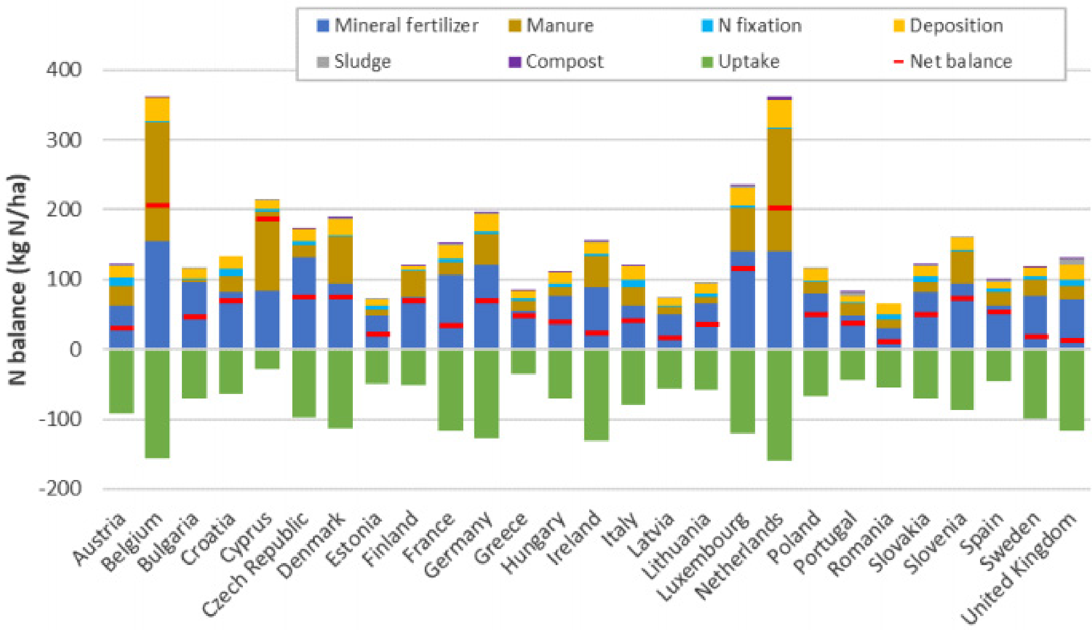


Figure 2.5 *Nitrogen balance by Member State*
Source: Reproduced from Duan et al. (2021).

As Figure 2.5 already suggests (e.g. role of manure), the livestock density per hectare will be the factor determining the gross nitrogen balance. Figure 2.6 illustrates the livestock density per hectare by EU Member State and the UK and the high animal densities for countries like The Netherlands, Belgium and to a lesser extent also in Denmark, Ireland. It should be noted that local conditions of regions within Member States (e.g. Normandie in France, the Po-valley in Italy) can vary and may also show high animal densities.

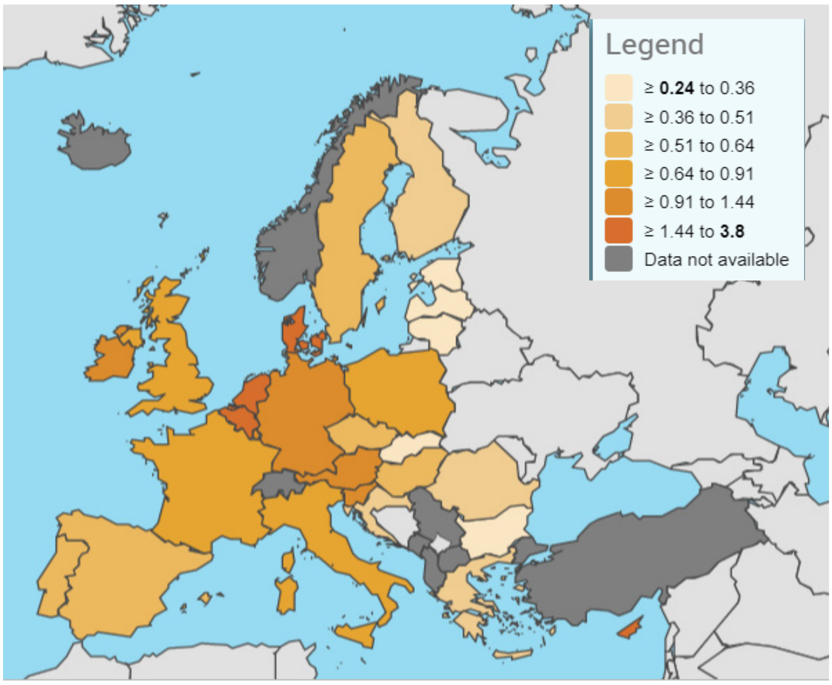


Figure 2.6 *Livestock density per hectare in the EU in 2016*
Source: Reproduced from Eurostat, livestock intensity index TAI09.

As described by Guyomard, Bureau et al. (2020), the technical solutions which were proposed in the EU Green Deal to reduce fertiliser use are: (i) precision farming, whose adoption relies on the availability of fast broadband internet access across rural areas; (ii) farm sustainability tools for nutrients; (iii) balanced fertilisation and sustainable nutrient management; (iv) expansion of organic farming, banning the use of synthetic fertilisers; and diversification inside the field, including crop sequences and landscape.

Focusing on the livestock management practices, adjusting feed rations may contribute to reduce nutrient losses (Gonzalez-Martinez et al., 2021; Barreiro-Hurle et al., 2021). Returning livestock excreta to cropland and grassland is another recommended measure which has proven to contribute positively to close the nitrogen cycle (Billen et al., 2021), and also contributes to the objective to making agriculture more circular. Organic manure application practices could also help (see Barreiro-Hurle et al., 2021 and also Table 4.1 below). Another option that could contribute to limit negative impacts on land productivity due to a reduction in fertiliser use is increasing the proportion of leguminous crops in pasture land and arable land (Conijn et al., 2002; Andert et al., 2016; Lamichhane et al., 2016; Lechenet et al., 2017). The expansion of the share of leguminous crops and temporary grasslands on total arable land could also contribute to the achievement of this objective. Finally, trade of organic manure from one region to another and the processing of organic manure could also help to limit negative impacts, especially in environmental hotspots.

2.3.3 Impact

In the study for CropLife (Bremmer et al., 2021), a set of cases have been investigated to assess the potential impacts on yields and prices achieving the fertiliser reduction objective. The results indicate that yields impacts are ranging -3% (maize and wheat in France) to -25% (apple in Poland). The JRC study (Barreiro-Hurle et al., 2021) arrives at production volume reductions for cereals and oilseeds of about 15%, of which part is caused by a reallocation of land over crops. No estimates are provided for the change in roughage production. However, it is indicated that livestock farmers will reduce their herds to satisfy the restrictions from the nutrient loss reduction requirements. The gross nitrate balance surplus per hectare is likely to be relatively large for livestock productions with intensive farming systems (e.g. high milk yields per hectare). Reducing such a surplus induces farmers to reduce organic manure production by, alongside other technical measures, also downsizing herds.

The assessment of the impacts of reducing mineral fertiliser application is somehow linked to the objective of increasing organic agriculture. When comparing organic and conventional yields, the existing literature suggests that organic yields tend to be around 20-25% lower than conventional yields, although large variations among crops and regions are identified (De Ponti et al., 2012; Seufert et al., 2012; Ponisio et al., 2015; Barreiro-Hurle et al., 2021, 35).

Pellerin et al. (2017) suggest that a 10% reduction in the use of fertiliser could be achievable by adjusting fertiliser application rates to yield targets and application dates to crop needs, as well as by making further use of organic fertilisers and decision support tools. Fertilisers Europe/EU Nitrogen Expert Panel (2015) suggest that the Nitrogen Use Efficiency (NUE) indicator should be in the range 50%-90%.

It can be concluded that the 20% fertiliser use reduction as such may have limited impacts on the pasture and roughage yields that are important for land-tied livestock production. However, the set of rules needed to reduce the gross nitrogen surpluses are restricting livestock production and likely to induce herd reduction impacts. According to the JRC study (Barreiro-Hurle et al., 2021) the combined effect of Nitrate measures (and the three other measures, including the organic agriculture objective) will lead to a reduction of the EU dairy, beef, pig and poultry herds of respectively about 12, 17, 14 and 15%, of which a key part is attributable to nitrate-related measures.

2.4 Pesticides

2.4.1 Introduction

The use of chemical pesticides in agriculture contributes to soil, water and air pollution, biodiversity loss and can harm non-target plants, insects, birds, mammals and amphibians. In August 2021, the Commission published updated EU Harmonised Risk Indicators for pesticides for the period 2011-2019 for the EU (European Commission, 2021e). These indicators show the trends in the risks associated with the use of pesticides since 2011 under Directive 2009/128/EC. Harmonised Risk Indicator 1 (HRI 1) measuring the use and risk of pesticides, shows a decrease of 21% since the baseline period in 2011-2013, and a 4% decline in 2019 compared to 2018, which was unchanged compared to 2017. Harmonised Risk Indicator 2 (HRI 2), which is based on the number of emergency authorisations, shows an increase of 55% since the baseline period in 2011-2013, but a 5% decrease in 2019 compared to 2018. There are two other notable positive trends in 2019: i) The continued, and accelerating, growth in the sales of pesticides containing non-chemical active substances, and ii) The notable decrease in the quantity of the more hazardous pesticides placed on the market.

2.4.2 Targets and measures

According to the European Commission there is no room for complacency if the EU is to further reduce the risks associated with pesticides. To this end, the Commission will continue to ensure the full implementation of existing EU rules on pesticides by Member States (including launching infringement actions if necessary), ensure that Member States undertake the necessary evaluations of the trends in Harmonised Risk Indicator 1 and 2, ensure that Integrated Pest Management (IPM) is fully implemented, ensure that, under the Common Agricultural Policy (CAP), the Member States Strategic Action Plans show a high level of ambition with regards to pesticides, carry out an evaluation and revision of the Sustainable Use of Pesticides (Directive 2009/128/EC), including consideration of establishing mandatory national targets at Member State level.

Please note that the EC will use different ranges of data depending on the process: for the Sustainable use of pesticides (SUDP) revision, the period 2011-2013 is used and for F2F targets, 2015-2017 (for use of pesticides).

Some key technical solutions which are proposed in the EU Green Deal are listed by Guyomard, Bureau et al. (2020), including: (i) the expansion of organic farming, banning the use of synthetic pesticides; (ii) precision farming, relying on fast broadband internet access across rural areas; (iii) farm sustainability tools for nutrients; (iv) Integrated Pest Management (IPM); and (v) diversification inside the field, including crop sequences and landscape.

Guyomard, Bureau et al. (2020) also discuss the possibility of implementing a tax at EU level on pesticides and veterinary drugs, which could be defined based on their ecological toxicity. From a conceptual point of view, the implementation of such a tax can be justified as an instrument to protect biodiversity and health. However, given the requirement to satisfy local pesticide use criteria or standards, from a governance point of view, that tax instrument is not practical as it will be hardly feasible to define a set of taxes and optimise these in such a way that the objectives will be achieved. This does not exclude that a (generic) tax on fertiliser could be part of a more comprehensive set of measure.

In terms of the synergies that can be achieved with other type of measures/objectives, direct reductions in pesticide use should be supported by the expansion of semi-natural habitat areas, preferably with feasible IPM alternatives, which can help to ensure a natural and effective system for pest control (Ricci et al., 2019). From the Netherlands there is evidence that strip cropping can potentially help to reduce the pressure from pests (Faber et al., 2020)

Education and evaluation have been proven to deliver positive outcomes to help reduce the use of pesticides. A good example in this regard is the Rhineland Palatinate in Germany which provides education, research and advisory services. In the case of the Netherlands, growers are requested to keep detailed records for the plant protection monitors that are used to review the implemented measures and adjust the strategy for the next year (see, European Commission, (2017a) for further details).

Finally, an interesting pilot initiative is IPMWORKS. IPMWORKS is an EU-wide network aiming at coordinating groups of pioneer farmers that are committed to explore IPM strategies to achieve substantial pesticides reductions (Munier-Jolain and Paveley, 2021).

2.4.3 Impact

The reduction targets for pesticides may have important implications for the livestock sector. Without adequate alternatives, harvests may be reduced and there could be negative impacts to product quality (e.g. mycotoxin prevalence in feed; lower quality grading of apples), which will both affect human and animal feeding. However, overuse of pesticides has been estimated around 10-20% (Pedersen et al., 2012; Skevas et al., 2014). Reducing overuse will have no impact on yields, although investments and increases in working times might be needed. Focusing on the measures described above, the use of precision farming could lead to a reduction in pesticide use ranging 10-20%. Achieving the intended 50% reduction in pesticide use would be a much more difficult objective to reach without a significant negative impact on yields (see, Guyomard, Bureau et al. (2020) for further discussion).

The case studies that were carried out in the context of CropLife (Bremmer et al., 2021), concluded that the intended reductions in the use of pesticides by 2030 will cause a reduction in both yields and quality. On average, the expected yield reductions are estimated around -2% for maize, -4% for wheat, -8% for rapeseed and -12% for sugar beet. Overall, the expected yield reduction will induce a price increase, but this ‘price gain’ may be negatively impacted by a loss in quality.

Another scenario simulated in the study for CropLife (Bremmer et al., 2021) assesses the potential consequences of achieving the intended reductions in pesticides and nutrient use, combined with an increase in set-aside percentage to 10%. Once again, important differences were identified among crops and EU Member States. Focusing on those crops that are of interest for the livestock sector, the case studies suggest a potential wheat yield decline of around -25%, -15% and -10% in Romania, Germany and Finland respectively. Large yield declines are also expected for maize in Romania (-23%), as well as for rapeseed and sugar beet in Poland (-18% and -23% respectively). However, the study does not provide information about potential yield losses in pasture and roughage production. The application of pesticides on (permanent) pastures is low relative to that applied in arable crop production. As such the reduction in pesticides is likely to have a limited effect on grassland productivity. The share of grass and roughage in the total EU protein feed balance is 44% (Silvis et al., 2020), which will be even higher for ruminant animals (e.g. 50% or more). This implies that the impact of the pesticides reduction requirement on an important part of ruminant feed provisioning is expected to be lower.

It is also important to mention the in-depth analysis carried out in the context of EPRS – STOA (2019) which analyses the possibilities of farming without using plant protection products. This study concludes that without a safe and effective toolbox at hand, especially in those cases in which farmers already use low levels of pesticides, it is scientifically proven that yields will be reduced.

More generally, reductions in pesticides use and risk are likely to have a negative effect on feed markets (lowering feed supply and inducing price increases), which will negatively affect the livestock sector, especially those sectors that are heavily dependent on compound feeds, and where the gross margin is very sensitive to feed costs (Silvis et al., 2021).

Guyomard, Bureau et al. (2020) conclude that the intended objective on pesticide use is unlikely to be achieved unless the process is supported with strong incentives and the provision of feasible alternatives. At Member State level, it can be expected that the higher the price ratio of pesticides on agricultural products is, the higher the adoption of IPM techniques will be.

2.5 Antimicrobials

2.5.1 Introduction

Antimicrobial resistance (AMR) is one of the top 10 global public health threats facing humanity, according to the WHO (2020). AMR in human medicine, veterinary and agricultural sectors is predominantly driven by inappropriate prescribing practices of antibiotics in humans, ineffective hygiene practices in hospital settings, and their overuse in the livestock sector. Globalisation of markets and mobility of people across the globe are contributing to the increase of AMR problems.

In livestock farming AMR arises notably in cases where there is extensive use of antibiotics for containment and treatment of diseases. As from 2010 the European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) monitors the sales of antimicrobial medicines in animals across the EU. This information is important to identify possible risk factors that could lead to the development and spread of antimicrobial resistance in animals. Large variations in antibiotic use exist between countries: ESVAC reports an average of 103 mg per Population Correction Unit (PCU) in 2018, varying from less than 50 to (far) more than 200 mg per PCU. Substantial differences exist between and within different livestock sectors (sheep/cattle low and pigs/broilers/veal calves high), and in the different livestock sectors between individual farms.

The European Commission adopted a new Action Plan to tackle AMR on 29 June 2017. This is based on the principle of 'One Health', as the health of humans, animals and the environment are interconnected. The overarching goal is to preserve the possibility of effective treatment of infections in humans and animals. Some actions focus on identified gaps in the EU response that require new activities, the discovery of new knowledge and the creation of new partnerships.

2.5.2 Targets and measures

The latest ESVAC report, published in October 2020, shows that the sales of antibiotics for use in animals in Europe has fallen significantly, by more than 34%, between 2011 and 2018. Even more importantly, the veterinary sales of antibiotics considered critically important in human medicine show a decreasing trend. The situation across Europe remains contrasting. Out of the 25 countries that provided data covering 2011-2018, 18 countries observed a decline in sales of veterinary antibiotics. For example, France reported for 2019 a reduction of 53.3% compared to 2011. The reference situations of member states are quite different. However, the substantial decline in some countries indicates that there is a potential for a decrease in other countries. Therefore, it is desirable to draw lessons from the experiences in several countries.

While human health is a Member State competence, the Commission's mandate for action is more clearly defined for veterinary and food related issues. Various legislative and regulatory actions were developed and implemented, including new EU legislation to harmonise the monitoring of AMR in zoonotic and commensal bacteria in farm animals and food (European Commission, 2020f), and regulations on veterinary medical products and medicated feed (European Commission, 2018a; European Commission, 2018b; European Commission 2017b), and in vitro diagnostic medical devices (European Commission, 2017c). The target of the Farm to Fork Strategy to reduce the sales of antimicrobials has been supported by the implementation of EU regulations on veterinary medical products and medicated feed (European Commission, 2018c; European Commission (2018d). The Commission also established the AMR One Health Network providing a forum for government experts in AMR, EU scientific agencies and Commission experts. In addition, the annual European Antibiotics Awareness Day and the Eurobarometer surveys were used to support Member States raising awareness of AMR challenges.

2.5.3 Impact

The EU as a whole could be on track to reach the reduction target by 2030 (depending on the reference year). Serious efforts will be required especially for those MSs (e.g. Italy, Spain) which have high uses. In a number of MS already serious and successful efforts have been made towards antibiotic use reduction. The Swedish National action plan is an interesting example (see text box).

Other examples of countries that had a relative high use at the start, like the Netherlands and Belgium, show that implementing hygienic measures at farm level enabled the reduction of antibiotic usage while maintaining or increasing high levels of production without affecting economic performance (AMCRA in Belgium (https://amcra.be/nl/home/), SDA in the Netherlands (https://www.autoriteitdiergeneesmiddelen.nl/nl).

Antibiotic use in Sweden is among the lowest in the European Union (EU). This applies to both the use of antibiotics for human and animal purposes. Early awareness, interdisciplinary and intersectoral measures have led to this low use (Jordbruksverket, 2020). In Sweden, there has long been a broad national consensus among stakeholders from all relevant sectors to keep the use of antibiotics as low as possible to ensure the effectiveness of treatments for bacterial infections in humans and animals. This consensus is reflected in the common priorities of the Swedish government and organisations active within the health, veterinary, livestock and the food chain (Jordbruksverket, 2020).

The first Swedish national action plan against antibiotic resistance was published in 2000 and emphasised the importance of a One Health approach. Today there is both a long-term government strategy and a national action plan against antibiotic resistance. This action plan is being implemented by a group of 25 government agencies and organisations active in areas such as human health, animal health, food, environment and research. Another example of the One Health approach is the annual surveillance report on antibiotic resistance and consumption, published by Statens Veterinärmedicinska Anstalt (National Veterinary Institute) and Folkhälsomyndigheten (Public Health Office of Sweden) (Jordbruksverket, 2020).

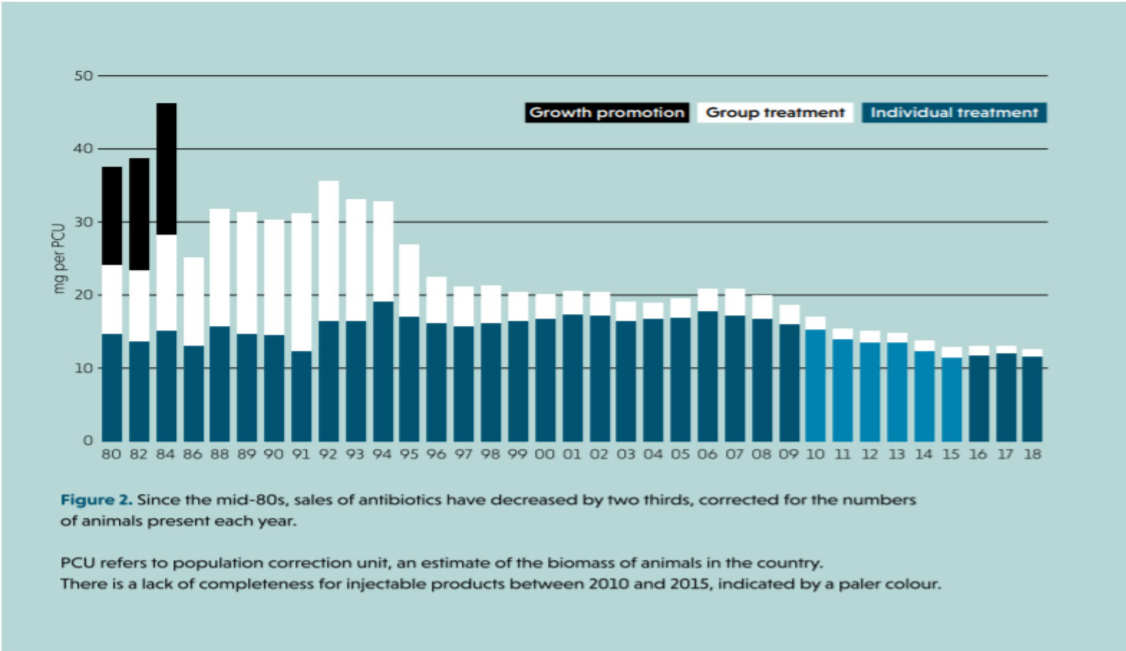


Figure *Sales of antibiotics in Sweden*
Source: Reproduced from Jordburksverket, (2020).

Antibiotic use in animal purposes
In 1980, the Swedish Farmers' Federation (Lantbrukarna Riksförbund) already adopted a sector-wide policy on antibiotics use. The policy was aimed at more controlled use of antibiotics. Since 1986, the use of antibiotics in feed to promote growth was no longer permitted (Jordbrukverket, 2020). Sweden was the first country in the world to introduce such a ban (WWF, 2019). After the introduction of this ban, an increase in health disturbances was noted. In response, efforts to implement prevention strategies were stepped up. Over the years, the need to use antibiotics to treat infections has decreased as a consequence of changes in farm management practices (Jordbrukverket, 2020).

Antibiotics for animal use are only available on prescription in Sweden and may only be sold by pharmacies. Guidelines for prudent use of antibiotics for different animal species, based on evidence or expert consensus, are readily available to veterinarians. Antibiotics should only be used when needed and the risk of resistance should be taken into account when prescribing. A 2013 regulation states that certain antibiotics may not be prescribed by veterinarians and that some other antibiotics are subjected to restrictions (Jordbrukverket, 2020).

In 2000, the Svarm programme was launched, a formalised monitoring of antibiotic resistance. The programme includes a list of antibiotic resistance that could potentially affect public health. Results of the monitoring are communicated through various channels and discussed with relevant stakeholders (Jordbrukverket, 2020).

All pharmacies in Sweden are required to provide daily sales statistics to a central database. Until 2013, this was an infrastructure company owned by the state, Apotens Service AB. Since January 1, 2014, all activities within the company have been transferred to the Swedish eHealth authority (eHälsomyndigheten) (EMA, 2019).

Successful action plans that resulted in a substantial reduction of antibiotic usage depended on a sense of urgency, combined with a target-based policy, with ambitious required targets. Bergevoet (2019) found that a substantial reduction of antibiotic usage in the Netherlands was accomplished at broiler and pig farms through the implementation of relatively easy and cheap measures at farm level. He did not observe a lasting decrease in production, animal welfare or economic performance of farms that reached a substantial reduction (minus 63% compared to 1999) of antibiotic usage. Under the implementation of the national strategy to reduce antibiotic usage, overall cost competitiveness of the Dutch pig and broiler farms was not negatively affected. To establish this, farmers had an action perspective that contained a set of measures they could implement in a farm specific mix, most suitable for their farm. Farm advisors and suppliers such as veterinarians and the feed industry were actively involved in the implementation of these measures.

For those MS that have already significantly reduced their use in the recent past, further reductions are likely to affect the possibilities to use therapeutic antibiotics and are likely to raise technical difficulties and to induce higher costs.

2.6 Animal welfare

2.6.1 Introduction

Animal welfare is an increasingly important component of contemporary EU livestock production. Protecting the welfare of farmed animals has entered the public policy mainstream in a growing number of countries, resulting in significant public and private regulation. Within the European Union, a substantive number of EU animal welfare related Directives, Regulations and Strategies constitute a supra-national governance framework for animal welfare (Broom, 2017).

Since the first EU legislation on the welfare of animals was adopted in 1974 the policy has evolved and expanded its coverage. The current legal framework for the keeping of farmed animals consists of a general Directive on the protection of animals bred and kept for farming purposes (Council Directive 98/58/EC). It sets out general principles and leaves room for Member States to adopt stricter provisions, provided these are compatible with EU rules. To complement the general Directive, sector-specific Directives were implemented that govern the welfare of laying hens, broilers, calves and pigs.

2.6.2 Targets and measures

In the Farm to Fork Strategy the Commission states that better animal welfare improves animal health and food quality, reduces the need for medication and can help preserve biodiversity. With the support of citizens in mind, the Commission intends to revise the animal welfare legislation, including on animal transport and the slaughter of animals, to align it with the latest scientific evidence, broaden its scope, make it easier to enforce and ultimately ensure a higher level of animal welfare. The Commission will also consider options for animal welfare labelling to better transmit value through the food chain.

By the end of 2023, the Commission will revise the animal welfare legislation to align it with the latest scientific evidence. In view of this revision, the Commission is preparing an impact assessment, evaluating all EU legislation on the welfare of farmed animals. Its objective is to assess the economic, social and environmental impact of the envisaged changes to the EU animal welfare legislation. To identify which pieces of legislation would need a revision and which gaps were present in the EU Strategy for Protection and Welfare of Animals (2012-2015), the Commission put in place several evaluation activities over the past years. Among these activities is the evaluation of the EU legislation on the welfare of farmed animals.

The evaluation found that the majority of problems and drivers identified by the strategy in 2012 are still relevant today (European Commission, 2021a):
- The objective to provide consumers and the public with appropriate information about animal welfare has become even more relevant today than it was in 2012.

- At an international level, the strategy contributed to promoting animal welfare standards with one voice in international fora and establishing synergies with activities on animal welfare of the World Organisation for Animal Health (OIE).
- The strategy contributed to setting common priorities that led to improvements on animal welfare across the EU. It also contributed to improve knowledge and sharing of best practices, as well as to enforcement of EU legislation in specific areas (i.e. group housing of sows and protection of laying hens). However, none of the strategy's objectives has been fully achieved. Notably, the strategy failed to deliver on the objective of introducing a simplified EU legislative framework on animal welfare.
- The forthcoming review of the animal welfare legislation will look at the legislative gaps identified in 2012 and at any new gaps that could emerge from the ongoing evaluation of the rules in force. This will support further reflections on the options available to make the animal welfare acquis fit for purpose. As regards enforcement, special attention will be given to compliance risk areas identified by this evaluation.
- A remaining challenge is the need to improve compliance across Member States in some risk areas (i.e. animal transport, routine tail docking of pigs, some stunning methods and other). In this respect, the new Official Controls Regulation offers the tools to address some issues, regarding control requirements and verification of compliance with animal welfare legislation.

The evaluation also notes the need to further optimise synergies with the Common Agricultural Policy (CAP) and to make better use of the instruments offered by it to improve animal welfare standards in animal husbandry and to increase CAP beneficiaries' awareness of animal welfare requirements. The CAP has encouraged farmers through the European agricultural fund for rural development (EAFRD) to implement animal welfare standards that go beyond the legislation. However, these measures are optional and only co-funded by the EU. As a result, only a limited number of countries have used this possibility. In the context of and subject to the ongoing legislative procedure regarding the CAP, a new system is envisaged from 2023 whereby Member States will be able to use 'eco-schemes' to support a transition to better animal welfare. Eco-schemes may provide farmers with support in the form of management commitments compensating them for additional costs or income losses associated with upgraded standards that go beyond mandatory requirements.

The Commission has stated that EU trade policy should contribute to enhance cooperation with and to obtain ambitious commitments from third countries. Animal welfare is among the key areas in this respect, next to the use of pesticides and the fight against antimicrobial resistance. The EU will strive to promote international standards in the relevant international bodies and encourage the production of agri-food products complying with high safety and sustainability standards.

2.6.3 Impact

Compliance with additional regulations for animal welfare generally does increase costs of production. For livestock producers it is important that cost increases are compensated through increases in revenues. For example, when the use of cages is banned, a number of farmers still need to make changes to their current farming systems and can be confronted with often costly investments. At the same time, the switch to farming systems with higher animal welfare standards often improves farmers' reputation in society (license to produce) and raises confidence in their work (Garcia Pinillos, 2017). Moreover, consumers are prepared to pay for products satisfying higher animal welfare standards, be it to different degrees (Vissers et al., 2021, and Van Galen et al., 2020).

There are different perceptions of animal welfare across MS. Some degree of subsidiarity could make national implementation of certain measures easier. However, this could lead to distortion of competition within the common market. Such an impact is also relevant for external trade: welfare regulations for production in the EU may be undermined by imports from third countries with less stringent regulations. This is especially important for the poultry meat sector.

According to an IEEP study on the transition towards cage-free farming in the EU there are many steps involved in the elimination of cages in the different branches of farming and the many conditions found on individual farms (Kollenda et al., 2020). Some farms would still need to take major steps to go cage-free, others could restrict themselves to narrower, more limited changes. Costs of change will vary as well. A transition to cage-free production would involve additional investment and the time required for good management generally would be greater.

Other areas raising potential issues for farmers could be revisions that are likely to be made to the Transport and Slaughter regulations. These concern a ban or more restrictive measures for long distances transport (more than 8 hours) to provide genetics/animals to farmers. Further constraints on animal transport could affect the specialisation patterns as they have been and are developing in and between EU Member States (e.g. veal, pigs).

2.7 Organic agriculture

2.7.1 Introduction

Organic farming is an agricultural method that aims to produce food using natural substances and processes. This means that organic farming tends to have a limited environmental impact as it encourages: responsible use of energy and natural resources; maintenance of biodiversity; preservation of regional ecological balances; enhancement of soil fertility; maintenance of water quality. Additionally, organic farming rules encourage a high standard of animal welfare and require farmers to meet the specific behavioural needs of animals (European Commission, 2021b). The most important trade-off is that because of the lower yield, more land is required for the same volume of product.

EU regulations on organic farming are designed to provide a clear structure for the production of organic goods across the whole of the EU. This is to satisfy consumer demand for trustworthy organic products whilst providing a fair marketplace for producers, distributors and marketers. Organic producers need to adopt different approaches to maintaining soil fertility and animal and plant health. Livestock farmers must also fulfil specific conditions if they wish to market their products as organic. These rules include respect for animal welfare and feeding animals in accordance with their nutritional needs, and are designed to protect the animals’ health and environment. These rules also help to build public trust as they ensure that organically farmed animals are kept separate from non-organic.

2.7.2 Targets and policy measures

To reach the target of at least 25% of agricultural land under organic farming management, the EU should more than triple its 2018 share of agricultural land under organic farming. There is a rapid progression of organic farming in several MS over the most recent years, but the current shares of agricultural land under organic farming vary substantially from one MS to another. Aiming for a premium on the organic product (needed for covering higher costs), production should follow the market/demand growth.

The EU has passed new legislation. Due to the complexity and importance of the secondary legislation under preparation, its entry into force was postponed by one year, from 1 January 2021 to 1 January 2022. Among the changes that will be made under the new legislation are:

- a strengthening of the control system, helping to build further consumer confidence in the EU organics system
- new rules for producers which will make it easier for smaller farmers to convert to organic production
- new rules on imported organics to ensure that all organic products sold in the EU are of the same standard
- a greater range of products that can be marketed as organic.

The new organic legislation will be supported by the action plan for organic production in the EU, launched by the European Commission in March 2021 (European Commission, 2021c).

The Organic Farming Action Plan for the development of EU organic production must work as a lever to stimulate both the supply and the demand side. An unbalanced development of organic production could hamper its profitability. The plan will drive investment and innovation in sustainable farming, respond to increased consumer interest in organic food and boost demand for organic food. The plan builds on the action plan for the period 2014-2020, which already addressed some of the problems identified by the review of the EU organic policy. This resulted in the adoption of Regulation (EU) 2018/848 on organic farming, which will apply from 1 January 2022. All of the 18 actions in the 2014-2020 plan have been implemented. Major non-regulatory achievements include the roll-out of the electronic Certificate of Inspection (E-CoI) in Traces (Trade Control and Expert System) which has improved the traceability and thus also integrity of organic products, and increased the information on organic imports into the EU; specific funding for research and innovation on organics in the EU Research and Innovation Framework Programmes; and the inclusion of organics into 'green public procurement'.

The action plan is organised along three axes that accommodate the structure of the food supply chain (production, processing, and retailers and consumers). Apart from continuing some of the existing actions, the plan also puts forward new actions, and mobilises different sources of funding.
To monitor progress, the Commission will organise yearly public follow-up meetings with representatives of the European Parliament, Member States, the Union's advisory bodies and stakeholders as appropriate. The Commission will also publish every two years progress reports – including a scoreboard - and present them at dedicated events, as well as a midterm review in 2024 of the action plan, to be presented at a high-level conference. To raise awareness on organic production, the Commission will also organise a yearly EU-wide 'Organic Day'.

2.7.3 Impact

Although organic farming has rapidly expanded in numerous MS, it's share in the EU remains low (on average about 3% of EU animal production), and even very low, in several countries (EU Commission, 2019c). In practice, any large-scale expansion of organic farming raises three main issues (Guyomard, Bureau et al., 2020):
- First, the technical dimension is notably related to the capacity of reducing current gaps between organic and 'conventional' yields.
- Next, the economic dimension is notably linked to the numbers of consumers who are willing (and can afford) to pay price premiums for organic products, and last,
- The political dimension is linked to the support of organic farming in the future CAP.

Guyomard, Bureau et al. (2020) note that any significant increase in the share of agricultural land under organic farming will contribute (by definition of its technical specifications that prohibit the use of chemical pesticides and mineral fertilisers, and severely restrict the use of antibiotics in livestock) to reducing the total use of chemical pesticides, mineral fertilisers and antibiotics.

As to the last point, there is no target in organic livestock production. Therefore it is not said that the expansion of the EU land under organic farming will also mean an increase in organic livestock production. Organic livestock production is still very low but as of 2022, most of organic animals will have to be fed mainly with only organic feed and ruminant animals will have to have sufficient access to outdoor grazing areas. This may have important consequences on the prices of feed and hinder the expansion. The most important organic feed crop in the EU is permanent grassland, which has a share of about 44% in total organic feed crop production (EU Commission, 2019 c).

For GHG emissions there is a trade-off, as organic farming is characterised by lower yields which increases its footprint (Searchinger et al., 2018). This negative trade-off is because the GHG emissions produced by organic agriculture are lower per hectare, but generally higher per kilogramme of product, compared to 'conventional' agriculture. Moreover, the lower yields may require the total agricultural area in the EU to be expanded or agricultural imports from third countries to be increased for the purpose of maintaining unchanged production and consumption levels in the EU.

The impact of the target for organic agriculture has been addressed in the JRC-study (Barreiro-Hurle et al., 2021). The policy target on minimum organic agricultural area was translated into a combination of constraints and parameter adjustments for the average (representative) regional farm models, under the assumption that the sum of these regional targets should add up to the overall EU target. The adjustments include: (i) lower use of mineral fertilisers; (ii) lower use of plant protection products; (iii) lower crop yields; and (iv) cost increase reflecting the different cost structure of organic farms. Due to lack of data, yield shocks were not applied on livestock activities. Due to model limitations, no changes were made to reflect the higher market value of organic product. The price differential currently observed in the market for organic products would probably be reduced when achieving such a high share of total production as those envisaged in the modelled target. The researchers stress that the analysis must be interpreted as exploratory and has to be taken with care, while it is acknowledged that it was not possible to capture the impact of the Action Plan in a proper way (see Chapter 3).

2.8 Biodiversity

2.8.1 Introduction

Agriculture supports and shapes a wide variety of plants, animals, fungi and microorganisms. According to the European environment agency (EEA), 50% of all species in the EU rely upon on agricultural habitats. At the same time, agriculture relies on biodiversity. Agricultural production depends upon a variety of genetic resources and on the services these resources provide, such as soil and water conservation, maintenance of soil fertility, resistance to pests and diseases, and pollination. A number of these services are also essential for mitigating and adapting to climate change and environmental pressures. However, agricultural biodiversity is in serious decline across the EU and elsewhere (Benton et al., 2021). While there are several contributing factors – including land use change, pollution, climate change, and the impact of invasive species – much of the decline is directly related to agriculture, especially to N-related emissions (see Figure 2.7). Nearly all EU Member States face N-related emission problems, including N depositions (ammonia) on nature areas in excess of critical deposition loads. Regions with the greatest excess dispositions are the Netherlands, Flanders, Brittany, Po-region and Denmark. Through the common agricultural policy (CAP), the European Commission aims to help farmers: restore, conserve and enhance biodiversity in their farms; preserve and maintain landscape features; conserve and valorise diverse genetic resources; facilitate the wide array of ecosystem services made possible by biodiversity (European Commission, 2021d).

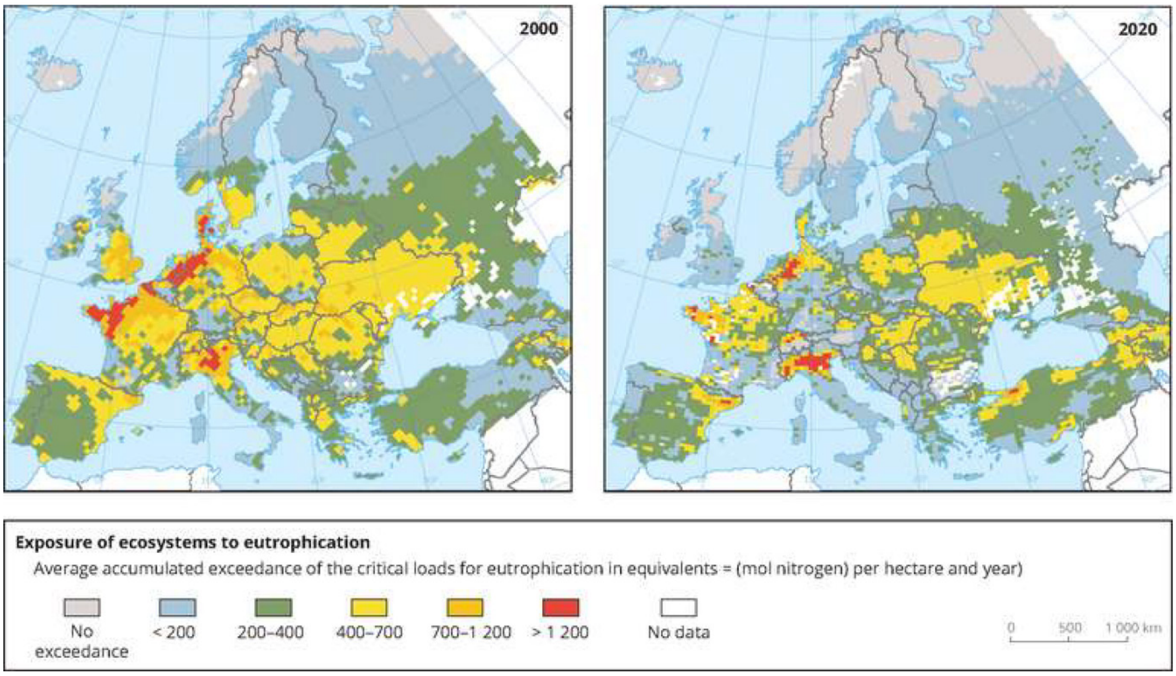


Figure 2.7 *Maps of Europe in 2000 (left) and 2020 (right), showing the calculated exceedances of critical loads for nitrogen-sensitive nature areas. Exceedance of critical loads is given in mol nitrogen per ha per year (1,000 mol nitrogen = 14 kg nitrogen)*
Source: EMEP/EEA, 2017).

2.8.2 Targets and measures

Today, legally protected areas represent 26% of total EU land area (18% for areas under the Natura 2000 network and 8% for areas under national schemes), as noted by Guyomard, Bureau et al. (2020). The gap with the corresponding Green Deal target equals 4 percentage points. The gap is much higher for the target related to strictly protected areas, as these areas are currently equal to only 3%. As regards the status of habitats and species, trends are rather pessimistic, although there is an extension of habitat protection in some MS. Assessing the share of agricultural area under high-diversity landscape features is difficult, notably because the Green Deal does not precisely define what constitutes a high-diversity landscape feature. At least for arable crops, the share of agricultural land devoted to actual high-diversity landscape features is very low, much lower than the Green Deal target of 10%.

The EU Biodiversity Strategy for 2030 addresses the main causes of biodiversity loss with the renewed objectives of halting this loss and restoring damaged ecosystems. The negative impacts of agricultural intensification on crop pollination, bird communities, flora and soil biodiversity are emphasised (see also EEA (2019b), Eurostat (2020h), and Section 3.2).

The EU Biodiversity Strategy acknowledges the vital role of farmers in preserving biodiversity, as well as the benefits that farmers could draw from as a result of restored biodiversity. It also emphasises the importance of helping farmers to engage in the transition to fully sustainable practices, and the importance of eco-schemes and result-based payment schemes. It states that the EC will 'ensure that the CAP Strategic plans are assessed against robust climate and environmental criteria, and that MS set explicit national values for the relevant targets set in this strategy. Biodiversity is part of the general and specific CAP objectives, and can be tackled through measures in the first pillar (eco-schemes) and second pillar (rural development). The assessment of the CAP Strategic Plans will be based on 23 result indicators (4 of which refer to biodiversity). However, Guyomard, Bureau et al. (2020) find that the EU Biodiversity Strategy for 2030 questions the consistency and completeness of the political agreement on the future CAP with the high level of ambition displayed by the EC in that domain.

2.8.3 Impact

The European Commission is preparing an impact assessment to support the development of EU nature restoration targets, and to assess their potential environmental, social and economic impacts. Public and stakeholder views and insights will contribute to the impact assessment. In general yield improvements should outweigh the impact of harvested area reduction. Afforestation, avoided deforestation and peatland restoration are all likely to reduce the area cultivated. The amount of production and emissions displaced will depend on the yield of the land no longer cultivated.

Although it is currently still not clear how the proposed measures will impact the EU livestock sectors there is a potential for the impacts to be significant. In the JRC study, the impact of having at least 10% of agricultural area under high-diversity landscape features has been approximated by taking into account an additional set-aside (5% set-aside in addition to the 5% of the land that is already devoted to ecological focus areas). This however captures only the negative impact on agricultural production by shrinking its land-base, but does not indicate its contribution to increased favourable status of biodiversity. Taking into account some leakage and slacks (in some Member States the share of land not used for agricultural production now already exceeds 5%) a negative impact on agricultural production of about 2-4% may be expected.

A potentially more important impact, which is not addressed in any of the impact assessments known to us, concerns the requirement to improve the favourable status of habitats: N2000 areas with unfavourable status should decrease by about 20 percentage points, from 72% to 51%. An important factor in this would be to reduce the ammonia emissions from livestock production (especially cattle), which is a key emitter, in order to reduce its deposition on nature conservation areas. In many regions of the EU the current deposition exceeds the critical load values (De Vries et al., 2015). This can potentially lead to serious costs to livestock farming, and in particular affect regions with intensive production systems (Reis et al., 2015; Jongeneel and Gonzalez-Martinez, 2021).

2.9 Conclusions

This chapter has presented an overview of the major Green Deal targets that are relevant for the livestock sector. Special attention was given to the announced and expected measures and their impacts. Table 2.2 concludes the overview by highlighting some of the impacts.

Table 2.2 *Impact of reaching selected Green Deal targets*

Issue	Impact of reaching Green Deal targets
Climate	Achieving the climate target depends on the adoption of a series of measures and is benefitting from a reduction of the production volume of the livestock sectors (due to other factors). The impacts on farm income are likely to be limited under the assumption that adoption of measures takes place when the compensation covers additional costs.
Fertilisers and nutrient loss reduction	Reducing the use of fertilisers will imply yield reductions for crops in the order of magnitude of 10 to 15%. The gross nitrate balance surplus per hectare is likely to be relatively large for livestock productions with intensive farming systems (e.g. high milk yields per hectare). The impact on the pasture and roughage yields may be limited. However, the set of rules needed to reduce the gross nitrogen surpluses are restricting livestock production and likely to induce a reduction of the herd.
Pesticides	The reduction targets for pesticides may have implications for the livestock sector because of reduced crop yields and negative impacts on harvested crop quality, e.g. mycotoxin prevalence in feed and food crops. For reaching the target strong incentives and the provision of feasible alternatives are deemed necessary.
Antimicrobials	The EU as a whole could be on track to reach the reduction target by 2030. In a number of MS already serious and successful efforts have been made towards antibiotic use reduction. Serious efforts will be required especially for those MSs which have high uses. For those MS that have already significantly reduced their use in the recent past, further reductions are likely to affect the possibilities to use therapeutic antibiotics and are likely to raise technical difficulties and to induce higher costs.
Animal welfare	Compliance with additional regulations for animal welfare generally does increase costs of production. For livestock producers it is important that cost increases are compensated through increases in revenue. There are different perceptions of animal welfare across MS. Welfare regulations for production in the EU may be undermined by imports from third countries with less stringent regulations. Constraints on animal transport could affect the specialisation patterns as they have been and are developing in and between EU Member States (e.g. veal, pigs).
Organic agriculture	Although organic farming has rapidly expanded in numerous MS, it remains low, and even very low, in several countries. There is no target in organic livestock production. Expanding the EU land under organic farming will not necessarily mean an increase in organic livestock production. From 2022 most of organic animals will have to be fed mainly with only organic feed. This may have important consequences on the prices of feed and hinder the expansion.
Biodiversity	In general yield improvements should outweigh the impact of harvested area reduction. Afforestation, avoided deforestation and peatland restoration are all likely to reduce the area cultivated. A negative impact on agricultural production of about 2 – 4% may be expected as a result of the additional area devoted to landscape elements. A potentially more important impact concerns the requirement to improve the favorable status of habitats which will in particular affect regions with intensive production systems.

Source: Authors.

3 Impact on production, trade and prices

3.1 Introduction

The scenario analysis of JRC (Barreiro-Hurle et al., 2021) includes four of the F2F and BDS targets: the 50% reduction of nutrient surplus, the 50% reduction of the risk and use of pesticides, the increase of area under organic farming (25% of agricultural area), and an increase of area for high-diversity landscape features. In addition also measures and impacts related to climate change are taken into account. The combined impact of these targets are modelled with CAPRI under three scenarios. The first is a status quo scenario assuming no change in the CAP compared to its implementation during 2014-2020. The other two scenarios include a potential implementation of the CAP post 2020 legal proposal targeting these objectives (CAP LP), both with and without the targeted use of Next Generation EU funding (NGEU). Here the results of the last two scenarios are presented.

The researchers stress that any conclusions as regards impacts have to be taken with caution and represent a preliminary evaluation of their magnitude. The results provided are contingent and bounded by assumptions and model capacities and should not be taken as the precise quantitative impact that would be realised should the targets be reached. The limitations that have been described throughout the report highlight the lack of coverage of all measures in the strategies and lack of data for some assumptions affect the results reported.

3.2 Production and trade

Declining production
The F2F and BDS targets & CAP LP scenarios (both without and with the NGEU) are expected to lead to changes in land allocation, animal numbers, production, and the trading position of the EU compared to the baseline.

Total Utilised Agricultural Area (UAA) is expected to still increase by 2.6%, but crop production and livestock production are declining. Due to the fact that forestry clearing or wetland drainage is banned in most MS, it is assumed that the UAA increase was previously abandoned land: the increase mainly consists of pasture and fruits and vegetables. The supply of the crop and livestock sectors is negatively affected in the scenarios. In the livestock sector, the Gros Nitrogen Balance (GNB)-reduction target dominates the simulated impacts on animal herds. Animal herds are reduced to decrease the manure output and to trigger an improvement in the nitrogen balance. Consequently, meat supply decreases by about 14% and raw milk supply by 10% in 2030 (Figure 3.1).

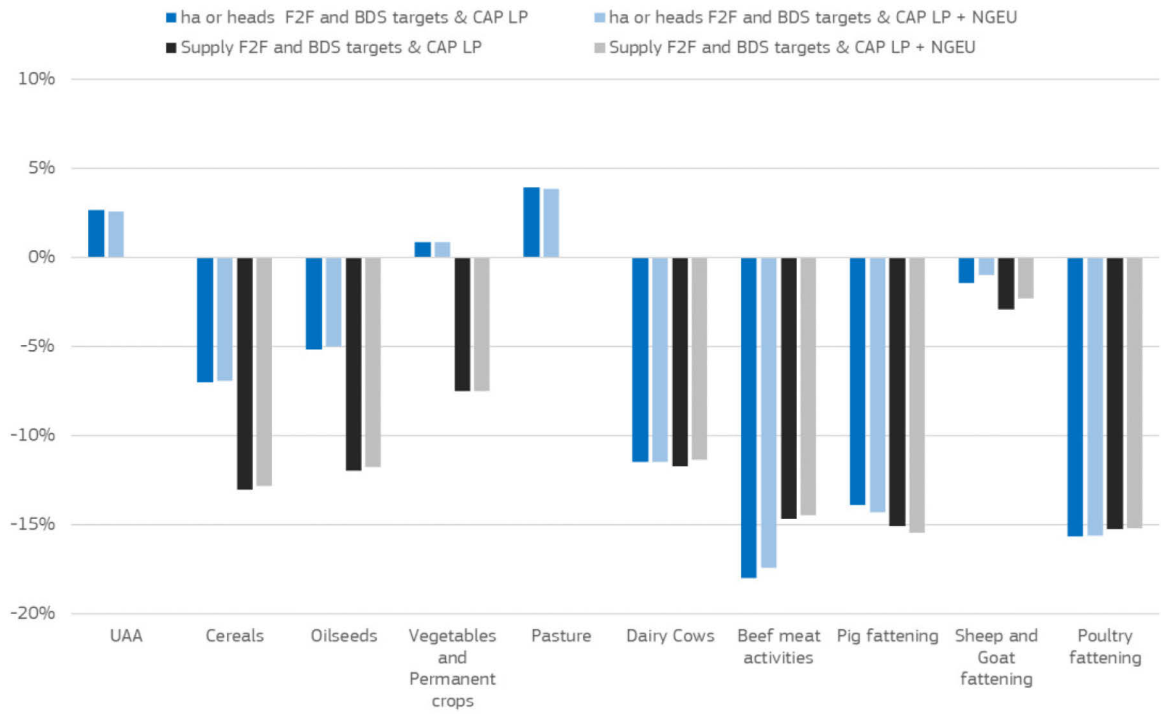


Figure 3.1 *EU-27 area (ha) or animal number and supply changes in 2030 for the F2F and BDS targets & CAP LP and F2F and BDS targets & CAP LP + NGEU scenarios, relative to the baseline Source: Barreiro-Hurle et al. (2021).*

Comparing the changes in area and number of heads into supply changes shows a dual effect of the measures implemented for crops and livestock. On the one hand, the yield decrease associated with the increase in organic farming, the reduction in pesticides, and reduction in fertiliser use, exacerbates the reduction in area, leading to higher drops in production. On the other hand, the increased efficiency derived from genetic improvements means that reductions in animal numbers could be higher than the declines in animal production (e.g. beef and dairy).

Sharp decrease in exports of pork and poultry
The changes in production would lead to a sharp decrease in net export positions for pork and poultry, and a worsening in the EU trade deficit for beef and sheep and goat meat (Figure 3.2). In the case of dairy, the EU's net export position is expected to improve slightly, due to increased production derived from genetic improvements.

In the analysis of environmental effects, it is noticed that the F2F and BDS targets & CAP LP can help to deliver a 28.4% reduction in GHG emissions (including both non-CO_2 and CO_2) from the agricultural sector by 2030 compared to the baseline. Focusing only on non-CO_2 emissions (i.e. methane and nitrous oxide) this reduction is 17.4%. However, more than half is 'leaked' to the rest of the world (i.e. emissions increase in non-EU regions).

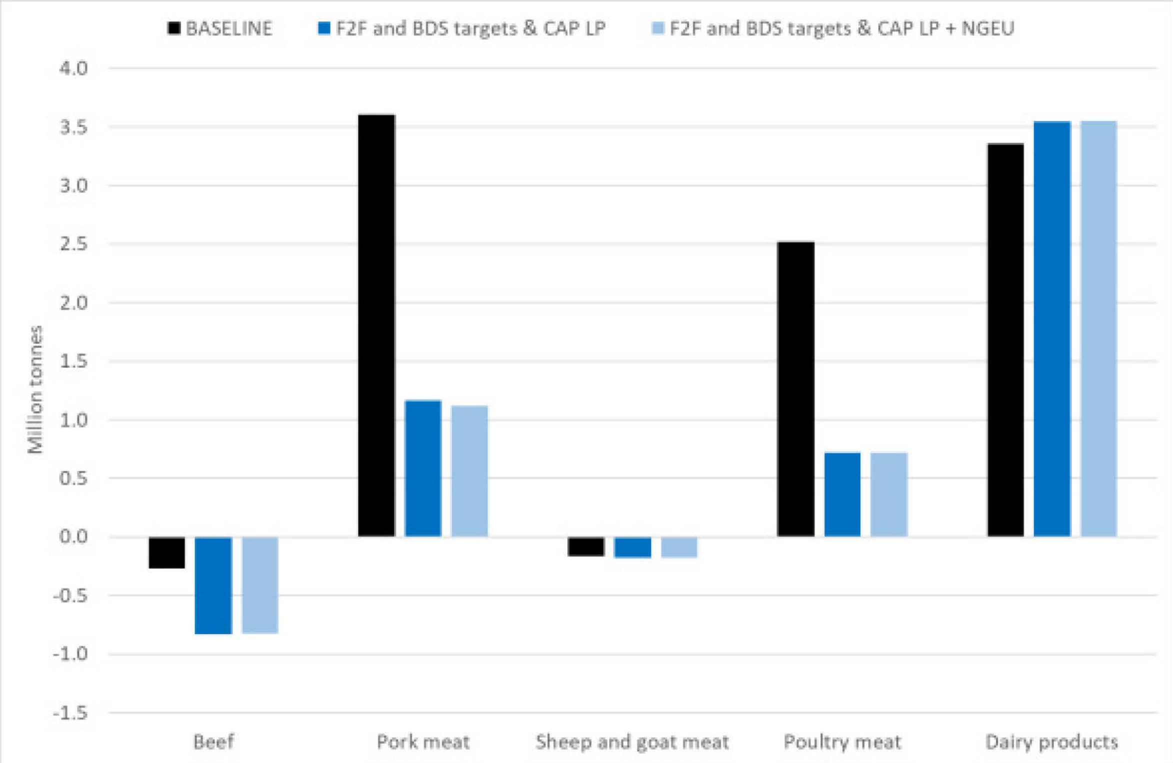


Figure 3.2 *EU27 livestock products net trade (exports minus imports) in baseline, F2F and BDS targets & CAP LP and F2F and BDS targets & CAP LP + NGEU scenarios in 2030*
Source: Barreiro-Hurle et al. (2021).

3.3 Prices and income

Producer prices show a 10% increase in both scenarios (Figure 3.3, all primary agricultural outputs); the increases in prices are significantly higher for livestock products than for crop products.

The increase in meat prices also occurs in the scenario without changing the CAP. The increase is due to the combination of shrinking animal herds (as a result of the GNB reduction target) and relatively inelastic food demand. In theory, increasing imports from main EU trading partners (at low prices) might impact on EU domestic price peaks. However, in the scenario analysis EU imports do not increase sufficiently to counterbalance the drop in EU supply. Although the net trade position for meats decreases considerably, EU meat imports do not expand to an extent that would keep domestic prices at lower levels. This is due to the presence of barriers to imports (e.g. tariff rate quota systems applicable to several animal products).

The magnitude of price changes resulting from implementation of the F2F and BDS targets & CAP LP scenario could also be considered excessive from a market-response point of view, in particular for pork. To check the robustness of these results, a sensitivity analysis was run by shocking the alternative Aglink-Cosimo model with the changes in animal numbers and supply coming from CAPRI, and another sensitivity was done by tripling the demand elasticities for meat in the CAPRI model. As the EU is a net exporter of pork meat, the change in the representation of external border protection was not relevant there. The analysis tends to confirm that the price impact for pork is robust for the type of model or the assumptions regarding demand elasticities. Although the EU remains a net exporter, the magnitude of its net exports is decreased by two thirds. The main reason is that due to the increased price responsiveness of demand EU demand becomes lower. Potential new origins of pork imports are not captured in the model and could dampen the calculated price increase of pork.

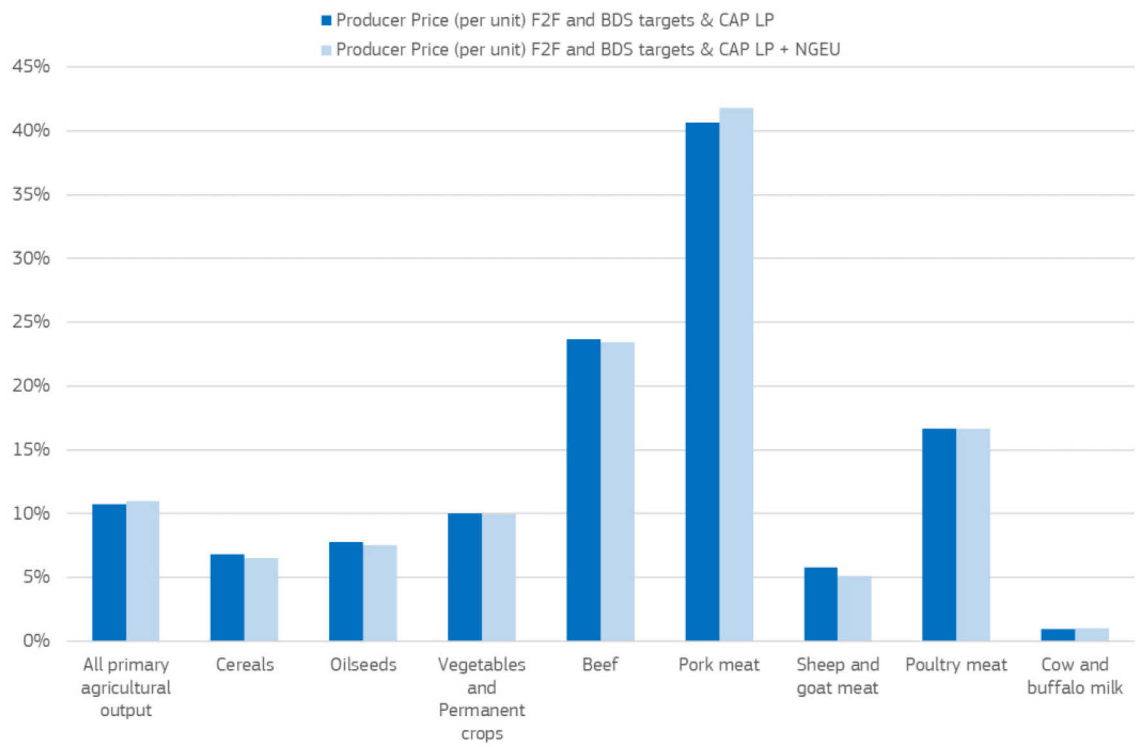


Figure 3.3 *Changes in producer prices for main crop and livestock aggregates for the F2F and BDS targets & CAP LP and F2F and BDS targets & CAP LP + NGEU (2030 compared to baseline)*
Source: Barreiro-Hurle et al. (2021).

Positive impact on income meat sectors
The price increases would translate into disproportionate positive impacts on total income in the meat sectors. The price increase for beef would trigger more than a doubling of total income for beef meat production activities. Similarly, the increases in pork meat prices and poultry meat prices would lead to higher total income for the relevant production sectors. Although the estimated revenue changes for all meat activities are in a similar range, the relative income changes depend to a large degree on the initial income position of the sectors. While the initially negative income positions for beef, pig meat and poultry meat would be significantly affected by the revenue impacts, the small positive initial income of the sheep and goat meat fattening sector increases only to a smaller degree.

For some commodity markets, EU domestic producer prices are not the key drivers. For example, EU domestic production of soybeans is small relative to imports. Consequently, the price of imported soybeans mostly defines EU internal prices for feed processing of soybeans. This is a factor which codetermines the impacts on EU feed provisioning.

3.4 Discussion

The modelling study of JRC (Barreiro-Hurle et al., 2021) is a valuable study for the topic of this paper. Because it tries to make a refined and quantitative analysis, it becomes clear how complex assessing the F2F and BD strategies is. The limitations and uncertainties are again and again emphasised. This policy paper, which uses much less resources, and has a primarily qualitative nature, shares in the same fate. This does not disqualify any of the work done, but underscores the need to have further investigations, not only at this early stage, but also as real measures are being developed.

The JRC study provides a combined assessment of four key measures of the F2F and BD strategies: fertilisers, pesticides, organic agriculture, and biodiversity. It is important to note that climate is also taken into account in the JRC study. An interpretation of the findings could be that the fertiliser/nitrate theme and climate could well walk parallel, but the achieved results follow from the implementation or adoption of different measures, be it that there are also synergies between both domains (e.g. herd declines). From our own assessment we agree that the JRC study has identified four key factors, which are likely to be on top of the agenda for the livestock sector in the coming decade. The JRC study indicates that the fertiliser/nutrient surplus reduction issue is the driving force behind the negative production impacts found for the livestock sectors.

Table 3.1 provides a short summary of synergies and complementarities (see upper triangle), which could be further complemented by trade-offs (see lower triangle). However, the negative trade-offs between the four themes assessed in the JRC study seem to be limited. There are two important issues however, which need to be mentioned in this context. First, the high diversity landscape features measure is one objective of the biodiversity theme. However, the biodiversity objective also implies to strictly protect at least a third of the EU's protected areas. As indicated before habitats at an unfavourable status have been estimated at more than 70% in 2013-2018, which should decrease to about 50% by 2030. This will require significant reductions in emissions of ammonia by agriculture, which may even impose more stringent emission norms to agriculture than those that are currently considered in the modelling assessment. Second, the climate objective is not an explicit goal in the JRC study, but it has been taken into account. With respect to this there are positive (reducing nutrient surplus losses, high diversity landscape features) and negative (organic agriculture) trade-offs foreseeable. The identified interactions are important and an argument to follow an integral approach when further pursuing these issues with further policy actions (policy coherence).

Table 3.1 *Synergies and trade-offs between the four policy domains assessed in the JRC study*

	Nutrient surplus reduction	Pesticides reduction	Organic area increase	H.D.-Landscape features increase
Nutrient surplus reduction	-	Lower N application may reduce pesticides use	Organic area contributes to lower N use	More landscape features lead to a decline in effective UAA and less fertiliser use
Pesticides reduction		-	Organic are contributes to lower pesticides use	More landscape features lead to a decline in effective UAA and less fertiliser use
Organic area increase			-	More area needed which may negatively affect natural areas
H.D.-Landscape features increase				-

Source: Authors.

There are more spill-over effects to be mentioned. As an example, some of the measures that are considered to reduce ammonia emissions of the livestock sector, also contribute to lower the non-CO_2 emissions. The reduction in fertiliser use will lead to a reduction in NOx emissions, with a positive impact on climate. Lower ammonia emissions measures may lead to an increase of N in manure and additional NOx losses (during application).

There are a number of other aspects regarding the JRC study ((Barreiro-Hurle et al., 2021) and its findings that deserve attention:

- Nutrient loss reduction: As regards addressing the nutrient loss reduction in the JRC study this is constraining manure production in such a way as to limit livestock production. What the study not seems to consider is that an alternative to herd reduction could be the processing of manure into a valuable fertiliser. When the profitability of livestock production is sufficient, manure processing could be a way out to avoid a decline (e.g. in the Netherlands about 90% of poultry manure is processed and sold outside agriculture or exported). Also it was not fully clear to what extent manure transport from environmental hotspot areas to other regions has been considered.
- Pesticides: The pesticides reduction objectives have been implemented in the modelling assessment as an enforced reduction in costs. This is a very rough approximation as is also acknowledged. The Croplife study (Bremmer et al., 2021) provides a more refined analysis here, though it is based on a

limited number of case studies. A negative impact of about 7% is estimated on the average yields of main arable crops. The 2% yield reduction estimate used in the JRC study may be too low.

- Yield losses: In the JRC study a 10% reduction in pesticide costs and 10% increase in other costs is assumed to reflect alternative pest control. Note that the net cost impact is unclear but could well be negative. Moreover the estimated yield reduction of 2% reduction in yields for annual and permanent crops seems to be underestimated in the light of the results obtained from the Croplife study (Bremmer et al., 2021).
- Biodiversity: The worrying conditions of habitats (more than 70% is estimated to have an unfavourable status) need improvement. It is not clear from the JRC study if (most likely not) and how this has been taken into account. Although the study indicates the consideration of a number of measures aimed at reducing ammonia emissions, it is not clear whether this will be sufficient to achieve the nature protection objective. This issue needs further attention and exploration as it can lead to additional negative consequences for livestock production.
- Climate: Although the JRC study focuses on only four objectives of the F2F and BD strategies, the climate objective has been taken into account also. A set of measures and actions aimed to achieve this is included in the modelling exercise. It should be noted that, although this seems not to result in additional costs to farmers in the way it has been currently implemented in the modelling assessment, it will still require a substantial policy effort and actions from farmers to achieve the GHG reduction as reported in the JRC study.
- Costs of measures: the JRC study seems to largely rely on endogenous (voluntary) adoption of measures. This is induced by incentive payments, which then implicitly also limit potential income consequences: whenever the benefits (compensatory policy payment) will fall short of the costs (monetary or implicit opportunity costs of efforts that have to be made) farmers will not adopt the measures and stay with existing practices. This assumption is important because on the one hand it limits negative farm income consequences, while on the other hand it presumes enough public money will be available to properly incentivise these measures.
- Market impacts: The JRC study estimates a 5 to 10% increase in prices, with the beef and pork price increases being the two exceptions: the beef price is projected to increase more than 20% and the pork price even by more than 40% relative to the baseline. The projected price increases depend on price elasticities and trade policy measures (including the often complex system of tariff rate quota as this is applicable for several livestock products). Based on discussions with market experts made in the context of this research, it is difficult to accept the projected structural beef and pork price changes of the JRC study as realistic. This issue needs further exploration, because both when it would be true or not true, this would have consequences for assessed impacts (e.g. on farm income).
- In the JRC study the role of innovation is taken into account via the endogenous adoption of emission reducing technologies. The latter, however, refer mainly to innovations that are already available, although often there is not an EU-wide farm level readiness yet. As is acknowledged new innovations may help to (further) mitigate impacts on agriculture and farms. As manure processing options have not been taken into account, for example, impacts on animal reductions may be overestimated to some extent.

4 Income effects for selected farms

4.1 Introduction

In addition to the estimates of farm incomes in the JRC study (see previous chapter), this chapter provides a number of farm type and case specific assessments. A selection of production systems and regions has been made for the assessment, in order to illustrate the heterogeneity characterising EU livestock production systems. Data used for this exercise come from the public database of the EU farm accountancy data network (FADN). The need to rely on the public database implied some limitations with the possibility to select farms in a very targeted way (only group data are available, no individual farm data) and also with respect to the selection criteria (e.g. the option to select specific farm type-size class combinations was not available). Given the many uncertainties with respect to specific market and regional impacts (see also previous chapter), the calculated farm income impacts should be seen as indicative and illustrative, even though they are based on the best information that is available.

4.2 Market and policy factors impacting farm income

For the income calculations price and volume shocks have been assumed as presented in Table 4.1. The impacts on volume of production and prices have been based on JRC-study (rounded numbers). Based on the sensitivity analyses done in this study a lower price increase could also be possible (see the 14% number in brackets). Note that as the JRC study does not include antimicrobials and animal welfare, impacts of these objectives on farm income are not taken into account. For the antimicrobials objective this may be justified as our analysis (see chapter 2) shows that the impact of this objective on farm income can be limited and non-lasting, even though it may require changes in farming practices. To a lesser extent this also holds with respect to animal welfare, although for specific sectors and regions (e.g. the abolition of cages especially in the Central and Eastern part of the EU, and restrictions with respect to live animal trade-related logistics) impacts may be anticipated. It is beyond the scope of this study to quantify such impacts.

The estimated impact on feed prices has been based on an expert assessment, using information from the JRC study with respect to energy (cereals) and protein (soybeans) prices, and the relative importance of feeds relative to roughage. With respect to roughage it has been assumed that its scarcity is to stay more or less stable, as the intensity of livestock production per hectare of land is lowered (no change in the volume of purchased feed induced by changes in own roughage production). It has been realised that the roughage yields could also be negatively affected (EU Nitrogen Expert Panel, 2015), but this impact could be limited and local since manure application is likely to (partly) compensate impact of lower fertiliser use. Moreover, under some conditions (e.g. more extensive forms of farming) the use of leguminous crops (e.g. white and red clover) could be a way to replace N fertiliser while limiting production losses. Taking into account the results from other studies (e.g. Barreiro-Hurle et al., 2021 and Bremmer et al., 2021), it has been assumed that the energy (coarse grains) and protein (oilseeds) prices of compound feeds will increase by 6 and 7% respectively.

As regards other costs (fertilisers, antimicrobials), in the FADN-system these are included in the total specific costs (which are in turn part of the intermediate costs). Whereas it is assumed that N-fertiliser expenditure will decline by 20% (volume effect), it has been assumed that other fertilisers (P, K) will be also reduced. Price effects of reduced fertiliser demands by farms have been ignored, due to lack of information. As regards the antimicrobials it has been assumed that the decline in antimicrobial use may lead to lower medicine cost, which is however likely to be more than compensated by additional veterinary services in terms of guidance and additional management efforts. Because of lack of detailed information about the magnitude of these counteracting factors, farm expenditure on veterinary services has been left unchanged.

Table 4.1 *Input parameters with respect to production volume, price and costs shocks that are used for illustrative farm income calculations*

Indicator/sector	Dairy	Beef a)	Pigs	Poultry b)	Sheep & goat
Volume of production	-12	-14 (-16)	-15	-15	-3
Price	+2	+24 (+14)	+41	+17	+5
Net revenue impact	-10	+10 (-2)	+26	+2	+2
Feed price	+3	+2	+6	+6	+2
Other costs (fertiliser) c)	-20	-20	-	-	-

a) Numbers between brackets indicate estimates obtained from the sensitivity analysis from the JRC study; b) It is assumed that broilers and eggs will be affected in a similar way; c) Details for other costs of mixed farming enterprises are given in the main text.

Source: Authors; estimates based on JRC study (Barreiro-Hurle et al., 2021).

As became clear from the JRC study (Barreiro-Hurle et al., 2021) the objective to reduce nutrient losses is an important driver in how environmental measures and regulations are likely to constrain local production (also the increase in organic area and the additional land used for landscape features are contributing to a decline in land-tied animal and crop productions).

Based on the gross nitrate balance surplus data as provided in (European Commission, 2020h, annexes) and the differentiated N-surplus reduction rule as this has been applied in the JRC study, an estimate has been made about the generic reductions Member States have to make (see Figure 4.1). Also it has been calculated by which factor the required reduction at Member State level deviates from the EU average level (see dots in the figure): e.g. in the Netherlands this factor is 2.3 times the calculated EU average (Italy and Denmark are at about the EU average). This scaling will be applied to calculate the localised production volume adjustments, where the factor of adjustment is limited to the range 0.8-1.5. E.g. in the Netherlands it is assumed that the reduction in the volume of milk production is 1.5 (2.3 factor is capped at the maximum of 1.5) times the EU production decline (of 12%), which equals a reduction of -18%. For other Member States, such as Poland and Sweden, the production declines are scaled down by a factor 0.8. The assumption made with respect to the capping is to account for factors like regional specific measure implementation, additional technical measures to reduce N emissions in environmental hotspot areas and the role of other adjustment mechanisms (e.g. manure transportation). It is acknowledged that this scaling is a rough approximation to differentiate the impacts over Member States and that it is applied linearly to all sectors. However, also the JRC study uses a spatially differentiated approach, while also the condition to preserve soil fertility invites for this.

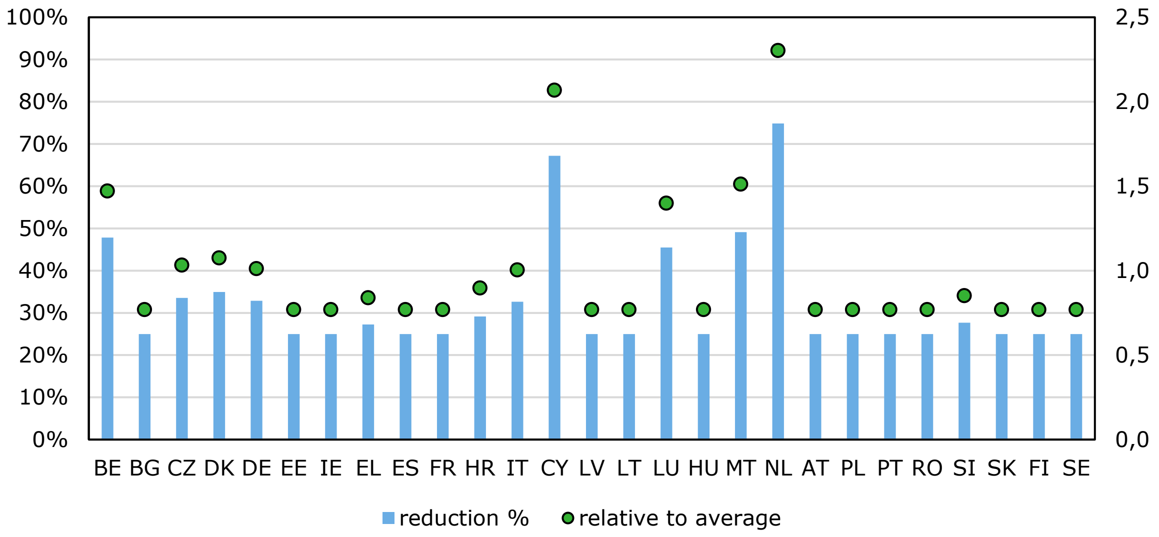


Figure 4.1 *Calculated Gross Nitrogen Surplus (GNB) reductions (%) based on 2012-2014 kg/per ha GNB levels (European Commission, 2020h) and a differentiated GNB reduction rules*
Source: Barreiro-Hurle et al. (2021, 23).

The farm income assessment takes into account that livestock production may be combined with arable production. Where this is the case, for the arable sector part a generic 10% decline in crops sold at the market is accounted for, while the expenditures on fertilisers and pesticides should be reduced by respectively 20% and 50%. The costs of N and other fertilisers are separately recorded. It is assumed that the amount of N-fertiliser will be reduced by 20% and that the amount of other fertilisers will be reduced as well, but less so (-15%). However, the costs for pesticides are not directly known from the farm accountancy data. Following the Croplife study (Bremmer et al., 2021) it is assumed that additional tillage costs (e.g. mechanical weeding) will compensate for the pesticide costs decline, leaving zero net cost effect of pesticides.

Farm incomes in the livestock sector are also dependent on CAP support, especially pillar I direct payments, as these are important both in terms of their value and because of their nature as targeted income with limited counter obligations. In the JRC study different CAP scenarios have been defined, including the CAP after 2021 scenario (as it is defined in the draft legal proposals) and a CAP extended with additional funding aimed to facilitating the transition, especially with respect to a partial coverage of the non-productive investments and costs. Here the following assumptions are made:

- The pillar I budget will be reduced by 10% (partly because of the budget reduction and partly because of a net transfer from pillar 1 to pillar 2).
- A minimum 25% of the pillar I envelope in 2030 has to be spent on eco-schemes.
- The money paid for eco-schemes will have a limited income support component of 20%, as its main role will be to compensate the additional costs related to the efforts required by the schemes.
- The green payment of the current CAP, having a 30% share in the pillar I envelop, is assumed to have a 70% income support coefficient (see also Baaijen et al., 2021 for a similar approach).

As a consequence of these assumptions, relative to a baseline of continuing the current CAP, the income support derived from direct payments for the CAP 2021-2017 can be calculated to be about 80% of the current income support.

When contributing the income support derived from the CAP an important uncertainty is the costs associated with specific measures and practices that farms will have to take. It was beyond the scope of this project to make any detailed estimates about this. For this reason a rather rough and generic approach has been followed. Rather than quantifying these costs they have been classified in a qualitative way by experts, with a summary of the results presented in Table 4.2.

Some indications about these costs are derived from Reijs et al. (2021) and experts:

- Low-emission stables can imply costs of 120-900 euros per cow place.
- Air purification in animal housing may cost 35 euros per pig place or 2.5-3.0 euros per chicken place.
- Low emission applications can imply an extra cost of 1-4 euros per tonne of liquid manure.
- Low nitrogen feed can imply an annual cost of 9-25 euros per cow.
- Reducing fertiliser use on grassland can create a revenue or a cost, depending on the farming system (for extensive farming system a net revenue of 15 euros/cow was found, while for intensive farming systems a cost of 10 euros per cow was found; Reijs et al., 2021, 73).

Table 4.2 *Classification of measures, their cost, character and their relevance for particular animal production systems*

				Particular relevance for sector			
Theme	Measures	type of costs involved	expected cost impact	Dairy	Beef	Pigs	Poultry
Feed	low nitrogen	operational	low	x	x		x
	linseed-additive	operational	limited	x	x		
	nitrate-additive	operational	limited	x	x		
	(multi-phase feeding)	operational + investment	low - significant			x	x
Animals	vaccination against methanogenic bacteria	operational	limited - significant	x	x		
Genetics	increasing milk yields	cattle price	off-farm	x			
	increasing ruminant feed efficiency	cattle price	off-farm	x	x		
	increasing productivity (feed conversion)	animal prices	off-farm			x	x
Manure	low emission application	operational + investment	significant	x	x	x	x
	cover storage manure	operational	significant	x	x	x	x
	(dilluting mnanure with water)	operational + investment	limited - significant	x	x		
	(processing of manure)	operational + investment	significant	x	x	x	x
	nitrification inhibitors	operational	limited	x	x	x	
	anearobic digestion	operational + investment	high	x	x	x	
Animal housing	low emission stables	operational + investment	high	x	x	x	x
	air purification in animal housing	operational + investment	high	x	x	x	(x)
Land management	increasing legume share on temporary grassland	operational	low - significant	x	x		
	fallowing of histosols (peat)	operational + disinvestment	high	x	x		
	(shallower water teable peat soils)	operational + investment	high	x	x		
Precision farming	better timing of fertilization	operational	low - limited	x	x		
	variable rate technology	operational + investment	high	x	x		

*) Note that dairy and beef production systems are classified as land-based by their nature, whereas this does not hold for intensive livestock production systems (e.g. pigs and poultry). Disinvestment refers to value reduction of current assets due to a decline in their productivity.

Measures between brackets (...) have been added as interesting measures that are available, but have not been included in the JRC study.

Source: Authors.

As this overview illustrates, the largely non-productive measures and investments that have to be taken can imply various and serious costs to farmers, with the impact varying with the farming system and farm size. Anaerobic digestion, for example, requires significant investments, which are likely to amount 10 thousands of euros and has strong scale properties. Note that the net cost to farmers will ultimately also depend on the compensating measures from the CAP and/or national budgets.

4.3 Selected cases and their coverage of farm, sector and spatial heterogeneity

Based on the FADN data (group averages) 13 farm cases have been selected, covering heterogeneity with respect to regions, farm types/production system and sectors. In order to arrive at a 'normalised' situation all results are based on a two-year average (covering 2018 and 2019 data). The potential impacts of the F2F and BD strategy measures have been 'translated' into specific shocks with respect to feed costs (taking into account changes in feed availability due to changes in the productivity of the use of 'own' land (including rented land), and changes in livestock productivity and farm returns, including specific assumptions on policy payments.

Table 4.3 *Preliminary overview of selected farm case studies and the size class, region and production systems they are assumed to be linked to*

Sector	Production system	Region	Selected case study
Dairy	Conventional – intensive	North-Western EU (Denmark, Germany, Netherlands, Belgium, Northern France)	NL, specialist milk
	Conventional – average	Eastern EU (Poland, the Baltics, Hungary, Slovenia, Slovakia)	Mazowsze i Podlasie, Specialist milk
	Conventional – extensive	North-Western EU (Denmark, Germany, Netherlands, Belgium, Northern France)	Baden-Würtemberg, specialist milk
	Conventional – peat	Peat sol regions in EU (Finland, Sweden, Poland, Germany, Ireland, Estonia, Latvia, The Netherlands, France)	Zuid-Holland, specialist milk
	Non-conventional	South/Western-central EU (Italy PDO)	Emilia-Romagna, specialist milk
	Conventional	South/Western-central EU (France)	Franche-Compte, specialist milk
Beef	Conventional	North-Western EU (France)	Pays de la Loire, specialist cattle
	Veal	North-Western EU (Denmark, Germany, Netherlands, Belgium, France)	Netherlands, specialist veal
	Extensive livestock	Southern EU (Italy, Spain, South of France)	Galicia, specialist cattle
Granivores	Intensive, semi-intensive	Central-Eastern EU (Poland, the Baltics, Hungary, Slovenia, Slovakia, Romenia, Bulgaria)	Közép-Magyarország specialist granivores (pigs)
	Intensive	North-Western EU (Denmark)	Denmark, specialist granivores (pigs)
	Intensive	North-Western EU (France)	Aquitaine, specialist granivores (broilers)
	Extensive	Central-Eastern EU (Poland, the Baltics, Hungary, Slovenia, Slovakia, Romenia, Bulgaria)	Romania Sud-Est, specialist granivores (eggs)

Source: Authors.

Applying shocks to the farms and evaluate the impacts based on the current farm balance sheets, may lead to an overestimation of the impact, since it cannot take into account how farmers respond or cope with the new requirements. So the assessed impacts should be interpreted as indicative, directional short-term impacts. When the F2F and BD strategies will be gradually phased in, the scope to reduce farm income impacts by making adjustments in the farming system, farm management practices, and technical innovation will increase.

Part of the measures include an extensification of production (lower animal densities per ha of land), which may go together with additional closure of farms relative to the baseline, and associated disinvestments. No attempt has been made to estimate the costs (and benefits) associated with this structural change in the farm sector.

4.4 Income effects

This section will present the results of the income assessment, taking into account the shocks and assumptions as discussed in the previous paragraph. To arrive at the Farm net income effect the changes in the underlying variables (total output, total intermediate costs (total specific costs), (gross farm income), and balances of subsidies and taxes) are provided, as these will change in specific ways due to the cost changes (see, Table 4.4).

Table 4.4 Simulated changes in farm income statement and change in farm net income as a consequence of the EU F2F and BD strategies for selected farm cases (x 1,000 euros) a)

Financial variables/ cases	Total output	Intermediate costs	of which specific costs	(De)coupled payments	Gross farm income	Farm net income
NL, specialist milk	370 (425)	264 (264)	171 (171)	18 (22)	120 (180)	14 (74)
Mazowsze i Podlasie, Specialist milk	40 (42)	20 (23)	13 (15)	5 (7)	26 (27)	19 (19)
Baden-Würtemberg, specialist milk	209 (222)	140 (142)	74 (77)	15 (19)	96 (110)	35 (49)
Zuid-Holland, specialist milk (peat)	271 (313)	168 (167)	101 (101)	14 (18)	117 (163)	44 (90)
Emilia-Romagna, specialist milk	279 (297)	127 (131)	94 (98)	15 (19)	175 (192)	136 (153)
Franche-Compte, specialist milk	211 (222)	133 (139)	62 (68)	23 (29)	116 (127)	46 (57)
Pays de la Loire, specialist cattle	160 (150)	109 (115)	46 (51)	30 (38)	85 (77)	35 (27)
Galicia, specialist cattle	30 (28)	18 (19)	13 (13)	7 (9)	23 (22)	18 (17)
Netherlands, specialist veal	689 (671)	552 (524)	485 (458)	7 (9)	144 (156)	51 (63)
Közép-Magyarország, specialist granivores (pigs)	89 (76)	62 (57)	55 (50)	1 (1)	32 (24)	24 (16)
Denmark, specialist granivores (pigs)	2,016 (1,693)	1,165 (1,105)	971 (912)	42 (52)	892 (640)	478 (225)
Romania Sud-Est, specialist granivores (eggs)	353 (329)	245 (225)	229 (209)	3 (4)	127 (124)	66 (63)
Aquitaine, specialist granivores (broilers)	290 (274)	213 (207)	144 (139)	8 (10)	86 (78)	38 (30)

a) Numbers between brackets indicate amounts without the policy change and are added for reasons of comparison.

Source: Own calculations.

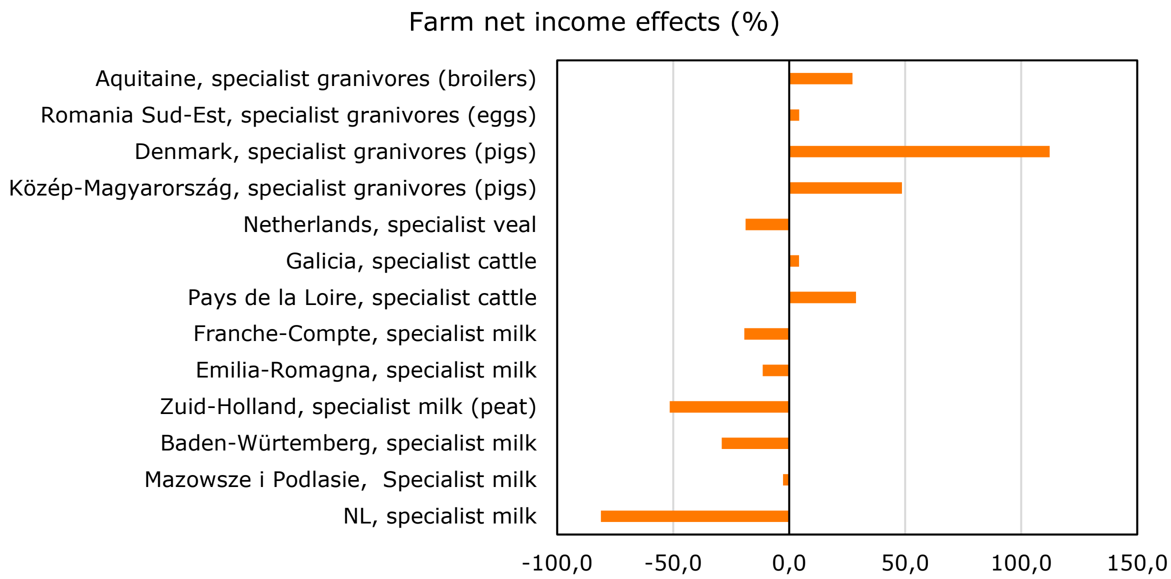


Figure 4.2 *Potential impacts of F2F and BD strategies on farm income (percentage changes) for selected farm cases*
Source: Authors.

Table 4.4 and Figure 4.2 illustrate the simulated impacts on net farm income, and their underlying components. The average farm net income reduction for the dairy cases is 32%. There is however a lot of variation between cases. Relative high income reductions are expected for the two Dutch cases, which is driven by on the one hand the relatively strong production decline that has been projected, while also the production adjustments that are enforced in the peat area (Zuid-Holland) have a strong negative income impact. The result obtained for these cases may be typical for intensive dairy production systems also elsewhere in the dairy belt region (EU Commission, 2015).

The income impacts for the cattle cases (Pay de la Loire, Galicia) are in both cases positive. This is mainly driven by the significant beef price increases that have been used as an input to the simulations (see Table 4.1, 24% price beef price increase).

The income impacts for intensive livestock productions (granivores) are in all cases positive (especially for the Denmark and Hungary cases, followed by Aquitaine). This result is driven by the strong market impact (see Table 4.1, the pork price increase of more than 40%). As Table 4.4. shows, for the granivore-farms the feed costs have an important share in the intermediate costs (this also holds for the veal farm). As such these type of farms are relatively sensitive to what happens to their feed costs.

To deepen the insight a sensitivity analysis has been done for those cases (beef, pork) where the projected market price increases (see Table 4.1) were found to be rather extreme. Henning et al. (2021), which use the same model as has been used in the JRC study, have even more extreme price increases. In the USDA study on the Green Deal price increases are expected for beef and pork of 17% and 9.5% respectively (Beckman et al., 2020, Annex B4). For pork the JRC study also mentions a lower potential price increase (14%). For dairy the Kiel-Eurocare study suggested a 36% price increase for dairy (raw milk), which suggests that the potential price increase for dairy products can be significantly larger than has been assumed in Table 4.1.

Taking into account the uncertainty with respect to the projected price increases in the different studies, it was decided to recalculate the income effect for the dairy, beef and pork cases assuming price increases of 15% for all three products, rather than 2% (dairy), 24% (beef) and 41% (pork). The results are provided in Figure 4.3 and show that this changes the results for dairy farms in a positive way (on average farm net income increases by 33 percentage points and becomes positive for the Baden-Würtemberg and Mazowsze i Podlasie and Emilia Romagna cases). Not surprisingly for the beef and veal cases, which now face lower price increases, the impact on farm net income is negative (on average a decline of 18 percentage points) and the income effect becomes slightly negative for the extensive beef production case (Galicia). The most notable effects are observed for intensive livestock production (granivores, pigs), where the lower price leads to clearly negative net income effects for both the Denmark and Hungarian granivore farm cases (the Aquitaine broiler case being an exception). As such the results of Figure 4.3 show the sensitivity of the net farm income to price impacts.

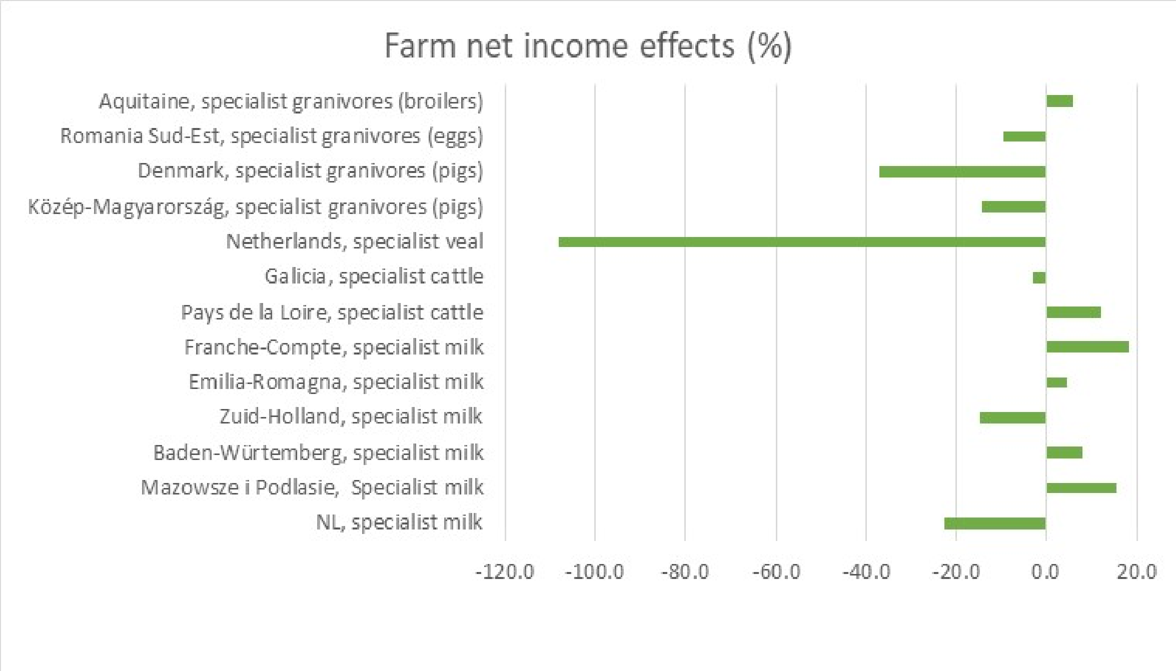


Figure 4.3 *Sensitivity analysis of potential impacts of F2F and BD strategies on farm income (percentage changes) for selected farm cases, assuming a 15% price increase for dairy, beef and pork*
Source: Authors.

Note that the calculated income effects are conditional on the assumptions that the new technologies, production practices or measures are voluntarily adopted by farmers and supported by incentive payments from the CAP. It is reasonable to assume that under such conditions farmers would only adopt measures as long as costs and benefits balance for them. However, this 'zero income'-effect is only feasible under the condition of a larger CAP budget being available. As Table 4.2 shows out of the 21 listed measures only 6 have low or zero costs to farmers. As regards the others measures, costs vary from significant to high, where especially costs associated with adjusting animal housing (low emission stables) and manure handling can have substantial financial implications. From Reijs et al. (2021) it appears that such measures aimed at reducing nitrate (including ammonia) emissions could cost about 1.10 euros/100kg of milk. This does not include climate related measures, and the cost per kg of milk may be relatively low due to the relative large scale of (specialised) Dutch dairy farms (average herd size is around 100 dairy cows, whereas the EU-15 average is 55, while for the EU-13 the average is about 10 (European Parliament, 2018)). Adding the climate measures and taking into account the disadvantages in the economies of scale of the average (specialised) EU dairy farm, costs could easily double. This would imply, in milk price equivalent, a cost increase with the order of magnitude of 10% of the milk price.

As Figure 4.4 shows, when there would be no incentive payments to cover the costs of adopting climate, ammonia and nutrient surplus reduction measures, the impacts on the net farm income of the considered cases would be worse (on average they are 28 percentage points lower than in the baseline case with compensatory payments). In the case of the Netherlands specialist milk farm, the farm would even make an annual loss of about 20 thousand euros, threatening the continuity of the farm. What this sensitivity analysis shows, that without compensatory payments, voluntary adoption of measures could be a problem, as it would go at the cost of farm profitability and farmer incomes. It also indicates that when measures will be obligatory the income effect could be significantly negative, indicating a need for income support or innovation if one wishes to counteract these losses.

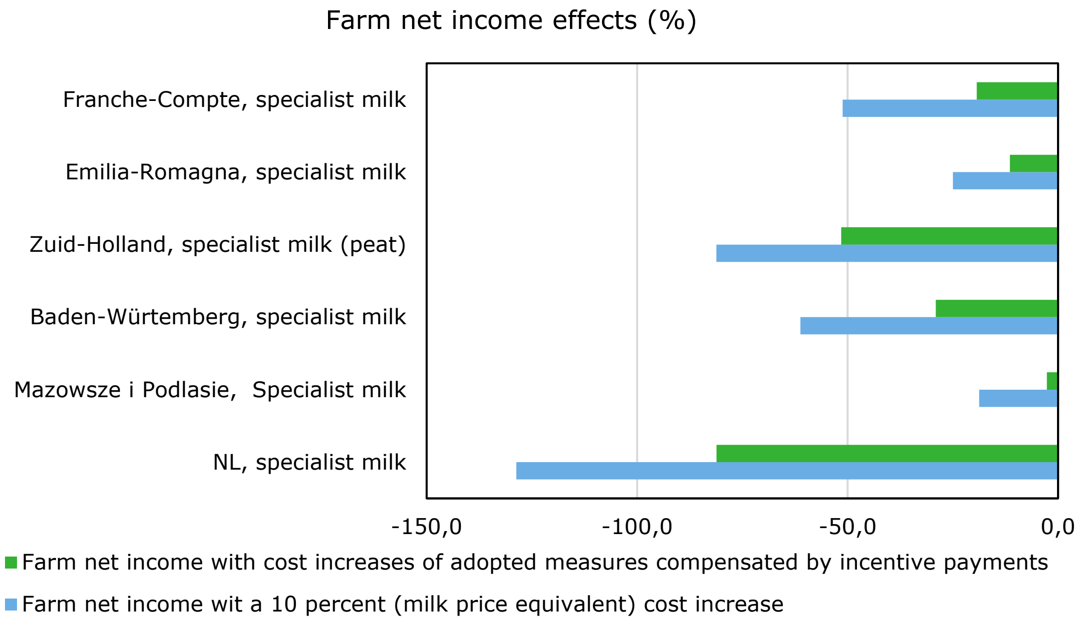


Figure 4.4 *Sensitivity analysis of potential impacts of F2F and BD strategies on farm income (percentage changes) for selected farm cases, assuming no incentive payments for measure adoption and a cost increase equivalent to 10% of the milk price*
Source: Authors.

4.5 Discussion

Whereas market impacts (total supply, prices) are generic, the effects of environmental and climate restrictions can be very different locally. This may also lead to locally-specific adjustments in production. Under the current setting only a rough hypothesis could be used to regionalise the production impact, where a gross nitrate balance per hectare surplus criterium has been used.

The income effects vary. In some cases (beef, pigs) the projected price increases play a strong role in making the income impacts strongly positive. However, these projected price increases may be overstated. Nevertheless, at market level the price increase compensates partly (dairy) or even more that proportionally the projected reduction in production volumes (dairy being an exception).

The sensitivity analysis suggests that the farm net income-impacts are depending on market prices. The projected market price increases could even more than proportionally compensate for the reduction in the volume of production. However, when assuming that price increase will not exceed the range of 15%, the results for dairy farms would improve, but those for the beef, pigs (and poultry) farm cases would decline. As price impacts will be codetermined by what happens at the foreign trade side, the importance of that part of the equation for the final farm net income impacts becomes clear.

Costs associated with measures to reduce emissions are currently uncertain, as well as the specific implementation mode (incentives, regulations) that will be chosen. From a qualitative overview it appears that the costs can vary from low, substantial, to high. These are a non-negligible factor in determining ultimate impacts on farm income. From a sensitivity assessment, aimed at illustrating the potential impacts of cost increases associated with the adoption of climate, ammonia and nutrient surplus reduction measures, it turns out that without incentive payments there are serious extra negative impacts on net farm income foreseeable. Under a voluntary policy regime this would probably lead to low degrees of measure adoption. Under an obligatory measure adoption policy regime, the exercise shows the need for additional income support and/or innovation if one wishes to counteract the negative income effects.

4.6 Concluding remarks

Based on expected price impacts as these are projected in the JRC study on average the impact on net farm income on the sample of analysed farms would be slightly positive. But the impacts vary a lot over farms and regions. Beef and pig farms may benefit, while others (e.g. dairy) may face negative impacts on net farm income, especially in regions characterised by intensive production and environmental issues (large gross nitrate surpluses).

However, the obtained results are conditional on strong price increases that have been projected for beef and pork. When assuming that the structural price increases for beef and pork will be less extreme and not exceed 15% and also assuming a 15% increase in milk price (rather than a 2% price increase) the net farm income impacts will change: for the case studies an average net farm income reduction of about 17% would result. Although the pattern of income impacts would then be more even, still quite some variation is observed.

The income impacts will also be influenced by the costs associated with the measures that farmers will have to take. When the adoption of such measures is voluntary and supported by incentive payments, the impacts on farm net income will be more or less neutral. To the extend measures will be obligatory and imposed via regulations, potentially significant negative impacts on farm net income may result, as has been demonstrated in a sensitivity analysis with respect to the dairy sector.

For the assessment of impacts on net farm income the FADN database has been used, which provides a (comparative) static result. The strength of this approach is that it is based on empirical data, reflecting the different positions farms may have in reality. A limitation of this approach is that it underestimates the dynamic responses of farmers to the new challenges. One such a response observed in the past is the mitigation of negative income or margin impacts by increasing farm scale. Our approach could not directly take this into account, and as such may overestimate the negative impacts on farm income. Another assumption inherent in our approach is that the volume shocks are applied directly to farms, implying that all farms will adjust in a similar way, whereas in reality some farms may shrink or exit, whereas others could even expand. Changes in the farm size distribution as a result from different individual farm responses have not been taken into account, but would in reality also play a role.

From the assessment it appears that the impacts of the F2F and BD strategies are likely to substantially differ over farms, sectors and regions, depending on the general market conditions and local environmental constraints farmers will face, as well as on the policy approach (voluntary, obligatory) and the policy incentives (subsidies related to the voluntary adoption of measures). From this it follows that a targeted policy approach, both by and within Member States, will be important to deal with the local particularities. The new delivery model of the CAP may be helpful in this regard as its facilitates such a tailored policy implementation approach.

To the extent a tailored policy approach will be not realised one may expect a regional divergence of production impacts. Especially regions where there is a high pressure on the environment (as for example measured by the gross nitrate surplus per hectare) will experience a competitive disadvantage and face declines in the volume of animal production.

5 Conclusions

This chapter highlights the main conclusions drawn from this research:

- Achieving the EU's Green Deal objectives may lead to a reduction of livestock production in the order of 10 to 15%. This is mainly driven by the objective to halve nutrient losses (e.g. reducing Gross Nitrogen Balance (GNB) surpluses). Part of this has to be realised by lowering manure production and herd size. In some cases the decrease in production volume would lead to more than proportional price increases.
- Agricultural product market conditions are of key importance in determining the impacts on revenues and farm income. Costs (notably related to feed) as well as product prices are likely to increase, although it is difficult to quantify these with any precision. Partly this is due to the incomplete coverage of F2F and BD measures in the impact assessments; e.g. unknown impact of reductions in food waste and shifts in diets.
- The (short-term) impacts on farm net income are diverse and influenced by various factors such as prices, region-specific impact of environmental constraints, changes in CAP direct payments, development of costs (e.g. purchased feed, fertiliser, etc.), and subsidies compensating for costs associated with the adoption of specific measures. In some cases, i.e. beef and pigs, the projected price increases play a strong role in making the estimated income impacts strongly positive. However, these projected price increases may be overstated.
- Without incentive payments there are serious extra negative impacts on net farm income foreseeable due to the increase in costs associated with the set of different measures that farmers would need to take. Under a voluntary policy regime this would lead probably to low degrees of measure adoption. Under an obligatory measure adoption policy regime, the exercise shows the need for additional income support and/or innovation if one wishes to counteract the negative income effects.
- As the environmental problems and biodiversity challenges are spatially differentiated, regionalised tailored policy approaches are recommended. A targeted policy approach, both by and within Member States, will be important to deal with the local particularities. The new delivery model of the CAP will be helpful in this regard as it facilitates such a tailored policy implementation approach. But in addition to this also more budget may be needed when the wish is to simultaneously achieve all objectives while compensating farmers for the efforts they have to make.
- To the extent a tailored policy approach will not be realised, one may expect a regional divergence of production and associated net farm income impacts. In particular, regions where there is a high pressure on the environment (as for example measured by the gross nitrate surplus per hectare) will face a competitive disadvantage and declines in the volume of production.
- More generally the competitive position of EU farmers relative to those outside the EU is likely to worsen. Here the degree to which border measures (e.g. existing TRQ and import tariff structure) will protect EU farmers (thereby sustaining price increases as a response to a decline in EU domestic production) will be important. As regards the climate objective, adjustments in trade may also negatively affect the effective realisation of the objective (leakage).

These conclusions are conditional on the subset of measures of the Farm to Fork and Biodiversity strategies that have been analysed, which excludes measures affecting food demand such as changes in consumer diets and reduction of food waste. Moreover, the calculation tool used to assess the impacts on net farm income has as a limitation that certain mitigation responses to the new challenges, notably structural change (e.g. farm-scale increase), could not be taken into account. As a consequence, the presented results may overestimate the negative impacts on farm income, especially for the longer run.

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Appendix 1 Projections for the EU's livestock sector in 2030

A1.1 Introduction

As the basis for this impact analysis of the EU's Green Deal, this appendix gives an overview of projections for the EU-livestock sector in 2030. The information is derived from the medium-term outlook for the EU agricultural markets, income and environment to 2030 (European Commission, 2020a). The analyses of agricultural markets rely on information available at the end of September 2020 for agricultural production and trade and on an agro-economic model used by the European Commission. Projections assume a continuation of current agricultural and trade policies, and not the ones under discussion such as the post-2020 CAP reform, the next multi-annual financial framework or the European Green Deal. This selection of the EC-report concerns the production, consumption and trade of the different livestock products markets (dairy, beef, pig meat, poultry and sheep and goatmeat). Finally, attention is given to changes in land use and feed markets.

A1.2 Dairy

Production increasing, but dairy herd decreasing
EU cow milk production is expected to reach 162 million t by 2030 (+0.6% per year). Sustainability objectives are considered to play an integral part of the EU dairy sector growth, with action taken in the whole supply chain, from feed sourcing, transport and packaging to delivery of final products. Shorter and local supply chains could further strengthen the economic and social pillars of sustainability. At farm level, disease- and injury-prevention measures are expected to improve animal welfare. Assuming longer lifespans and increasing productivity per cow, GHG emissions per kg of milk may be reduced. In the period 2010-2020, the yield increase is estimated to be around 20% (to an average production of 7 400 kg/cow/year in 2020). By 2030, EU average yield should grow further to reach 8 300 kg/cow/year as productivity gaps between EU Member States continue to close. The projected yield growth (1.4% per year) is lower than in recent years, to some extent due to further segmentation in production methods/market segments. The share of organic milk production is expected to be 10% in 2030 (3.5% in 2018), but other systems could also gain (e.g. pasture-based, hay-based, GM-free fed). Nevertheless, by 2030 the dairy herd could be reduced to 19.2 million heads (7% below 2020).

EU to remain largest dairy exporter
Fresh dairy products (FDP) quality and nutritious image and the progress made in keeping products fresh in long-distance transport may contribute to increasing EU net exports of FDPs by 2030 (7% per year). With an expected slowdown in global import growth, EU export growth by 2030 is to be slightly lower than in the last 10 years (around 2% per year). Nevertheless, the EU is expected to remain the largest dairy exporter (28% of world dairy trade in 2030). New Zealand is set to lose some share (2 percentage points), while the US is expected to gain the most (2 percentage points). At the same time, the value of EU exports should grow at around 3% per year, 50% of which should come from cheese trade, followed by Skimmed Milk Powder (32%). In the next 10 years, more exports are expected to come from other regions (e.g. South America). These are likely to compete on strongly price-driven dairy commodities markets (e.g. milk powders), whereas markets of value-added products (notably cheese and butter) are set to be dominated by the EU, New Zealand and partially also the US. This is due to newcomers facing higher entry costs in order to be able to compete with their already high existing standards and sophisticated production streams.

A1.3 Beef

Beef production falling down
Continuing its downward trend from 2019 onwards, the EU gross beef production is expected to fall by 0.6 million t (-8.3%) between 2020 and 2030. While the average slaughter weight could increase slightly thanks to advanced technologies (e.g. in the management of germinal products), animal numbers will continue to shrink. The total EU cow herd is set to decline by 2.2 million heads (-7%) by 2030, and the dairy herd should decline progressively as the milk yield increases. The suckler cow herd is set to decline to 9.9 million heads by 2030; it has already been declining for years in key producing countries (except Poland and Spain), despite the voluntary coupled support, while overall the decline is driven by loss of profitability in the current price environment.
Beef consumption in the EU went sharply down in 2020 due to the effects of the COVID-19 pandemic, and is expected to continue its downward trend. By 2030, it could drop from 10.6 kg to 9.7 kg per capita. Overall, lower domestic production and stable imports will be in line with lower beef consumption. Total EU meat consumption is set to decline from 68.7 kg to 67.6 kg retail weight per capita by 2030, accompanied by changing consumer preferences, with consumption of beef continuing to decrease and poultry meat replacing pigmeat.

EU share in global exports of beef falls
World demand for beef is increasing, but competition is high, both for live animals and for meat. As a result, the EU share in global exports is projected to fall from 7% in 2020 to 6% in 2030. Exports of live animals are expected to decline gradually due to lower demand from Turkey and concerns over animal welfare during transport. Some smaller niche markets for EU beef have expanded in 2020 (the US, Japan, Canada, Norway), while beef exports to the UK have declined for 2 years.

A1.4 Pigmeat

Production and consumption of pigmeat expected to fall
Environmental concerns in several EU Member States, coupled with the risk of African Swine Fever (ASF) and changes in consumers' preferences are likely to constrain EU pigmeat production in the medium term. It is expected to fall by 1 million t (-4.6%) between 2020 and 2030. The global pigmeat market will continue to add uncertainty to production and to the availability of meat for consumption in the EU. For instance, EU production did not rise in 2020 due to the unfavourable investment climate, despite the peak in world demand and favourable prices. EU per capita pigmeat consumption started to decline in 2019, when the EU redirected a large share of pigmeat production to China while domestic prices were high; this caused consumers to switch to cheaper alternatives. The decline is set to continue after a short recovery in 2021, to 32 kg per capita by 2030 (1.4 kg less than 2020). EU consumers may not return to pigmeat and instead are likely to favour poultry meat.

EU to remain global leader in pigmeat exports
The global and EU pigmeat market remains uncertain due to the continuous but diminishing impact of ASF in Asia. Firstly, production potential in Asian countries may improve faster than expected. Secondly, the ASF-related import bans have intensified in Asian countries after the ASF outbreak in Germany in September 2020 and will bring the large outflow of EU pigmeat to a halt in 2021.
By 2030, EU exports may remain slightly higher than in 2018, thanks to demand from other Asian partners who might not manage to recover entirely from ASF. Overall, the EU will remain the global leader in pigmeat exports (38% of global exports).

A1.5 Poultry

Poultry production and consumption expanding
EU poultry production is expected to be the only meat category to grow between 2020 and 2030 (+620 000 t or +4.6%), building on its recent performance while adapting better to consumer demand and becoming more sustainable. It is the only sector to have expanded in 2020 during the COVID-19

pandemic, even without increased exports. In the medium term, production growth should benefit from significant investments, which capitalise on lower costs in eastern European countries, as well as from increasing prices.

EU demand for poultry meat has been rising consistently for many years, as consumers perceive it to be healthy. The COVID-19 lockdown measures strengthened the importance of affordability and convenience of poultry meat for home cooking. The EU per capita consumption of poultry meat, supported by imports of breast meat, is projected to reach 24.6 kg per capita by 2030 (1.2 kg more than 2020). It is likely that EU consumers may not return to pigmeat even if it becomes more available as a result of fewer exports to Asia.

EU poultry exports benefit from valorising specific cuts (e.g. wings to Asia, halves and quarters to Africa), and will increase steadily towards 2030, after the current drop. Demand is projected to grow in key export destinations (including the UK), where poultry meat is expected to replace less abundant and more expensive pigmeat. EU poultry imports, often supplying fast foods and other foodservice, should start to recover once shipments from traditional trading partners strengthen after the decline induced by COVID-19 lockdown measures and closures of food services in 2020. Total imports should grow gradually to around the total volume of tariff-rate quotas opened by the EU (around 900 000 t as of 2020).

A1.6 Sheep and goatmeat

After decreasing gradually up to 2013, sheep meat production stabilised and is expected to remain around 630 000 t over the next decade, supported by voluntary coupled payments and the prospect of stable returns for producers. Production will remain concentrated in a few EU Member States, with slaughterings in Spain, Greece, France and Ireland representing more than half of total EU production in 2019. EU per capita consumption of sheep meat is expected to remain relatively stable by 2030 (1.3 kg, the same level as in 2020). In general, sheep meat consumption, which is lower than for other meats, is less sensitive to price changes but more affected by peaks in demand related to religious celebrations.

EU exports of live animals are expected to decline slowly to 40 000 t by 2030 (by -32% compared to 2020), mainly due to animal welfare concerns and financial risks linked to certain trade destinations. Exports of meat might face tough international competition since Australia and New Zealand, which represent 80% of international trade, are expected to keep their dominant position on the world market. Even though the EU is still a major export destination, Australia and New Zealand will focus more on the closer Asian markets. While Australia is expected to fill its EU tariff-rate quota (TRQ), New Zealand’s production capacity is unlikely to be able to serve both the Asian and European markets. Therefore, EU imports will be stable and stay significantly below the total volume of TRQs opened by the EU.

A1.7 Land use

Between 2020 and 2030, a further 0.5 million ha reduction in agricultural land is expected, taking the total to 161.2 million ha. Since 2012, pasture and fodder areas have been increasing in various regions in the EU, such as Germany, Spain and Italy. In 2018, EU permanent grassland area reached 50.1 million ha (+4% compared with 2012). Grassland area is expected to continue to increase to meet the demand for feed, but at a slower pace than in previous years, partly because of the reduction in livestock herds of ruminants. Grassland area could increase by 0.7% to 50.5 million ha by 2030. Similarly, EU fodder areas such as temporary grassland and silage maize could increase and reach 20.2 million ha to meet the demand for feed as well as the demand for feedstock for biogas production.

Within a declining trend of EU total agricultural land, cereal and oilseed areas in particular should also decline in the upcoming decade. The cereals area could decline to 51.0 million ha (-2.8% compared with 2020), mainly due to a downward trend in wheat and barley. As for oilseeds, total EU area could go down to 10.7 million ha (-0.4%), driven by a continuous decline in rapeseed.

Growth in organic land could remain strong in the 2020-2030 period. The share of organic land in total agricultural land increased from 5.5% in 2012 to 8% in 2018. By 2030, that share could increase by an additional 4 percentage points and reach 12%. Permanent pasture and permanent crops already occupy the highest share of land under organic farming because they are easier to convert. However, it is expected that organic arable land will need to increase to meet the strong demand currently met by imports.

A1.8 Feed

With the expected decline in the EU pigmeat production, feed demand in this sector is expected to drop. By contrast, the poultry sector is expected to grow and could boost feed demand. For ruminants, even if suckler cows and the dairy herd are projected to decrease in numbers, further production growth in milk could sustain the feed demand. The ongoing restructuring of the dairy sector is expected to continue. At the same time, extensification and diversification of production systems will expand in certain regions of the EU, favouring some specialised systems along the value chain (organic, pasture-based, GM-free, short supply chains). In 2019-2020, 45% of the proteins for livestock feed already come from grass.

Low-protein feed (less than 15% protein content, mainly cereals) is the largest contributor of EU feed rations in volume and represents 76% of the feed mix. The overall use of cereals in feed is projected to slightly decline to 162.2 million t (-0.2% compared with 202018). High-protein feed (over 30% protein content) includes oilseed meals, fish meals and skimmed milk powder. It is projected that the use of high-protein feed, particularly of oil meals, could slightly decrease by 2030 (-0.2%). The decline in pig and other livestock herds will contribute to the downward trend of high protein feed in 2030, as will the fall in rapeseed availability and environmental and climatic concerns vis-à-vis soya utilisation in feed rations. By contrast, the use of medium-protein feed (between 15-30% protein content, such as protein crops) is expected to increase by 2030.

Appendix 2 Gaps between targets and trends

A2.1 Introduction

This appendix is derived from Guyomard, Bureau et al. (2020) and provides an overview of the gaps between selected Green Deal targets and the trend values.

A2.2 Climate

The different sources of agricultural GHG emissions, their composition and evolution are presented in Figure A2.1.

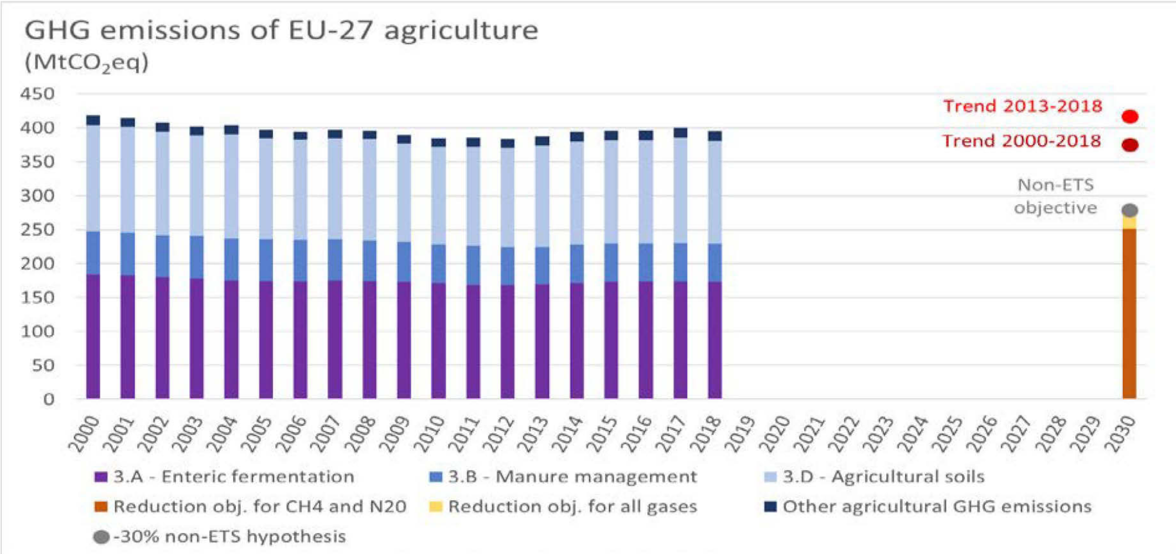


Figure A2.1 *Agricultural GHG emissions in the EU-27 in MtCO2eq, 2000-2018 evolution and projections by 2030*
Notes: The first target in 2030 (grey point) corresponds to a 30% reduction between 2005 and 2030. The second target (orange bar) has been recently proposed by the EC for non-CO_2 gases that for a large part are emitted by the farm sector. This second target implies a 35% reduction between 2015 and 2030. The two red points in 2030 correspond to linear prolongations of 2000-2018 and 2013-2018 past trends, respectively.
Source: Guyomard, Bureau et al. (2020).

EU agricultural GHG emissions declined by 24% between 1990 and 2013 and increased by 4% between 2013 and 2017, with similar trends for emissions from animal production and soil fertilisation. Emissions fell slightly by 1.3% between 2017 and 2018.

A2.3 Fertilisers

The EU-27 nitrogen balance increased 7.4 million tonnes in 2009 to 8.2 million tonnes in 2015 (Figure A2.2).

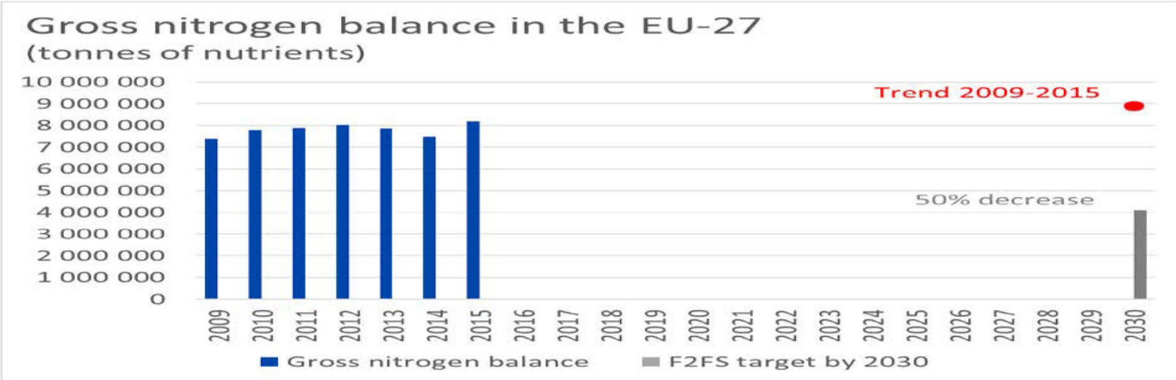


Figure A2.2 *Gross nitrogen balance in the EU-27 in tons of nutrients, 2009-2015 evolution and projections by 2030*
Note: The 2030 target (grey bar) corresponds to a 50% decrease from the 2015 base year. The red point in 2030 corresponds to the linear prolongation of the 2009-2015 trend.
Source: Guyomard, Bureau et al. (2020).

The prolongation of the 2009-2015 trend will lead to a nitrogen balance in 2030 at odds with the target of a 50% reduction in nitrogen losses at that date.

A2.4 Pesticides

The evolution of pesticide sales in the EU-27 between 2011 and 2018 is shown in Figure A2.3.

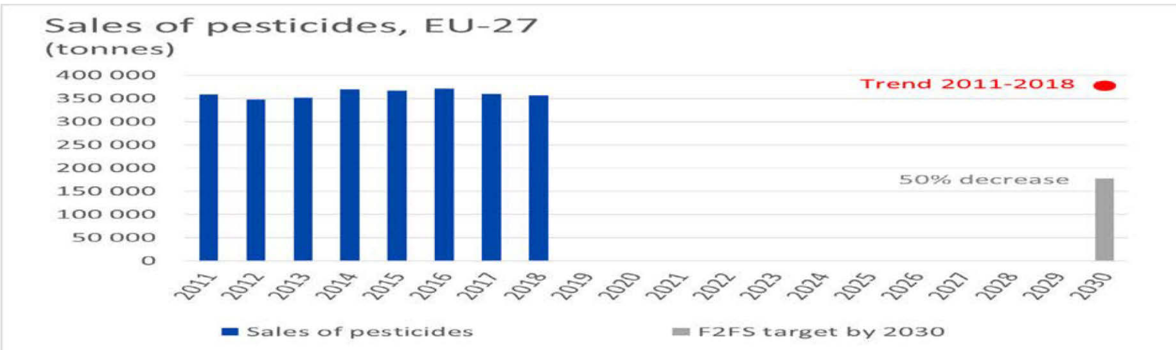


Figure A2.3 *Sales of pesticides in the EU-27 in tons, 2011-2018 evolution and projections by 2030*
Notes: The 2030 target (grey bar) corresponds to a 50% reduction of sales from the 2018 base year. The red point in 2030 corresponds to the linear prolongation of the 2011-2018 trend.
Source: Guyomard, Bureau et al. (2020).

Sales of pesticides are globally constant. A prolongation of the 2011-2018 trend will clearly be at odds with the 50% reduction target related to the use of pesticides in the EU.

A2.5 Antimicrobials

The Green Deal target is to reduce overall EU sales of antimicrobials for farmed animals and in aquaculture by 50% by 2030. Significant progress has been made over the two last decades in the reduction of sales of antimicrobials in agriculture. Among the 25 European countries (within the EU and outside) that have provided data, overall sales of antimicrobials have decreased by around 33% from 2011 and 2017, and the EU as a whole could be on track to reach the reduction target by 2030 (Figure A2.4).

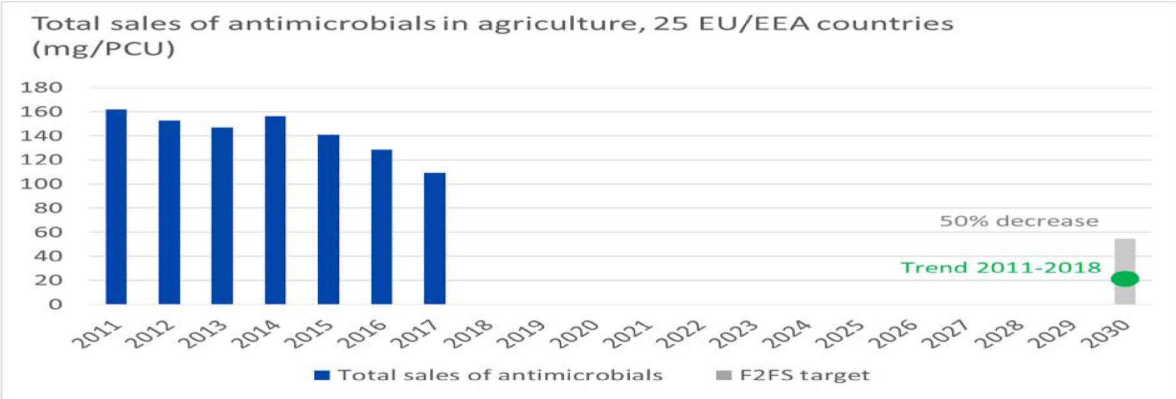


Figure A2.4 *Total sales of antimicrobials in agriculture, for 25 EU/EAA countries, in mg/PCU, 2011-2017 evolution and projections by 2030*
Notes: The 2030 target (grey bar) corresponds to a 50% reduction from the 2017 base year. The green point in 2030 corresponds to the linear prolongation of the 2011-2018 trend. Mg/PCU for milligrams per population correction unit.
Source: Guyomard, Bureau et al. (2020).

A2.6 Organic agriculture

Under the provisions of the EU Biodiversity Strategy for 2030, at least 25% of the EU's agricultural land must be under organic farming by 2030. At the EU-27 level, the share of land under organic farming was equal to 8% in 2018 (Figure A2.5). This share has been continuously increasing over the past years. In 2012, it was equal to 5.9%. The linear prolongation of the 2012-2018 trend would allow the EU to reach a share of 12.3% by 2030; that is, a percentage that would be far below the 25% target.

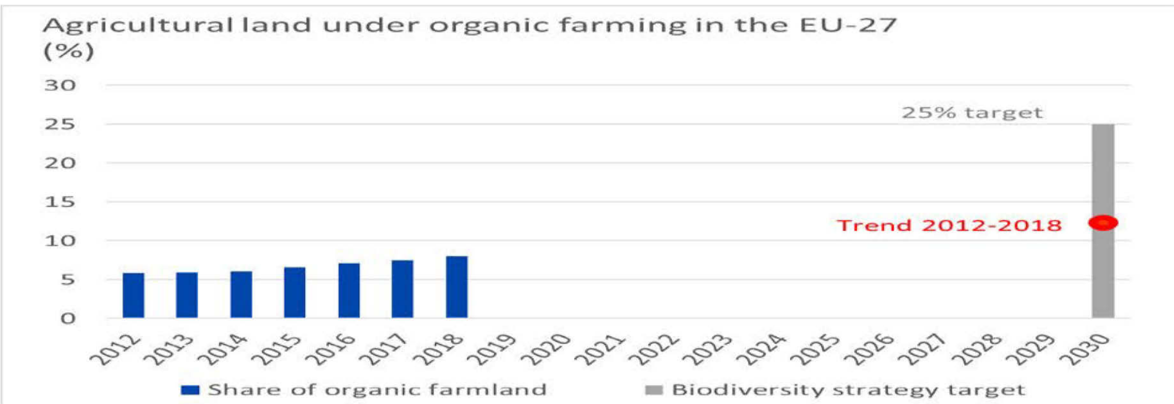
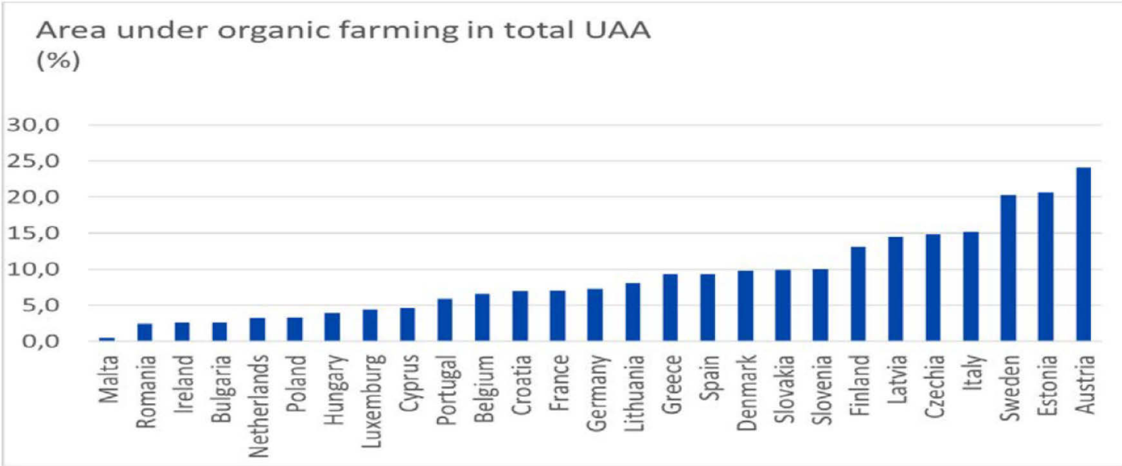


Figure A2.5 *Share of agricultural land under organic farming in the EU-27, 2012-2018 evolution and projections by 2030*
Notes: The target (grey bar) corresponds to a share of agricultural land under organic farming equal to 25% in 2030. The red point in 2030 corresponds to the linear prolongation of the 2012-2018 trend.
Source: Guyomard, Bureau et al. (2020).

It is noted that the current shares of agricultural land under organic farming vary substantially from one MS to another (Figure A2.6).



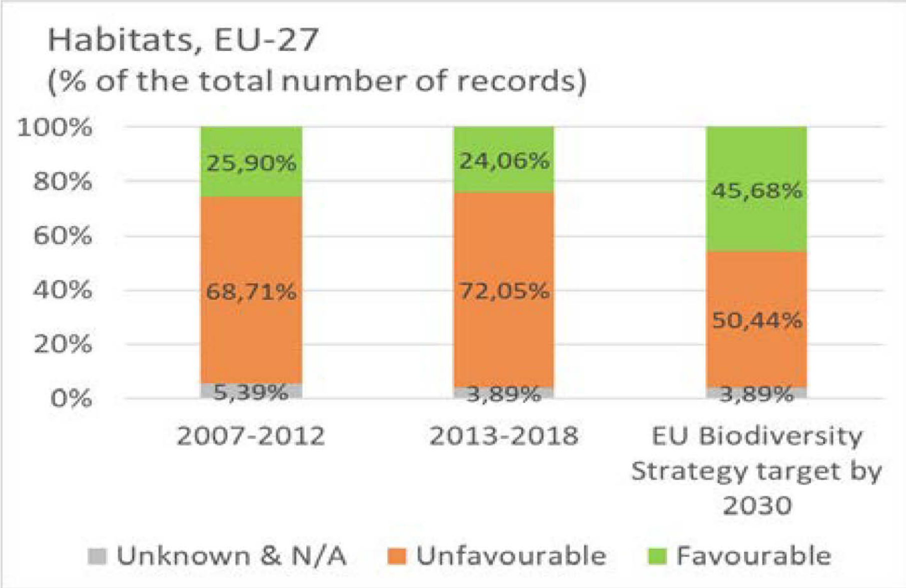
Source: Own elaboration from Eurostat data (Eurostat, 2020g).
Note: UAA for Utilized Agricultural Area.

Figure A2.6 *Area under organic farming in total UAA*
Source: Guyomard, Bureau et al. (2020).

A2.7 Biodiversity

As part of the EU Biodiversity Strategy for 2030, an enlarged coherent network of protected areas is promoted. The restoration of ecosystems is also covered by a commitment in the F2FS to bring back at least 10% of agricultural area under high-diversity landscapes features. Habitats at an unfavourable status have increased from 68.7% in 2007-2012 to 72.1% in 2013-2018. This percentage should decrease to 50.5% by 2030 in order to achieve the target of the EU Biodiversity Strategy for 2030 related to habitat status (Figure A2.7a). In the same way, species at an unfavourable status (that were globally constant between 2007-2012 and 2013-2018), should decline to 38.5% by 2030 in order to reach the target related to species' status (Figure A2.7b).

Panel a



Panel b

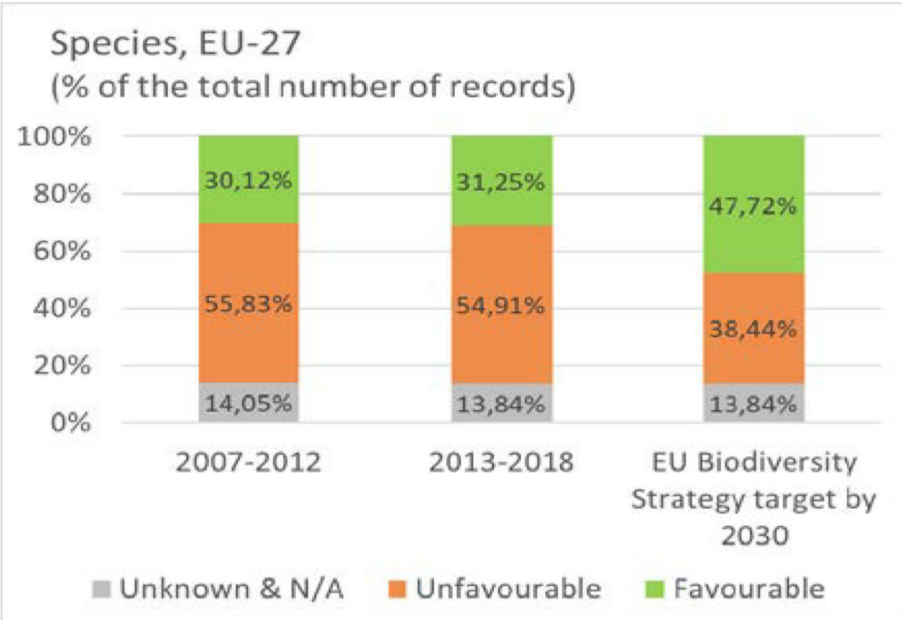


Figure A2.7 *Status of habitats (Panel a) and species (Panel b) in the EU-27, past evolutions and Green Deal targets for 2030*
Note: Figures in 2007-2012 and 2013-2018 are not strictly and directly comparable because methods have changed and data quality has improved.
Source: Guyomard, Bureau et al. (2020).

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