# Environmental impacts of achieving the EU's 25% organic land by 2030 target: a preliminary assessment

**Report for IFOAM Organics Europe, Brussels**


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# Summary

The European Union's Farm to Fork Strategy[1] target of a 25% organic share of agricultural land by 2030 is ambitious given that organically farmed land was just under 10% in 2020, but it is a clear statement of the value placed on the environmental, social and economic benefits that organic farming can deliver. Much has been written about the potential benefits in descriptive terms, but just how big could they be? This study seeks to put numbers on the possible benefits if the 25% target can be achieved.

Using published Eurostat statistical data for the EU 27 Member States, Switzerland, Norway and the United Kingdom, we have estimated various production and environmental outcomes for the actual organic area in 2020 and three scenarios for 2030: a) linear trend growth continuing as in 2016-2020, b) more rapid growth at 1.75 times the linear trend rate to deliver 25%, and c) equal 25% shares across all sectors. Similar calculations have been undertaken for different target shares in individual countries, reflecting their current starting points, but still delivering in combination the overall 25% target at EU27 level.

Our analysis shows that **achieving the 25% organic share of land area target in the EU could deliver:**

- **40 million hectares (Mha) of land managed organically**, an increase of 25 Mha over the nearly 15 Mha or 9.1% of EU27 farmland in 2020. The 'business as usual' linear growth scenario would only reach 23 Mha or 14% by 2030, so clearly additional impetus is needed to reach 25%. The linear growth scenarios reflect current organic production with a higher proportion of permanent grassland, vegetables and permanent crops but less arable land, whereas the equal share scenarios reflect agriculture in general and have more arable land at the expense of the land uses currently over-represented organically.
- Up to **84 million tonnes (Mt) of organic crops**, or 16.5% of total EU27 crop output, compared with 24 Mt or 4.7% in 2020. Relative yield data for a wide range of crops has been estimated, with organic yields ranging from 107% of conventional for durum wheat to 61% of conventional for standard wheat, with many other crops in the 80-90% range. Overall we estimate that total EU27 cereal output would be reduced by 5-10%, but that this would be more than offset by reduced livestock numbers and demand for feed cereals.
- **2.7 million tonnes (Mt) less synthetic nitrogen fertiliser** being used, or 26% of the total that might be used if there were no organic farming. This compares with 0.9 Mt (8.5%) reduction in N-fertiliser use in 2020. The difference between the two – 1.8 Mt or 18.6% of actual EU27 fertiliser use in 2020 – means that achieving the 25% organic target could also almost deliver the 20% fertiliser reduction target in the Farm to Fork Strategy as a co-benefit. This reduction is important for water quality, biodiversity and greenhouse gas (GHG) emissions, with potential reductions of up to 25 Mt $CO_2$e in agricultural emissions including 9.5 Mt $CO_2$e manufacturing sector emissions due to the energy use for N-fertiliser production and distribution.
- **90-95% reduction in pesticide use on organic land**, equivalent to 20-23% reduction in overall EU27 pesticide use – delivering at least a third of the 50% reduction target in the Farm to Fork Strategy. Due to methodological issues relating to the use of active substances as a basis for measuring pesticide use, and the absence of good quality data, a full assessment of pesticide use reduction potential was not possible. However, a specific assessment of copper (Cu)-based fungicides could be undertaken. This concluded that Cu use in organic farming was declining and was less than 4 tonnes of active substance in 2020. This represented 30% of total Cu use in the EU27, and only 50% of the potentially permissible use of Cu fungicides in organic farming. 70% of Cu use in EU agriculture takes place on conventional farms.

[1] https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en

- Up to **15 million livestock units (MLU) produced organically,** or 11% of the EU27 total, compared with 5 MLU or 4% in 2020. In the 25% equal share scenario, the lower proportion of permanent grassland has a more significant impact on cattle numbers, reducing total livestock production. Total livestock numbers are estimated to be reduced by 7% in 2020 due to organic farming, with a further 11% reduction by 2030, giving a combined total of 18% under the 1.75x linear growth scenario. These reductions are not inconsistent with the linear trend projections for total livestock numbers (ruminants declining by 10%, total livestock by 5%) and changes in consumer demand for meat and dairy products. They would also reduce the demand for feed cereals and oilseeds, more than offsetting the projected reductions organic output. Further reductions in demand for feed grains could result from increased emphasis on pasture-based diets.
- **Antimicrobial and anthelmintic use declining at least in proportion to livestock numbers**, and probably significantly more due to the constraints of organic regulations, but it has not been possible to analyse this on the basis of the available statistical evidence. This reduction is of environmental significance in the context of soil microbial and insect biodiversity impacted by residues in manures and slurries.
- Up to **68 million tonnes carbon dioxide equivalents (Mt $CO_2$e) reduced greenhouse gas (GHG) emissions**, or 15% of total EU27 agricultural GHG emissions, annually. This compares with a reduction of 24 Mt $CO_2$e (5% of EU27 total) emissions from existing organic farming in 2020 and is equivalent to a 1.6-1.7 t $CO_2$e reduction per hectare of agricultural land. These figures include a component of carbon sequestration due to the 50% additional temporary grassland in organic rotations in the linear trend scenarios, but which would not occur in the 25% equal share scenario. The emissions reduction from N-fertiliser manufacturing and distribution (9.5 Mt $CO_2$e) would be an additional benefit, as these are not normally included in agricultural emissions.
- Up to **450 thousand tonnes (kt) reduction in ammonia ($NH_3$) emissions**, or 13% of total EU27 $NH_3$ emissions, annually, with significant impacts on air quality and reduction in indirect GHG emissions. This compares with the 157 kt (5% of EU27 total) reduction delivered by organic farming in 2020.
- **30% increase in biodiversity on organic cropland**, or a 5-10% increase in total EU farmland biodiversity. This is a complex assessment to make with relevant statistical data lacking, so these estimates should be treated with caution. There is further potential biodiversity gain to be achieved with the integration of natural habitats and landscape elements in organic systems supporting beneficial insects and pollinators, which is consistent with the EU Biodiversity Strategy's target of 10% of farmland to be prioritised for nature restoration by 2030.

As this study has shown, delivering the 25% target has the potential to deliver substantial environmental benefits, making organic farming a key policy tool to reach EU environmental policy objectives with manageable productivity impacts. This has already been emphasised qualitatively in the Farm to Fork Strategy and the European Organic Action Plan[2], and more recently restated by the French Court of Auditors report on organic farming policy [3].

But the expansion of organic farming to deliver environmental gains needs adequate resourcing, recognising that the benefits are for society as a whole and not limited to organic food consumers. Public support needs to work in partnership with the organic market. Support for organic maintenance and conversion payments in the EU amounted to almost 2 billion € in 2018, and it has been estimated that 9-15 billion € annually might be needed by 2030. The CAP Strategic Plans submitted by Member States foresee a total of 15 billion € for the period 2023-2027, or 3 billion € per year on average, far short of the sums needed to achieve the 25% target and remunerate organic farmers appropriately for the environmental benefits delivered.

[2] https://ec.europa.eu/info/food-farming-fisheries/farming/organic-farming/organic-action-plan_en
[3] https://www.ccomptes.fr/fr/publications/le-soutien-lagriculture-biologique

# 1 Introduction

## 1.1 Aims of this study

The European Commission in its Farm to Fork[4] and Biodiversity[5] Strategies has set a target of 25% of total utilisable agricultural area (UAA) in the European Union to be managed organically by 2030. This is one of several targets specified, also including 50% reductions in pesticide and antimicrobial use, a 20% reduction in fertiliser use, and 10% of farmland to be used primarily for nature, all by 2030. The strategies and targets aim to support the EU in delivering the new Common Agricultural Policy (2023-2027)[6] and the Green Deal[7], which seek to substantially improve the collective impacts of Member States on climate, biodiversity, soil health, water quality and animal welfare. These public good deliverables from agriculture and other economic activities contrast with market goods traditionally associated with these sectors, including food production, the maintenance of soil fertility and plant and animal health, which are usually the core focus of agricultural businesses.

While there has been considerable debate around the achievability of the organic area target, including the contributions required from individual Member States and the new situation for agricultural commodities and food security created by the Ukraine war, there have only been limited attempts[8] to quantify the impacts on organic crop and livestock production and the environmental benefits that could be delivered if the 25% target were achieved. These questions will be explored in detail as part of a new EU-funded project, Organic Targets for EU[9], which will run from September 2022 until February 2026.

However, as some indicative values are needed to support ongoing discussions sooner, IFOAM Organics Europe has commissioned this study to provide a quantitative and qualitative analysis of the environmental, climate and social implications of the achievement of the 25% target for organic land, in particular:

1. How would land use changes impact on **production quantities** and **carbon sequestration**?
2. How much would **nitrogen fertiliser use** be reduced and what would be the implications for **greenhouse gas emissions** and **water quality**?
3. How would changes in livestock numbers and production methods impact on **greenhouse gas and ammonia emissions**?
4. How would the change in **production quantities** impact on land requirements elsewhere and potential interactions with intermediate uses (e.g**., livestock production, human diets and food waste**)?
5. How would **pesticide use** (in particular copper) be impacted, in terms of total active ingredients used and impacts on biodiversity?
6. To what extent would **biodiversity** be enhanced by the planned increase of organic practices?

## 1.2 Approach

The approach we have taken is to use Eurostat data[10] for EU Member States (EU27), as well as Switzerland (CH), Norway (NO) and the United Kingdom (UK), to calculate the shares of total agriculture attributable to organic and non-organic holdings for the different parameters. Normally, it has been possible to determine actual values for 2020 or 2019. In some cases, individual data items were either missing or complete data

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[4] https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en
[5] https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en
[6] https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/new-cap-2023-27_en
[7] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en
[8] https://publications.jrc.ec.europa.eu/repository/handle/JRC121368
[9] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/999999999/project/101060368/program/43108390/details
[10] https://ec.europa.eu/eurostat/data/database

sets for individual countries were missing. Various techniques were used to determine a reasonable value to use for missing data cases, so that total values at EU27 level could be determined. These techniques include interpolation between actual values in adjacent years, assuming similar values if end year data were missing, using EU averages to estimate national values, or searching national databases for relevant values. Where this was major issue for a particular estimate, this will be discussed in further detail in the relevant sections. Specific assumptions relating to the output and environmental data are also discussed in more detail below.

Much of the data used could also be analysed on a regional level (NUTS 2), but we chose not to go to this level of disaggregation due to limited resources and potentially greater problems with missing data.

As a baseline for most variables, data for the five year period 2016-2020 were used. The time series data were used as a basis for trendline projections. For comparisons, normally 2020 or 2019 data were used alone. There may be a case for using an average over three or five years to even out impacts of variable weather conditions, for example, but as the data may also reflect growth or other circumstances of the organic sector, we opted not to do this. We also calculated values for non-organic production based on the difference between total and organic values. This is necessary to get a representation of the non-organic sector, as the organic sector can no longer be considered to be a negligible component of the total values in many cases. In some cases (e.g., reductions in crop and livestock output, nitrogen use and greenhouse gas and ammonia emissions), an adjusted 2019/2020 value was calculated on the basis of zero organic farming, so that actual 2020 organic farming impacts could be estimated and presented on a similar basis to the 2030 projections.

## 1.3 Scenarios

To assess potential outcomes in 2030, we analysed the data on the basis of the following scenarios:

1. Linear trend projections to 2030 based on the five-year time-series data for 2016-2020
2. A multiple of the linear growth rate needed to deliver the 25% organic at EU level by 2030: in the top-level EU case, a multiple of 1.75 (i.e., 75% faster growth) was calculated to deliver the desired result
3. An alternative 'equal share' scenario including 25% shares of sector totals for all sectors such as cereals or oilseeds.

The linear growth scenarios resulted in land use and livestock outcomes that were more similar to the existing organic sector. The equal share scenarios were more similar to the overall agricultural situation.

Undertaking the analysis at EU level meant that sometimes implausible results were calculated for individual products or countries. For example, Austria (AT) already has a 28% share of UAA managed organically in 2020, so that the linear trend multiple projection would imply an organic share of nearly 75% of land in AT by 2030. For this reason, scenarios 2 and 3 were repeated on a national basis, using national targets derived from a variety of sources[11] that would in combination deliver the 25% EU target, and the equal share values for individual sectors that would deliver the same national targets. In practice, very similar values emerged from both EU and national target approaches, so in the presentation of the results we have normally used the EU27 values for the EU charts, and the national target values for the charts showing results from individual countries.

It should be noted that the estimates based on these scenarios represent 'what if?' calculations, not forecasts of the likelihood of particular outcomes. We have made no assessment of likelihood in this study.

11 https://www.organicseurope.bio/content/uploads/2021/06/ifoameu_advocacy_CAP_StrategicPlansAnd25Target_202106.pdf?dd

# 2 Land use/crop area projections

## 2.1 Introduction

The approach used for estimating areas of different crops in 2030 is as described in the preceding section.

## 2.2 Results and conclusions

Based on linear growth of the organic area as in the last five years (reaching 9% in 2020), only 14% of EU27 total land area would be achieved by 2030, or just over 55% of the 25% target (Figure 2.1). Increasing the linear growth rate by 75% would result in the EU's 25% target being achieved.

Some crop types are more prevalent that others, notably grain legumes (24% of total EU grain legumes in 2020 were managed organically), vegetables, forage crops, grassland and permanent crops, especially fruit. The linear growth scenarios result in these crops reaching substantially more than 25% by 2030, for example grain legumes increasing to 73% and permanent grassland increasing from 12% to 32% in the 1.75x linear growth scenario. Other crops are far below the average organic land area share in 2020, including cereals, oilseeds, potatoes and arable in total, which would rise from 7% to 20% in the 1.75x linear growth scenario.

The equal 25% share across all land use types would result in more arable but proportionately less grain legumes, permanent crops and grassland. While the linear trend multiples might result in some unrealistic results, the 25% flat rate approach could restrict some growth potential in already well developed situations.

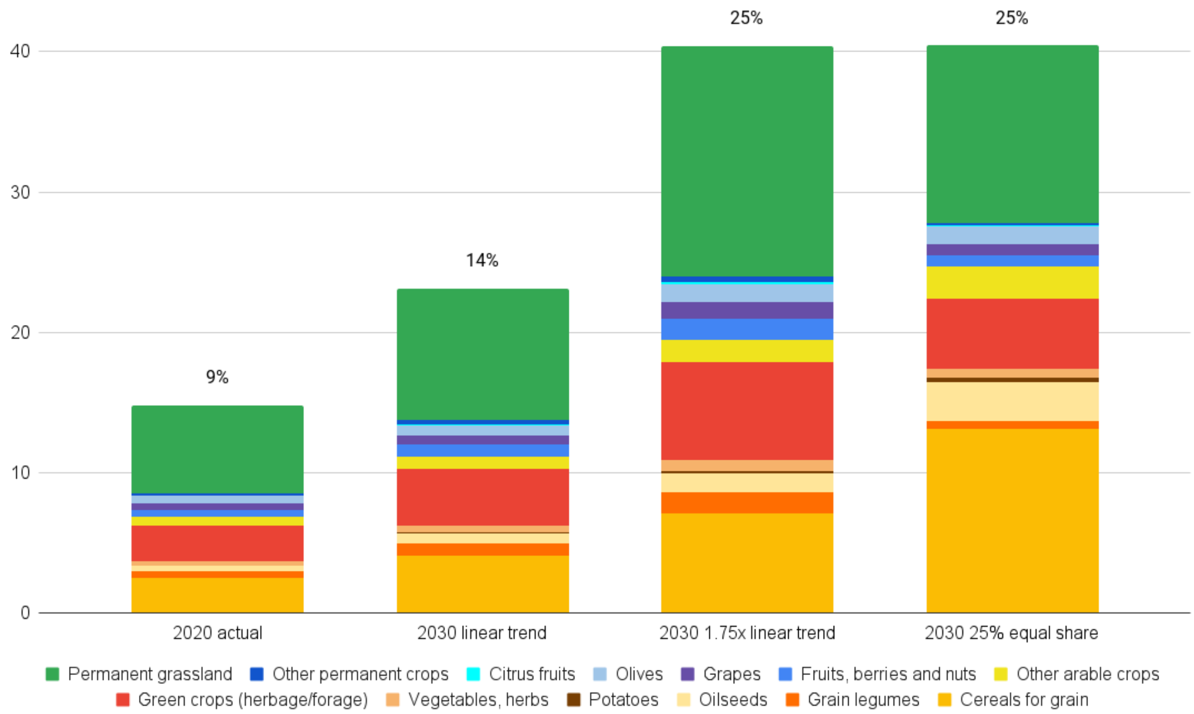


*Figure 2.1: EU27 organic and in-conversion land area projections for different land uses/crops (million hectares)*

See section 1.3 for an explanation of the 2030 scenarios
% values are share of EU 27 total UAA (full column represents total organic UAA)

## 2.3 Individual country results

The very different situations and potential outcomes in individual Member States and CH, NO and UK can be seen in Figure 2.2 to Figure 2.5, where each chart represents an individual scenario. The scenarios are outlined in Section 1.3.

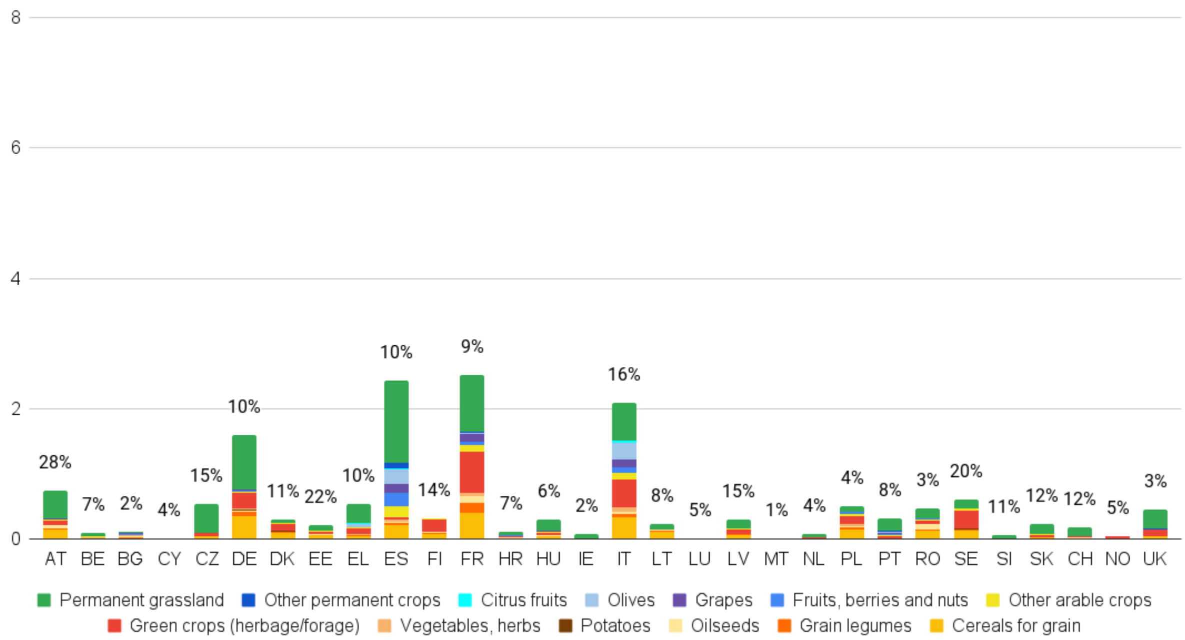


*Figure 2.2: Organic land area (million ha UAA, 2020 actual) in EU27 Member States, CH, NO and UK*

% values are share of national total UAA (full column represents total organic UAA)

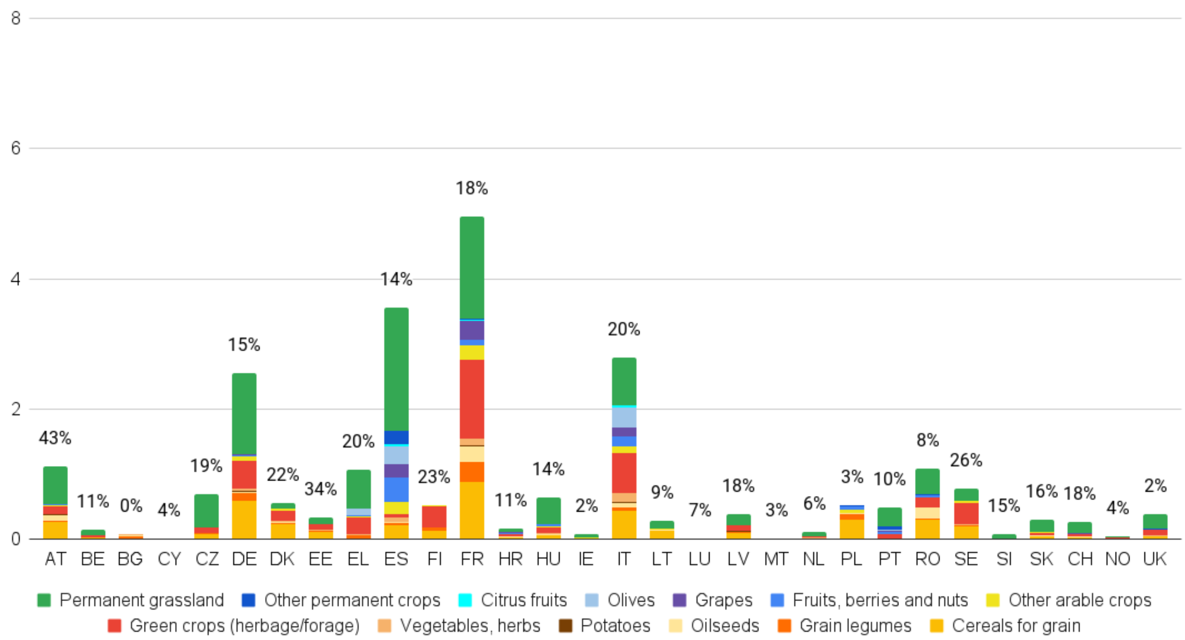


*Figure 2.3: Organic land area projections (million ha UAA, 2030 linear growth scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total UAA (full column represents total organic UAA)

In the scenarios that would deliver 25% organic at the EU level (Figure 2.4 and Figure 2.5), the land area is dominated by four countries: Germany (DE), Spain (ES), France (FR) and Italy (IT), even though some smaller countries like Austria (AT) and Sweden (SE) might achieve higher organic shares of national land area.

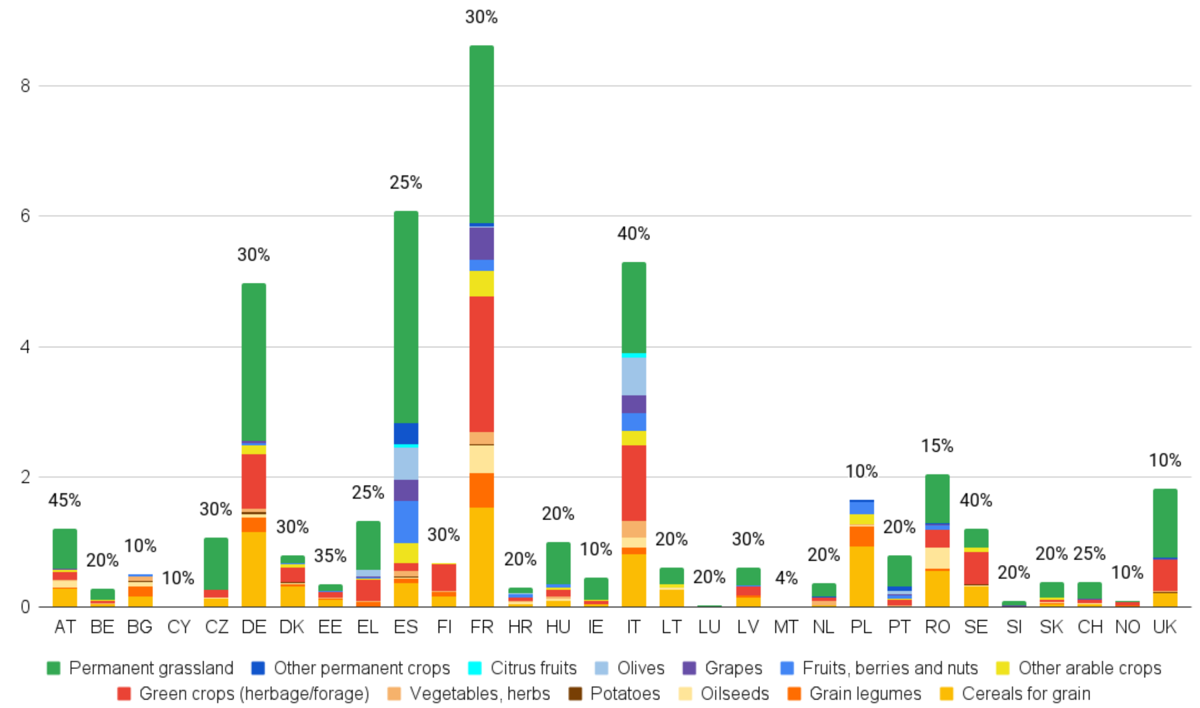


*Figure 2.4: Organic land area projections (million ha UAA, 2030 higher linear growth scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total UAA (full column represents total organic UAA)

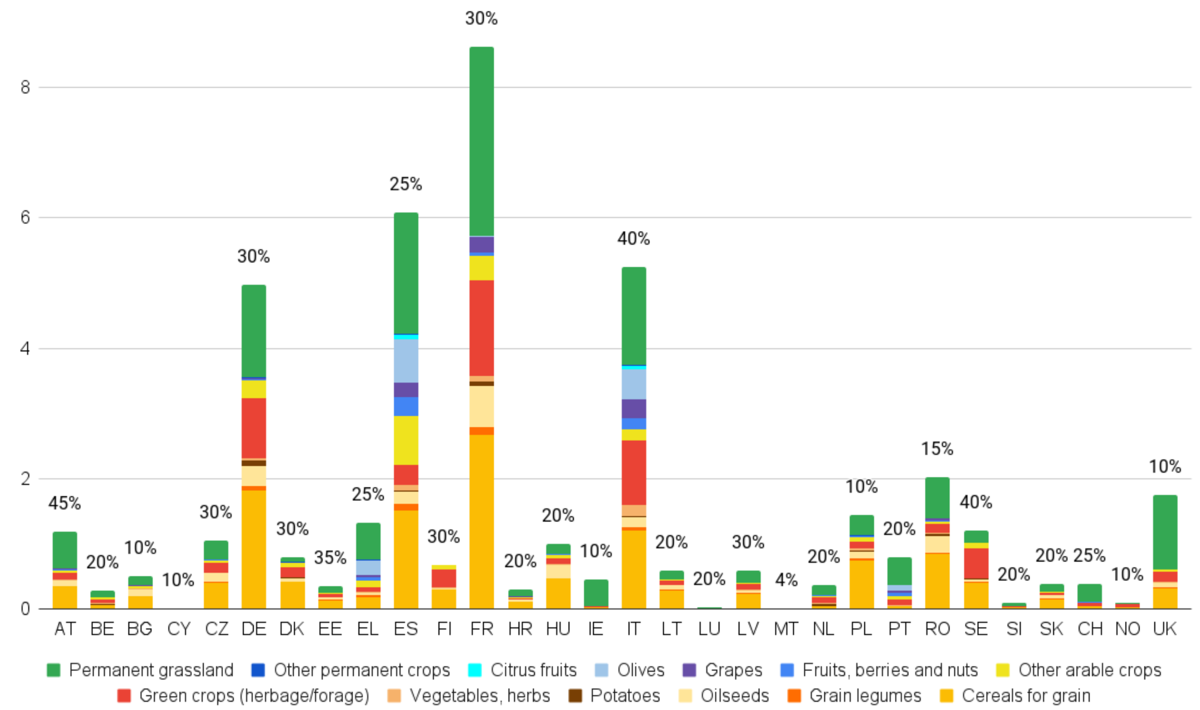


*Figure 2.5: Organic land area projections (million ha UAA, 2030 national equal shares scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total UAA (full column represents total organic UAA)

# 3 Organic crop yields and product quantities

## 3.1 Introduction

The question of the physical productivity of organic farms is much debated, in part due to concerns that environmental benefits achieved on a per hectare basis may not be realised on a per tonne of product basis, leading to the exporting or leakage of environmental problems to land elsewhere, often in other countries. There have been a number of meta-analyses of organic yield data[12] which have concluded that globally, on average, organic yields are 20% lower than non-organic. However, this hides a high degree of variation between crops and between countries. Crops which in a particular region are produced conventionally with high nitrogen inputs, for example wheat in northern Europe, tend to show much larger yield differences than crops produced with less, and the same crop grown in different parts of the world at different intensities may show very little difference, for example wheat grown in the USA. In cases where access to nitrogen inputs is limited, for example subsistence or resource poor farmers, organic yields might even be higher, because of the emphasis on ecological systems design to make more effective use of available resources.

There is also a tendency to focus on individual crop yields, rather than on total system yield and its relationship to demand or human needs. Most cereals produced in the EU, for example, are used to feed to livestock, while ruminant livestock at least could be more reliant on grassland rather than cereals in their diets, and potentially more animals can be sustained per hectare of grassland than per hectare of cereals. Might a reduction in cereals output under organic management be balanced by a reduction in livestock produced, more reliance on pasture to feed livestock, reduced consumer demand for meat and dairy products, and reduced food waste? These are complex questions to answer, but it is necessary to do so to get the full picture. We attempt to illustrate this later in this report.

There are further issues to be considered when looking at relative yield data, especially from agricultural survey data such as the Farm Accountancy Data Network[13]:

- Farms may be mixed organic and conventional, or in-conversion, with no clear identification of individual product status in the survey returns.
- The organic farms may be present based on a sampling frame for all of agriculture rather than ensuring a representative sample of organic farms, with group averages not providing a like for like comparison and more complex analytical approaches needed to ensure comparability.
- The earlier organic farms may also be predominantly drawn from more extensive holdings, so that productivity differences are determined more by location than by management.
- Research evidence shows that yields tend to increase on organic farms during and after conversion, due to a combination of developing skills and experience as well as the system benefits, for example from rotations becoming better established.

There is therefore a need to be very cautious about the quality of organic yield data available, and its ability to reflect the productive potential of organic systems. However, in the absence of alternatives, there is also a need to work with what we have, keeping the above considerations in mind.

Eurostat publishes data on total tonnes of selected agricultural products as well as total tonnes of similar fully organic products produced in each country. However, the production from in-conversion organic land is not included, and the total production data includes the organic data. In order to test whether the Eurostat data might be used to determine relative yields per hectare, we calculated:

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[12] For a review of the reviews, see Section 4.2 in this report: https://www.nature.scot/role-agroecology-sustainable-intensification-lupg-report
[13] https://ec.europa.eu/info/food-farming-fisheries/farming/facts-and-figures/farms-farming-and-innovation/structures-and-economics/economics/fadn_en

a) the difference between organic and total areas and organic and total tonnes of products to get similar values for non-organic areas and products
b) the yields per hectare for organic and non-organic crops, and the relative yields implied
c) missing organic product data for some key countries, including AT, Denmark (DK), Portugal (PT), Germany (DE – except horticulture), and France (FR – except arable): for these countries, the EU relative yield differences were used to estimate the potential output from the organic land areas
d) an overall EU relative yield table (see below) from the combined values from individual countries.

## 3.2 Crop yields

As anticipated, the results confirmed the lower yields per hectare on organic land (Table 3.1) but, despite the potential weaknesses of the datasets and method used, the generated relative yield values are consistent with other studies.

*Table 3.1: EU27 average yields for selected organic and non-crops, estimated using Eurostat total tonnage production data for organic and all crops in 2020*

| Crop | Non-organic yield (t/ha) | Organic yield (t/ha) | Organic as % of non-organic |
|---|---|---|---|
| Wheat and spelt | 5.7 | 3.5 | 61 |
| Durum wheat | 3.5 | 3.7 | 107 |
| Rye and winter cereal mixtures | 3.0 | 2.5 | 83 |
| Barley | 4.6 | 2.7 | 58 |
| Oats and spring cereal mixtures | 2.8 | 2.4 | 84 |
| Maize (grain) and corn-cob mix | 7.7 | 6.7 | 87 |
| Rice | 7.0 | 6.1 | 88 |
| Grain legumes (pulses) | 2.0 | 1.5 | 74 |
| Potatoes | 29.5 | 24.4 | 83 |
| Sugar beet | 75.7 | 39.6 | 52 |
| Oilseed rape | 2.9 | 1.6 | 57 |
| Sunflower seeds | 2.4 | 1.7 | 72 |
| Soya beans | 3.2 | 2.3 | 71 |
| Brassica vegetables | 25.0 | 19.2 | 77 |
| Leafy and stalked vegetables | 19.6 | 11.9 | 61 |
| Root, tuber and bulb vegetables | 32.2 | 33.3 | 103 |
| Apples, pears | 21.2 | 12.6 | 59 |
| Peaches, nectarines, apricots | 17.7 | 10.3 | 58 |
| Citrus | 19.9 | 30 | 150 |
| Grapes | 7.9 | 6.6 | 83 |
| Olives | 1.9 | 3.7 | 197 |

These results confirm the difference between crops like wheat with high nitrogen use conventionally and higher yield gaps, and crops like oats, rye, durum wheat and grain legumes, where less nitrogen is used and the yield gap is correspondingly lower. For horticulture, other factors may be involved, which are not possible to assess on the basis of the data sets available. Higher organic citrus and olive yields may reflect that many very extensive orchards and groves are not registered as organic, and that production may be more intensive due to the specific market focus. For vegetables, grading standards including unit size may be relevant factors affecting yield assessments, and horticultural systems are notoriously diverse in terms of scale and cropping activities.

## 3.3 Crop output

To estimate the impacts of these relative yields on total organic production, we extended the per hectare yield estimates for fully organic land to include in-conversion land. The total production results (Figure 3.1) clearly show the difference in production potential between the linear growth scenarios, with future land use similar to current organic land use, and the 25% equal shares scenario, involving a rebalancing of organic systems to include proportionally more cropland and less grassland, reflecting current total agriculture production more closely.

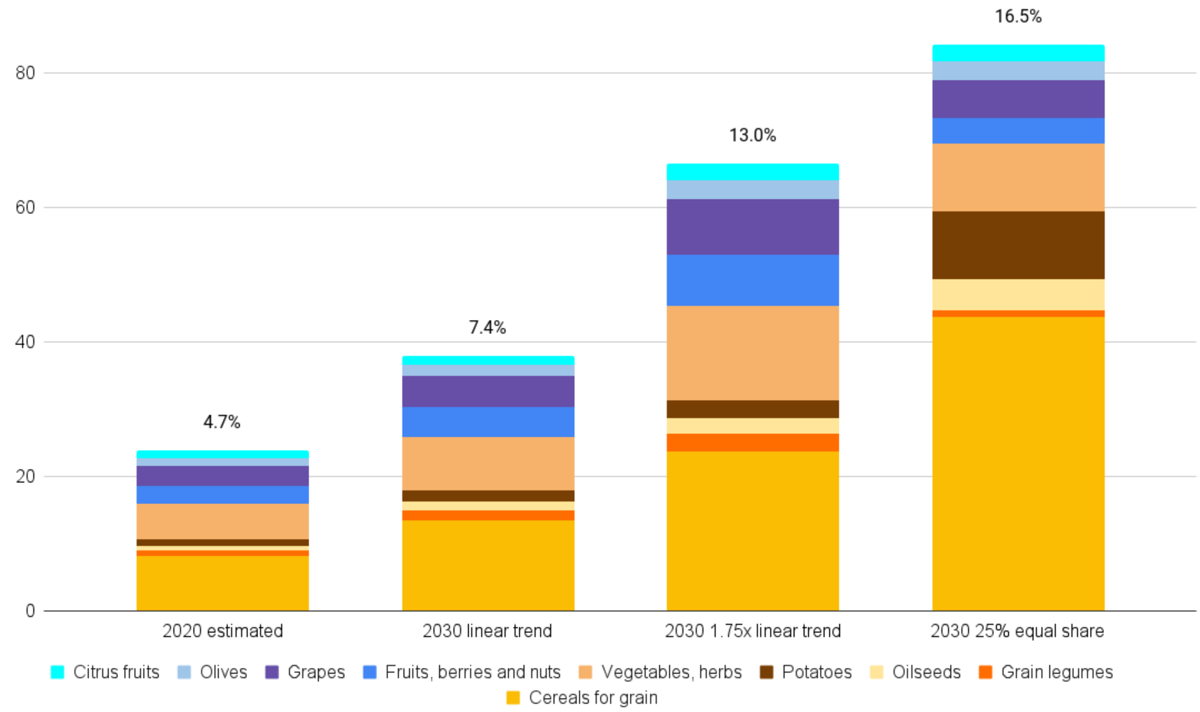


*Figure 3.1: EU27 organic crop output projections for 2020 and 2030 scenarios (million tonnes)*

See section 1.3 for an explanation of the 2030 scenarios
% values are share of EU27 total UAA (full column represents total organic UAA)

The estimated reductions in total output resulting from lower yields (Figure 3.2) indicate that cereals output, for example, might fall by 10% in the 25% equal share scenario, which involves a larger proportional increase in arable area. This study indicates that this can be more than offset by reductions in livestock numbers and demand for livestock feed (see Section 6.2). A lower reduction of only 5% is estimated in the 1.75x linear growth scenario, due to the increased prevalence of grassland and other crops with lower yield differentials. However, the very high proportions of grain legumes and horticultural crops in the linear growth scenario (explained above) leads to a high projected total output reduction.

Assuming that the productivity of organic systems might be increased by a combination of better quality land converting, better training and advice on system optimisation, and further research to improve organic systems, we have also estimated the impact of a 20% improvement in relative yields per hectare (10% for grapes, olives and citrus which already have high relative yields). In this context, the estimated 10% reduction in total cereals output for the 25% equal share scenario would be reduced to 7%.

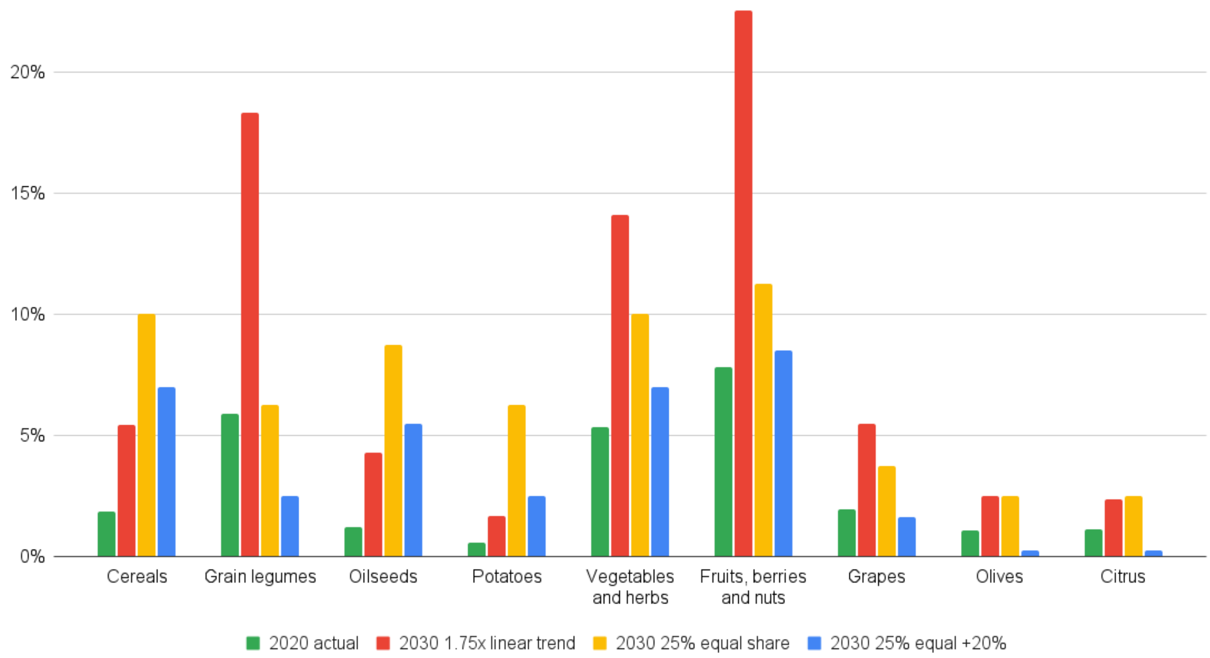


*Figure 3.2: Percentage reductions in total EU27 crop output resulting from organic farming in 2020 and 2030 25% scenarios*

See section 1.3 for an explanation of the 2030 scenarios

## 3.4 Individual country results

As with the crop areas, the results for individual countries show very diverse outcomes (Figure 3.3 to Figure 3.6). The different scenarios are outlined in Section 1.3.

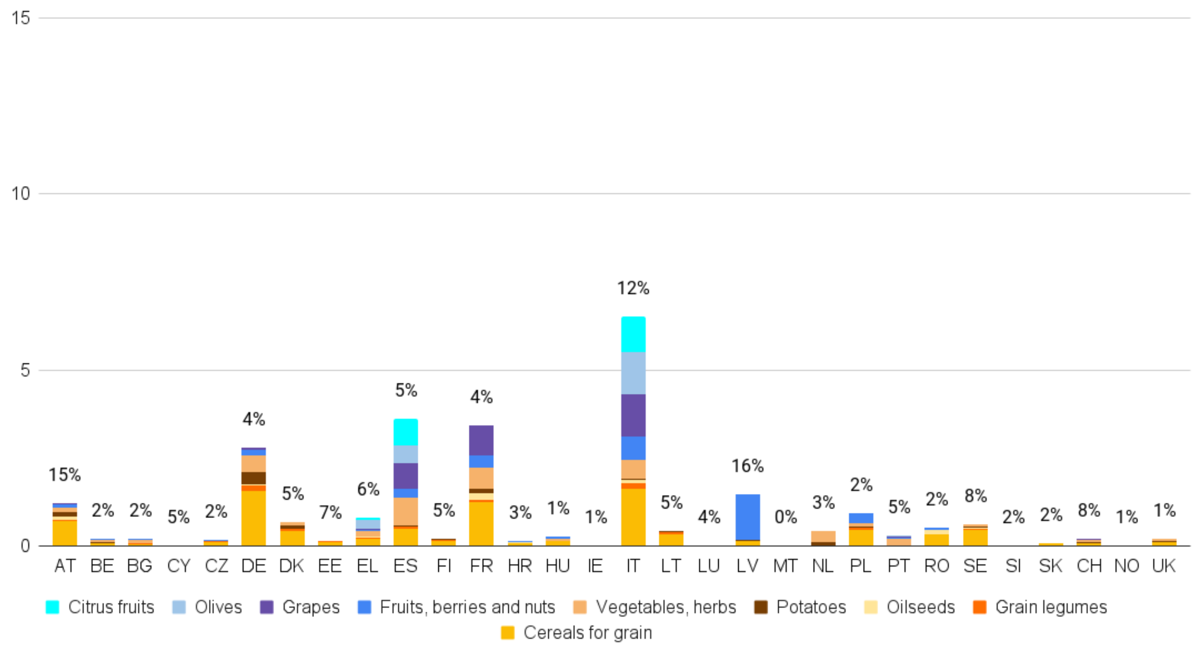


*Figure 3.3: Organic crop output (million tonnes, 2020 actual) in EU27 Member States, CH, NO and UK*

% values are share of national total crop output (full column represents total organic crop output)

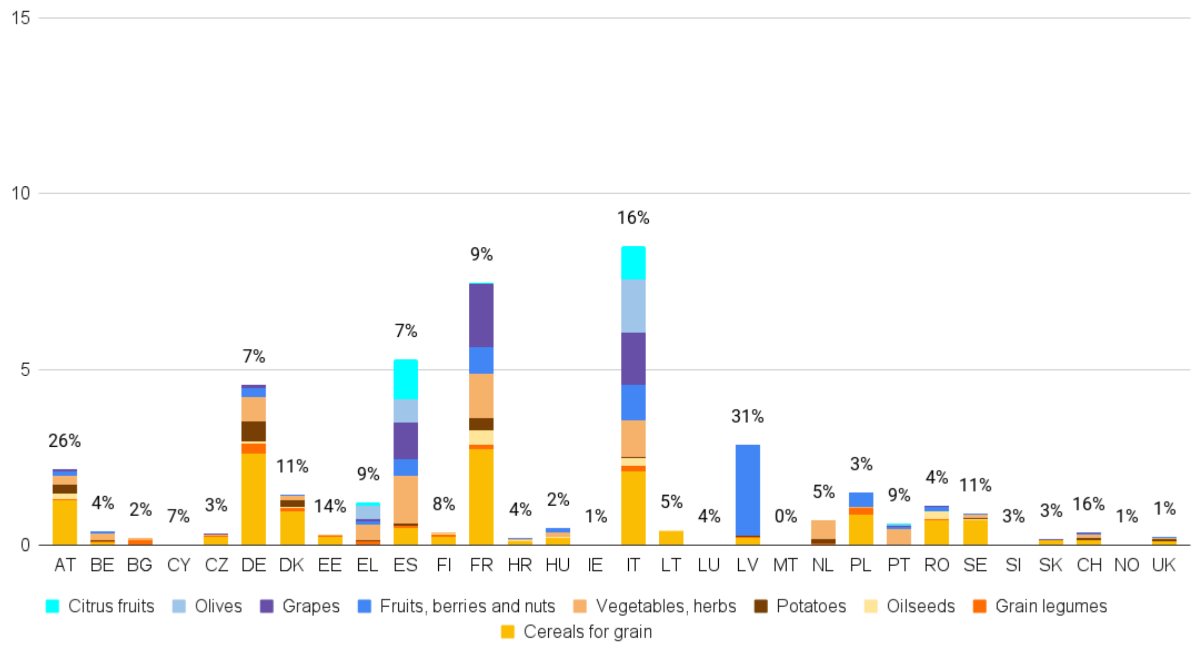


*Figure 3.4: Organic crop output projections (million tonnes, 2030 linear growth scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total crop output (full column represents total organic crop output)

Consistent with the land area projections, four countries (DE, ES, FR, IT) dominate the total output of organic products in the scenarios delivering 25% (Figure 3.5 and Figure 3.6), with Latvia (LV) and Poland (PL) playing a potentially important role with respect to fruit product in the linear growth scenario, but less so in the equal shares scenario.

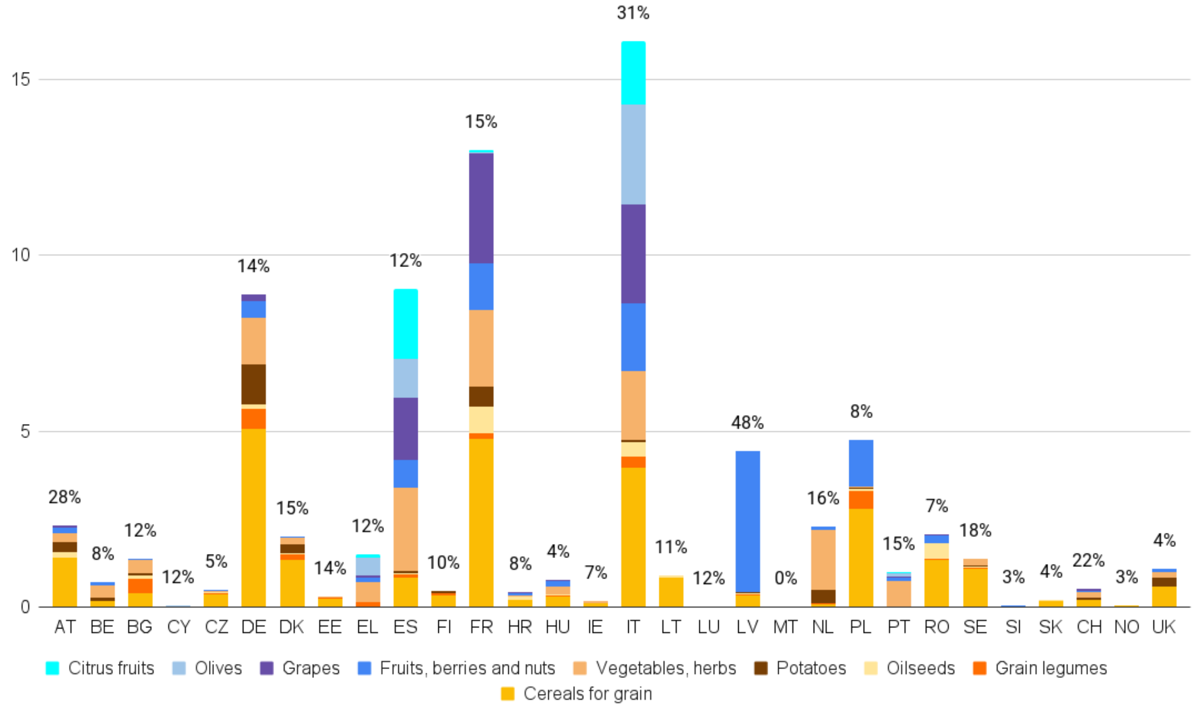


*Figure 3.5: Organic crop output projections (million tonnes, 2030 higher linear growth scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total crop output (full column represents total organic crop output)

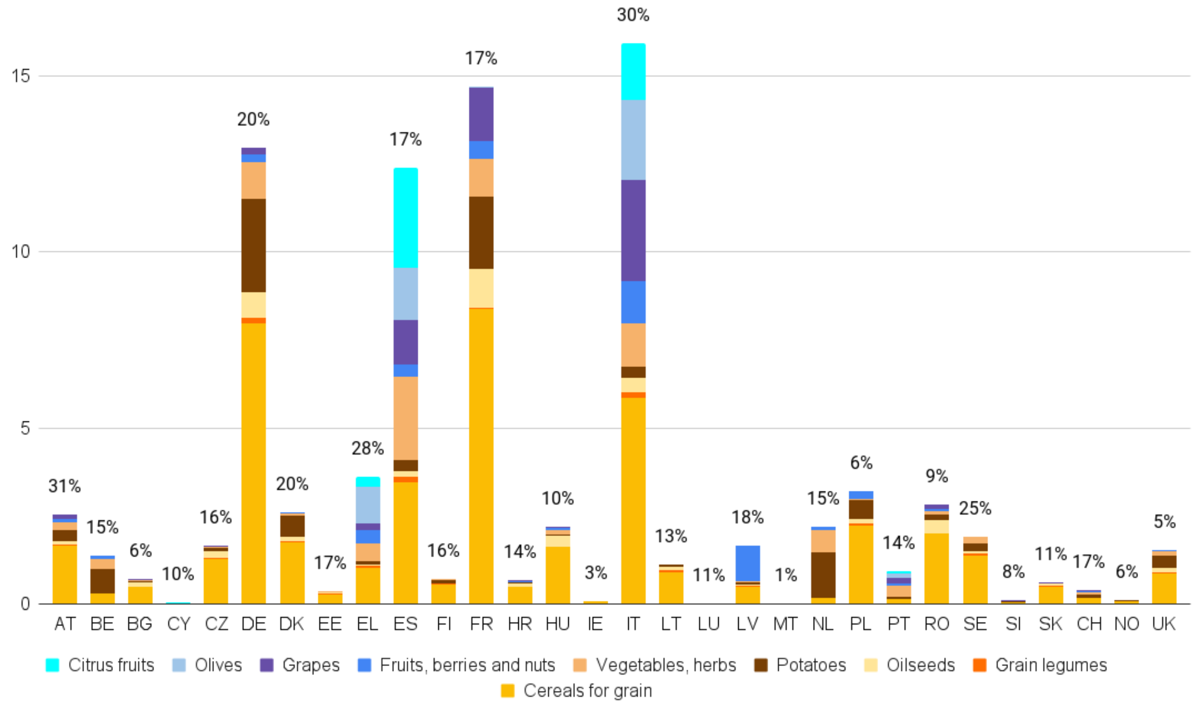


*Figure 3.6: Organic crop output projections (million tonnes, 2030 national equal shares scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total crop output (full column represents total organic crop output)

# 4 Nitrogen fertiliser use

## 4.1 Introduction

Organic farming does not use synthetic nitrogen fertiliser, which has significant positive environmental impacts, including:

- reduced climate-relevant nitrous oxide and ammonia emissions,
- reduced nitrate leaching affecting water quality, and
- positive biodiversity impacts through the reduction of eutrophication in surface waters and the protection of N-sensitive species.

Nitrogen fertiliser production is also an energy intensive process, accounting for 50% of energy use in European agriculture[14] as well as GHG emissions of about 3.5t $CO_2$e/t N[15] normally attributed to manufacturing rather than agriculture in GHG inventories.

The primary source of nitrogen in organic farming is biological fixation through legumes, in particular clover/grass or lucerne/grass mixtures which according to the IPCC[16] have negligible direct nitrous oxide and ammonia emissions, significantly reduced nitrate leaching risks (except at the point of ploughing-in), and contribute other benefits including increased soil carbon, soil biodiversity and pollinators. The utilisation of these forage crops by livestock and the recycling of the nutrients through livestock manures and slurries or biogas digestate can however lead to nitrous oxide and ammonia emissions as well as losses to water courses, but these losses are reduced at least in proportion to the reductions in livestock numbers on organic farms (see Section 6).

Pan-European statistics on nitrogen fertiliser use in agriculture are limited to total agriculture values in Eurostat[17], making no distinction between different crops. Other sources[18] make a distinction between usage on cropland (arable and permanent crops) and grassland. We used 2019 values from these sources, adjusting in some cases to ensure consistency with the Eurostat totals.

On average across the EU27, 66 kg N/ha non-organic UAA, totalling just over 9.75 million tonnes (Mt), were used in 2019. The majority was used on cropland (8.5 Mt, 82 kg N/ha non-organic UAA), with only 1.25 Mt or 28 kg N/ha non-organic UAA used on permanent grassland. These figures conceal potentially much higher uses on crops like wheat and on grassland (including temporary grass) for milk production.

## 4.2 Results and conclusions

25% of land under organic management on an equal sector shares basis in 2030 could potentially result in a reduction in total EU27 nitrogen use of 2.7 million tonnes (Mt) annually, or 26% of the estimated total nitrogen used in 2019 if there were no organic farming (Figure 4.1). On this basis, existing organic farming already delivers a reduction of 0.9 Mt N use, or 8.5% of the total. In terms of actual total N use in 2019, the additional organic land required to reach 25% by 2030 could reduce nitrogen fertiliser use by nearly 1.85 Mt, or 18.6 % of total EU27 nitrogen fertiliser use in 2019. The Farm to Fork Strategy's target of a 20% reduction in fertiliser use by 2030 would therefore almost be delivered solely on the basis of organic farming if the 25% target can be achieved (equal share scenario). The impact on N fertiliser use would be reduced if less arable land in proportion to grassland were converted, as in the linear growth scenarios.

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[14] https://www.fertiliserseurope.com/wp-content/uploads/2019/08/FertilisersEurope-Harvesting_energy-V_2.pdf
[15] Menegat et al. (2022) https://www.nature.com/articles/s41598-022-18773-w.pdf
[16] https://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_11_Ch11_N2O&CO2.pdf
[17] https://ec.europa.eu/eurostat/databrowser/view/aei_fm_usefert/default/table?lang=en
[18] https://www.nature.com/articles/s41597-021-01061-z; https://springernature.figshare.com/collections/Crop_production_and_nitrogen_use_in_European_cropland_and_grassland_1961-2019/5320772/1

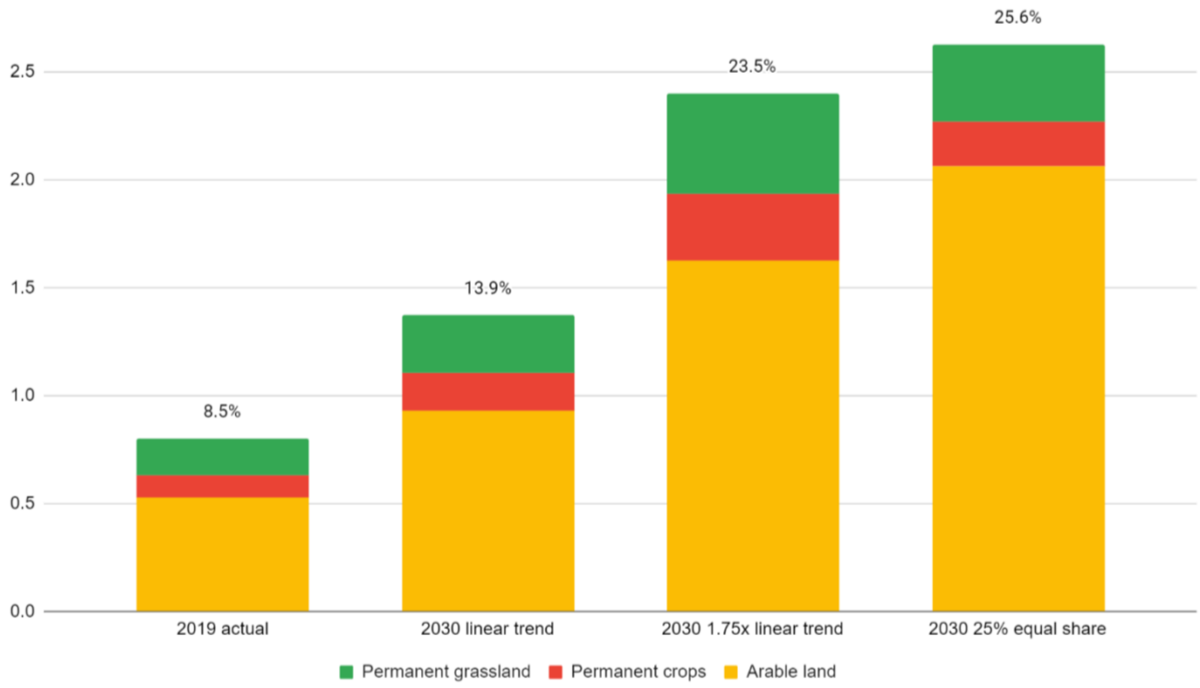


*Figure 4.1 Reductions in EU27 potential total annual nitrogen fertiliser use (million tonnes) resulting from organic land under different scenarios*

% values are share of EU27 total nitrogen fertiliser use (full column represents total reduction on all organic land)

The analysis is still quite crude – it would be desirable to make a more differentiated calculation with specific nitrogen use values for individual crop categories.

As discussed earlier, the reduction in nitrogen fertiliser use is not in itself important. More significant are the combined impacts on water quality, biodiversity, and greenhouse gas and ammonia emissions (see also below). We have not attempted in this study to estimate potential reductions in nitrate leaching, but these could also be substantial as organic farming is known to reduce nitrogen balances and consequentially nitrate leaching[19]. Menegat et al. (2022)[15] estimate EU28 nitrogen fertiliser use to contribute a total of 102.4 Mt $CO_2e$ annually to greenhouse gas emissions, or 9.2 kg CO2e/kg N used. The 2.7 Mt reduction in N fertiliser use from 25% organic farming in 2030 would contribute nearly 25 Mt $CO_2e$ annually to greenhouse gas emission reductions. This is equivalent to about 620 kg $CO_2e$/ha total organic area. About 38% of this reduction is relates to manufacturing and distribution (mainly energy use), with the balance due to reduced nitrous oxide emissions from soils.

[19] https://www.thuenen.de/media/publikationen/thuenen-report/Thuenen_Report_65.pdf

## 4.3 Individual country results

The potential nitrogen reduction outcomes in individual EU Member States and CH, NO and UK can be seen in Figure 4.2 to Figure 4.5, where each chart represents an individual scenario. The scenarios are outlined in Section 1.3.

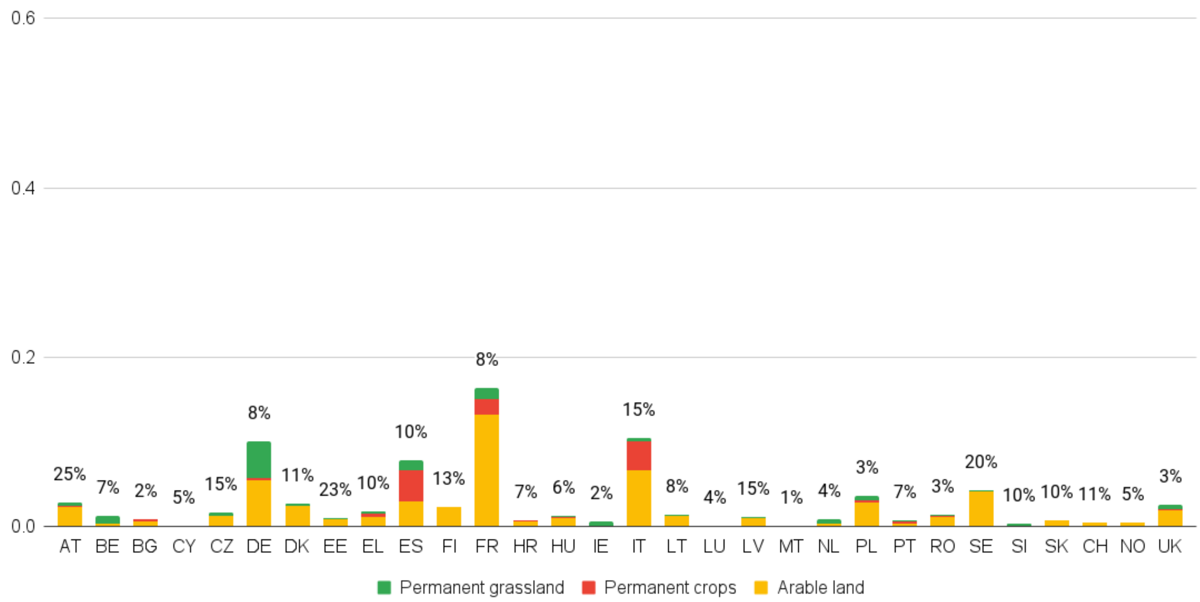


*Figure 4.2: Reduction in potential total nitrogen fertiliser use (Mt N annually) on existing organic land (2019 estimated) in EU27 Member States, CH, NO and UK*

% values are share of national total N use (full column represents total reduction on all organic land)

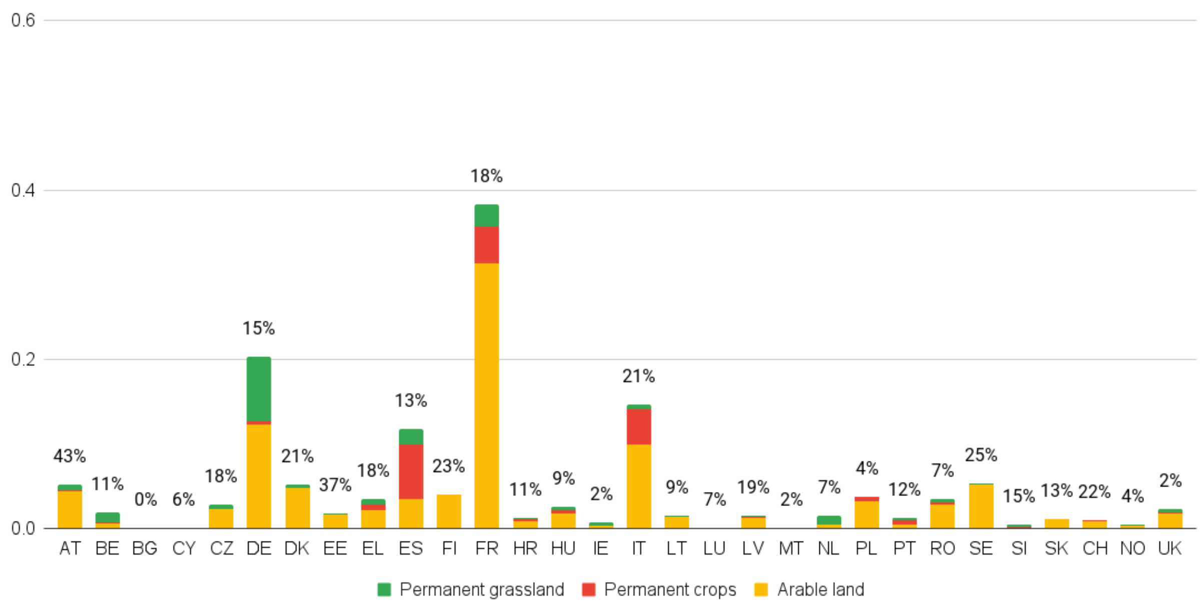


*Figure 4.3: Reduction in potential total nitrogen fertiliser use (Mt N annually) on organic land (2030 linear growth scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total N use (full column represents total reduction on all organic land)

France (FR), with its high proportion of arable land in the land area projections (Figure 2.4 and Figure 2.5), dominates the potential for nitrogen reduction with over 0.6 Mt or 30% of national N-fertiliser use annually in the scenarios that deliver the 25% EU target (Figure 4.4 and Figure 4.5). This represents nearly 25% of the total EU N-fertiliser reduction potential from achieving the target. Germany (DE) with a greater share of permanent grassland shows correspondingly less potential, though still substantial.

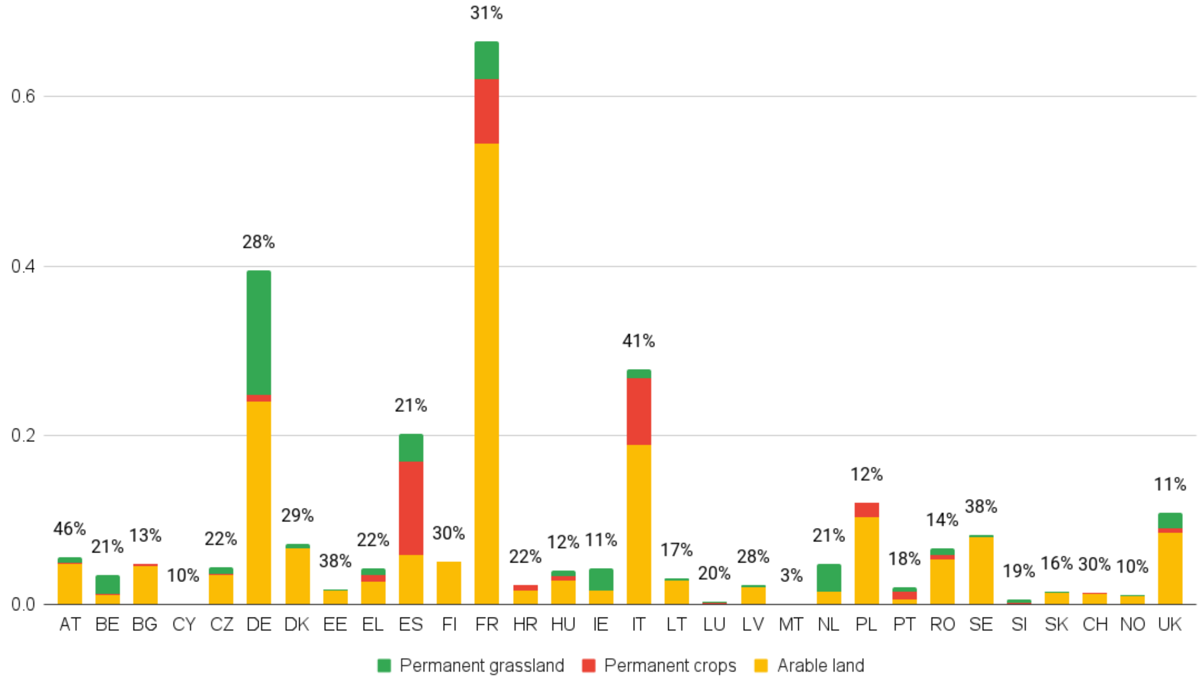


*Figure 4.4: Reduction in potential total nitrogen fertiliser use (Mt N annually) on organic land (2030 higher linear growth scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total N use (full column represents total reduction on all organic land)

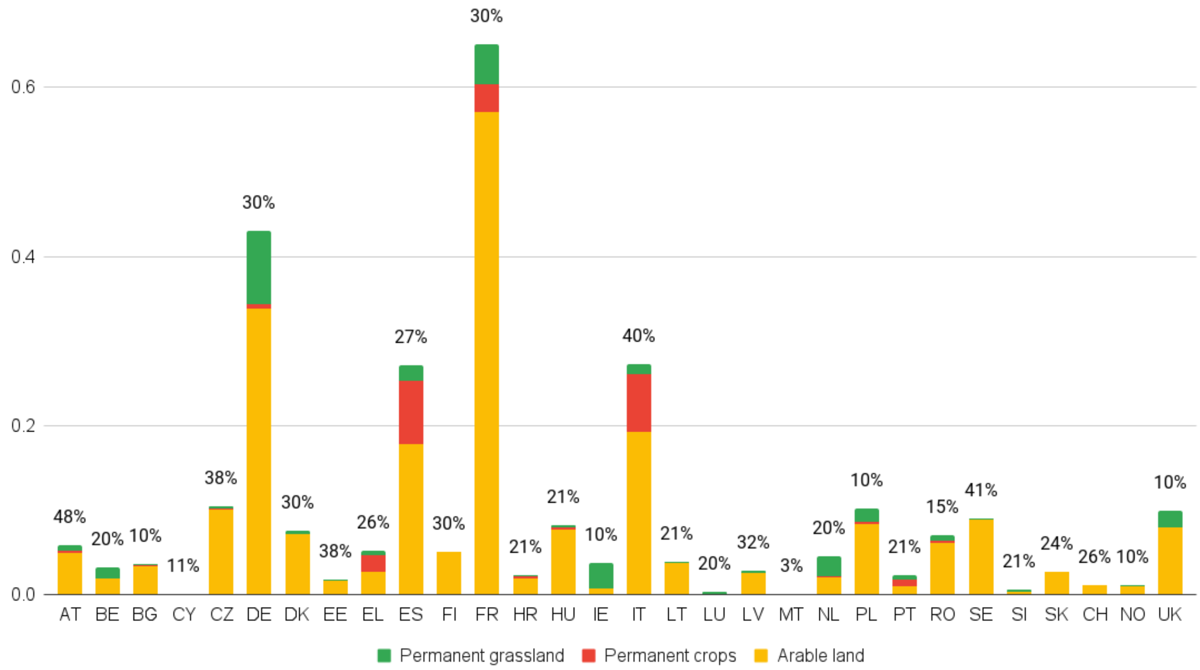


*Figure 4.5: Reduction in potential total nitrogen fertiliser use (Mt N annually) on organic land (2030 national equal shares scenario) in EU27 Member States, CH, NO and UK*

% values are share of national total N use (full column represents total reduction on all organic land)

# 5 Pesticide use

## 5.1 Introduction

The use of pesticides in agriculture and concerns about their potential impacts on the environment and human health have been a major influence on the development of organic farming and the demand for organic food over more than seventy years. During this time many active ingredients have been prohibited, reflecting the environmental concerns. As a further step, the EU published the Sustainable Use of Pesticides Directive[20] and Member States implemented National Action Plans[21] to deliver this. The European Commission's Farm to Fork Strategy[22] proposed two targets for agricultural pesticide use reduction, related to a three year (2015-2017) baseline:

1. 50% reduction in the use and risk of chemical pesticides, with measurement based on
   - the quantities of active substances contained in the pesticides which are placed on the market (sold), and therefore used, in each Member State, and
   - the hazard properties of the active substances, as reflected in the Harmonised Risk Indicator[23].
2. 50% reduction in the use of more hazardous pesticides, with measurement based on
   - the quantities of more hazardous active substances or 'candidates for substitution'[24].

The pesticide data available[25] for EU Member States, CH, NO and UK from Eurostat are currently limited to total quantities of active ingredients sold and some limited assessments of quantities of active ingredients used on individual crops, but not differentiated by individual active ingredient. While the use of active ingredients as an indicator of pesticide use is more precise than total product quantities, which may include water for dilution or other non-active substances, it has little relevance in terms of potential toxicity or environmental impact. The development of the Harmonised Risk Indicator[20] is an attempt to address this, by grouping active substances in generic hazard categories. This is, however, not adequate[26] to assess many of the products used in organic farming, such as sulphur and vegetable oils, where the whole product counts as an active ingredient and are used in larger quantities but with minimal environmental impact. This undermines the potential contribution of organic farming to the Farm to Fork pesticide reduction targets. There are more sophisticated approaches available, such as the Pesticide Load Index[27] (PLI) developed in Denmark, implemented in a number of countries, and supported by University of Hertfordshire databases[28] on active substances. However, the application of the PLI approach requires information on individual active substances not currently available through Eurostat.

As far as organic farming is concerned, not all pesticides are prohibited, but the vast majority are, and for some categories such as herbicides, no products are permitted. Many of the permitted products[29] are natural products or food-based products, or microbes such as *Bacillus thuringiensis*. In general terms, chemically synthesised pesticides are prohibited, with a few exceptions such as ferric phosphate as a molluscicide, copper compounds used as fungicides, and products like deltamethrin permitted only for use as an insecticide in pheromone traps. There is however a big difference between products being permitted for use

[20] https://ec.europa.eu/food/plants/pesticides/sustainable-use-pesticides_en
[21] https://ec.europa.eu/food/plants/pesticides/sustainable-use-pesticides/national-action-plans_en
[22] https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en
[23] https://ec.europa.eu/food/plants/pesticides/sustainable-use-pesticides/harmonised-risk-indicators_en
[24] Article 24 of Regulation (EC) No 1107/2009 and listed in Part E of the Annex to Implementing Regulation (EU) No 540/2011, or containing one or more active substances listed in the Annex to Implementing Regulation (EU) 2015/408
[25] See also: https://ec.europa.eu/food/plants/pesticides/sustainable-use-pesticides/farm-fork-targets-progress_en
[26] https://www.global2000.at/sites/global/files/GLOBAL-2000_Report_HRI-1_220228.pdf
[27] https://www.sciencedirect.com/science/article/abs/pii/S0264837717306002
[28] http://sitem.herts.ac.uk/aeru/ppdb/ These databases also include assessments of products permitted for organic farming under EU organic regulations.
[29] https://eur-lex.europa.eu/eli/reg_impl/2021/1165/oj

in organic' farming and their actual use in practice, which may be restricted to a small number of specialist crops. There is currently no dataset available indicating how much pesticide is actually used in organic farming, on what crops and on what proportion of land area. While EU organic regulations specify that records on the use of pesticides need to be kept by farmers, and these are checked by the authorised control bodies, the data are not normally collected or collated for analysis of actual usage at a sector level.

Due to the data limitations and the complexity of the issues, we were not able to complete a quantitative assessment for pesticides similar to others undertaken in this report.

## 5.2 Results and conclusions

In broad terms, it is likely that less than 10%[30] of the active ingredients permitted for use in non-organic farming (Table 5.2) are able to be used in organic farming, and that an even smaller percentage is actually used in practice. Anecdotal reports suggest that most organic land, especially grassland, uses no pesticides at all, and that usage is focused on horticultural crops (vegetables, in particular potatoes, and berries) as well as permanent crops (pome and stone fruits, citrus, grapes and olives), primarily for insect pest and fungal disease control.

*Table 5.2: Total active ingredients sold in EU 27 Member States by category and relevance to organic farming*

| Category | Total active ingredients (kt) | Share of total active ingredients | Usage in organic farming |
|---|---|---|---|
| Herbicides | 122 | 34% | None |
| Fungicides & bactericides | 150 | 41% | Copper, Sulphur |
| Insecticides & molluscicides | 50 | 14% | Pyrethrum, Ferric phosphate |
| Growth promoters | 10 | 0.3% | Negligible (citrus oils for storage) |
| Other | 30 | 8% | Mineral & vegetable oils |
| Total | 362 | 100% | |

Of the permitted products in organic farming, copper compounds have attracted the most critical attention, due to the potential environmental impact of copper accumulation in soils. This problem is well-recognised within the sector, with several research projects and regulatory adjustments leading to significant reductions in copper use over time[31]. Historically (from 1992), 40 kg Cu/ha over five years were permitted in organic farming, reduced to 30 kg in 5 years in 2008. The current EU organic and pesticide regulations permit a maximum of 28 kg Cu/ha over a seven year period, or 4 kg/ha per year on average, and copper is identified as a candidate for substitution. In five Member States (DK, EE, FI, NL, SE), copper is not registered as a plant protection product. In others, such as Germany, many of the organic organisations have restricted use to 3 kg Cu/ha per year.

In a study[32] of the use of copper-based fungicides in 12 European countries (BE, BG, DE, DK, EE, ES, FR, HU, IT, NO, CH and UK), Tamm et al. (2022) estimated that 3,258 t copper metal per year is used by organic farming, equivalent to 52% of the permitted annual dosage according to the EU organic regulations. This amount is split between olives (1,263 t/year), grapes (990 t/year), and almonds (317 t/year), followed by other crops, including potatoes, with much smaller annual uses (80 t/year). In 56% of the allowed cases (countries × crops), farmers use less than half of the allowed amount, and in 27%, they use less than a quarter.

[30] 8% excluding inert gases according to German pesticide regulators: https://www.bvl.bund.de/SharedDocs/Downloads/04_Pflanzenschutzmittel/01_meldungen_par_64/meld_par_64_2020.pdf;jsessionid=66457CEB12EFFC9AD81C8A806CBBE0CA.2_cid290?__blob=publicationFile&v=5

[31] https://www.organicseurope.bio/content/uploads/2020/10/ifoam_eu_copper_minimisation_in_organic_farming_may2018_0.pdf?dd

[32] https://orgprints.org/id/eprint/43952/1/Tamm_2022.pdf

As Eurostat does produce statistics specifically for copper compounds, we have attempted to analyse the potential scale of organic copper use relative to total copper use at the European level. We have done this on the basis of the Tamm et al. study with respect to average copper use on different organic crops (potatoes 2.0, vegetables 0.4, fruit and nuts 1.6, grapes 2.8, citrus 2.4, olives 2.0, other permanent crops 1.2 kg/ha) multiplied by the total area of those crops (Table 5.3). We estimate that less than 4 t Cu were used on organic farms in the EU in 2020, representing 30% of total EU27 sales, and 50% of the permitted usage levels in organic farming. 70% of copper use in EU agriculture is still attributable to conventional farms, which is consistent with the findings of a recent French study[33]. However, average use per ha is higher on organic land than on non-organic, as non-organic farmers have access to and higher use of alternative products.

*Table 5.3: Estimated copper fungicide (Cu) use on organic farms in EU27 Member States, CH, NO and UK*

| Country | Total sales 2020 (t) | Estimated organic use (t) | Organic as % of total | Organic max at 4kg/ha limit | Organic as % of total |
|---|---|---|---|---|---|
| **EU27** | 12,312 | 3,762 | 30.6% | 6,797 | 55.2% |
| **AT** | 134 | 41 | 30.3% | 69 | 51.3% |
| **BE** | 41 | 5 | 13.2% | 9 | 23.1% |
| **BG** | 188 | 53 | 28.1% | 101 | 53.9% |
| **CY** | 29 | 6 | 20.9% | 11 | 39.1% |
| **CZ** | 89 | 12 | 13.4% | 24 | 26.9% |
| **DE** | 284 | 78 | 27.7% | 139 | 48.9% |
| **DK** | Not authorised | | | | |
| **EE** | Not authorised | | | | |
| **EL** | 489 | 164 | 33.5% | 274 | 55.9% |
| **ES** | 4,211 | 1,388 | 33.0% | 2,653 | 63.0% |
| **FI** | Not authorised | | | | |
| **FR** | 1,600 | 495 | 31.0% | 793 | 49.6% |
| **HR** | 87 | 30 | 35.0% | 64 | 74.2% |
| **HU** | 600 | 29 | 4.9% | 60 | 10.0% |
| **IE** | 1 | 0.4 | 40.8% | 1 | 54.8% |
| **IT** | 3,500 | 1,176 | 33.6% | 1,987 | 56.8% |
| **LT** | 10 | 8 | 82.1% | 20 | 197.6% |
| **LU** | 2 | 0.4 | 26.1% | 1 | 45.3% |
| **LV** | 1 | 0.1 | 20.0% | 19 | 3888.0% |
| **MT** | 1 | 0.1 | 5.2% | 0 | 10.8% |
| **NL** | Not authorised | | | | |
| **PL** | 150 | 96 | 64.1% | 197 | 131.2% |
| **PT** | 531 | 129 | 24.2% | 263 | 49.5% |
| **RO** | 286 | 38 | 13.4% | 90 | 31.3% |
| **SE** | Not authorised | | | | |
| **SI** | 39 | 6 | 16.4% | 14 | 35.2% |
| **SK** | 42 | 4 | 10.1% | 9 | 20.3% |
| **CH** | 20 | 10 | 50.6% | 16 | 80.7% |
| **NO** | 4 | 1.0 | 23.6% | 2 | 44.0% |
| **UK** | 50 | 12 | 23.2% | 26 | 51.3% |

[33] https://www.generations-futures.fr/actualites/cuivre-versus-fongicides-synthese/

# 6 Livestock numbers

## 6.1 Introduction

Although organic farming is often associated with the keeping of livestock and the use of livestock manures, this does not mean that livestock numbers will increase overall as a result of converting more land to organic. More typically, livestock numbers are reduced compared with non-organic production due to a combination of:

- the prevalence of extensive grassland in many countries (e.g., Austria (AT), Czechia (CZ)),
- the non-use of nitrogen fertiliser on grassland,
- the reduced use of cereals as feed for ruminants, and
- free-range production of non-ruminants.

This can be seen from the lower shares of organic in total livestock numbers compared with organic land shares in 2020:

- Total land area 9.1%
- Permanent grassland 12.4%
- Arable land 6.9%
- Cattle 6.0%
- Sheep 7.3%
- Goats 8.7%
- Poultry 3.8%
- Pigs 1.0%

To estimate 2030 organic livestock numbers, we have assumed that numbers will increase in proportion to the area of temporary and permanent grassland for ruminants and arable land including temporary grassland for non-ruminants. Average stocking rates were calculated on this basis, using the livestock unit (LU) conversion factors defined by Eurostat[34]. As our dataset was limited to consistent values for dairy cattle and other bovine animals only, we used a compromise value of 0.75 LU/head for other bovines. We calculated the average stocking rates in the EU in 2020 to be:

- Grazing livestock units per grassland hectare 0.5 (45% of non-organic 1.1)
- Non-ruminant livestock units per arable hectare 0.2 (25% of non-organic 0.7)
- Total livestock units per hectare UAA 0.4 (42% of non-organic 0.9)

These stocking rates were used to estimate the increase in total livestock units for ruminants and non-ruminants under different scenarios, and proportional increases were applied to the individual livestock category numbers. A sensitivity analysis assuming a 20% increase in these stocking rates is included in Figure 6.2.

## 6.2 Results and conclusions

The total number of animals kept on organic farms is projected to increase from just over 5 million LU in 2020, or 4% of the EU total, to almost 15 million LU, or 11% of the EU total, in the 1.75x linear trend scenario (Figure 6.1). The lower proportion of permanent grassland in the 25% equal shares scenario results in a substantial reduction in cattle numbers, with a smaller increase in pig and poultry production so that the total number of animals kept is less than 13 million LU or 9.5% of the EU total.

[34] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Livestock_unit_(LSU)

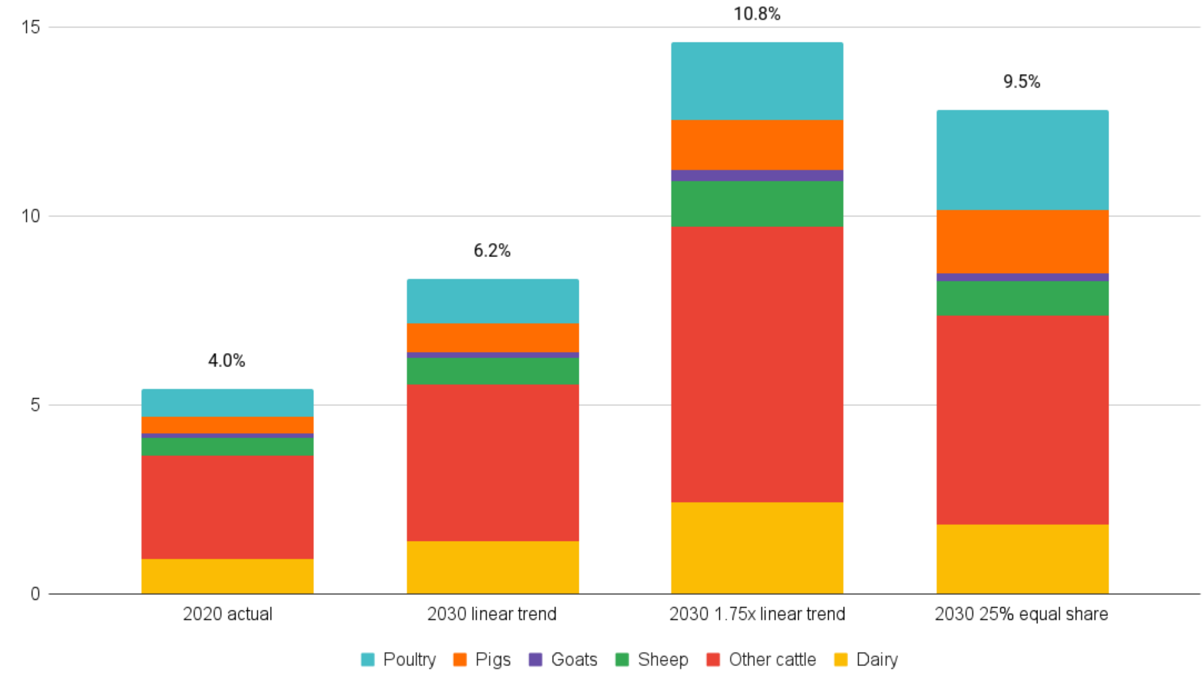


*Figure 6.1: EU27 organic livestock numbers (million LU) in 2020 and under different 2030 scenarios*

% values are share of EU27 total livestock units (full column represents total livestock units on all organic land)

The reduction in total livestock numbers resulting from 25% organic farmland is potentially highly relevant for reducing greenhouse gas and ammonia emissions, as well as balancing the reduction in crop output discussed in Section 3. Figure 6.2 shows the projected reductions for the main livestock groups: ruminants (cattle, sheep and goats) and non-ruminants (pigs and poultry) under different scenarios, including a 20% productivity increase as sensitivity analysis for the 25% equal shares scenario.

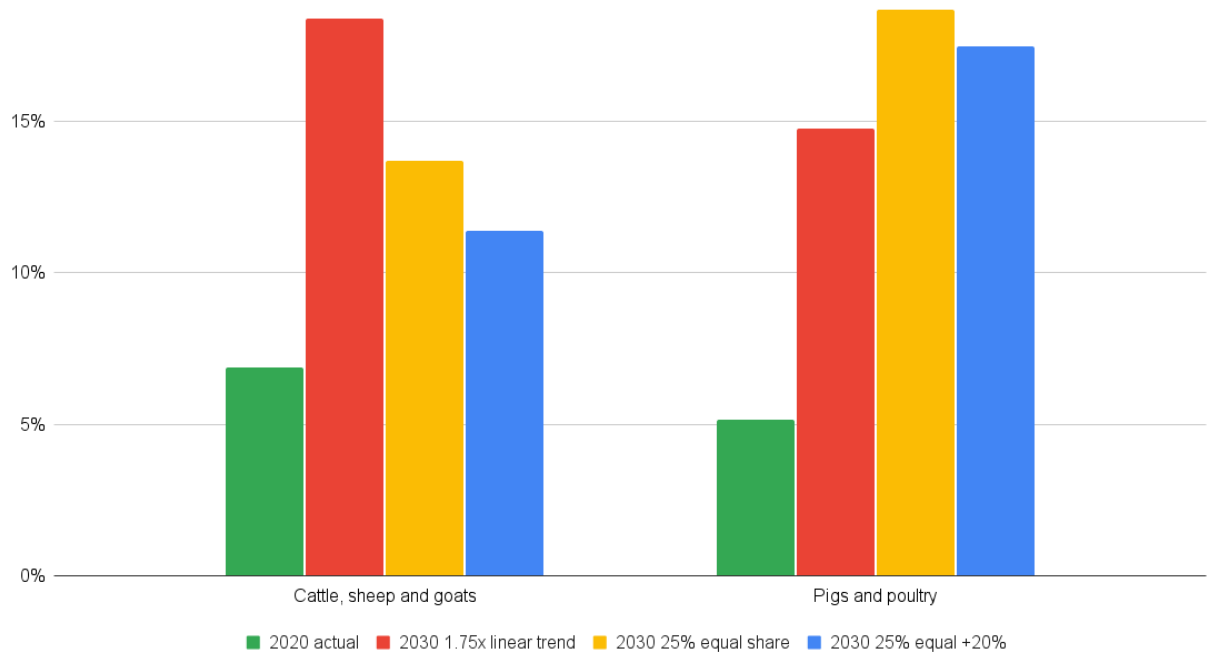


*Figure 6.2: Percentage reduction in total EU27 livestock numbers by livestock category on organic land under different scenarios*

Organic production in 2020 already delivers a 7% reduction in ruminant numbers compared with the situation that might exist if all land were stocked at the current rate on non-organic land. In the 1.75x linear trend scenario, involving proportionally more ruminant livestock, an additional 11% reduction (combined total 18%) in total EU27 livestock numbers is projected in 2030. In the 25% equal share scenario the reduction in ruminant numbers is less pronounced, but higher for pigs and poultry, reflecting the different proportions of permanent grassland and arable land in these scenarios. A 20% increase in productivity would reduce the output reductions slightly but does not have a major impact.

The projected reductions in livestock numbers are compatible with the continuing decline in consumer demand for livestock products. The EU Agricultural Outlook projections[35] forecast a decline in dairy product consumption of 0.2% annually to 2031, compared with 0.5% in 2021, and a decline in per capita meat consumption from almost 70kg/year in 2021 to 67kg/year by 2031. Large cohort studies in France[36] and earlier studies in Germany have demonstrated that organic consumers typically consume even less meat and dairy products and more plant-derived products, potentially even reducing the total land area needed to feed the population despite yield reductions[19]. Recent trends towards veganism and vegetarianism are likely to enhance this.

Although the EU Agricultural Outlook projections suggested that declining consumption could be compensated by increasing exports and continued increases in production, total EU27 livestock numbers, particularly ruminants, declined in the 2016-2020 period and linear trend projections suggest a further 10% fall in total ruminant numbers by 2030, with pigs and poultry remaining constant. This results in an overall 5% decline in livestock numbers. Our results suggest that most, if not all, of the decline in ruminant numbers would be absorbed through the growth of organic land area, leaving non-organic production less affected. However, the projected decline in pigs and poultry numbers may be a more significant issue given current non-organic demand projections.

The projected reduction in livestock numbers under organic management does provide an important balancing factor for the decline in cereals and oilseeds projected in Section 3. The projected worst case scenario of a 29 Mt (10%) reduction in EU cereals output resulting under the 25% equal share scenario compares with 185 Mt, or 65% of total EU cereals production, used for livestock feed, equivalent to 1.4t per livestock unit (LU). The cereals reduction due to the 25% target would be equivalent to about 15% of the cereals currently used to feed to livestock in the EU. The demand for cereals would, however, also fall, due to the:

- 16% reduction in livestock numbers due to organic management, resulting in a 32 Mt reduction in cereals demand, on its own cancelling out the projected reduction in cereals output; and
- reduced cereals use for feeding organic livestock – reliable statistics for this are not available, but a 25% reduction per LU would reduce cereals demand by ca. 4.5 Mt.

In combination, these have the potential to more than balance the reduction in cereals, even if productivity increases in organic farming lead to higher stocking rates. More rapid reductions in consumer demand for meat and dairy products, and reductions in food waste could contribute further.

[35] https://ec.europa.eu/info/news/eu-agricultural-outlook-2021-31-consumer-behaviour-influence-meat-and-dairy-markets-2021-dec-09_en#:~:text=EU%20production%20is%20expected%20to,supply%20and%20improving%20producer%20prices.
[36] https://academic.oup.com/ajcn/article/109/4/1173/5455612

## 6.3 Individual country results

As with crop production, livestock output projections vary markedly between countries (Figure 6.3 to Figure 6.6), where each chart represents an individual scenario. The scenarios are outlined in Section 1.3. It should be noted that Malta (MT) currently has no organic livestock production and no areas designated as permanent grassland.

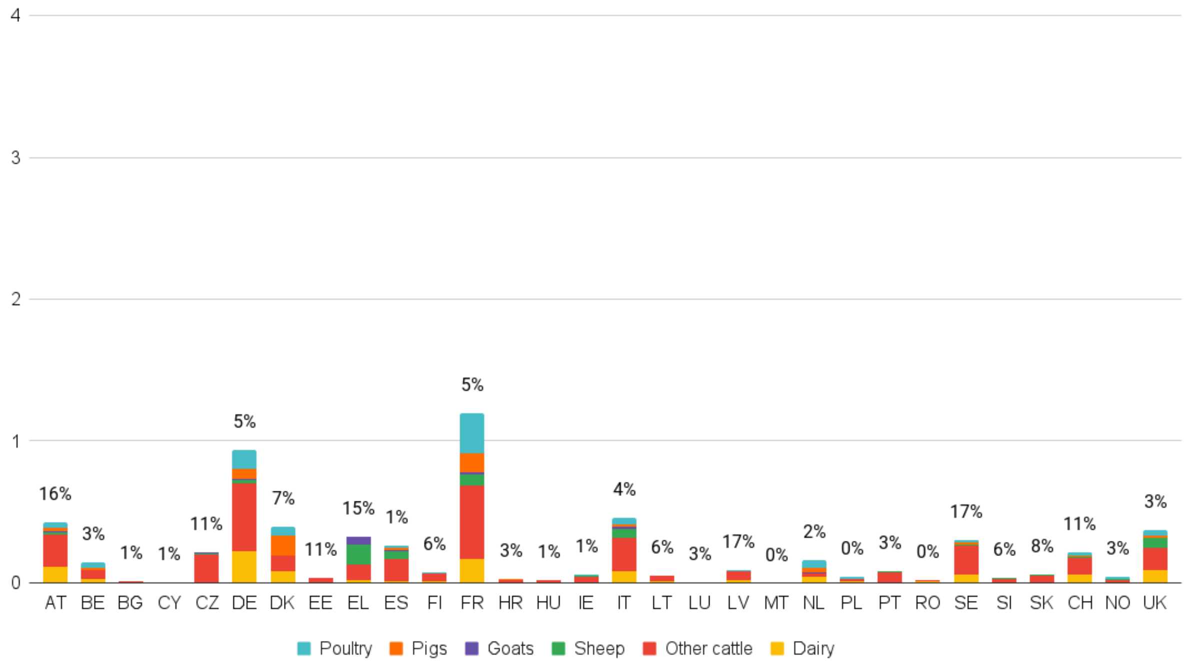


*Figure 6.3: Organic livestock numbers (million LU) in 2020 in EU27 Member States, CH, NO and UK*

% values are share of national total LU (full column represents total LU on all organic land)

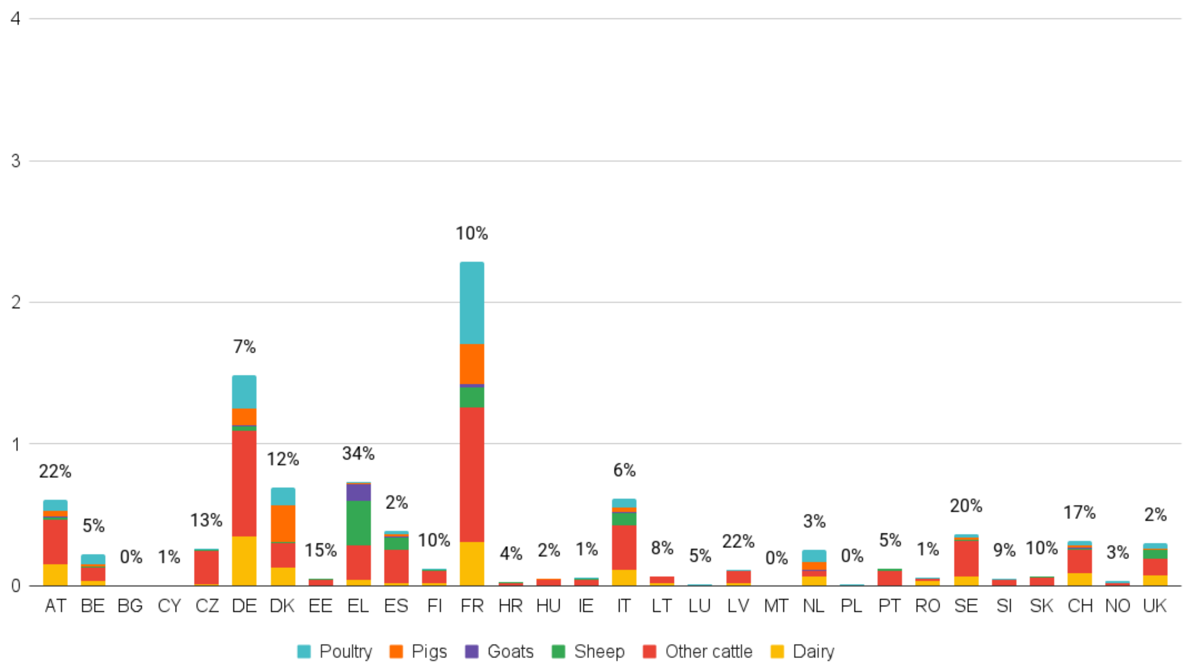


*Figure 6.4: Organic livestock numbers (million LU) on organic land under 2030 linear growth scenario in EU27 Member States, CH, NO and UK*

% values are share of national total LU (full column represents total LU on all organic land)

For Bulgaria (BG) and Poland (PL) the linear trend projections are for zero grassland therefore zero ruminants, very different to the equal share scenario. The analysis of the Eurostat statistics results in slightly higher stocking rates on organic compared with non-organic land in Latvia (LV), Lithuania (LT) and Greece (EL). as well as in Switzerland (CH) and the United Kingdom (UK). This leads to negative reductions (i.e., increases) in livestock numbers in contrast to the overall picture for the EU (as shown in Figure 6.2), resulting in relatively high percentage shares of total livestock production in these cases.

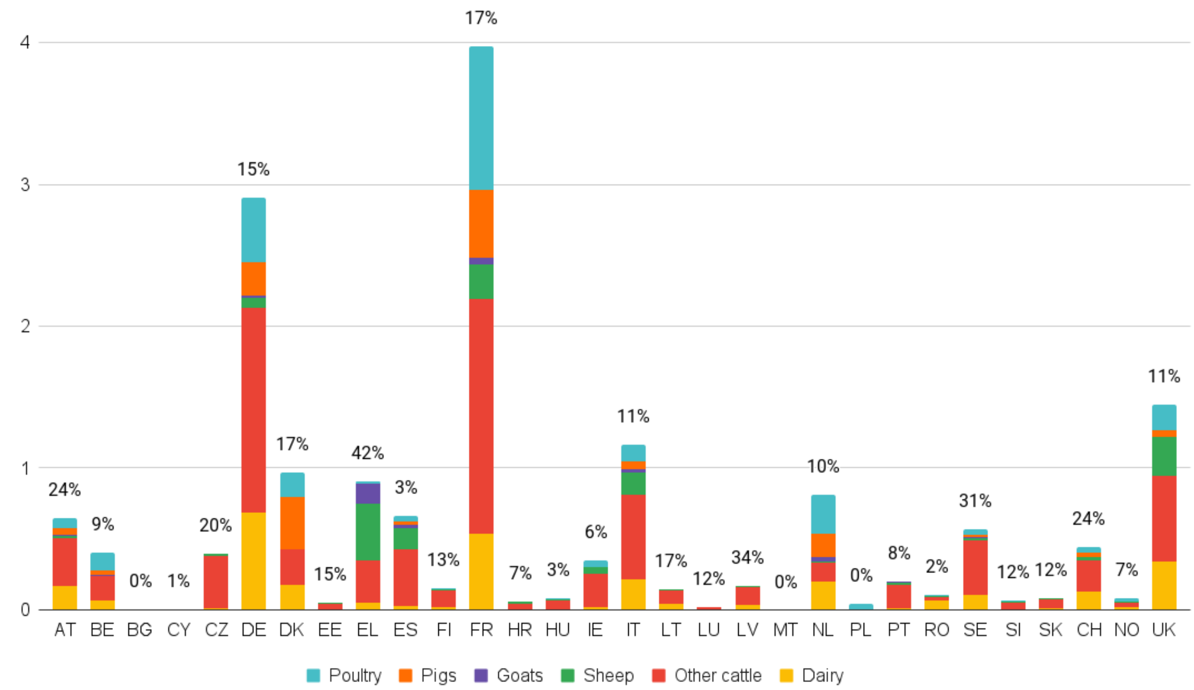


*Figure 6.5: Organic livestock numbers (million LU) on organic land under 2030 higher linear growth scenario in EU27 Member States, CH, NO and UK*

% values are share of national total LU (full column represents total LU on all organic land)

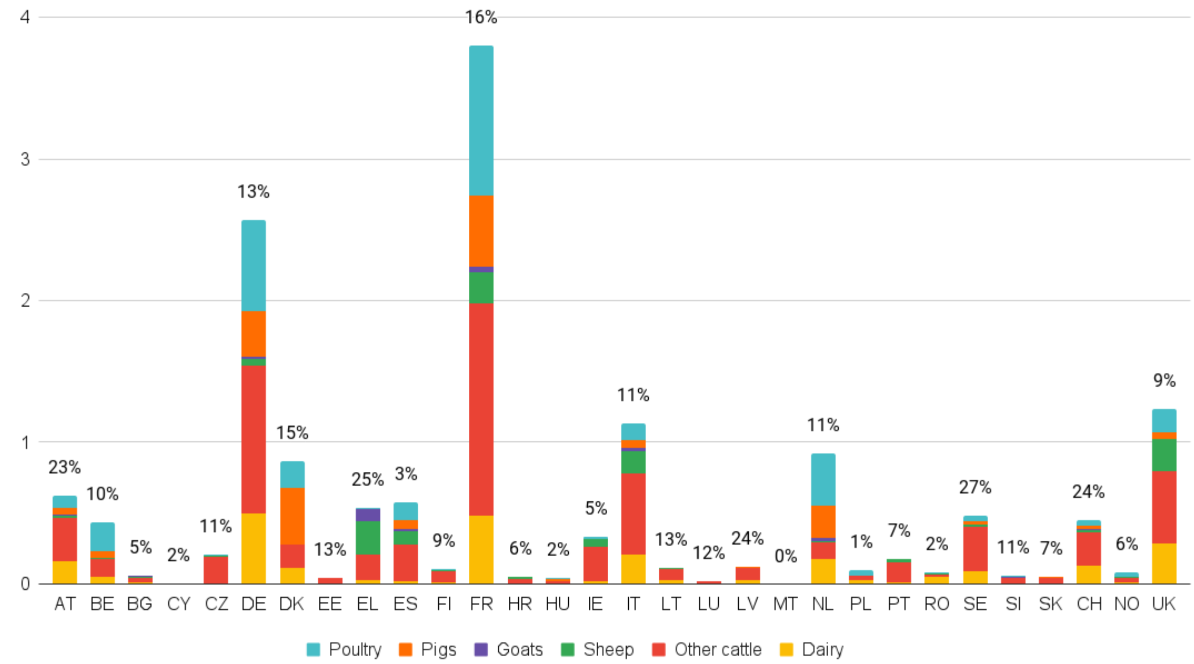


*Figure 6.6: Organic livestock numbers (million LU) on organic land under 2030 national equal shares scenario in EU27 Member States, CH, NO and UK*

% values are share of national total LU (full column represents total LU on all organic land)

# 7 Greenhouse gas emissions

## 7.1 Introduction

Greenhouse gas emissions from agriculture are derived from four main sources:

- Breakdown of soil organic matter and crop residues releasing mainly carbon dioxide ($CO_2$), potentially reversible if cultivated land is restored to grassland or forestry
- Enteric fermentation in the digestive system of ruminant livestock, and livestock manures generally, releasing mainly methane ($CH_4$)
- Mineralisation of nitrogen from fertilisers and atmospheric deposition in soils releasing mainly nitrous oxide ($N_2O$)
- Energy use in the manufacturing of inputs like fertilisers and for mechanical operations on farmland, releasing mainly $CO_2$

Ammonia ($NH_3$) emissions from livestock and fertiliser use are also relevant as an indirect source of nitrogen leading to $N_2O$ emissions.

The IPCC methodologies and national inventories for greenhouse gas emission reporting are notoriously complex. We have not attempted to calculate a complete carbon budget for organic farming due to data limitations. Instead, we have focused on some areas where clear potential for reduction exists. These three areas are:

- Reduced livestock numbers (Section 6) and pro rata impacts on methane emissions,
- Reduced N-fertiliser use (Section 4) and pro rata impacts on $N_2O$ emissions, and
- Increased proportion of temporary grassland in arable rotations (but not in equal share scenarios), with potential for carbon sequestration (reconversion to permanent grassland could be more effective, but assumed not to be significant land use change in this context)

This analysis bridges the Agricultural and LULUCF cropland and grassland categories in the IPCC national inventories but does not include energy use in manufacturing or on farms. In particular the energy use for nitrogen fertiliser production is significant, accounting for 50% of energy use in agriculture (see Section 4).

The Eurostat pan-European datasets for greenhouse gas emissions focuses on a limited number of key parameters listed in Table 7.1. In this Table, we have also set out the assumptions we have made in order to estimate potential greenhouse gas emission reductions. The assumptions link in different sections of this report, including crop areas, livestock numbers, nitrogen use and ammonia emissions.

We are conscious that there are many other ways in which organic management might reduce greenhouse gas emissions or increase carbon sequestration, for example:

- Improved manure management and application systems
- Reduced tillage practices
- Changes in livestock diets
- Changes in rooting depth of crops due to reduced surplus application of fertilisers, leading to more carbon stored lower in soil profile
- Inclusion of plantain in diverse forage mixtures reducing $N_2O$ emissions[37]

Due to the lack of appropriate data on the uptake of these practices on organic farms, we have not included any estimates of their impacts in this analysis.

[37] https://www.agresearch.co.nz/news/plantain-shows-potential-for-reducing-greenhouse-gas-emissions/#:~:text=%E2%80%9CA%20significant%20finding%20from%20this,senior%20scientist%20Dr%20Jiafa%20Luo

*Table 7.4: Assumptions used to estimate organic reductions for Eurostat published emissions parameters*

| GHG Emissions parameter | Assumption used |
|---|---|
| - Livestock | Sum of enteric and manure management reductions |
| - - Enteric fermentation | Sum of component reductions |
| - - - Enteric fermentation of cattle | Reduced pro rata to reduction in number of cattle |
| - - - Enteric fermentation of sheep | Reduced pro rata to reduction in number of sheep |
| - - - Enteric fermentation of swine | Reduced pro rata to reduction in number of pigs |
| - - - Enteric fermentation of other livestock | Reduced pro rata to reduction in number of livestock |
| - - Manure management | Sum of component reductions |
| - - - Cattle manure management | Reduced pro rata to reduction in number of cattle |
| - - - Sheep manure management | Reduced pro rata to reduction in number of sheep |
| - - - Swine manure management | Reduced pro rata to reduction in number of pigs |
| - - - Other livestock manure management | Reduced pro rata to reduction in number of livestock |
| - - - Manure management - indirect N2O emissions | Reduced pro rata to reduction in number of livestock |
| - Rice cultivation | No change |
| - Managed agricultural soils | Combination of N-fertiliser and ammonia reductions |
| - - Managed agricultural soils - direct N2O emissions | Reduced pro rata to reduction in total N-fertiliser use |
| - - Managed agricultural soils - indirect N2O emissions | Reduced pro rata to reduction in ammonia emissions excluding manure management (see above) |
| - Prescribed burning of savannas | Not applicable |
| - Field burning of agricultural residues | Total of cereals, other agricultural residues reductions |
| - - Field burning of cereals residues | Reduced by % of cereals land organic as not permitted |
| - - Field burning of pulses residues | No change |
| - - Field burning of tubers and roots residues | No change |
| - - Field burning of sugar cane residues | No change |
| - - Field burning of other agricultural residues | Reduced by % of arable land organic as not permitted |
| - Liming | No change |
| - Urea application | Reduced pro rata to reduction in total N-fertiliser use |
| - Other carbon-containing fertilisers | Reduced pro rata to reduction in number of livestock |
| - Other agriculture | No change |
| Land use, land use change, and forestry (LULUCF) | No change in unspecified categories, only cropland |
| - Cropland | Only unconverted grassland |
| - - Drainage, rewetting, other management of organic and mineral cropland soils - emissions and removals | No change |
| - - Unconverted cropland | 50% increase in temporary grassland @ 5t $CO_2$e/ha |
| - - Land converted to cropland | No change, assumed permanent grassland maintained |
| - Grassland | No change |
| - - Drainage, rewetting, other management of organic and mineral grassland soils - emissions and removals | No change |
| - - Unconverted grassland | No change |
| - - Land converted to grassland | No change |

## 7.2 Results and conclusions

The potential for reduced EU27 greenhouse gas (GHG) emissions from 25% organic land is illustrated in Figure 7.1. In 2020, organic farming delivered an estimated reduction of 24 million tonnes (Mt) carbon dioxide equivalents ($CO_2$e), or 5% of total adjusted[38] EU27 GHG emissions from agriculture and crop/grass LULUCF in 2019. The 1.75x linear trend scenario to reach 25% organic land is estimated to deliver a 68 Mt $CO_2$e reduction annually, or 15% of EU27 agriculture-related emissions. Not included in this total is the manufacturing sector impact of a reduction of 2.7 Mt of N fertiliser use under the 25% organic scenarios, potentially delivering an additional 9.5 Mt reduction in $CO_2$ emissions, mainly from reduced energy use.

An important element of this reduction is the carbon sequestration potential of the use of clover and lucerne grass mixtures as temporary grassland in organic rotations. This is estimated to represent a 50% increase in forage crops on arable land. However, in the equal share scenarios, the proportions of currently conventional temporary grassland and other crops are held constant to reach 25% each, so there is no carbon sequestration benefit to be derived, resulting in lower GHG emission reduction benefits of 44 Mt $CO_2$e or 9.5%.

These GHG emission reduction estimates for agriculture and crop/grass LULUCF are equivalent to 1.6-1.7t $CO_2$e/ha EU27 utilisable agricultural area (UAA) (Figure 7.2), or nearly 1.9t/ha if manufacturing energy reductions are included. Of the total 2.9t $CO_2$e/ha UAA emissions from all agricultural land assuming no organic farming, the 1.7t/ha estimated reduction (excluding manufacturing energy) leaves a further 1.2t/ha reduction, or just over 40%, needed by other means to achieve net zero on organic land.

## 7.3 Individual country results

The results for individual Member States, CH, NO and UK can be seen in Figure 7.3 to Figure 7.6, where each chart represents an individual scenario. The scenarios are outlined in Section 1.3. The emissions attributable to livestock are very low or zero in BG, MT and PL in the linear scenarios as a result of declining trends or initial zero values for livestock numbers as described in Section 6. The negative values for livestock in GR, LT, LV, CH and UK are linked to the increased livestock numbers projected as explained in Section 6.

[38] Actual 2019 emissions have been adjusted for the percentage reduction calculations to reflect the situation that might exist if there were no organic farming present

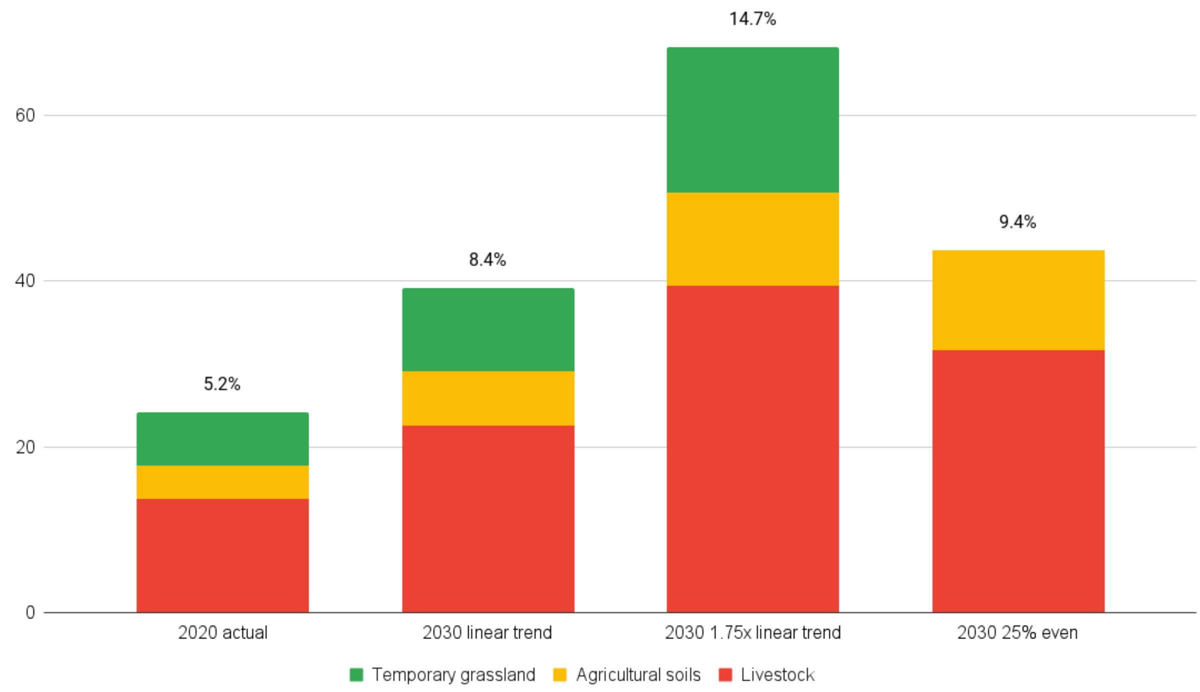


*Figure 7.1: Reduction in EU27 greenhouse gas emissions (Mt $CO_2e$) from organic farming in 2020 and for different scenarios in 2030*

Temporary grassland mainly $CO_2$ sequestration, Agricultural soils mainly $N_2O$, Livestock mainly $CH_4$
% values are share of total adjusted 2019 GHG emissions (agriculture and crop/grass LULUCF, full column represents total GHG reductions on all organic land)

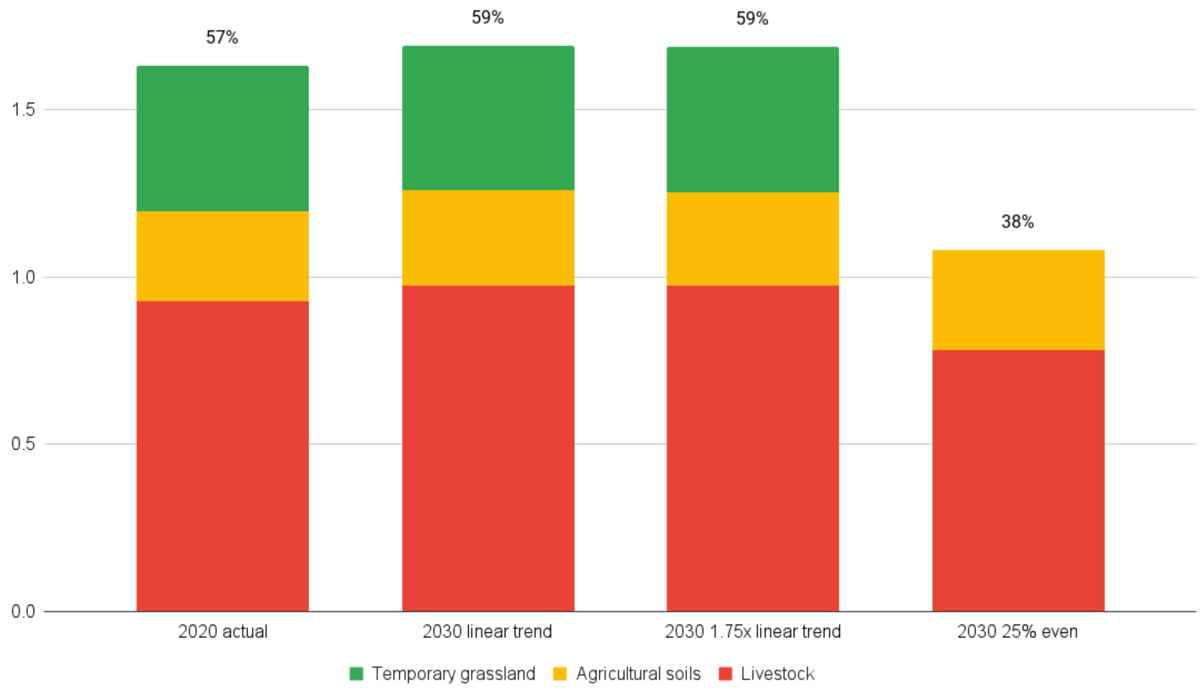


*Figure 7.2: Reductions in EU27 greenhouse gas emissions (t CO2e/ha UAA) from organic farming in 2020 and for different scenarios in 2030*

Temporary grassland mainly $CO_2$ sequestration, Agricultural soils mainly $N_2O$, Livestock mainly $CH_4$
% values are share of total adjusted 2019 GHG emissions per ha UAA (agriculture and crop/grass LULUCF) and represent the reduction in average emissions per hectare achievable on organic land based on the factors analysed

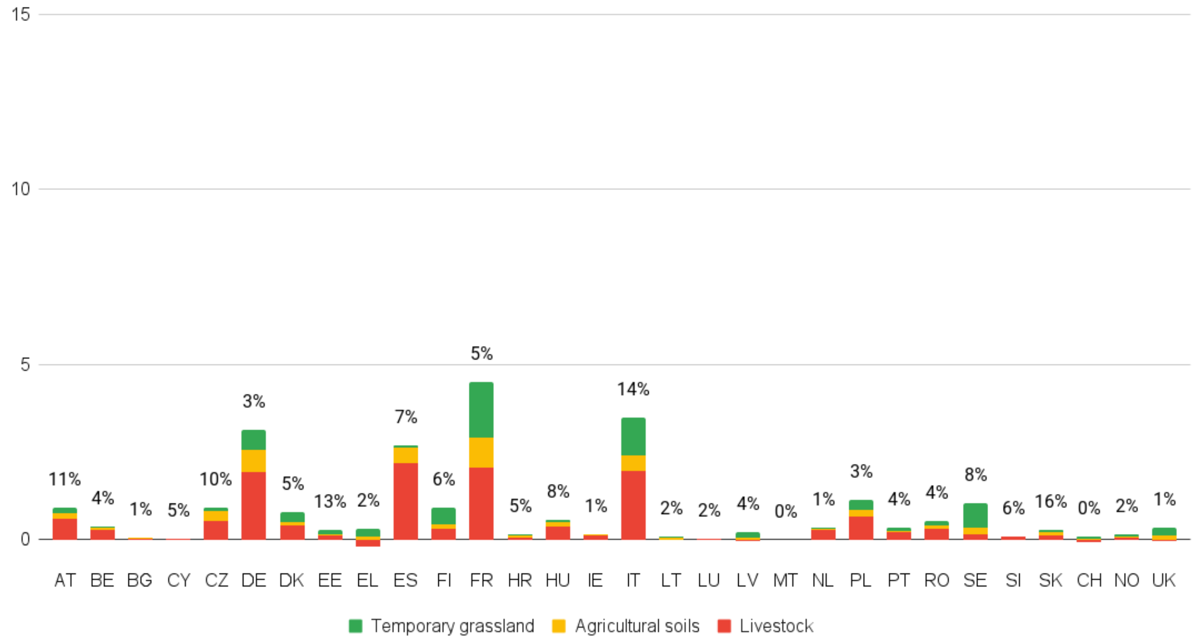


*Figure 7.3: Reduction in greenhouse emissions (Mt $CO_2$e) from organic farming in 2020 in EU27 Member States, CH, NO and UK*

Temporary grassland mainly $CO_2$ sequestration, Agricultural soils mainly $N_2O$, Livestock mainly $CH_4$
% values are share of national total adjusted 2019 GHG emissions (agriculture and crop/grass LULUCF, full column represents total reduction in GHG emissions on all organic land)

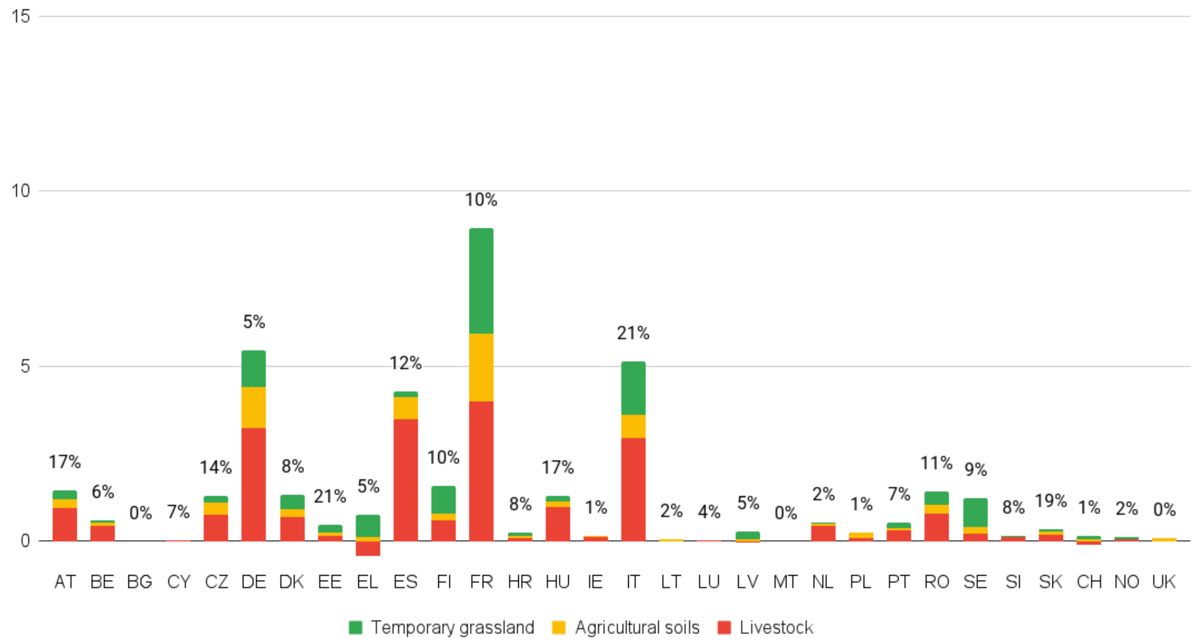


*Figure 7.4: Reduction in greenhouse emissions (Mt $CO_2$e) from organic farming under 2030 linear growth scenario in EU27 Member States, CH, NO and UK*

Temporary grassland mainly $CO_2$ sequestration, Agricultural soils mainly $N_2O$, Livestock mainly $CH_4$
% values are share of national total adjusted 2019 GHG emissions (agriculture and crop/grass LULUCF, full column represents total reduction in GHG emissions on all organic land)

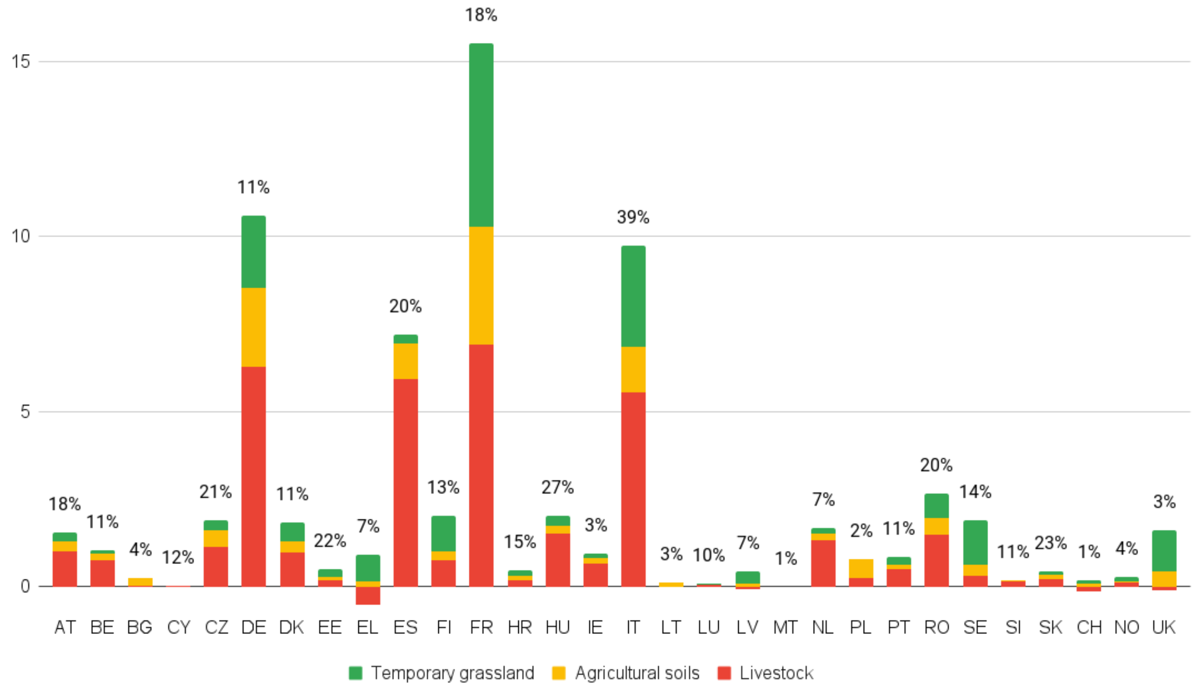


*Figure 7.5: Reduction in greenhouse emissions (Mt $CO_2e$) from organic farming under 2030 higher linear growth scenario in EU27 Member States, CH, NO and UK*

Temporary grassland mainly $CO_2$ sequestration, Agricultural soils mainly $N_2O$, Livestock mainly $CH_4$
% values are share of national total adjusted 2019 GHG emissions (agriculture and crop/grass LULUCF, full column represents total reduction in GHG emissions on all organic land)

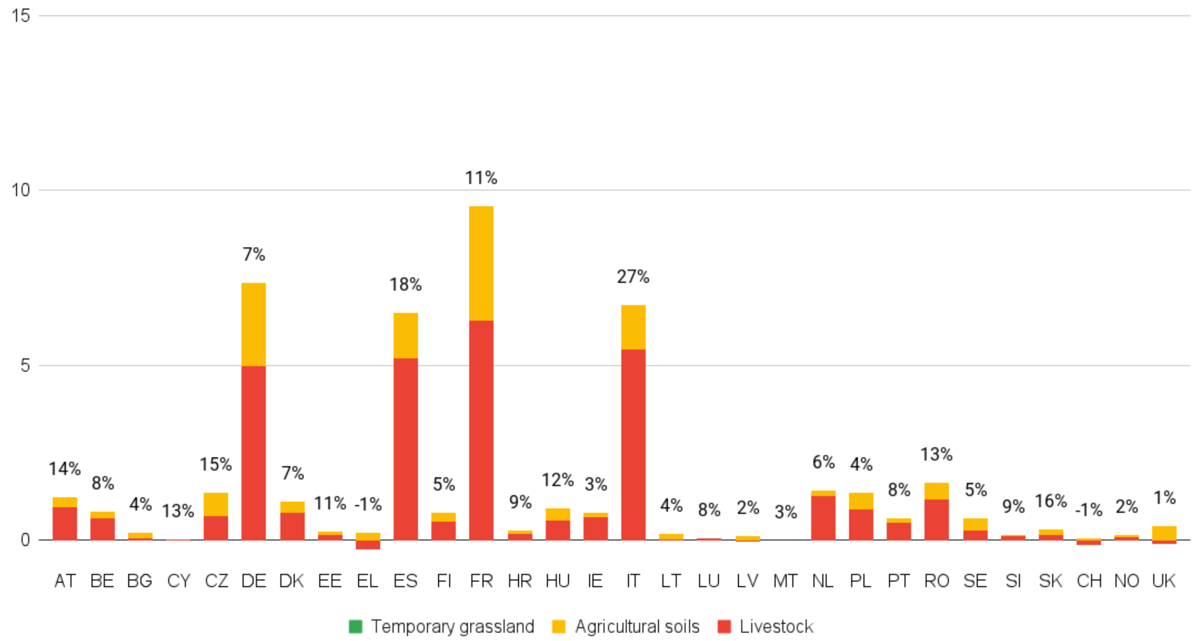


*Figure 7.6: Reduction in greenhouse emissions (Mt $CO_2e$) from organic farming under 2030 national equal shares scenario in EU27 Member States, CH, NO and UK*

Temporary grassland mainly $CO_2$ sequestration, Agricultural soils mainly $N_2O$, Livestock mainly $CH_4$
% values are share of national total adjusted 2019 GHG emissions (agriculture and crop/grass LULUCF, full column represents total reduction in GHG emissions on all organic land)

# 8 Ammonia emissions

## 8.1 Introduction

Agricultural ammonia emissions are mainly derived from animal urine, manures and slurries, as well as from nitrogen fertilisers including both synthetic and organic variants. They are considered problematic for the environment because they:

- Create potential animal and human health risks in poorly ventilated spaces
- Combine with sulphur in the atmosphere to create fine particles which are also a health risk for humans
- Provide an indirect source of nitrous oxide emissions due to atmospheric deposition and release from manures and slurries, particularly on spreading
- Via atmospheric deposition increase nitrogen availability in soils impacting negatively on plant species sensitive to high nitrogen levels

For this analysis, two major sources of ammonia were considered: inorganic N fertilisers, and animal manure, manure management and the urine and dung of grazing animals. Eurostat's database presents these as a single national value. We have attempted to differentiate the sources assuming[39]:

- 80% of ammonia emissions are due to livestock and reduced pro rata to the number of livestock kept under organic farming. It is possible that changes in livestock husbandry relating to bedding materials, housing and free-range production may also impact on ammonia levels, but suitable data were missing to include these aspects.
- 20% of ammonia emissions related to inorganic N-fertilisers, and in particular urea. In the absence of more detailed information we have assumed that this source is reduced in proportion to the reduction in N-fertiliser use presented in Section 4.

[39] The 80/20 ratio assumed here is reported in: https://www.mdpi.com/2077-0472/11/9/822/pdf?version=1630484752

## 8.2 Results and conclusions

As indicated in Figure 8.1, 25% of EU farmland managed organically has the potential to reduce $NH_3$ emissions by more than 13%, compared to the almost 5% reduction already being delivered by organic farming in 2020. The higher proportion of ruminant livestock in the 1.75x linear trend scenario is to an extent counterbalanced by the higher nitrogen use in the 25% equal share scenario, giving similar overall outcomes.

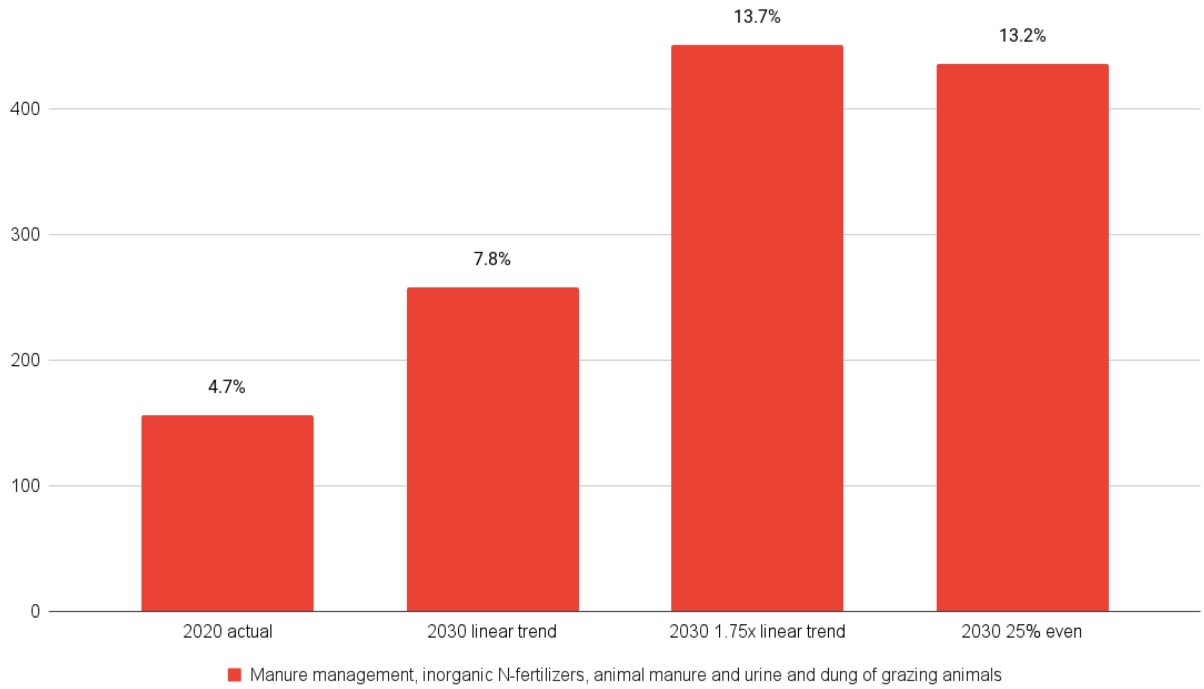


*Figure 8.1: Reduction in total EU27 ammonia emissions due to organic farming in 2020 and different 2030 scenarios*

% values are organic reduction as share of EU27 total $NH_3$ emissions

## 8.3 Individual country results

The potential ammonia reduction outcomes in individual Member States and CH, NO and UK are shown in Figure 8.2 to Figure 8.5, where each chart represents an individual scenario. The scenarios are outlined in Section 1.3.

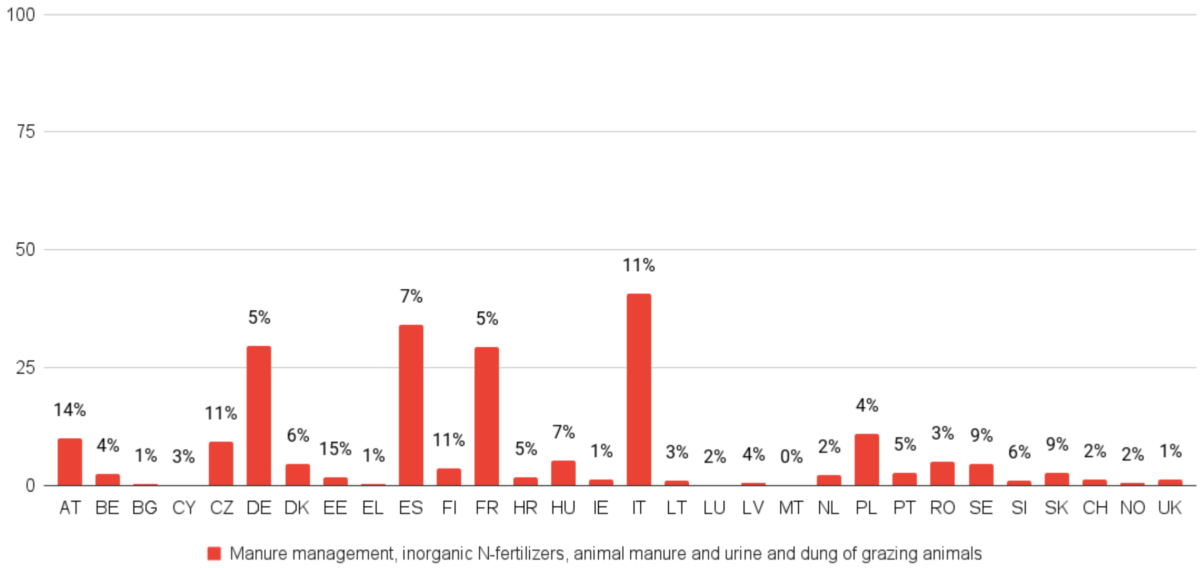


*Figure 8.2: Reduction in $NH_3$ emissions (thousand tonnes) due to organic farming in 2020 in EU27 Member States, CH, NO and UK*

% values are organic reduction as share of national total $NH_3$ emissions

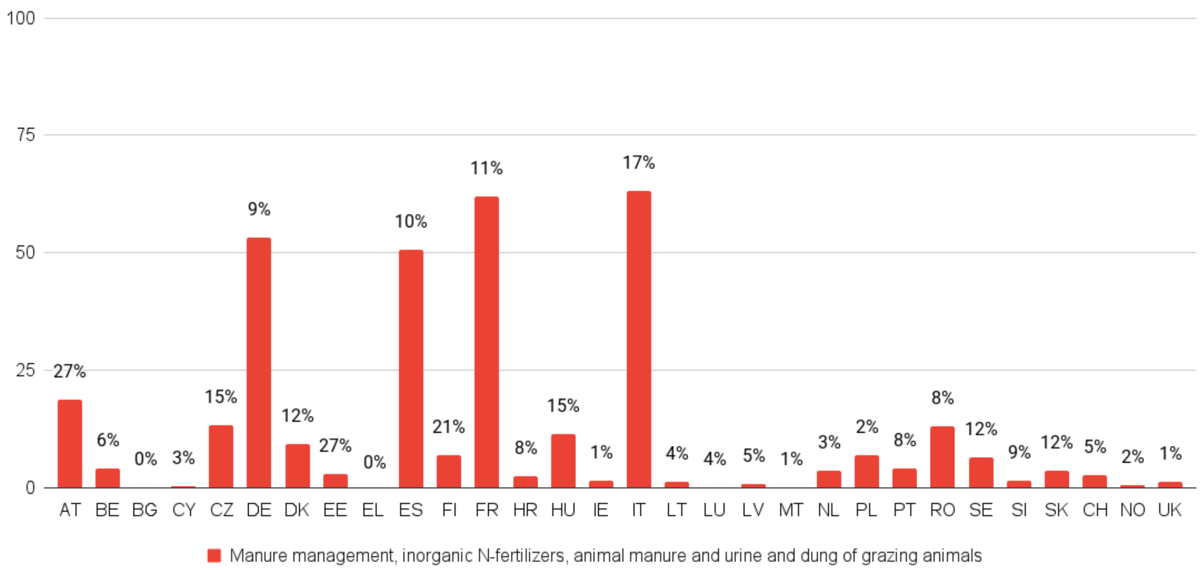


*Figure 8.3: Reduction in $NH_3$ emissions (thousand tonnes) due to organic farming under 2030 linear growth scenario in EU27 Member States, CH, NO and UK*

% values are organic reduction as share of national total $NH_3$ emissions

Several countries, including AT, CZ, DE, EE, FI, FR, IT and SE, have the potential to get close to or achieve more than 20% ammonia emissions reductions through meeting the national organic area targets set out in Section 2. In the Italian and Austrian cases, this could be almost 30%.

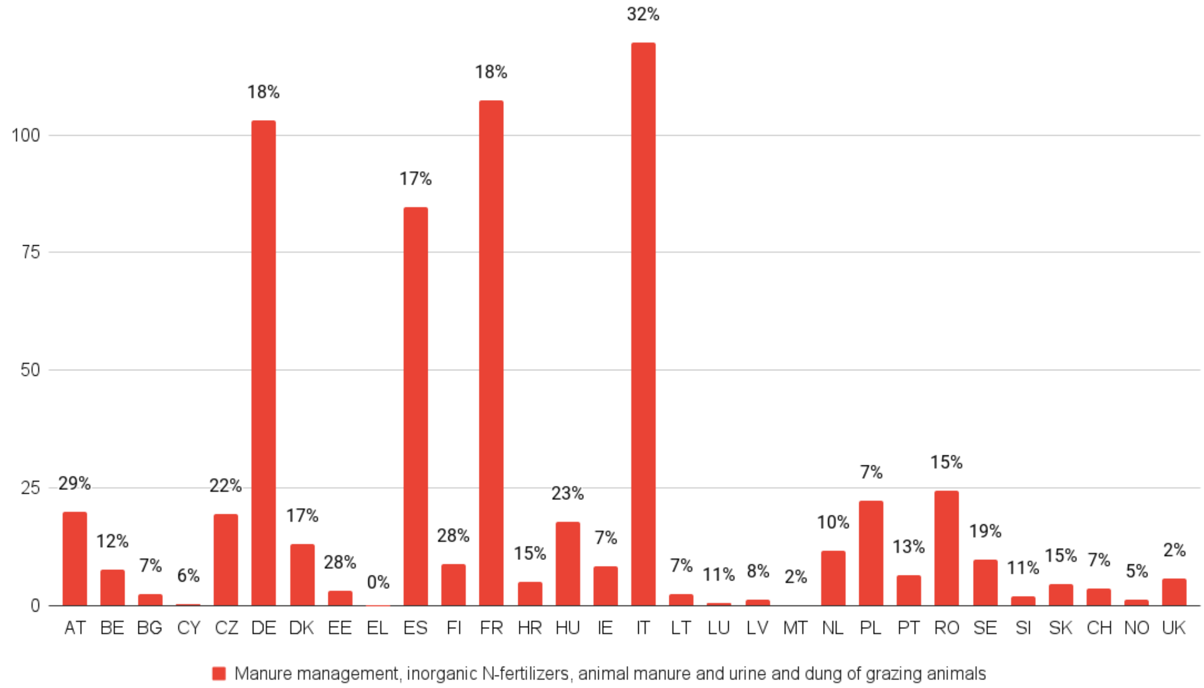


*Figure 8.4: Reduction in $NH_3$ emissions (thousand tonnes) due to organic farming under 2030 higher linear growth scenario in EU27 Member States, CH, NO and UK*

% values are organic reduction as share of national total $NH_3$ emissions

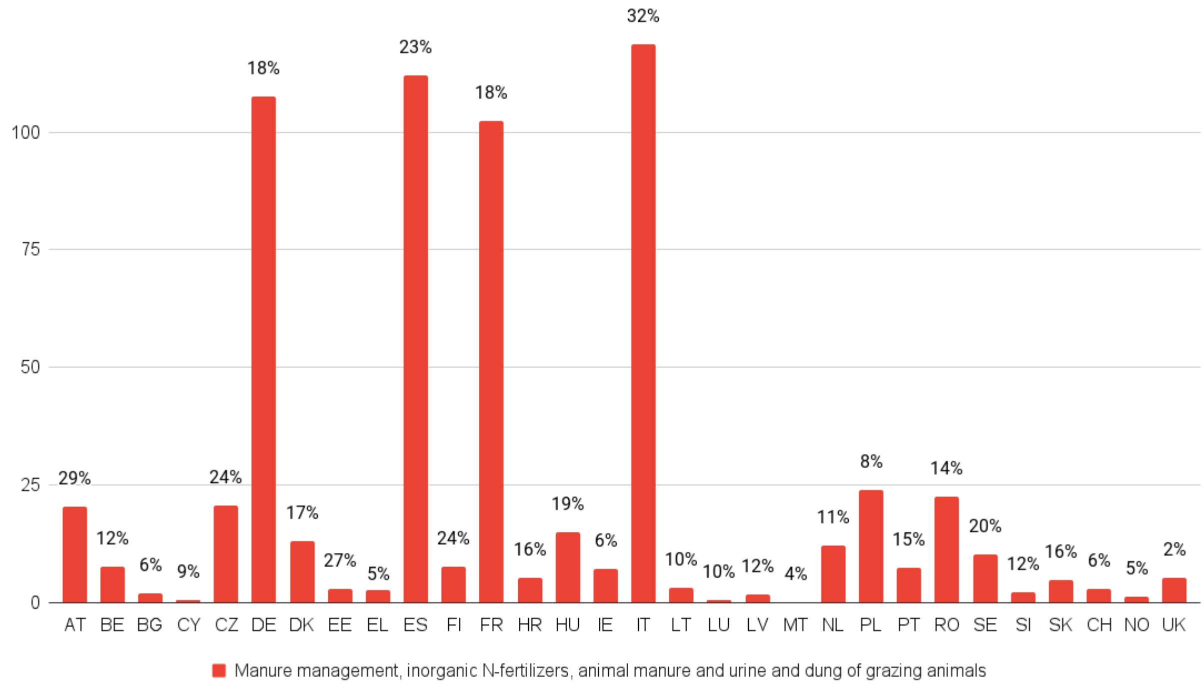


*Figure 8.5: Reduction in $NH_3$ emissions (thousand tonnes) due to organic farming under 2030 national equal shares scenario in EU27 Member States, CH, NO and UK*

% values are organic reduction as share of national total $NH_3$ emissions

# 9 Biodiversity impacts

Impacts on biodiversity are also an important aspect of an increased share of organic farming, affecting a wide range of species from soil micro-organisms and earthworms to plants, insects, birds, wild mammals and aquatic life. The impacts have been reviewed in some detail in Sanders and Hess (2019)[40] and Lampkin and Pearce (2021)[41]. They are illustrated, for example, in Figure 9.1[42], with some reviews concluding that biodiversity may be increased overall by 30% on organic cropland.

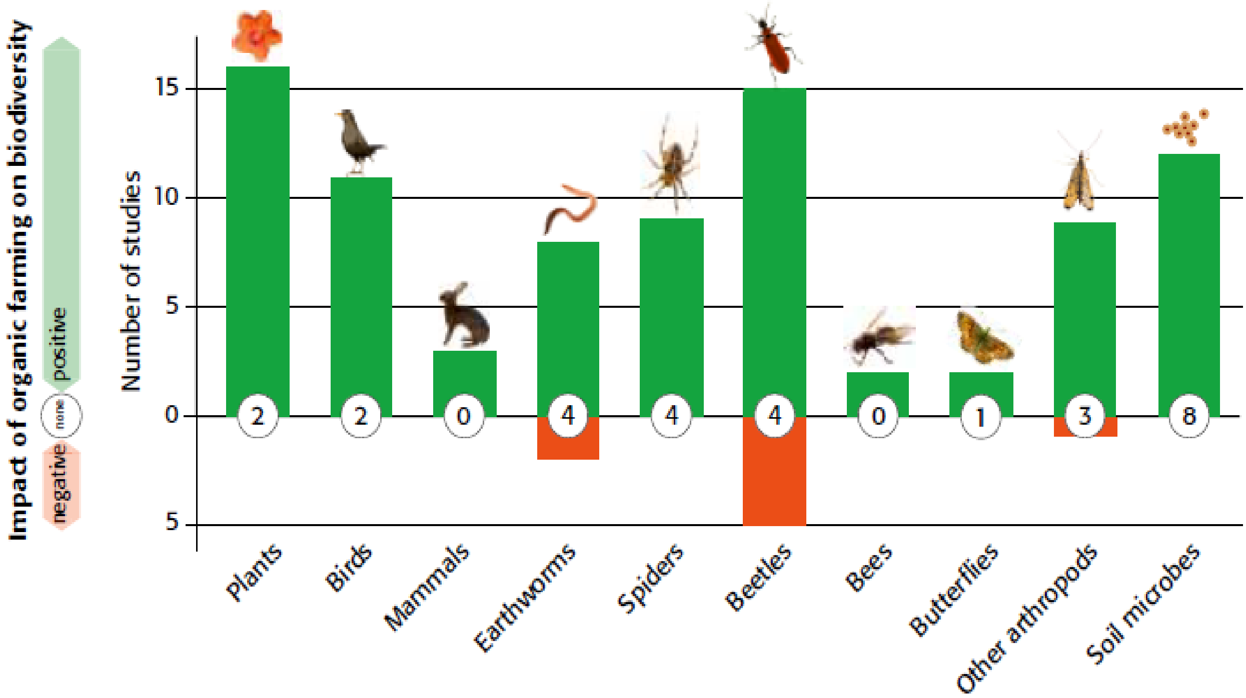


*Figure 9.1: Number of studies that show organic farming having a positive (green bar), negative (red bar) or no effect (number in white circle) on biodiversity compared with non-organic farms*

Across the 75 studies reviewed, Sanders and Hess (2019) found that:

- the number of arable plant species was 95% higher
- the number of field margin plant species was 21% higher
- the number of farmland bird species was 35% higher, and their abundance 24% higher
- the number of insect pollinator species was 23% higher, and their abundance 26% higher
- the abundance of earthworm species was 78% higher, and their biomass 94% higher
- overall, for flora 86% and for fauna 49% of the comparisons showed clear advantages from organic management
- only 2 of 75 studies reviewed showed negative effects in 12 out of 312 comparisons.

The biodiversity benefits result from a combination of factors, including:

- Changes in land use associated with extended and diversified crop rotations, including more spring crops impacting on farmland bird populations
- Non-use of herbicides and substantially reduced use of other pesticides

[40] https://www.thuenen.de/media/publikationen/thuenen-report/Thuenen_Report_65.pdf
[41] https://read.organicseurope.bio/publication/organic-farming-and-biodiversity/
[42] Organic Agriculture and Biodiversity Factsheet (2011). Research Institute of Organic Agriculture (FIBL), Frick, Switzerland

- Reduced livestock stocking rates and emphasis on free-range and pasture-based production
- Reduced nitrogen and phosphate fertiliser use and ammonia depositions protecting nutrient-sensitive species and reducing eutrophication of surface waters
- Integration of natural habitats and landscape elements, including flower and grass strips and agroforestry, to support beneficial insects, pollinators and other features that also benefit the production system

Given the diversity of farm types and the wide range of habitats and organisms impacted, it was not possible to conduct a similar quantitative analysis to the other environmental impacts assessed in this report. But it is not unreasonable to expect that a 25% share of organic farming in EU agriculture could increase farmland biodiversity by 5-10% in total (20-30% on the organic area). This could be further enhanced if the integration of natural habitats and landscape elements could be increased as part of the 10% nature restoration on farmland target set in the EU's Biodiversity Strategy[43].

[43] https://environment.ec.europa.eu/strategy/biodiversity-strategy-2030_en#:~:text=The%20EU's%20biodiversity%20strategy%20for,contains%20specific%20actions%20and%20commitments.

# 10 Making 25% organic a reality

This report sets out the substantial organic production and environmental gains that could be delivered if the European Union's target for 25% organic share of agricultural land by 2030 were to be achieved, making organic farming a key policy tool to reach EU environmental policy objectives. This was recently confirmed by the French Court of Auditors report[44] on public policy support for organic farming in France, which concludes that developing organic farming is the best way to achieve a transition to a sustainable farming system and to incentivise conventional farmers to adopt more sustainable practices.

This is unlikely to be achieved, however, on the basis of the business as usual linear trend growth scenario, projected to reach only 14% of EU agriculture by 2030, which would yield only a fraction of the additional benefits from organic farming that could be delivered with the 25% target.

The recent endorsement of the EU organic action plan[45] (published in 2021 to support the delivery of the 25% target) by the European Parliament[46] emphasises the need for the development of the organic sector to be market-led, but there is a risk of over-emphasising this at the expense of public policy support for organic farming to deliver public goods. The global market for organic products, supported in the EU by the regulations[47] defining organic production and certification procedures, has clearly played an important role in the growth of organic farming to its current scale (Sections 2 and 3) and will continue to be important in the future. But in many cases, the market has grown ahead of production, and the challenge is to increase production to meet market demand.

As far as the environmental benefits are concerned, it is also questionable whether the market is the most effective way to encourage and reward change. In particular, if the benefits are for society as a whole, should a minority of consumers carry the responsibility for remunerating organic producers for the environmental benefits they deliver? Given that the environmental benefits are largely delivered by producers, but most of the price paid by consumers is taken by other actors in the supply chain, this is not an efficient way of remunerating the benefits. There is clearly a role for the delivery of public goods by organic farmers to be supported by governments and public funds on behalf of society as a whole.

Since the 1990s, EU-wide organic conversion and maintenance support payments have recognised this. In 2018, nearly 2 billion € were spent on organic support, and previous projections[48] for IFOAM suggested that 9-15 billion € annually would be needed if the 25% target was to be reached. In preparation for the new CAP 2023-27, EU Member States have drawn up CAP Strategic Plans[49] including policies for the expansion of organic farming. An analysis[50] of these plans by researchers at the Thünen Institute found that EU Member States have budgeted nearly 15 billion € for organic farming over the five year period 2023-2027. At ca. 3 billion € per year on average, this represents a 50% increase on the previous period, which would support an increase to about 15% if similar payment rates to the previous period are available. This would be sufficient to support the business as usual linear trend growth scenario but would not be sufficient to reach the 25% target.

If the EU organic area target is to be reached, this support shortfall needs to be addressed, and suitable plans made for the 2028-2030 period. New policies for organic farming are required, in particular to transform the availability of organic agricultural knowledge and information across public institutions. Financial support

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44 https://www.ccomptes.fr/fr/publications/le-soutien-lagriculture-biologique
45 https://ec.europa.eu/info/food-farming-fisheries/farming/organic-farming/organic-action-plan_en
46 https://www.europarl.europa.eu/doceo/document/A-9-2022-0126_EN.html (notably excluding reference to the EU organic area target)
47 https://ec.europa.eu/info/food-farming-fisheries/farming/organic-farming/legislation_en
48 https://www.organicseurope.bio/content/uploads/2021/06/ifoameu_advocacy_CAP_StrategicPlansAnd25Target_202106.pdf?dd
49 https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-strategic-plans_en
50 https://ageconsearch.umn.edu/record/321830

could be more differentiated to directly remunerate the environmental benefits delivered by individual farmers[51]. These questions and many more relating to the 25% target, its achievability and impacts, as well as supporting policies, will be explored in detail as part of the new EU-funded project, Organic Targets for EU[52], to be co-ordinated by IFOAM Organics Europe from 2022 to 2026.

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[51] https://www.thuenen.de/en/institutes/farm-economics/projects/remuneration-for-the-environmental-benefits-of-organic-farming
[52] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/how-to-participate/org-details/999999999/project/101060368/program/43108390/details