Ecosystem accounts – Nordic estimates of pollination of crops: combining data from crop statistics, maps and biology

Maya Spencer, Statistics Sweden, maya.spencer@scb.se

Philip Krantz, Statistics Sweden, philip.krantz@scb.se

Viveka Palm, Statistics Sweden, viveka.palm@scb.se

Juuso Peltola, Statistics Finland, juuso.peltola@stat.fi

Michael Zörner, Statistics Denmark, miz@dst.dk

Abstract:

Ecosystem accounts are the most recent addition to the family of environmental accounts that combine economic and physical statistics to inform sustainability policies and show the interaction between economy and nature. The policy interest for the data has been substantial from the start. The ecosystem accounts are suggested for reporting indicators to the Convention on Biological Diversity as well as for the EU Nature Restauration Regulation.

Prior to the first reporting to Eurostat in 2026, the Nordic countries have used Eurostat grants to examine what methods can be applied, what data sources are available and how to best communicate the results. This paper summarizes recent experiences from Sweden, Finland and Denmark.

The ecosystem accounts open up the possibilities of using maps as a vital part of the data sources. That means opportunities to integrate more geospatial data as well as a potential to present parts of the results as maps, complementing the supply-use tables. However, it also entails that statistical offices need to have a skillset and an infrastructure that enable a production system and communication for geospatial data. The paper presents results from recent Eurostat grants projects on crop pollination ecosystem services in Sweden, Finland and Denmark as illustrative examples. A comparison across countries reveals shared challenges surrounding e.g. available spatial national datasets and the integration of national data in the reporting framework. It also highlights the potential for mutual learning and collaboration in addressing them.

Keywords: Environmental accounts, Ecosystem accounts, Ecosystem services, Crop pollination.

1. Introduction

This report builds on recent Eurostat grant projects conducted by the national statistical offices of Sweden, Finland, and Denmark on the development of crop pollination accounts as part of ecosystem accounting. It aims to compare the experiences of the three countries in developing crop pollination statistics, identify shared challenges with Eurostat's proposed methodologies, and to highlight the potential for mutual learning in discussing our different approaches to handling these challenges in preparation for future mandatory ecosystem services reporting.

2. Background

Crop pollination is one of seven ecosystem services that are included in ecosystem accounts and subject to mandatory reporting under Regulation (EU) No. 691/2011 starting from December 2026. The pollination account measures the contribution of wild pollinators to agricultural production, expressed as the quantity (tonnes) of pollinator-dependent crops attributable to wild insect pollinators. The results are reported in supply-use tables (SUTs) where the use side is allocated to intermediate consumption by industries as use per crop group – fruits, vegetables, pulses, oilseeds and "others" – whilst the supply side is allocated to ecosystem types acting as wild pollinator habitat.

Eurostat (2026) proposes a geospatial model for estimating crop pollination. It depends on the suitability of ecosystems as habitats for wild pollinators, pollinator activity and distribution, as well as the distance between pollinator-dependent crops and wild-pollinator habitats. The model requires the use of geographic information system software, e.g. QGIS, and may be executed using the INCA-tool, a QGIS plugin provided by Eurostat. EU-wide default input data is available through Eurostat's Geographic Information System of the Commission (GISCO) database. National compilers are however encouraged to use national data sources of higher quality when possible. Examples of required input data include an ecosystem extent map, ecosystem suitability scores, a crop type and crop yield map, crop-specific pollination demand figures, and a map of correction features. The ecosystem extent map shows the location and extent of ecosystem types, the crop type and yield maps give the location of pollination-dependent crop fields and their yields, and the correction feature map contains landscape features or management practices that enhance or degrade local ecosystem suitability scores.

If national compilers lack necessary data to execute a geospatial model, Eurostat proposes an alternative methodology. The “simple indicator” estimates the contribution of wild pollinators to crop yields by multiplication of national crop yield statistics with crop-specific pollination demand figures. This represents the (maximum) share of the yield attributable to wild pollinators (use side), which is then allocated to ecosystems surrounding any cropland in proportion to their extent using the ecosystem extent map in QGIS (supply side). This map is thus the only geospatial data used for the simple indicator, in contrast to the more complex geospatial model outlined above.

3. Nordic Eurostat grants projects – aim, methods and results

3.1 Overview

Sweden, Finland, and Denmark have each explored Eurostat’s proposed methodologies for estimating crop pollination indicators in line with Regulation (EU) 691/2011. The work was carried out through separate Eurostat grant projects, laying the groundwork for upcoming mandatory reporting. All three countries assessed the feasibility of applying both the simple indicator and the geospatial model approach proposed by Eurostat (2026) using the INCA-tool. However, due to differences in data availability and challenges encountered, the outcomes varied. Sweden developed a model based on the geospatial model, while Finland and Denmark opted for approaches based on the simple indicator.

Furthermore, all three countries set out to compare the use of national datasets with the use of default datasets provided by Eurostat, aiming to implement national data where feasible and advantageous. Finland and Sweden consulted national experts and scientific literature to revise the default pollination demand figures and ecosystem suitability scores, whereas Denmark opted for the default values. The details and results of each country’s grant project are outlined in the following chapters (3.2–3.4).

3.2. Sweden

A geospatial model was built for reference year 2018. The National Land Cover Database (NLCD) was used as ecosystem extent map, offering a 10 m spatial resolution as opposed to the default's 100 m. A correction feature map was built using diverse national sources for spatial data, such as the area-based support payment schemes for farmers maintaining semi-natural pastures and meadows. That same source was also used to create a crop type map, as farmers can apply for support for crops grown in identifiable land parcels in the dataset. The dataset is managed by the Swedish Board of Agriculture and part of the EU-wide Integrated Administration and Control System (IACS). The crop yield map was created by distributing the official yield figures of assessed crops evenly across all fields that grew that same crop.

For comparison, an alternative geospatial model using mainly default data was built for the same year. The use side of the simple indicator was also calculated to give the maximum potential pollinator contribution to crop yields for comparison with the geospatially modelled estimates. The geospatial model using national data gave that ecosystems, by functioning as habitat, contributed an estimated 69 491 tonnes to yields of pollinator dependent crops in 2018. In comparison, the estimate based on default data was 50 886 tonnes. Most of the service was supplied by ecosystem types "Grassland" and "Forest and woodland", and the service was mainly used in the production of fruits, oil-bearing crops and pulses. The estimated share of pollinator-attributable crop yields can be seen in Table 1.

3.3. Finland

Finland constructed one geospatial model using the default ecosystem extent map, and another one using a national map of higher resolution. Both versions used default datasets for crop type and yield maps with reference year being 2021. As the default crop type map portrays aggregated crop categories as opposed to individual crops, national material flow accounts were used to obtain more detailed crop classifications, enabling a more precise estimation of crop-specific pollination demands.

An altered version of the simple indicator was also applied. It estimated the use side as described in section 2 and then allocated the supply-side to ecosystems using buffer zones around croplands. The buffers represent areas where pollinators live or forage, with variations (200–500 m) tested to reflect different flight distances. The model was further refined using ecosystem-specific weighting instead of equal allocation across ecosystems. Sensitivity analyses were conducted, including linearly decreasing weights over distance, which led to a more realistic allocation to ecosystem types.

The results showed substantial differences between the two approaches. The simple indicator produced significantly higher estimates compared to the geospatial models. This difference was largely driven by input data discrepancies, such as the inclusion of home-grown fruit in the national crop yield data used for the simple indicator, and the incomplete coverage of some vegetables in the default datasets used for the geospatial models, see Table 1. The results show that fruits and oilseed crops dominate the use side, and that most of the supply came from “Cropland” and “Forest and woodland” ecosystems, although their relative shares vary depending on the modelling approach. The resolution of the ecosystem extent map furthermore significantly affects the results, as the higher resolution map would emphasize small features in ecosystems.

3.4. Denmark

The Danish project compiled pilot crop pollination accounts for reference year 2021. First, the geospatial model approach was tested using Eurostat’s default data and parameter settings. Due to problems related to the required input data (further detailed in section 4), the simple indicator was calculated subsequently. For this purpose, Eurostat’s ‘Crop production in EU standard humidity (apro_cpsh1)’ data and the default pollination demand figures were used to estimate the maximum potential pollinator contribution to production. Supply-side calculations (allocation to ecosystem types) were run in QGIS, ArcGIS and GRASS GIS following the step-by-step instructions in the guidance material (Eurostat, 2024). Besides, two different ecosystem extent maps for 2021 were tested: the default map at 100 m spatial resolution and an ecosystem map based on the Danish Basemap04 at 10 m spatial resolution.

The simple indicator estimates can be seen in Table 1. Oil-bearing crops (rape and turnip rape seeds) accounted for the largest share of pollinated crops by far. As almost the entire land area of Denmark is either cropland or within a 1 km flight distance from it (urban areas being an exception), the ecosystem type ratios used to assign the supply are somewhat similar to the overall distribution of ecosystem types. When using Basemap04 instead of the default map, the contribution of the ecosystem types ”Settlements and other artificial areas” and ”Cropland” is increased at the expense of ”Grassland” and ”Forest and woodland”.

4. Concluding discussion: shared challenges and potential for mutual learning

All three countries encountered challenges related to the spatial data on pollinator species distribution (SGSI) which the INCA-tool required for running the model. Although available as default data, Denmark and Sweden found that the tool’s automatic processing of this dataset resulted in a limited spatial extent that excluded parts of the countries. Resolving this issue proved critical for producing the geospatial model as all countries struggled with identifying alternative datasets to substitute the default SGSI. Responding to this constraint, Denmark opted to apply the simple indicator for estimating the crop pollination service. Sweden addressed the issue by replacing the SGSI with a placeholder map containing no information on species distribution but allowing for this input requirement to be bypassed, albeit at the cost of excluding information on pollinator species distribution.

Like Denmark, Finland also opted for a version of the simple indicator in the end to estimate the crop pollination service, partially due to limitations imposed by the current version of the INCA-tool and the lack of available data. Regarding the default crop type map, Finland found it lacking both coverage of several relevant crop types and transparency in terms of its aggregation of crops into groups. In Sweden’s case, the default crop type data was replaced with national data, allowing the identification of relevant crop locations. However, the INCA-tool is fixed to a single coordinate reference system (CRS), meaning that input maps of crop types and yields automatically get reprojected and resampled. This caused some degree of spatial and numeric distortions, leading to inconsistencies between the estimated results and official crop yield statistics. The issue was resolved by manually adjusting yield figures in the resulting SUTs, but it could possibly have been avoided by providing national input maps in the tool’s preferred CRS from the start.

While the geospatial model built with the INCA-tool has the potential to yield more accurate estimates by considering the interplay between ecosystems, correction features, and location in relation to specific crop fields, the complexity of the tool and its automated processing steps cause transparency issues that affect reliability negatively. Assessing the tool's source code may prove useful in this context, but herein lies a shared challenge concerning time and knowledge constraints. On the other hand, the simple indicator relies only on national crop production statistics, pollination demand figures and data on ecosystem extent, providing more transparent estimations.

The simple indicator does nonetheless lack in accuracy, as it assumes that the pollination demand has been fully satisfied for all assessed crop categories and allocates the supply to cropland and its surrounding ecosystems after the fact. Pollinator-dependent crops are in the simple indicator approach assumed to be uniformly distributed across all grid cells classified as cropland in the ecosystem extent map, implying that all cropland is equally suitable for growing e.g., fruits. This issue is particularly problematic for oblong countries in the north with less favourable climatic conditions. Geospatial information on crop locations, such as the EU-wide IACS data used by Sweden to produce the crop type map, could be integrated to improve the simple indicator in this sense. Furthermore, Finland refined the simple indicator in ways which increased the methodology's accuracy in several ways, e.g., by using ecosystem-specific weighting factors for calculating the supply-side in consultation with national experts.

Another shared challenge is the availability of high-resolution ecosystem extent maps for the annual reporting starting in December 2026. Denmark is expected to receive updated basemaps every three years, while Sweden and Finland will receive updates every five and six years, respectively. This means that basemaps must be updated in the interim to more accurately reflect ecosystem extent in the years between new releases. Statistics Sweden is currently exploring the potential of using supplementary data sources to update the basemap for annual reporting purposes. The findings from this ongoing work will be presented within a Eurostat grant project. It is hoped that these results will offer a practical solution to this shared challenge.

In conclusion, all three countries have assessed the feasibility of applying the geospatial model proposed by Eurostat in addition to applying variations of the simple indicator. Due to differences in data availability and challenges encountered, the outcomes varied. In the end, Sweden opted for the geospatial model, while Finland and Denmark opted for approaches based on the simple indicator. The exchange of experiences from the three countries has illustrated the relative advantages and flaws of both methods. The report highlights similar challenges and provides a portfolio of approaches to handling these issues in addition to highlighting areas in which further work is needed.

Table 1: Results from crop pollination indicator estimates

Country	Sweden	Finland	Denmark
Reference year	2018	2021	2021
Wild insect pollinator-attributable yield as share of total yield (%)	1.10	1.09 *(0.65*)*	1.36
Methodology	Geospatial model	Simple indicator modified for higher accuracy *(Geospatial model)*	Simple indicator

* Excluding home-grown crops

5. Appendix: List of references

European Parliament, 2024. *Regulation (EU) 2024/3024 of the European Parliament and of the Council of 27 November 2024 amending Regulation (EU) No 691/2011 as regards introducing new environmental economic account modules (Text with EEA relevance).* [online] (accessed 12-05-2026).

Eurostat, 2024. Guidance notes on ecosystem services accounts. Version: Dec 2024. [PDF]

Eurostat, 2026. *Ecosystem accounts handbook.* Luxembourg: Publications Office of the European Union. [PDF]