# Robust scientific evidence for policy support

## IMAP Activities to support environmental objectives within the CAP

## How IMAP SP can provide more knowledge and analysis on environmental objectives

**PRESENTATION TO CDG CAP**

*2nd March 2022*

# iMAP4AGRI – Support to CAP environmental objectives

## Objectives and main outputs available

*Andrea Furlan (AGRI A2)*

*Meeting CDG CAP, 2 March 2022*

# iMAP4AGRI - Support on the CAP environment and climate objectives

- "Integrated modelling platform for agro-economic commodity and policy analysis" (iMAP4AGRI) is an administrative agreement between AGRI and JRC D4/D5 active since 2006: main focus on agro-economic modelling and specific studies
- Tasks on "Support on the environment and climate objectives" active from July 2020
- **Objectives**: provide a long-term knowledge base on environmental farming practices, their link with CAP indicators, develop indicators methodologies (resilience, landscape features, avoid double counting on areas)
- What was achieved?
  - Results in a wiki website online from April 2021:
    - Initial choice to provide a "restricted access" website to DG AGRI and other DGs desk officers/environmental experts → technical nature of the results
    - Member States accredited from the beginning
  - To access the website it is still needed to authenticate users, however we are working to build a public version (e.g. less technical, with merged results) in 2022

# Access the wiki

https://webgate.ec.europa.eu/fpfis/wikis/display/IMAP/Home

- Accessibility to the wiki is granted based on EU login registry, which is needed: external users can have access contacting JRC through the Functional Mail Box to be accredited

JRC-wiki-CAP-SP@ec.europa.eu

# The IMAP wiki sections

- Farming practices fiches and general matrix on intervention logic
- Matrixes on indicators
- Inventory of environmental legislation
- Other complementary information (work in progress):
  - animal welfare practices extracted from the ongoing study (no meta analysis review)
  - good practices on selected practices (agroforestry, organic, sustainable fertilisation)
- Events: webinar on landscape features

- Policy questions: answer in real time – JRC «helpdesk»

# Meta-analysis literature review on farming practices

## Methodology and results

*M Pérez-Soba, A Schievano, S Bosco, A Montero, JM Terres (JRC-D5)*

*D Makowski, M Chen (INRAE)*

*G Tamburini (Univ Bari)*

*Meeting CDG CAP, 2 March 2022*

# Robust scientific evidence to identify effective measures in the CAP

EUROPEAN COURT OF AUDITORS
Guardians of the EU finances

## Biodiversity on farmland continues to decline despite specific CAP measures

05/06/2020


## Special report 16/2021: Common Agricultural Policy and climate: Half of EU climate spending but farm emissions are not decreasing

21/06/2021

During the 2014-2020 period, the Commission attributed over a quarter of the Common Agricultural Policy (CAP)'s budget to mitigate and adapt to climate change.

We examined whether the CAP supported climate mitigation practices able to reduce greenhouse gas emissions from agriculture. We found that the €100 billion of CAP funds attributed to climate action had little impact on such emissions, which have not changed significantly since 2010. The CAP mostly finances measures with a low potential to mitigate climate change. The CAP does not seek to limit or reduce livestock (50 % of agriculture emissions) and supports farmers who cultivate drained peatlands (20 % of emissions).

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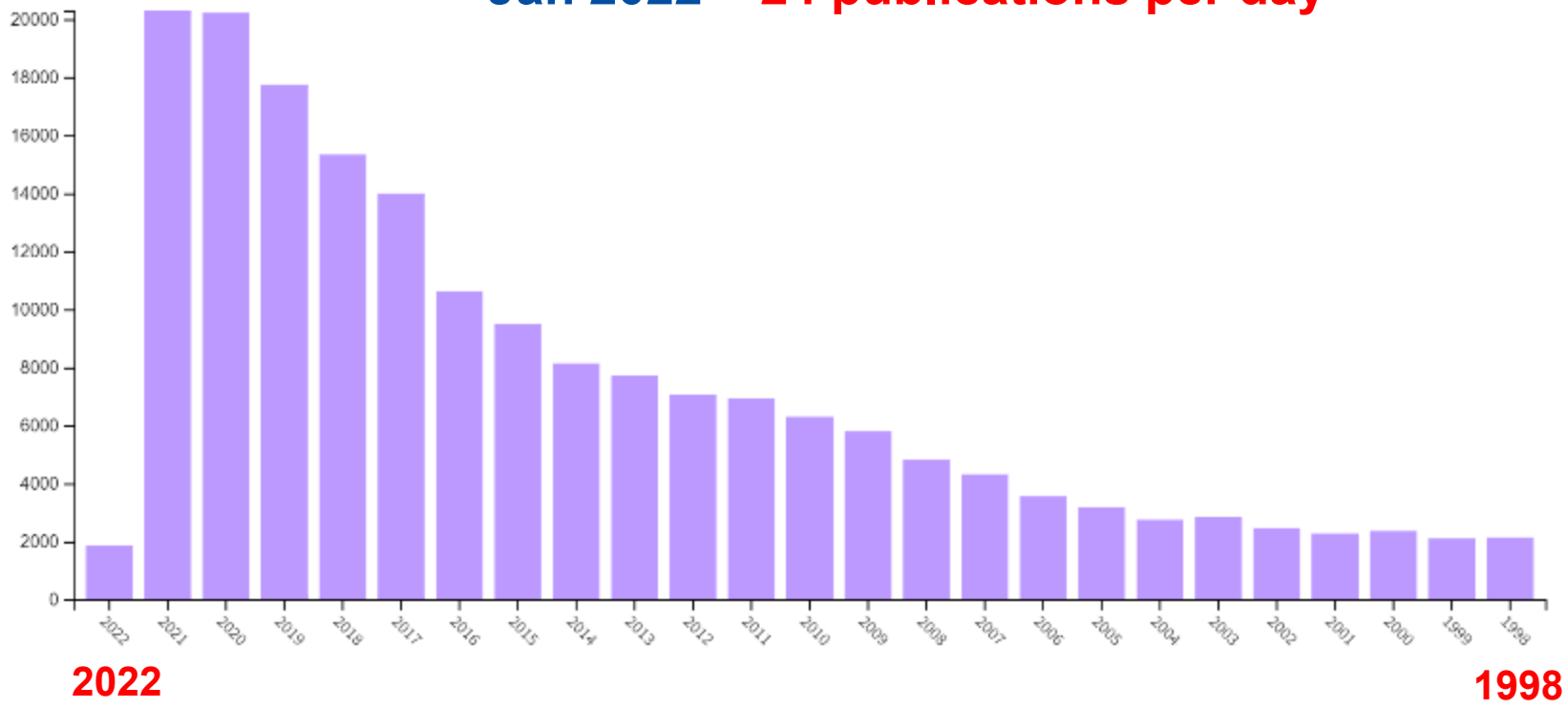
# The methodology *developed at JRC.D5 based on Meta-analyses*

# Much evidence available: need for synthesis

**195,858 publications on agriculture from Jan 1998-Jan 2022 = 24 publications per day**




**2022** **1998**

Source: Web of Science Core Collection

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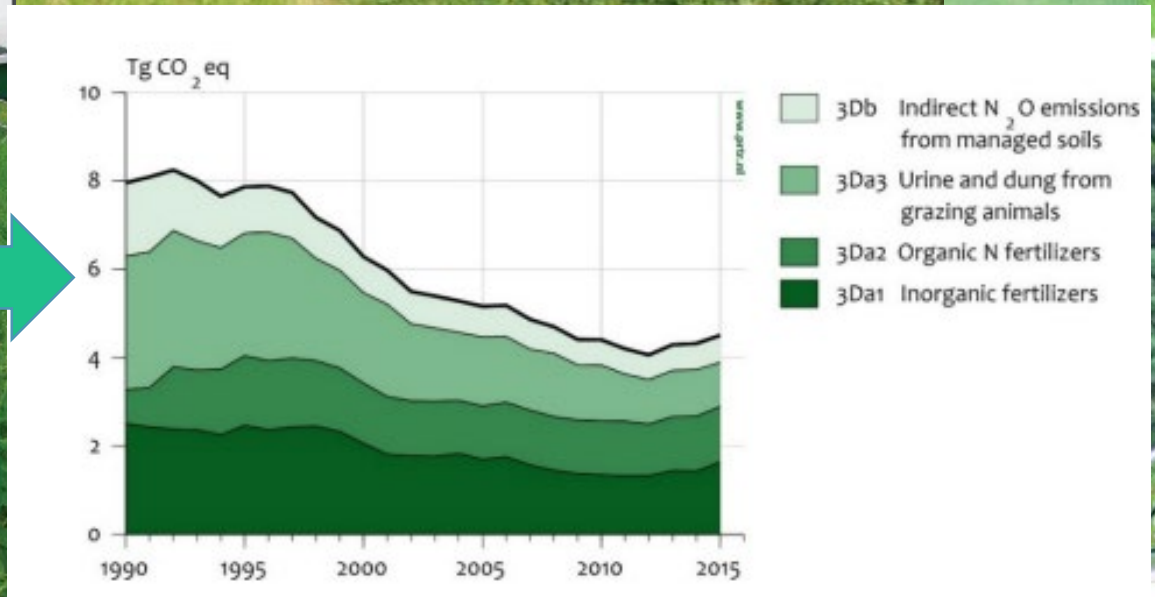
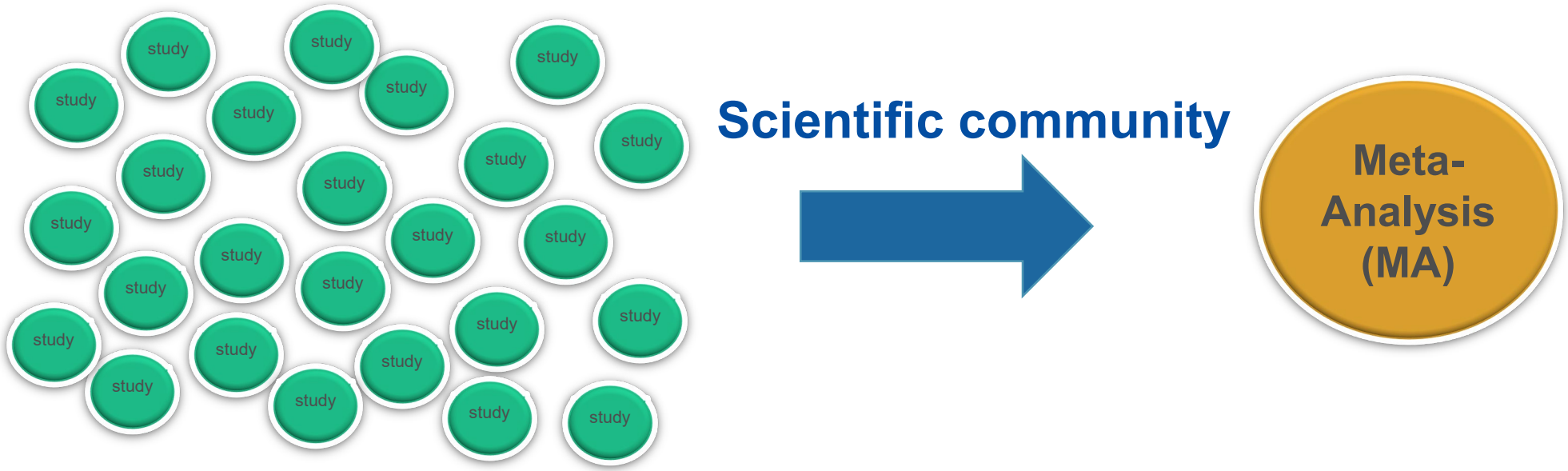
# Evidence from many individual field studies




# Meta-analysis a powerful synthesis tool

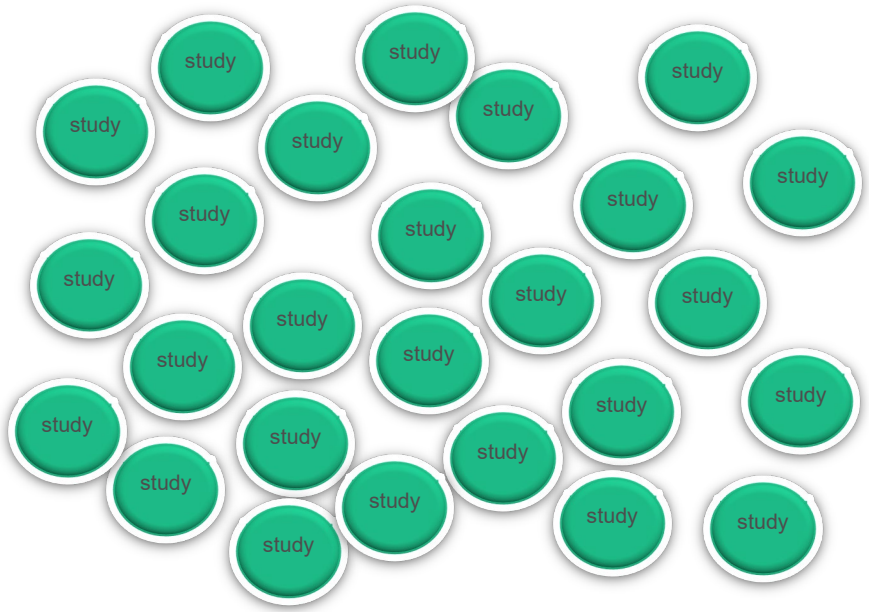



## Meta-analysis and the science of research synthesis

Jessica Gurevitch[1], Julia Koricheva[2], Shinichi Nakagawa[3,4] & Gavin Stewart[5]

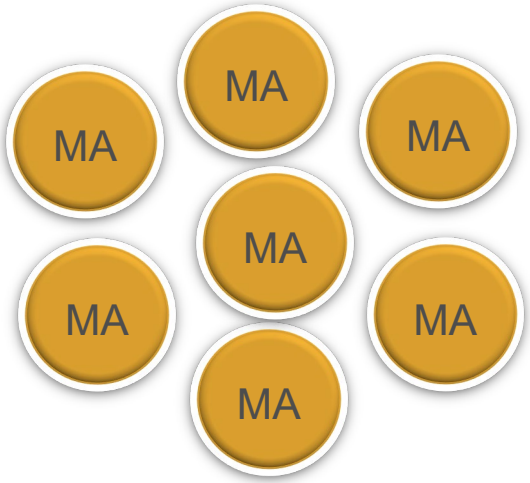
Nature, March 2018

# JRC method to synthesise scientific evidence




**Scientific community**

**Meta-Analysis (MA)**




**JRC activity**

**Review of meta-analyses**

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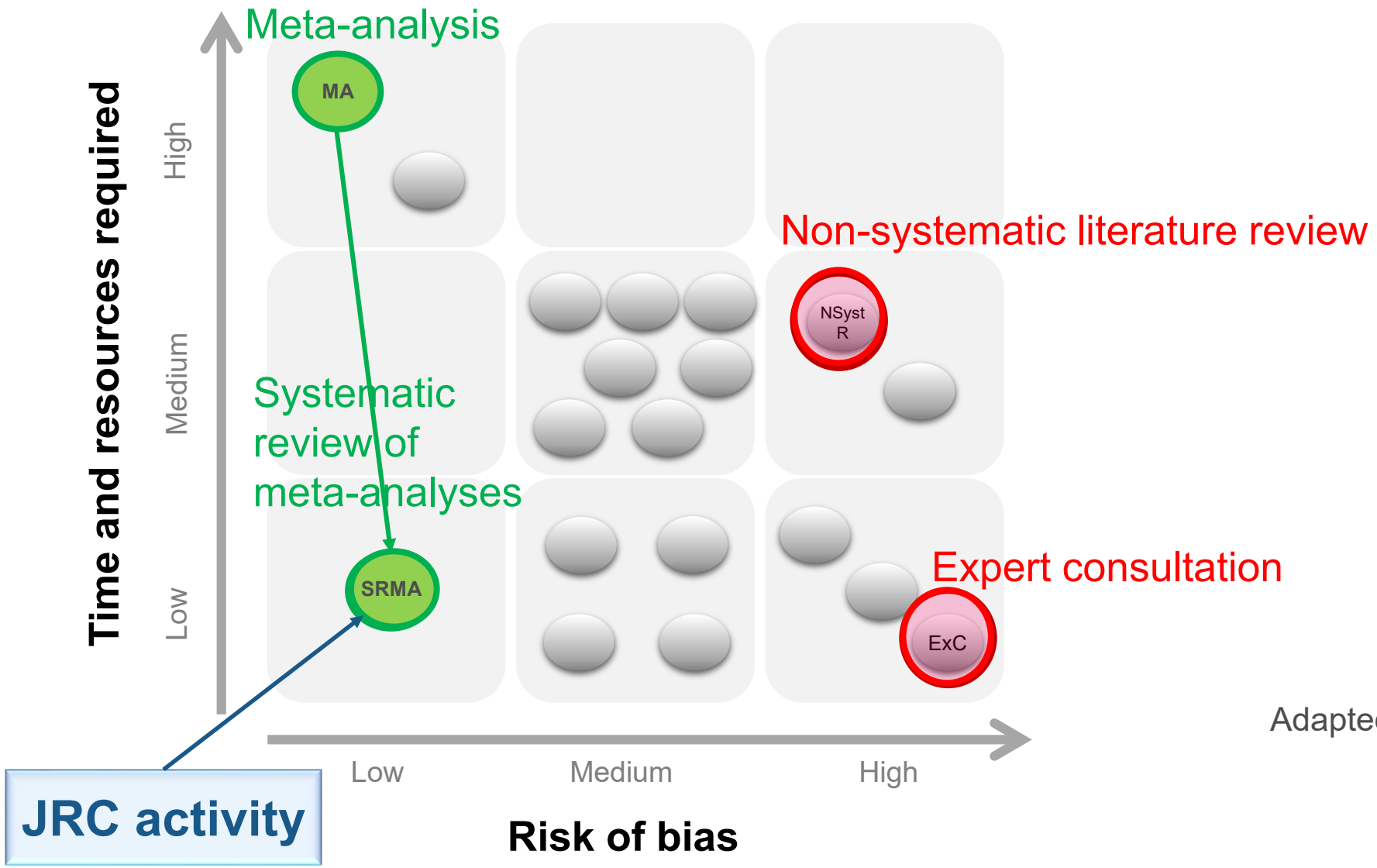
# We check the quality of the meta-analyses

| Quality criteria | | |
|---|---|---|
| 1. | List of studies | Quality of meta-analysis |
| 2. | Selection criteria | |
| 3. | Objective specified | |
| 4. | Databases mentioned | |
| 5. | Search string | |
| 6. | Number of studies at each step of the selection process | |
| 7. | Quantitative results described | |
| 8. | Statistical methods described | Quality of statistical analysis |
| 9. | Individual effect sizes presented | |
| 10. | Individual effect sizes weighted | |
| 11. | Dataset available | |
| 12. | Confidence intervals presented | |
| 13. | Method of data extraction described | |
| 14. | Heterogeneity of results analyzed | Risk of bias |
| 15. | Funding sources mentioned | |
| 16. | Publication bias analyzed | |

# Advantages of the JRC method




Adapted from EKLIPSE (2018)

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# Results

# 2021: Review 17 farming practices to support AGRI

Agroforestry

Organic systems

Fallowing

Landscape features

Fertilisation strategies

- Organic fertilisation
- Green manure
- Enhanced efficiency fertilisers
- Nitrification inhibitors
- Low ammonia emission techniques

Pesticide reduction strategies

Intercropping

Soil amendment

- Lime or gypsum
- Biochar

Livestock practices

- Manure land application
- Manure storage
- Manure processing
- Livestock dietary manipulation
- Livestock housing techniques

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# 2021: Review of 17 farming practices - Impacts

- Carbon sequestration
- Greenhouse gas emissions
- Soil organic carbon
- Energy use

- Air pollutants emissions ($NH_3$, NO)
- Acidification
- Eutrophication
- Agricultural area use
- Nutrient leaching and run-off
- Plant nutrient-uptake
- Plant water use efficiency
- Soil biological quality
- Soil nutrients
- Soil erosion
- Soil physic-chemical properties
- Water quality
- Water retention

- Biodiversity
- Pollination

- Pest- and disease-control
- Plant uptake of toxic compounds
- Crop yield
- Animal production

# 2022: Review of other farming practices


Conservation agriculture

Tillage management

Catch and cover crops

Crop rotation

Multicropping

Grazing and grassland management

Grassland conservation

Rewetting peatlands and Wetlands

N-fixing crops

etc

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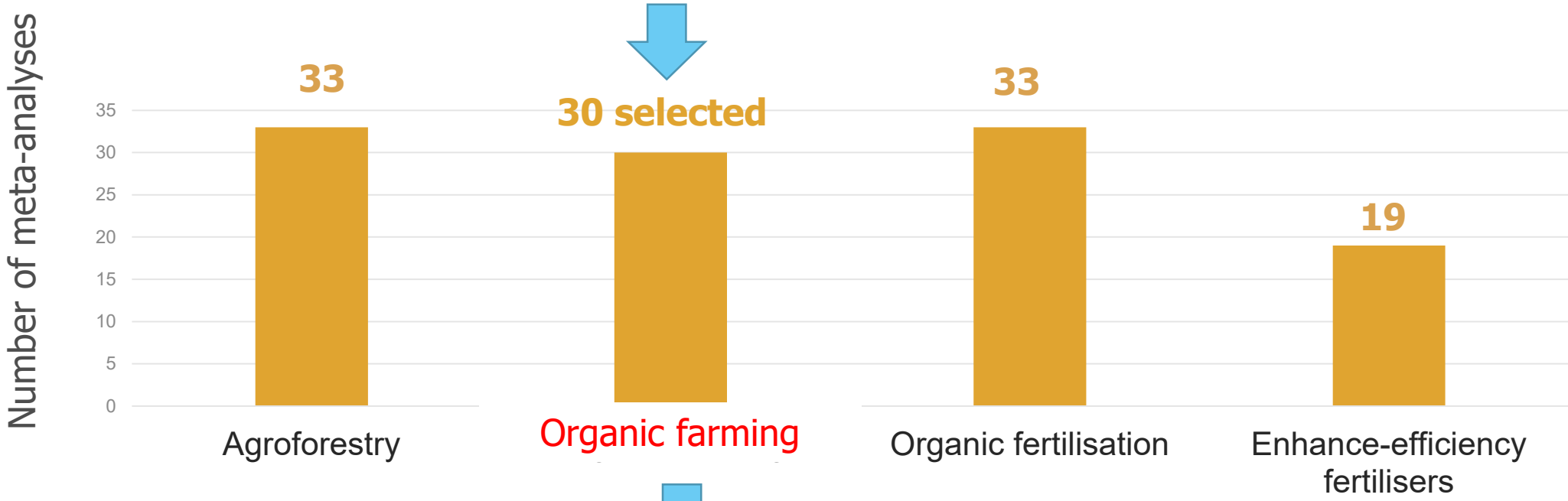
# Many single studies available for each practice

Meta-Analyses

220 available in the web




Each meta-analyses includes 7 to 164 single studies

study

≈3300 single studies on organic farming

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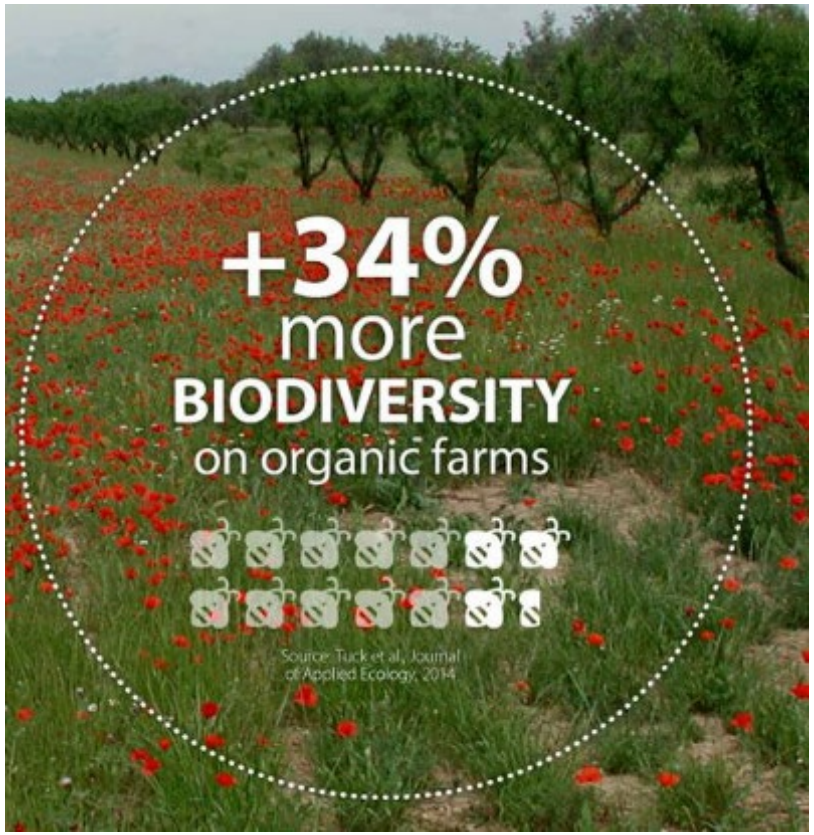
# Organic farming impacts (30 meta-analyses)

CAP Specific objectives

| | Effects per unit of area (e.g., per ha) | | | |
|---|---|---|---|---|
| **Impact** | **Positive** | **Negative** | **No effect** | **Uncertain** |
| Increase carbon sequestration | **7 (6)** | 0 | 0 | 2(1) |
| Decrease greenhouse gas emissions | **2 (2)** | 0 | 0 | 1(1) |
| Decrease ammonia emission | **0** | 0 | **1 (1)** | 0 |
| Decrease nutrient loss (Nitrogen) | **3 (3)** | 0 | 0 | 0 |
| Decrease nutrient loss (Phosphorus) | 0 | 0 | **2(2)** | 0 |
| Increase soil nutrients | 0 | 0 | | 1(0) |
| Improve soil biological quality | 1(1) | 0 | 0 | 1(0) |
| Increase biodiversity | **9 (9)** | 1(1) | 1(1) | 1(0) |
| Increase abundance of pests natural enemies | **2(2)** | 0 | 0 | 0 |
| Reduction of pests and diseases | 0 | **2(2)** | 0 | 0 |
| Increase crop yield | 0 | 9(9) | 2(2) | 1(0) |

# Organic farming increases biodiversity

- 9 out of 10 meta-analysis report positive effects
- All meta-analyses include studies in Europe
- Some numbers:
  - *On average, increase in species richness around 30%* (Bengston et al., 2005)
  - *Organic sites had greater biodiversity (34%)* (Smith et al, 2020)
  - *Organic farming systems supported on average higher bird numbers (1 to 3 more birds)* (Wilcox et al, 2013)




Source: IFOAM Organics Europe

# Agroforestry impacts (33 meta-analyses)

CAP Specific objectives

| | Effects (studies including EU) | | | |
|---|---|---|---|---|
| Impact | Positive | Negative | No effect | Uncertain |
| Increase carbon sequestration | **5 (5)** | 0 | 0 | 1 (1) |
| Decrease greenhouse gas emissions | **1 (1)** | 0 | 0 | 0 |
| Increase biodiversity | **2 (2)** | **0** | **0** | 0 |
| Increase pollination | **1 (1)** | 0 | 0 | 0 |
| Pest- and disease-control | **2 (2)** | 0 | 0 | 1 |
| Increase crop yield | **0** | 0 | **2 (2)** | 0 |

# Agroforestry increases carbon sequestration

- 5 out of 5 meta-analyses report positive effects
- *All four main Agroforestry systems—alley cropping, windbreaks, silvopastures, and homegardens—sequestered significantly more C than did cropland (or pasture)(Shi et al, 2018)*
- *Large differences in soil carbon sequestration values among the land use systems can result from biophysical and socio-economic characteristics of the system and/or methodological issues (Feliciano et al, 2018)*

Source: Groen Kennisnet

# Agroforestry increases biodiversity

- 2 out of 2 meta-analyses report positive effects
- Overall for Europe: *Agroforestry generally enhances biodiversity. However, substantial variation depending on biophysical and land use conditions (Torralba et el, 2016)*
- Mediterranean basin*: Dense systems have more species than open systems (Plexida et al, 2018)*

Source: AgForward

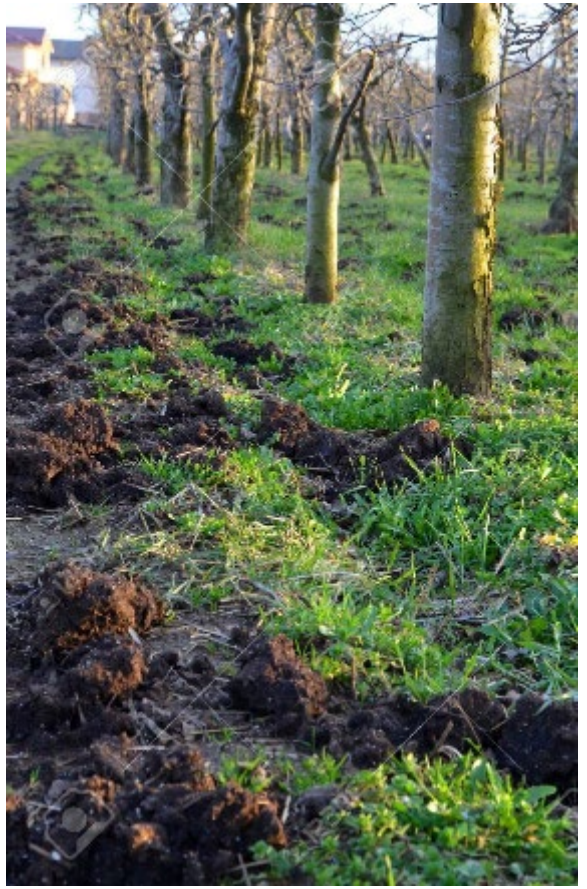
# Organic fertilisation (33 meta-analyses)

CAP Specific objectives

| | | Effects | | | |
|---|---|---|---|---|---|
| **Impact** | **Metric** | **Positive** | **Negative** | **No effect** | **Uncertain** |
| Decrease greenhouse gas emissions | $CH_4$ emissions | 0 | **1(1)** | **1(1)** | 0 |
| | $CO_2$ emissions | 0 | **1(1)** | 0 | 0 |
| | $N_2O$ emissions | 1(1) | 2(2) | **6(6)** | 0 |
| Decrease air pollutants emissions | $NH_3$ emissions | **2(2)** | 0 | 1(1) | 0 |
| Decrease Nitrogen leaching/run-off | | **1(1)** | 0 | 0 | 0 |
| Increase Nitrogen use efficiency | | 0 | **1(1)** | **1(1)** | 0 |
| Increase soil biological quality | | **4(4)** | 0 | 0 | 0 |
| Increase soil organic carbon | | **7 (7)** | 0 | 0 | 0 |
| Increase soil nutrients | | **5(4)** | 0 | 2(1) | 0 |
| Increase crop yield | | **0** | 0 | **2 (2)** | 0 |

# Organic fertilisation has trade-offs

- 2 out of 3 meta-analyses report decrease in ammonia emissions
- Overall, positive effects on soil biological quality, nutrients and soil organic carbon
- However, 9 of 12 meta-analyses report negative or no-effect on GHG emissions
- No effect on crop yield
- All meta-analyses include studies in Europe



Source: 123RF Copyright: nehru

# Helpdesk upon DG AGRI requests - examples

- Feb 2021 – Effects of liming on Carbon sequestration
- Oct 2021 - Effect of tillage techniques on pesticide use and related metrics
- Oct 2021 – Short narrative for the Report on the assessment of the performance of the common agricultural policy 2014-2020
- Oct 2021 - Environmental impacts of extensive farming practices compared to land abandonment in European mountain regions
- 2022 (planned): Summary of impacts across farming practices

# Conclusions about the method

- ensures access to the best current scientific evidence with a low risk of bias
- can reply to specific policy questions in a rapid mode (e.g. helpdesk function)
- can be easily updated following new scientific evidence

# From science to policy: extraction of qualitative and quantitative results for impact assessment in the CAP

Farming practices' Knowledge base

iMAP


Contribution of practices to CAP Strategic Plans performance and impact assessment (Result and Impact Indicators).

Quantitative assessment on some Impacts of farming practices.

Qualitative

| Result Indicators | | R.14 Carbon storage in soils and biomass | R.15 Renewable energy from agriculture | R.16 Investments related to climate change mitigation | R. 19 Improving and protecting soils | R.20 Improving air quality | R.21 Protecting water quality |
|---|---|---|---|---|---|---|---|
| **Organic systems - crops** | **Commitments** | Increase soil organic carbon | | | increase soil biodiversity, increase soil N stock. | No significant effect | Decrease nutrient loss |
| **Organic systems - livestock** | **Commitments** | Increase soil organic carbon | | | Increase SOC | | No significant effect |

# Questions & Answers


# Thank you