Knowledge synthesis on the effect of farming practices on environment and climate

iMAP assessment

JRC.D5 iMAP SP group

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Contents

- Context of the iMAP assessment.
- Pilot study on the ex-ante likely impacts of draft CAP SP interventions on climate mitigation.
- Methods for systematic review of synthesis research papers as a source of data.
- Quantitative data available on meta-analysis.

iMAP assessment

iMAP is an **administrative agreement** between the JRC and DG AGRI to provide **scientific support** for the evaluation, implementation, and monitoring of **the environmental and climate objectives of the CAP.**

iMAP performs:

- scientific **evidence-based** evaluation of the **impacts of sustainable farming practices (FPs)** on the **environment** and the **climate**.
- qualitative evaluation of the **contribution** of sustainable farming practices **to CAP Specific Objectives** and **PMEF indicators**
- extraction of **numerical coefficients** from scientific literature to **support the quantification** of the environmental impacts of sustainable farming practices
- development of a **classification scheme** based on sustainable agricultural practices for the **interventions proposed** in the CAP **strategic plans**.

Likely impacts of CAP SP on climate mitigation

AIM: To develop a simplified methodology to assess the **climate mitigation potential** (by reducing emissions and increasing C sequestration) of **draft CSPs** to contribute to the 2030 climate target for agriculture and forestry sector.

Mapping farming practices by intervention contributing to **SO4**

CLIMAP iMAP → **Mitigation potential by farming practice** (using quantitative coefficients)

Mitigation potential estimated by intervention

Overall mitigation potential of a CAP Strategic Plan

Area of FP implementation X FP mitigation potential coefficients

- Area of FP implementation estimated from planned outputs.
- Mitigation potential coefficients retrieved from scientific literature.

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Likely impacts of CAP SP on climate mitigation

This methodology is now being used by the Evaluation Helpdesk on their work on rough estimation of the climate mitigation potential at national level of the CSP interventions.

The methodology can provide an indication about the mitigation potential of the CAP draft SP, with some **limitations**:

- Attribution of interventions to SO4 may be incomplete.
- Methodology does not allow for a counterfactual analysis.
- Lack of baseline information (just contribution of newly implemented FPs).
- Incomplete information at draft-phase of the strategic plans.
- Link of proposed interventions and FPs not always feasible.
- No data on mitigation potential coefficients for all identified FPs.

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Using Meta-analysis to fill data gaps

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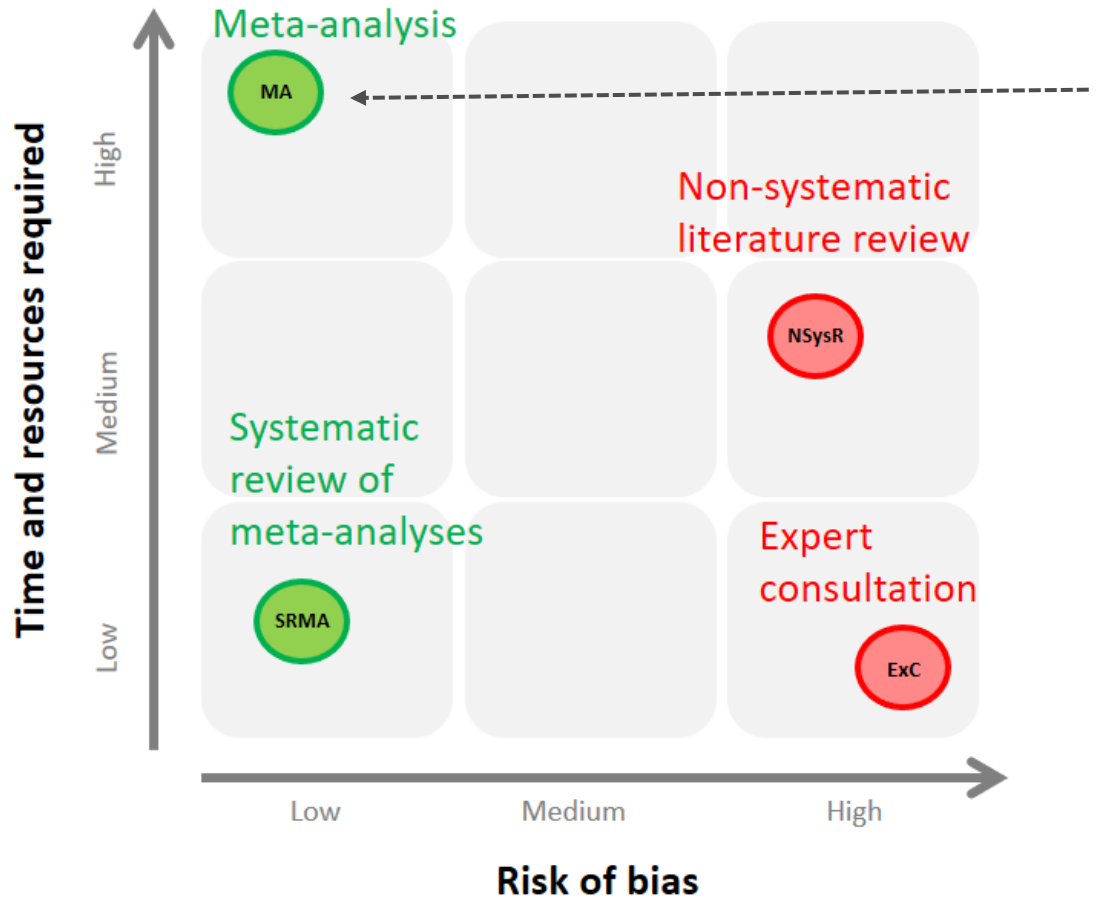
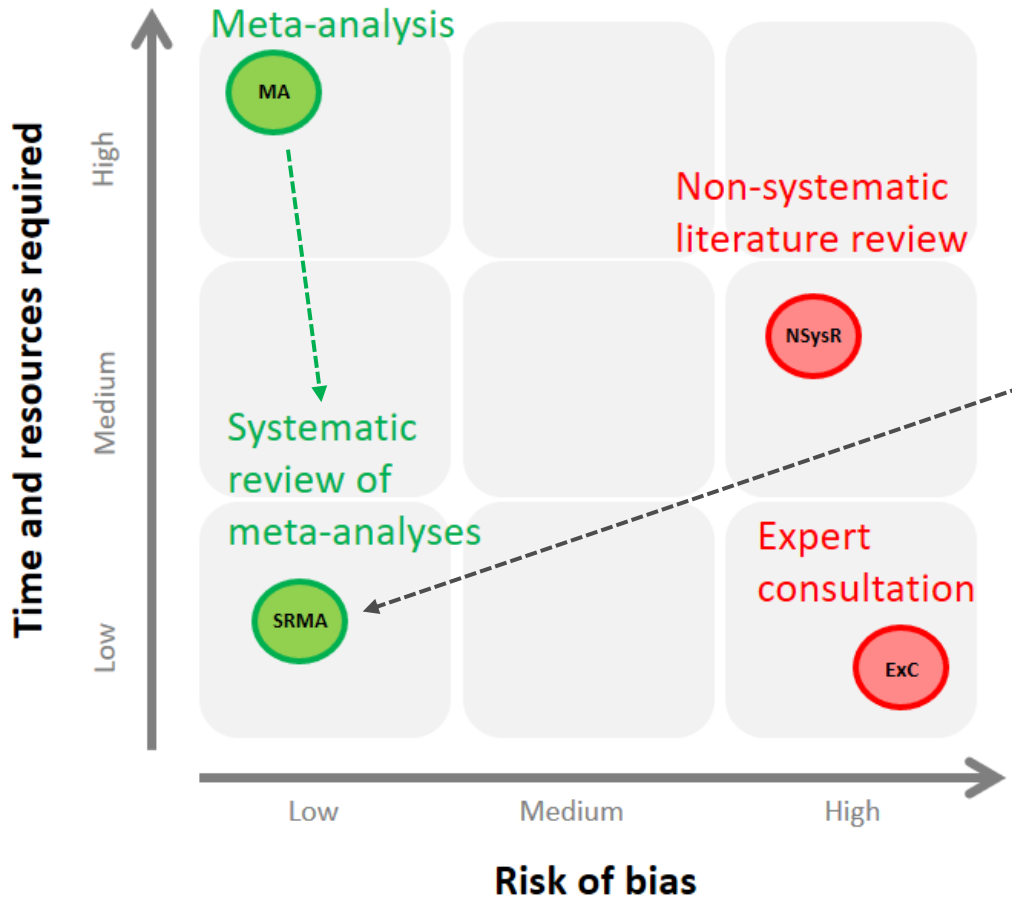
Systematic review of meta-analysis



A **meta-analysis** reanalyses data from multiple primary studies resulting from a review.

Knowledge synthesis methods (adapted from EKLIPSE, 2018)

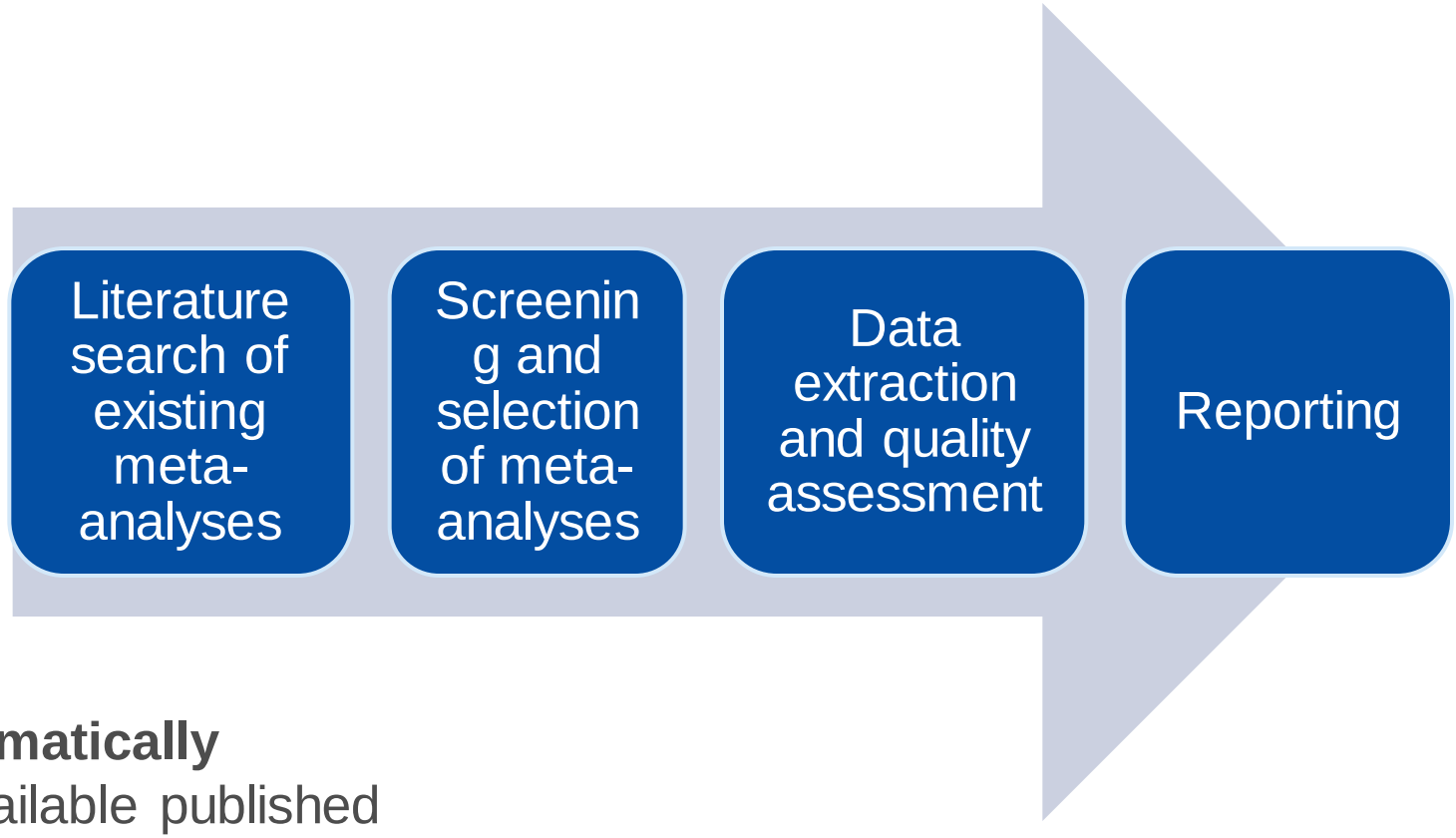
Systematic review of meta-analysis



We are **systematically reviewing** available published **meta-analyses** on the environmental impacts of farming practices (FPs).

Knowledge synthesis methods (adapted from EKLIPSE, 2018)

Systematic review of Meta-Analysis



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Systematic review of meta-analysis

For each farming practice (FP), the assessment summarizes **all the environmental and climate impacts found in** a systematic review of **meta-analysis**

These impacts are then evaluated for their **relevance** with respect **to environmental factors** covered
by **CAP SO** and **PMEF indicators**

Example

Result from literature/fiches:
agroforestry
increases species
richness of many groups
including soil invertebrates

R. 19PR Share of UAA under supported commitments
beneficial for soil management
to improve soil quality **and biota**

I.19 Increasing farmland bird populations:
Farmland bird index

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Systematic review of meta-analysis

IMAP

/ Home / LINKING FARMING PRACTICES TO INDICATORS

Matrix linking Farming Practices and PMEF Result indicators

Created by Augusta BANDE, last modified by Michael ASSOULINE on Apr 11, 2022

- Positive effects - strong evidence
- Overall Positive effect
- Negative effects - strong evidence
- Overall negative effect
- No significant effect
- Uncertain a effects
- Not pertinent to investments/commitments
- Differing effects
- No link can be established

Select a farming practice = Click and start typing

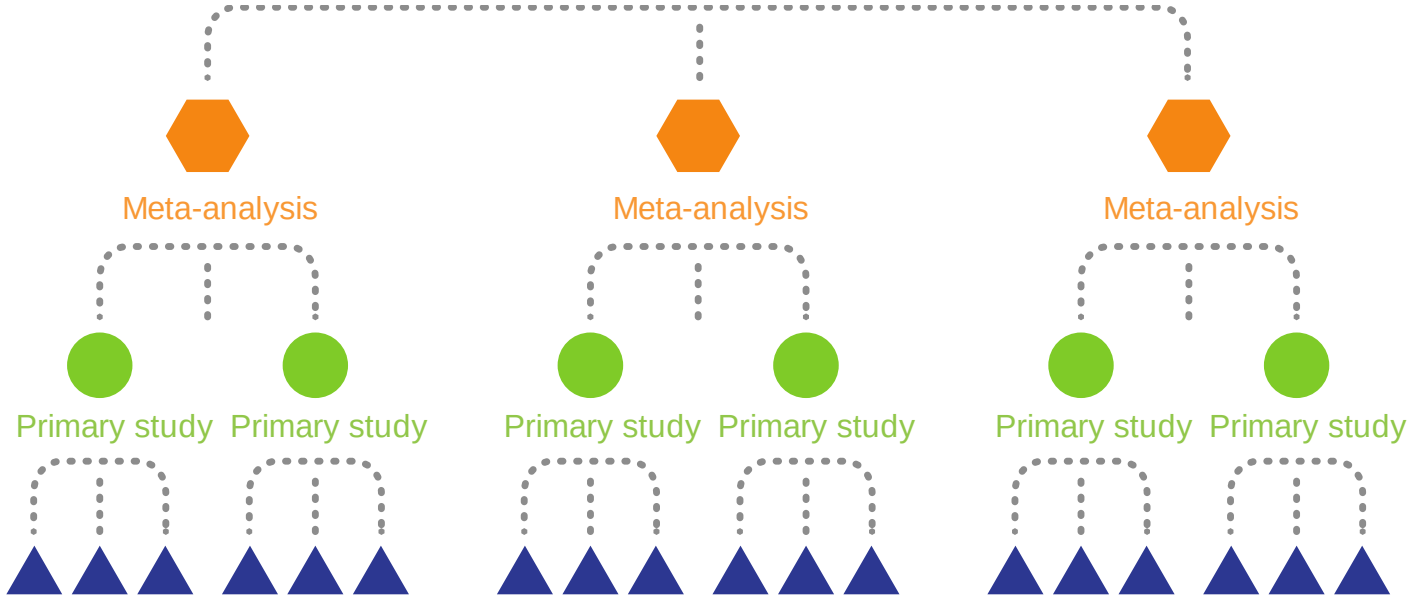
Edit Document

Result Indicators (Final version)		R.12 Adaptation to climate change: Share of UAA under supported commitments to improve climate adaptation	R.13PR Reducing emissions in the livestock sector: Share of livestock units (LU) under support to reduce Greenhouse gases (GHG) emissions and/or ammonia, including manure management	R.14PR Carbon storage in soils and biomass: Share of UAA under supported commitments to reduce emissions, maintain and/or enhance carbon storage (including permanent grassland, permanent crops with permanent green cover, agricultural land in wetland and peatland)	R.15 Renewable energy from agriculture, forestry and from other renewable sources: Supported investments in renewable energy production capacity, including bio-based (in MW)	R.16 Investments related to climate: Share of farms benefitting from CAP investment support contributing to climate change mitigation and adaptation, and to the production of renewable energy or biomaterials	R.17PR Afforested land: Area supported for afforestation, agroforestry and restoration, including breakdowns	R. 19PR Improving and protecting soils: Share of UAA under supported commitments beneficial for soil management to improve soil quality and biota (such as reduce tillage, soil cover with crops, crop rotation included with leguminous crops)
Agroforestry	Commitments - maintenance of existing areas	Increase soils' water retention capacity		Increase carbon sequestration and storage, no significant effects on carbon emissions.				Positive on soil erosion, soil fertility and on availability of nutrients. Positive impacts on soil biodiversity

Quantitative data extraction

1 Qualitative information

2 Quantitative data available in meta-analysis



Quantitative data extraction

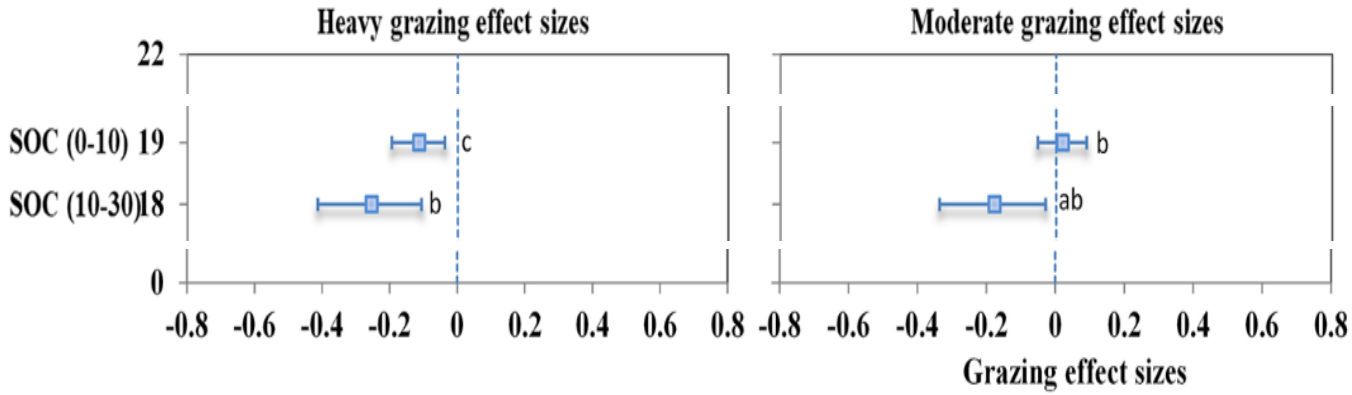
The most suitable paper is selected based on:

Overall quality of the meta analysis (statistical robustness, studies selection, potential bias)
Relevance of the results (geographic coverage, crops/livestock types, metric)

The criteria used for selection depend on the research question to be answered.

Quantitative data extraction

Once a paper is selected, we extract the mean effect size and convert it to interpretable metric (% change by applying the FP).



	Grazing level	Soil depth	CI_LOW	Mean	CI_HIGH	Effect
Effect of **Grazing** on **Soil Organic Carbon** (% change).	Moderate	0-10 cm	-5.2	1.9	9.2	No effect
		10-30 cm	-28.7	-16.4	-3	Negative
	Heavy	0-10 cm	-17.7	-10.8	-3.8	Negative
		10-30 cm	-33.9	**-22.5**	-10.2	Negative

The confidence interval (CI) provides a range within which the effect size is estimated based on combining results from multiple studies.

LAI, Liming; KUMAR, Sandeep. A global meta-analysis of livestock grazing impacts on soil properties. PLoS One, 2020, vol. 15, no 8, p. e0236638.

Data disaggregation

Meta-analyses can provide results disaggregated according to different factors, such as the geographical location of the studies.

Effect of **organic fertilisation** on **soil organic carbon** by regions.

All techniques types	Biogeographic regions	CI_LOW	Mean	CI_HIGH	Effect
All regions *Source:* (Chen et al. 2018)	**Overall**	**27.0**	**29.0**	**31.0**	Positive effect
	Mediterranean, arid and semi-arid	23.0	31.3	40.4	Positive effect
	Continental	17.4	22.8	28.3	Positive effect
	Humid-temperate	7.0	13.9	21.4	Positive effect

Overall value to be used at global level

Specific geographic information can be used to better target the assessment.

Chen, Y et al. The long-term role of organic amendments in building soil nutrient fertility: a meta-analysis and review. Nutrient Cycling in Agroecosystems, 2018, vol. 111, p. 103-125.

Data disaggregation

Coefficients from meta analysis can provide very specific information on single FP.

Effect of **green manuring** on **soil organic carbon**.

Biogeographic regions	CI_LOW	Mean	CI_HIGH	Effect	IPCC Factor	IPCC Climate regime	IPCC default
All regions *Source:* (Muhammad et al. 2019)	9.5	15.2	22.4	Positive	Input Level High-without manure	Temp., Bor., Trop. Wet	11±10%
Mediterranean climate regions *Source:* (Shackelford et al. 2019)	4	9	15	Positive		Temp., Bor., Trop. Dry	4±13%

The IPCC Factor *High C input without manure* is defined as: *significantly greater crop residue inputs over medium C input cropping systems due to additional practices, such as production of high residue yielding crops, use of green manures, cover crops, improved vegetated fallows, irrigation, frequent use of perennial grasses in annual crop rotations, but without manure applied*.

Data disaggregation

Meta-analyses can provide results disaggregated by sub-practice

Effect of **organic fertilisation** on **ammonia** (NH_3) emissions with 50, 75 and 100% substitution of synthetic N fertilizer by manure

Techniques types		**CI_LOW**	**Mean**	**CI_HIGH**	**Effect**
Syntethic N substitution by manure.	Manure 100%	-78.9	-67.2	-46.9	Positive effect
	Manure 75%	-69.7	-16.2	133.2	No effect
	Manure 50%	-44.5	-16.8	25.6	No effect

Specific practice information can be used to better target the interventions.

TI, Ch. et al. Potential for mitigating global agricultural ammonia emission: a meta-analysis. Environmental Pollution, 2019, vol. 245, p. 141-148.

Final remarks

- Information from published meta-analysis can be used to fill data gaps.
- Data from meta-analysis is usually at global or biogeographical scale, but rarely at national level.
- Numerical coefficients can be used to feed models (CAPRI).
- The results are tied to the scientific literature, so their use may be limited: links are not always feasible and straightforward.

Thank you

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