



# Trade-offs associated with carbon sequestration

MARTA GOBERNA AND ROBERTA CALONE  
and the TRACE-Soils and SOMMIT teams



EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695





**REDUCING SOIL DISTURBANCE**



**DIVERSIFYING AGROECOSYSTEMS**



**INCREASING ORGANIC INPUTS**



**SEQUESTERING SOIL CARBON**

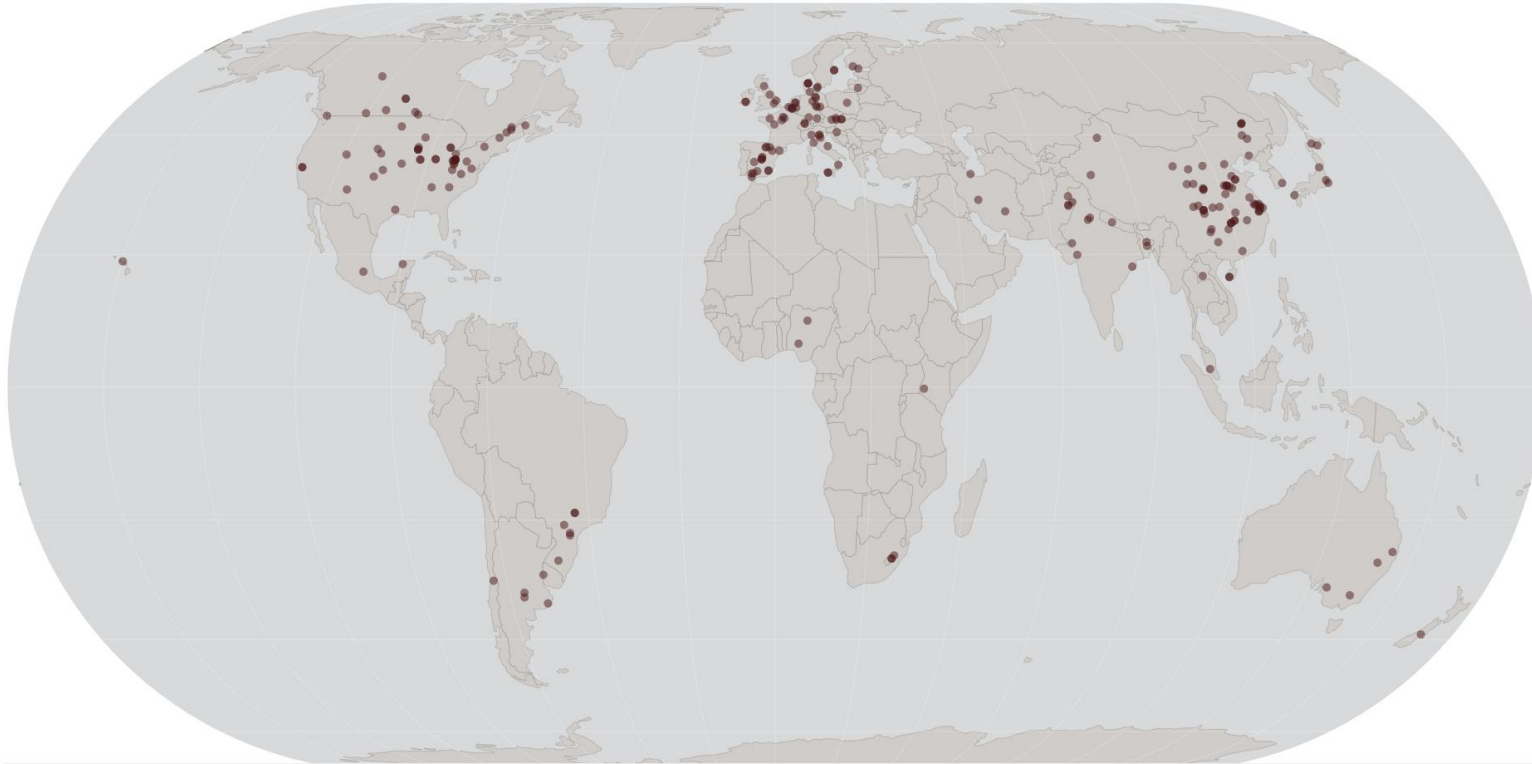
**SYNERGIES**

- MAINTAINING SOIL STRUCTURE
- PRESERVING SOIL BIODIVERSITY

**POTENTIAL TRADE-OFFs**

- INCREASING GHG EMISSIONS
- ENHANCING NUTRIENT LOSSES

# LESSONS LEARNED FROM THE LITERATURE



232 studies  
215 sites  
38 countries

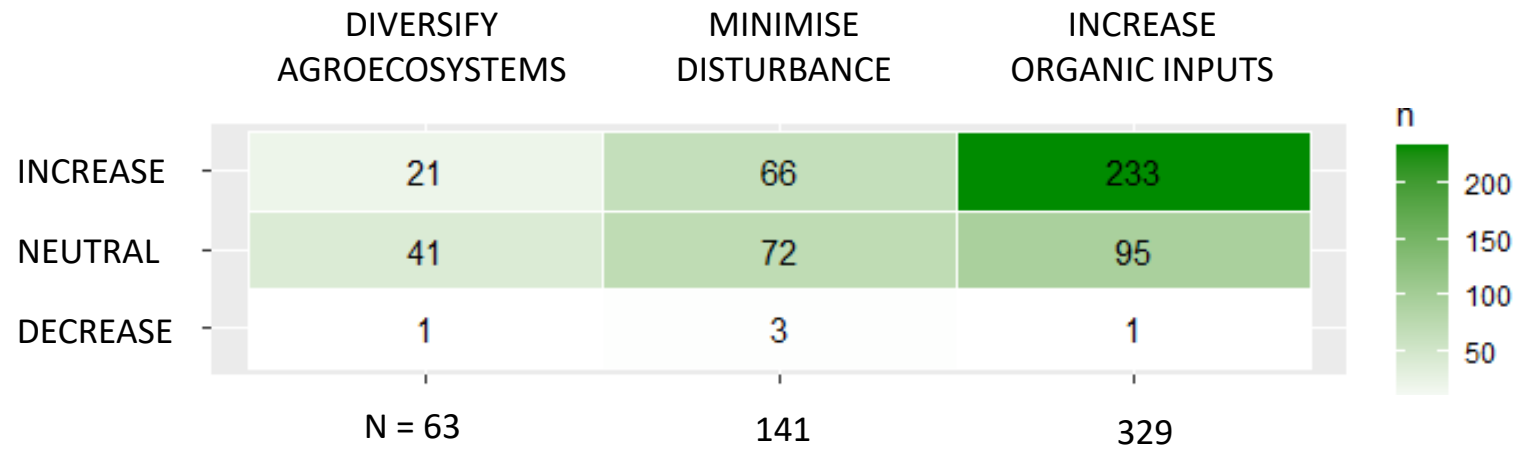
Geo Point Plotter

NO TILLAGE

STANDARD TILLAGE



## SUSTAINABLE PRACTICES ARE NOT EQUALLY EFFICIENT IN SEQUESTERING CARBON



## EVIDENT SYNERGIES WITH SOIL STRUCTURE AND BIOTA

### HIGHER SOIL CARBON

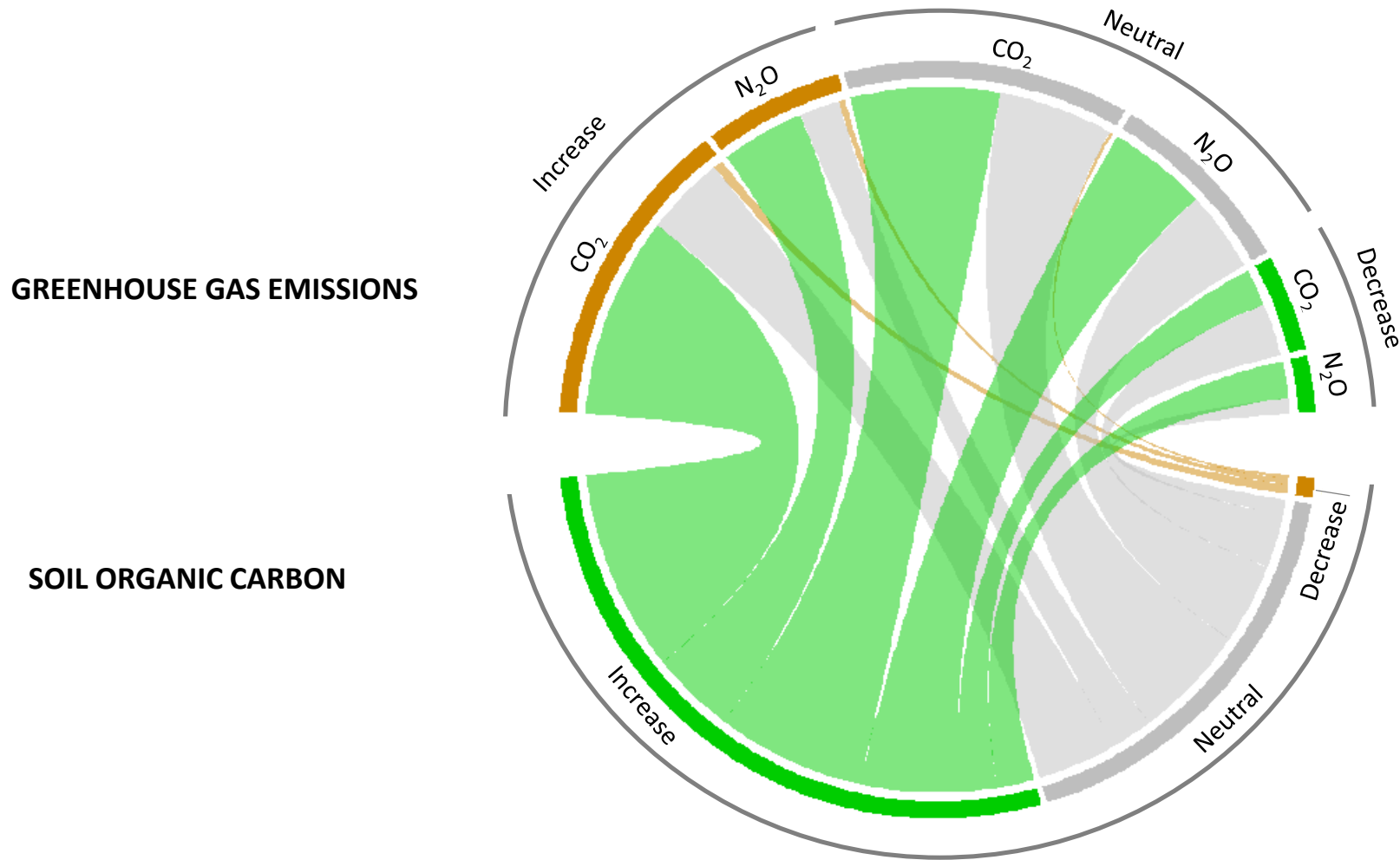


### LOWER SOIL CARBON

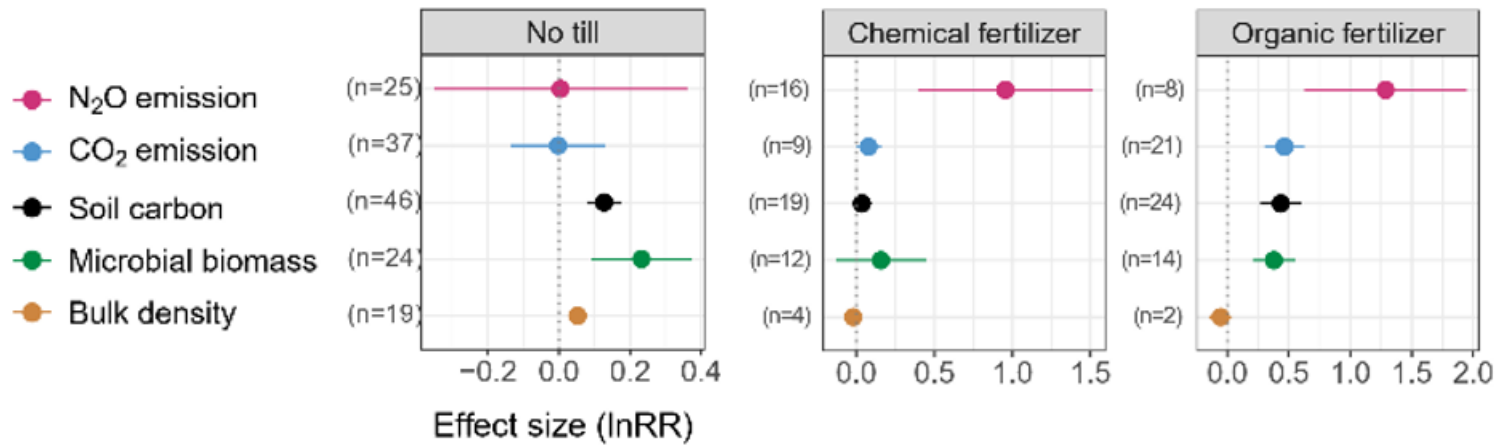


- IMPROVED SOIL AGGREGATION
- INCREASED SOIL POROSITY
- ENHANCED WATER RETENTION
- REDUCTION OF SOIL COMPACTION
- ABUNDANT AND DIVERSE SOIL BIOTA

**NO CLEAR TRADE-OFFS DETECTED IN TERMS OF GHG EMISSIONS IF WE CONSIDER ALL PRACTICES TOGETHER**



## INCREASE IN GHG WITH ORGANIC AMENDMENTS ...



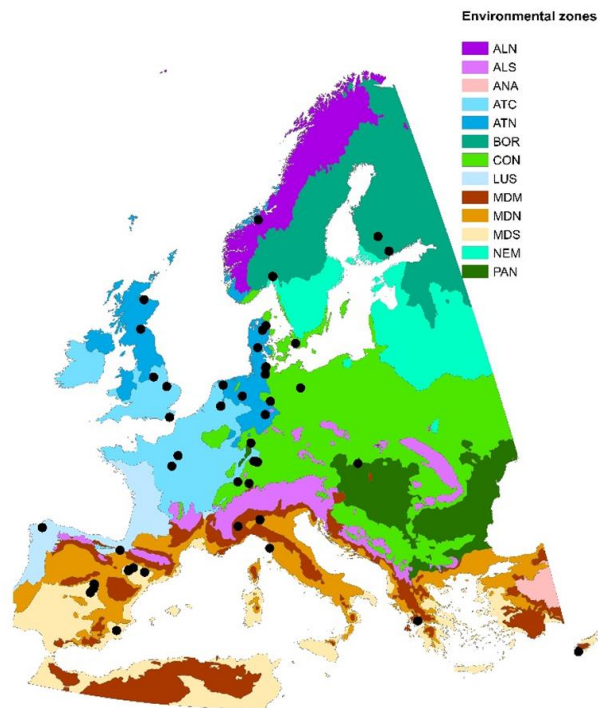
73 Experiments  
World  
Treatment vs. No treatment

... BUT

- POTENTIAL TRADE-OFFS OF ORGANICS ARE SMALLER THAN THOSE OF CHEMICALS**
- LARGE CONTEXT-DEPENDENCY**



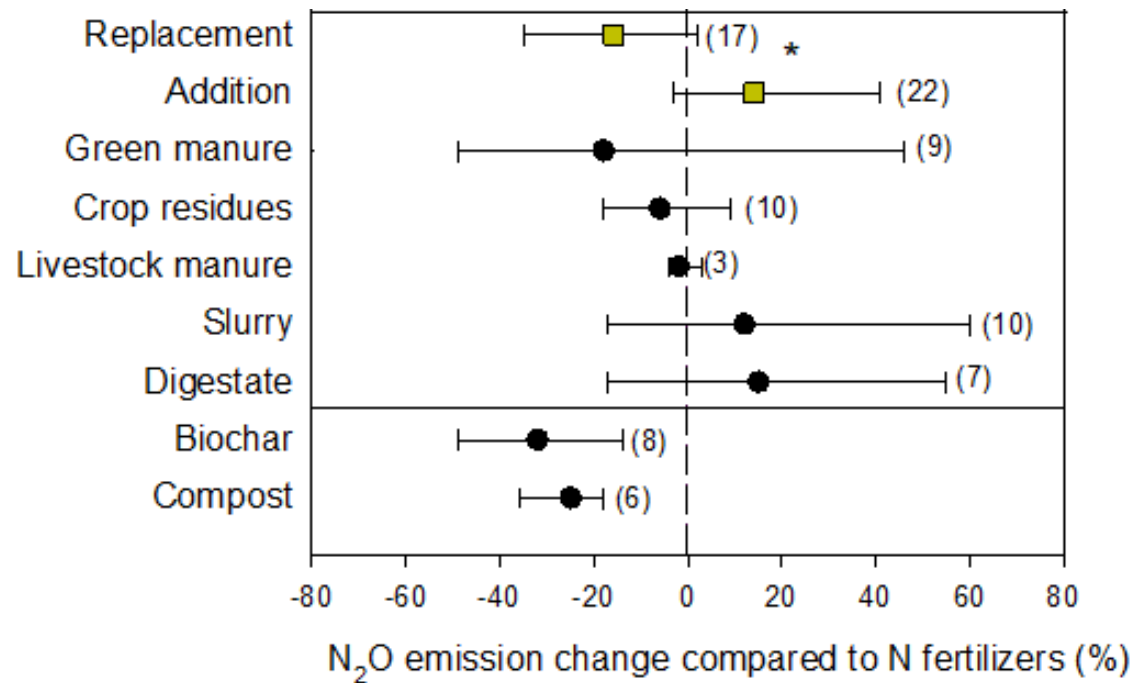
## BETTER ORGANICS ALONE THAN IN COMBINATION WITH CHEMICALS



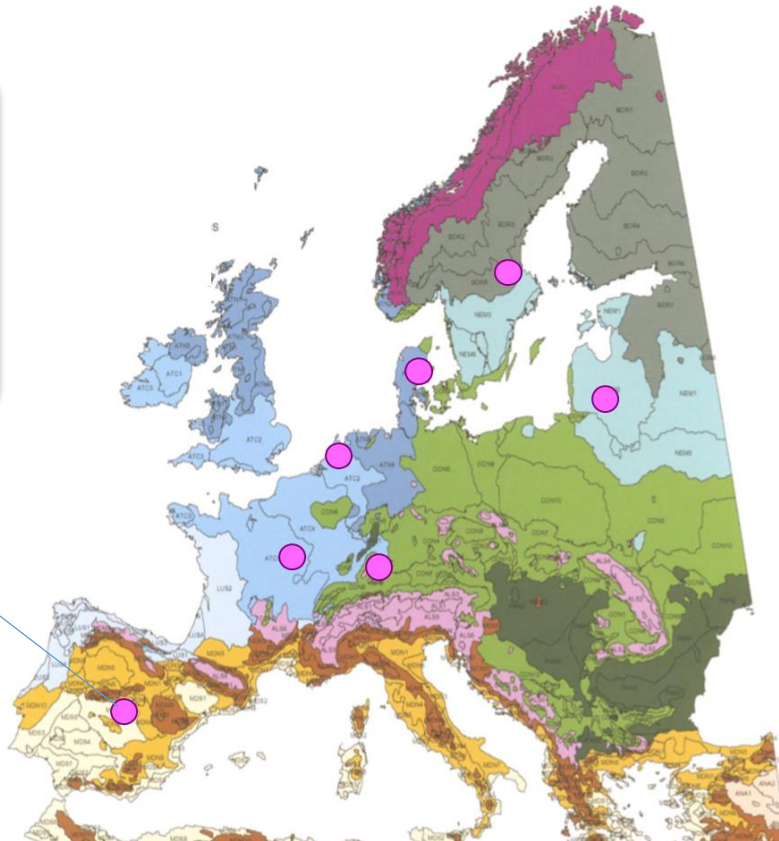
46 experiments

Europe

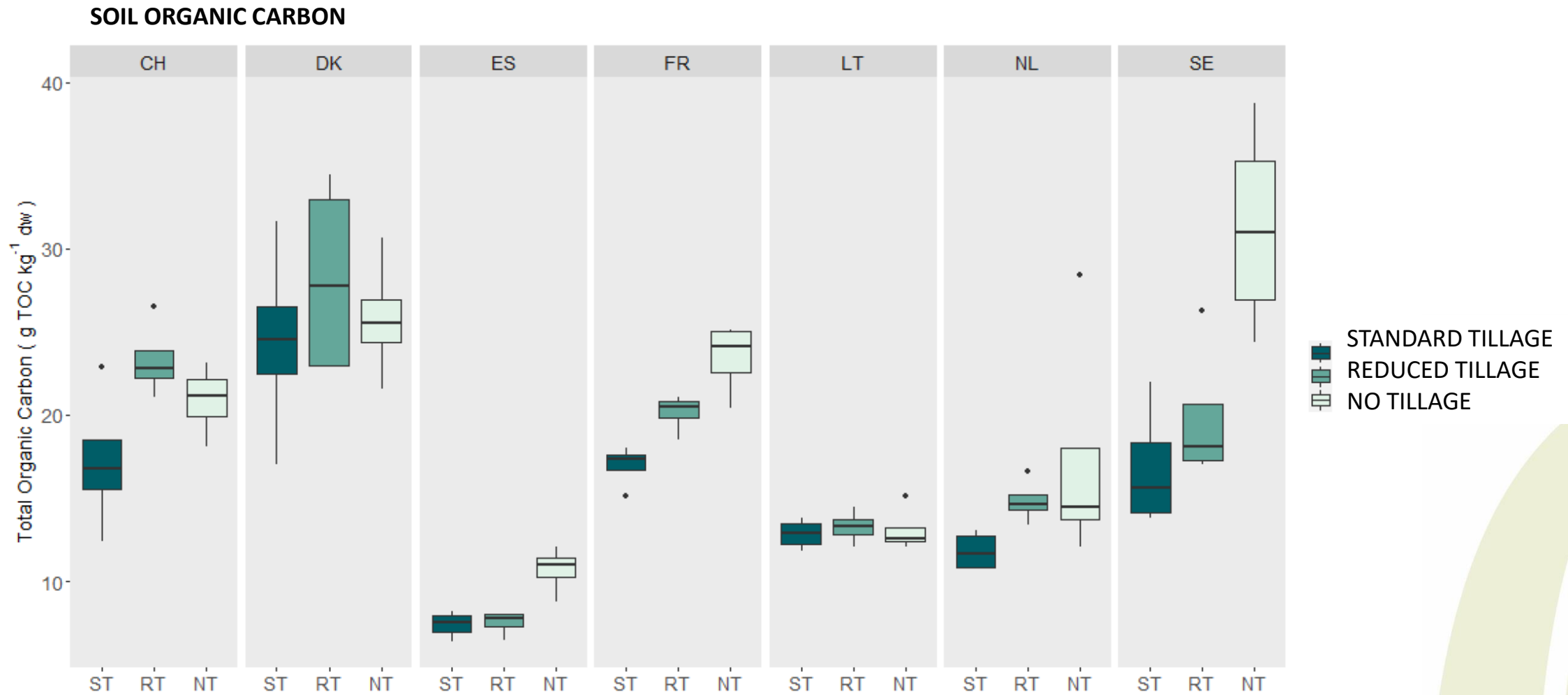
Organic amendment vs mineral fertilization



# VALIDATING TRADE-OFFs EMPIRICALLY

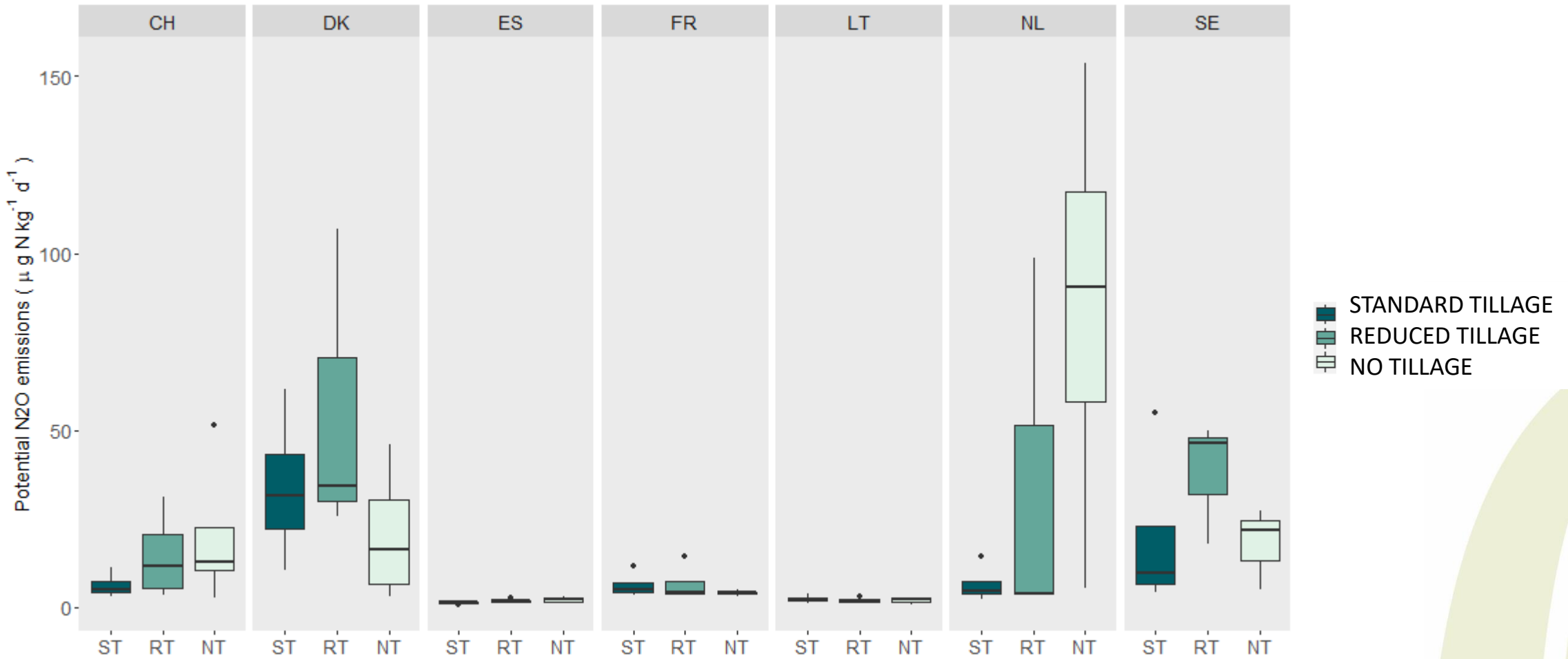


## LARGE VARIABILITY THROUGH THE EU PEDOCLIMATIC REGIONS

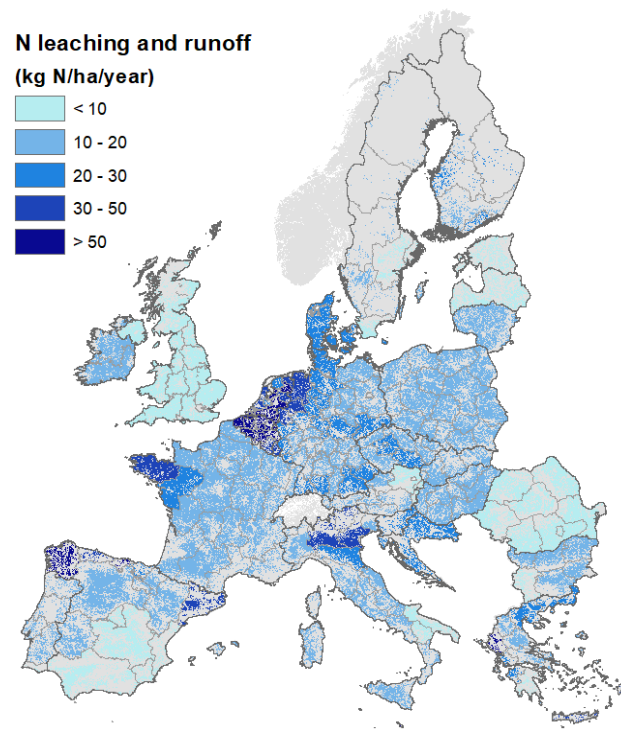


## LARGE VARIABILITY THROUGH THE EU PEDOCLIMATIC REGIONS

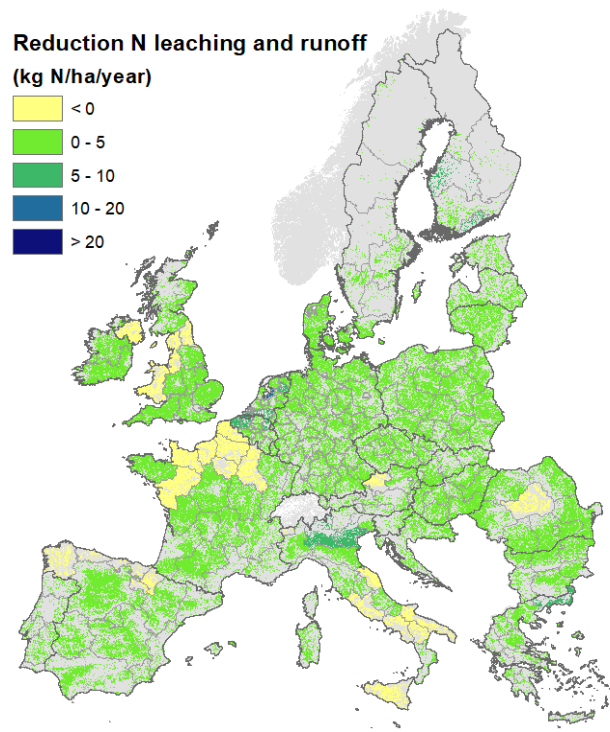
### POTENTIAL N<sub>2</sub>O EMISSIONS



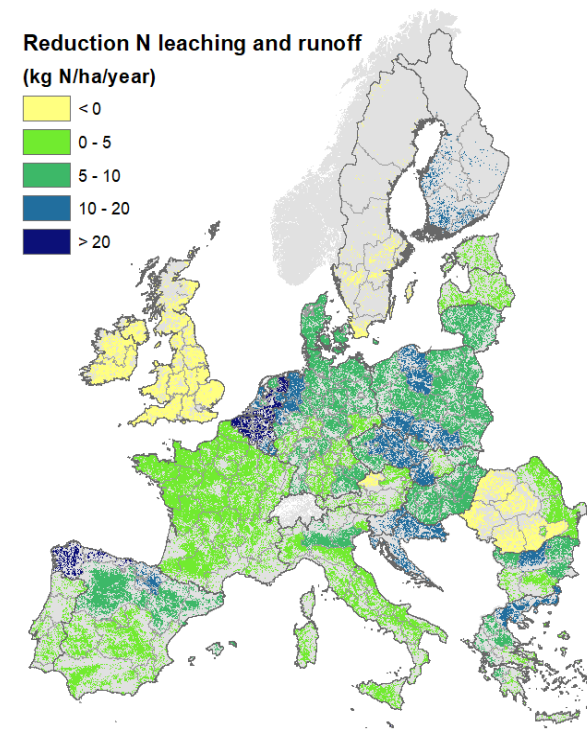
# EVALUATING LARGE-SCALE IMPACTS: MECHANISTIC MODELLING



**REFERENCE YEAR: 2017**



**COVER CROPS**



**COVER CROPS + BALANCED N  
FERTILIZATION**

## DATA GAPS TO IMPROVE CALCULATIONS OF NITROGEN AND CARBON FLOWS AT THE PROVINCIAL EU-LEVEL

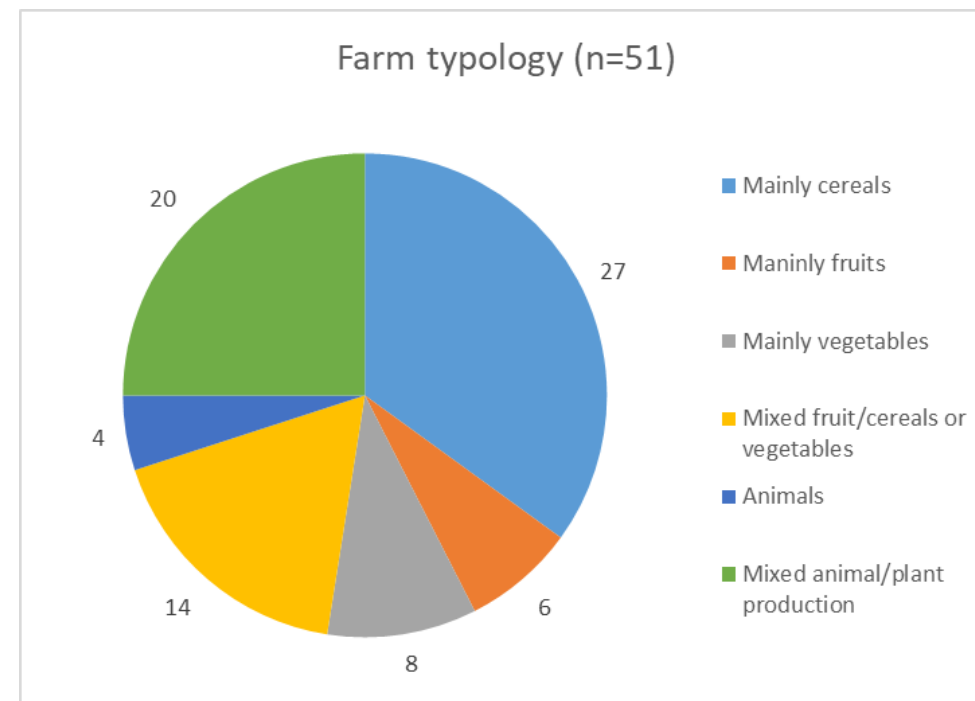
- USE OF ORGANIC FERTILIZERS (MANURE, COMPOSTS, AND DIGESTATES)
- COVER CROPS: AMOUNT OF BIOMASS PRODUCED AND TYPE OF CROPS
- N<sub>2</sub>O EMISSION FACTORS AND NO<sub>3</sub> LEACHING FACTORS FOR FERTILIZERS AND ORGANIC RESOURCES
- INTERACTION OF N EMISSIONS WITH C MANAGEMENT MEASURES (e.g. different N<sub>2</sub>O emission factors for mineral fertilizers and manures)

# KEY HIGHLIGHTS

- **EVIDENT SYNERGIES** BETWEEN CARBON SEQUESTRATION AND OTHER AGROECOSYSTEM SERVICES
- INCREASED **GHG EMISSIONS** DETECTED MAINLY FOR SOME ORGANIC AMENDMENTS
- STILL, AMENDMENTS LEAD TO SMALLER TRADE-OFFs THAN CHEMICAL FERTILIZERS. REPLACING CHEMICALS BY ORGANICS IS BETTER THAN USING THEM IN COMBINATION
- **NOT “ONE SHOE FITS ALL”**: LARGE CONTEXT DEPENDENCY OF TRADE-OFFs
- **QUANTIFYING TRADE-OFFs REQUIRES:**
  - **MULTI-SITE, SYSTEMATIC AND LONG-TERM FIELD MONITORING**
  - **FILLING IN INFORMATION GAPS ON FARM MANAGEMENT**

# STAKEHOLDER'S PERCEPTION

Living labs	Category
Rome (IT) Mediterranean north	13 organic farms
	5 category association
	1 technician (agronomist)
	1 cultural broker (sociologist)
Grabow (PL) Continental	1 farm
	3 farmer association
	3 advisor/extension service
	1 trader
Murcia (SP) Mediterranean south	3 farms
	2 technician/advisor
	1 category association
	1 fertilizers company
Ljubljana -Moskanjci (SL) Alpine south	27 farms
	2 technician (LTE research associate)
	3 category farmer/social association
	5 advisor
	1 seed company
Rutzendorf (AU) Pannonian	1 farmer
	1 extension service/chamber of agriculture
	3 Institutions (regional governments)
	2 education (professional schools)

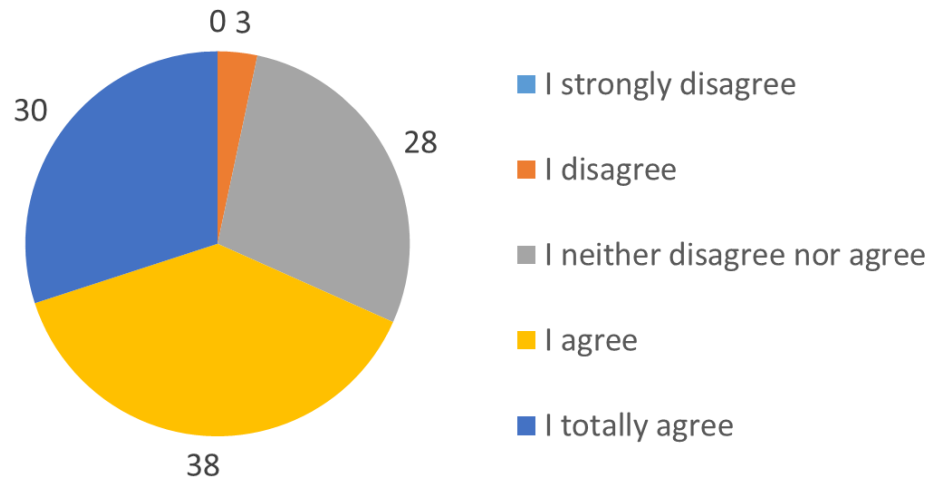


- The **Stakeholders' platform** was queried for:
- i) **awareness** of the impact of management choices on climate change,
  - ii) research **ambitions** on the interaction between land management and climate,
  - iii) **interest** in and
  - iv) **knowledge** of the SMSs tested in the LTEs

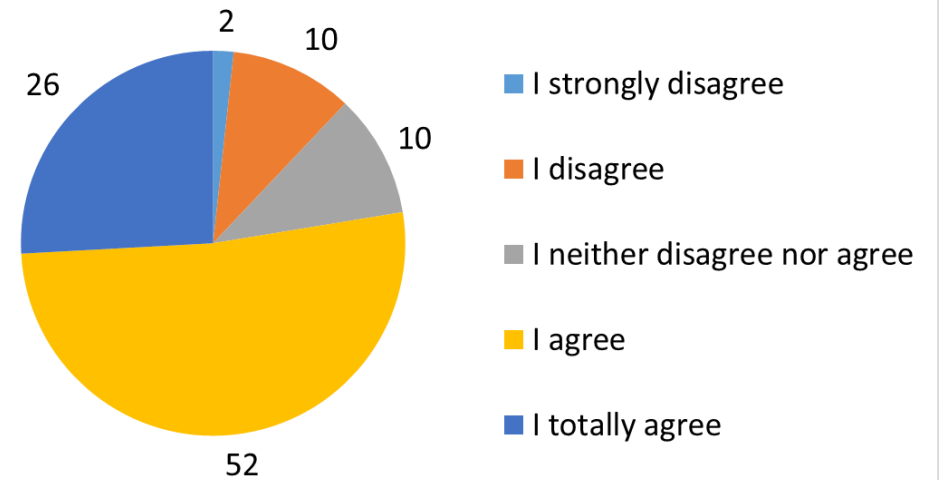


# AWARENESS

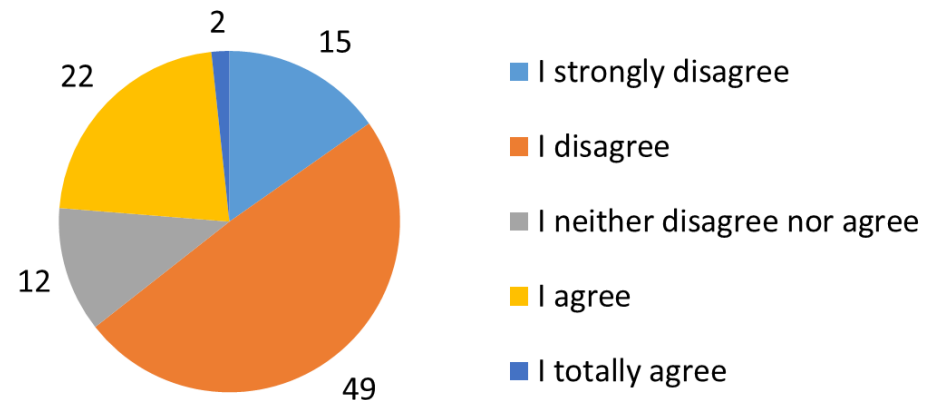
I think that agricultural land management practices have an impact on carbon sequestration



I think that soil management may be linked to greenhouse gas emission

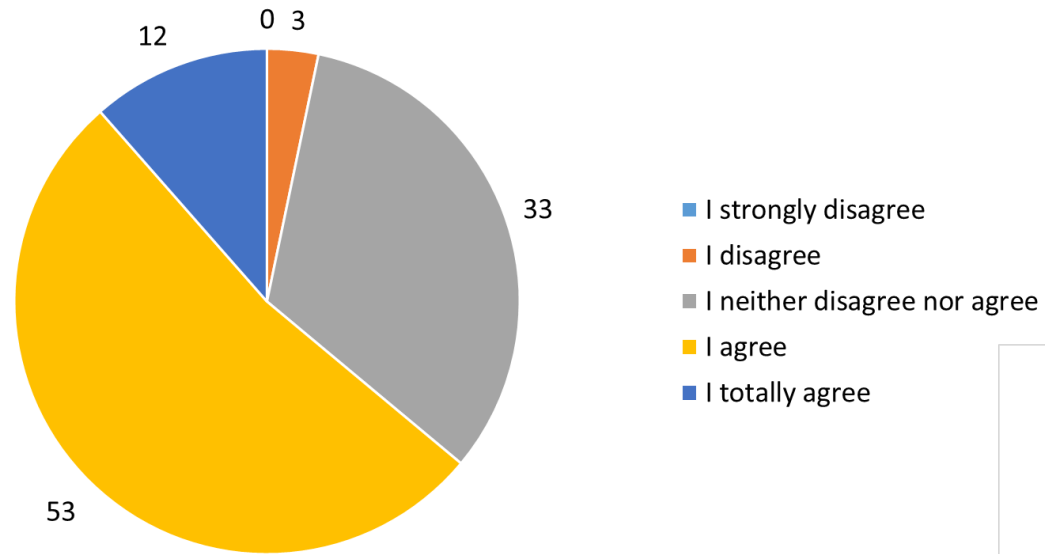


I think that soil management strategies to increase organic matter can lead to a reduction of the system productivity

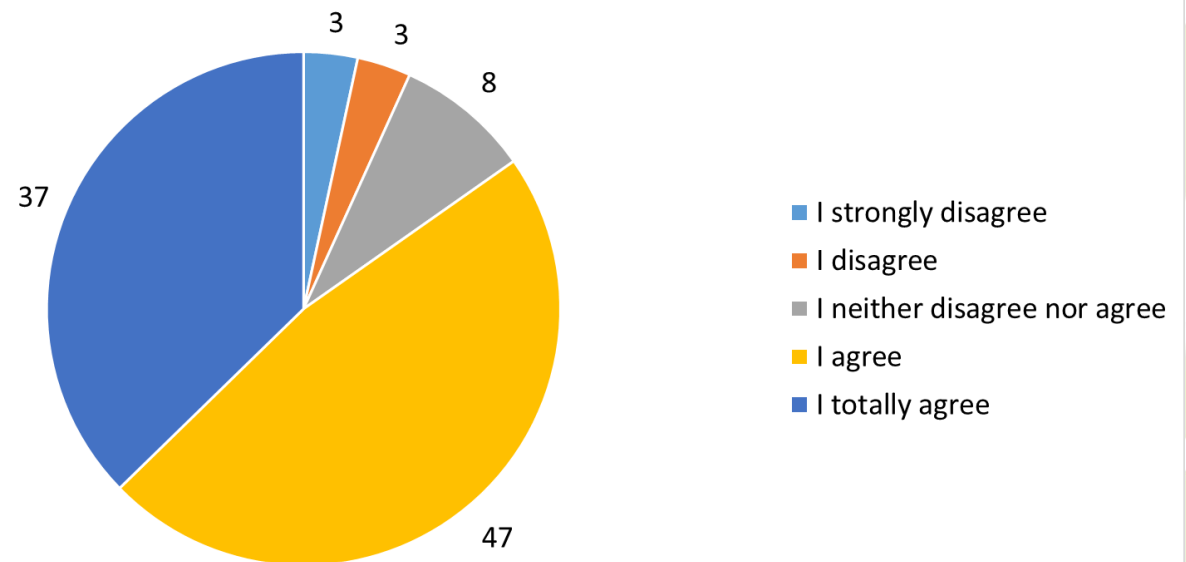


## INTEREST TO TEST AND SELF-EFFICACY

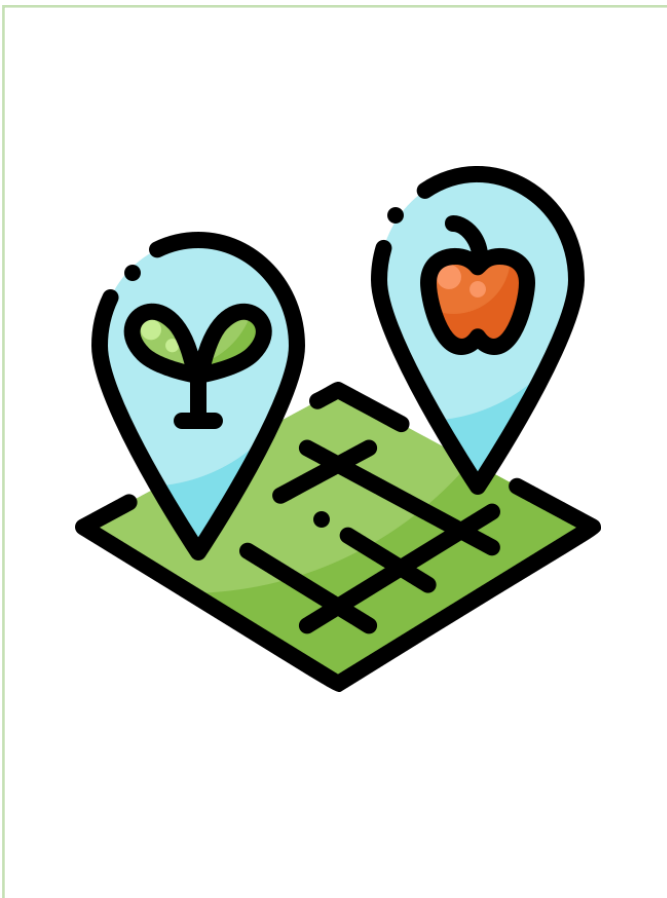
If it were entirely up to me, I'm sure I could use soil management practices able to reduce the effects on climate change



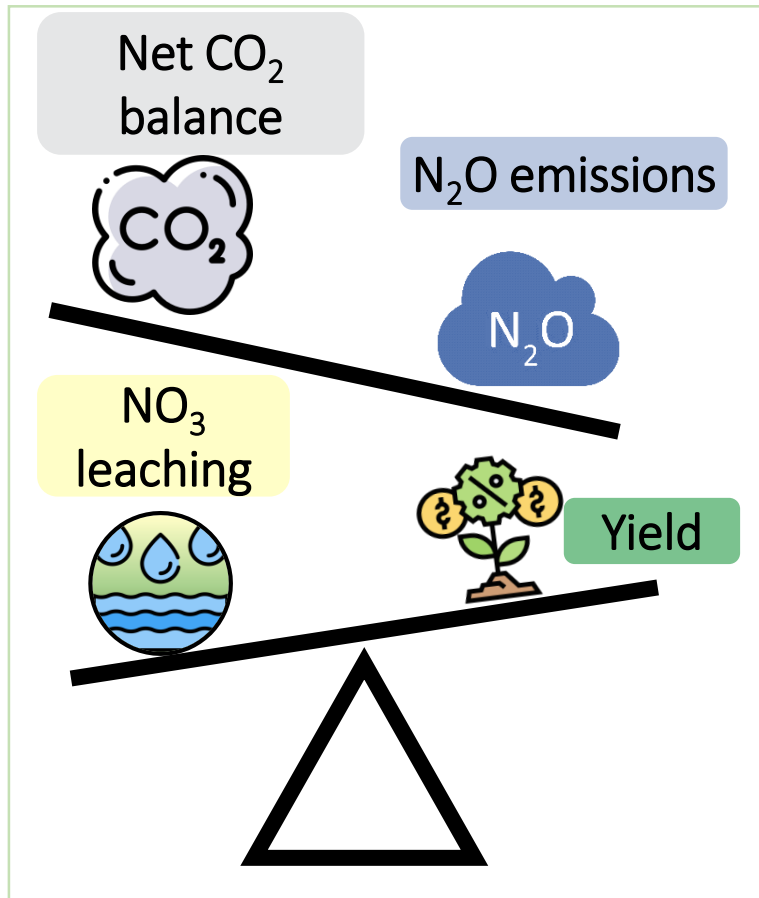
I could use soil management practices able to reduce the effects on climate change if they involve obtaining agricultural subsidies



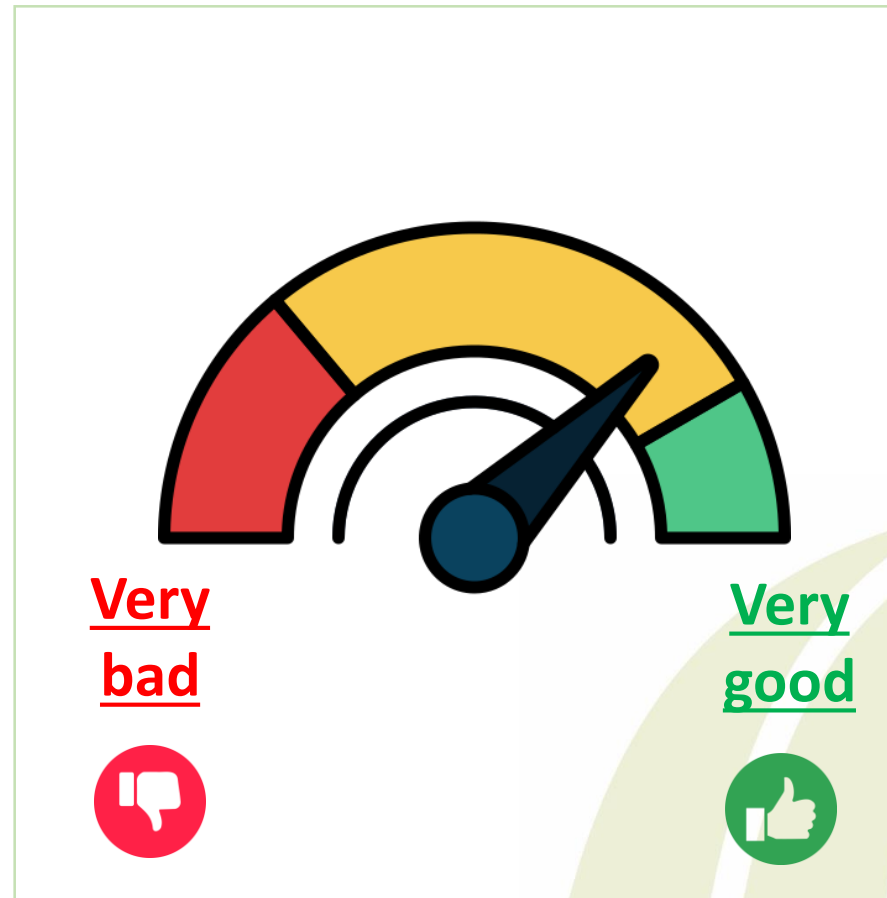
# Trade-off assessment system



Agronomic case-scenario

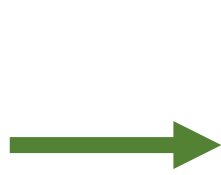
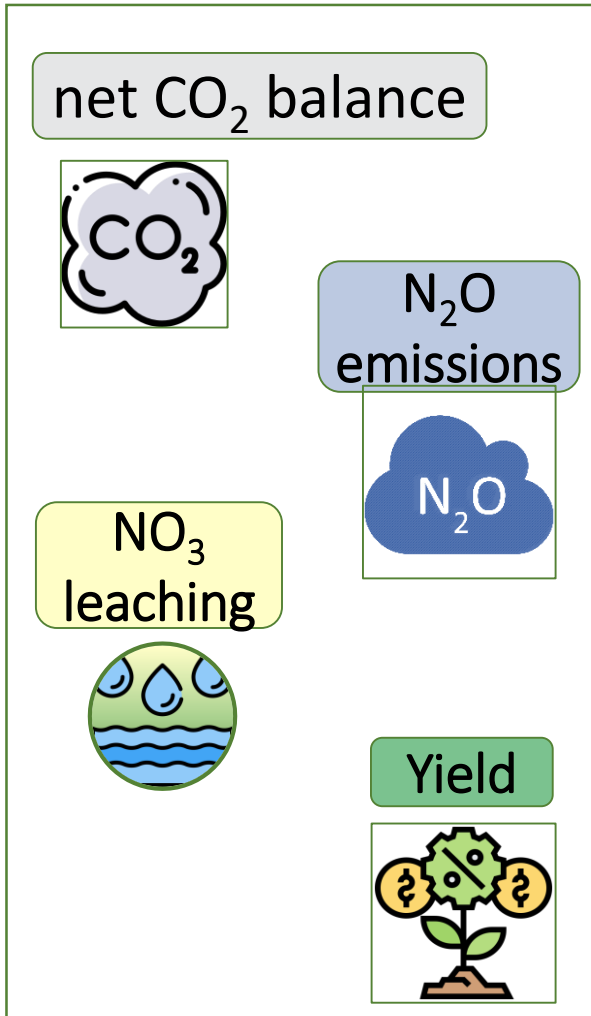


4 trade-off components

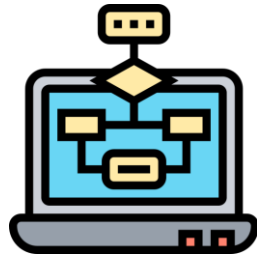


Σommit index

# Trade-off components estimation



Guidelines and other meta-analysis



Simulation models



Long term experiment

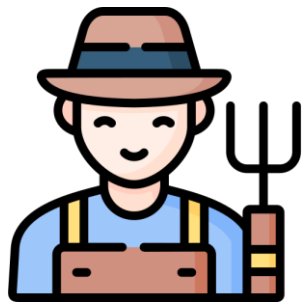


Generic  
Large-scale application

Site-specific  
Time-cost consuming

## Expert opinions

The index robustness can be enhanced by incorporating opinions from domain experts to account for the priorities and perspectives of different users



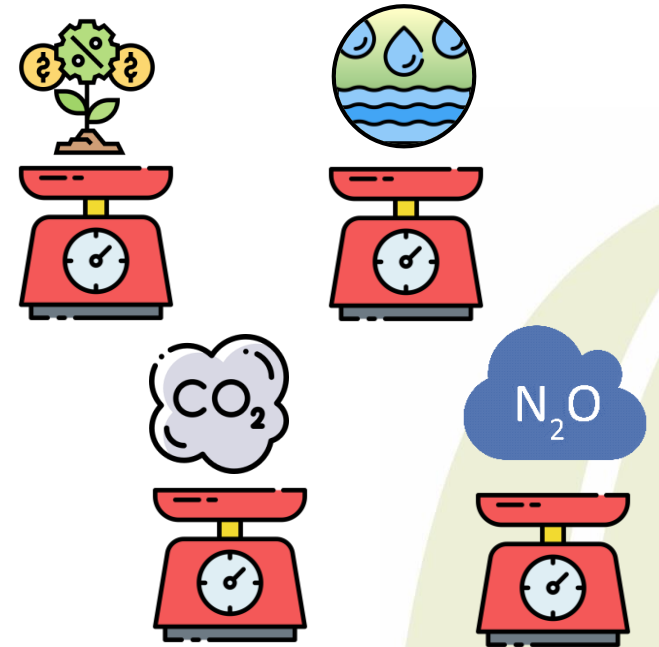
Farmers



Agrochemical  
multination  
company



Agency for  
CAP funds  
allocation



Weight of the trade-off  
components



X @TraceSoils



TRACE Soils

European Joint Programme



Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile



Univerza v Ljubljani



EJP SOIL  
ΣOMMIT



EJP SOIL  
European Joint Programme

EJP SOIL has received funding from the European Union's Horizon 2020 research and innovation programme: Grant agreement No 862695

