Diffuse Pollution Swapping in Arable Agricultural Systems

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Pollution swapping *occurs when a mitigation option introduced to reduce one pollutant results in an increase in a different pollutant*

(one pollutant is "swapped" for another).

Introduction

This study investigated diffuse pollution mitigation options applied in combinable crop systems

- Arable agriculture is considered to be a major contributor to diffuse nitrogen, phosphorus, and carbopollution.
- The mitigation of diffuse pollution is an important directive in Europe but there is a conflict between pollutants, and pollution swapping occurs
- Pollutants considered for this investigation were:
  Nitrogen (N), Phosphorus (P), Carbon (C), Sulfur (S), Pesticides and Pathogens

Introduction

- The mitigation options that have been investigated in this study are:

    1. cover crops
    2. residue management
    3. no-tillage
    4. riparian buffer zones
    5. contour grass strips and
    6. constructed wetlands.

- These were chosen because they are widely promoted as being useful for controlling diffuse pollution

Cover crops

Cover crops (also called catch crops) are used in agricultural systems throughout the world to reduce losses of nutrients through leaching and to protect the soil surface from erosion.

- Reduce NO_3 leaching by intercepting N
- There are no changes apparent in N_2O emissions.
- Generally reduce soil losses, as compared to bare fallow.
- Losses of particulate P are generally reduced in runoff, but losses of dissolved reactive P may be increased by cover crops.
- There is no difference in CO_2 emissions between cover crops and bare fallow.

Crops residues management

Crop residues are either removed or left on the soil surface

- Crop residues are very successful in reducing sediment losses, even at low cover.
- N, P and C in runoff are also reduced. However, losses in leaching may increase.
- Gaseous emissions of N_2O and CO_2 can increase with crop residues; the pattern for CH_4 is less clear.
- Losses of the pesticides (atrazine and metolachlor) can be reduced using crop residues.

Tillage

Conventional Tillage

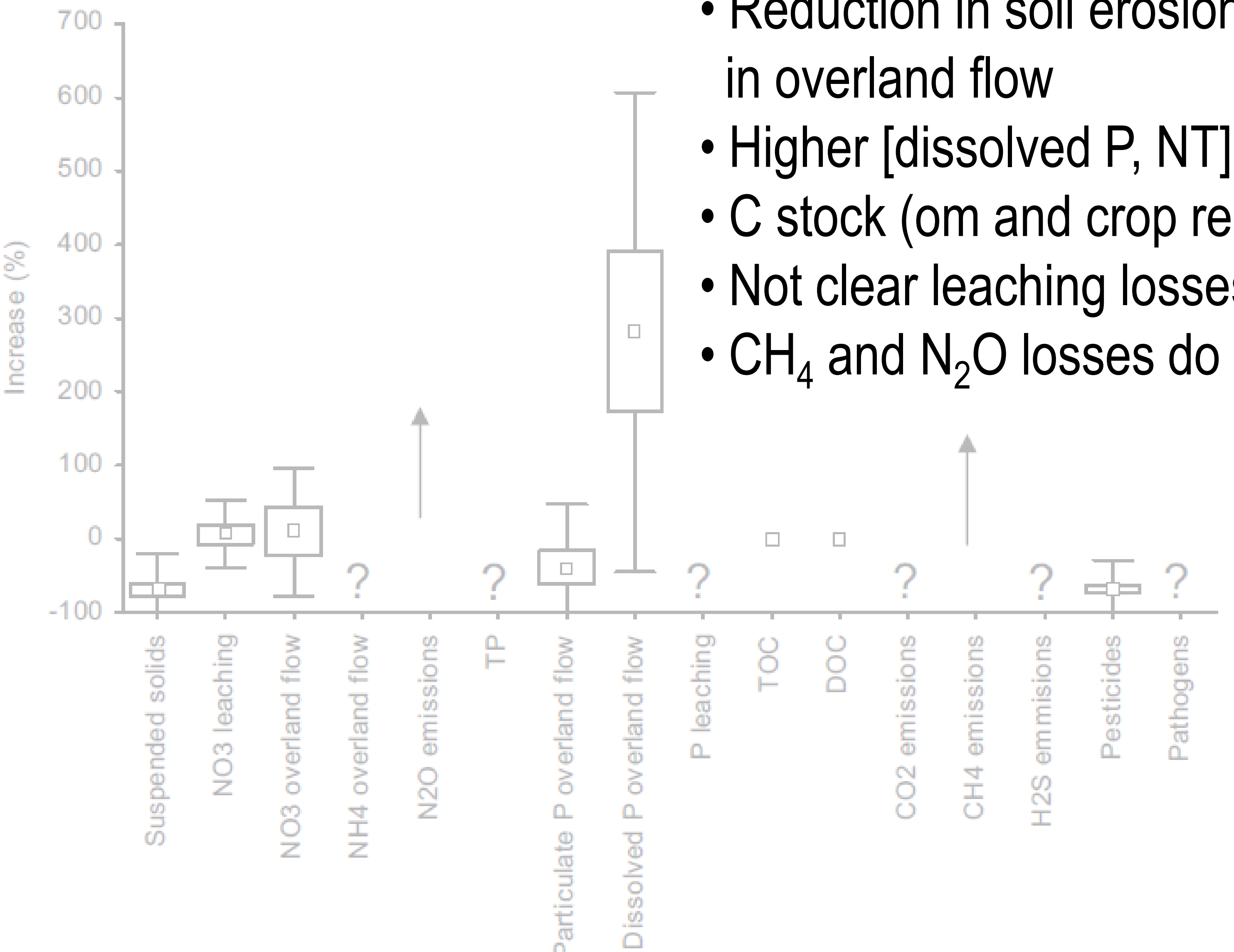
Invert soil with mouldboard plough

No Tillage

Higher dissolved P
Fertilizer
Crop residue

No Tillage vs. Conventional Tillage:

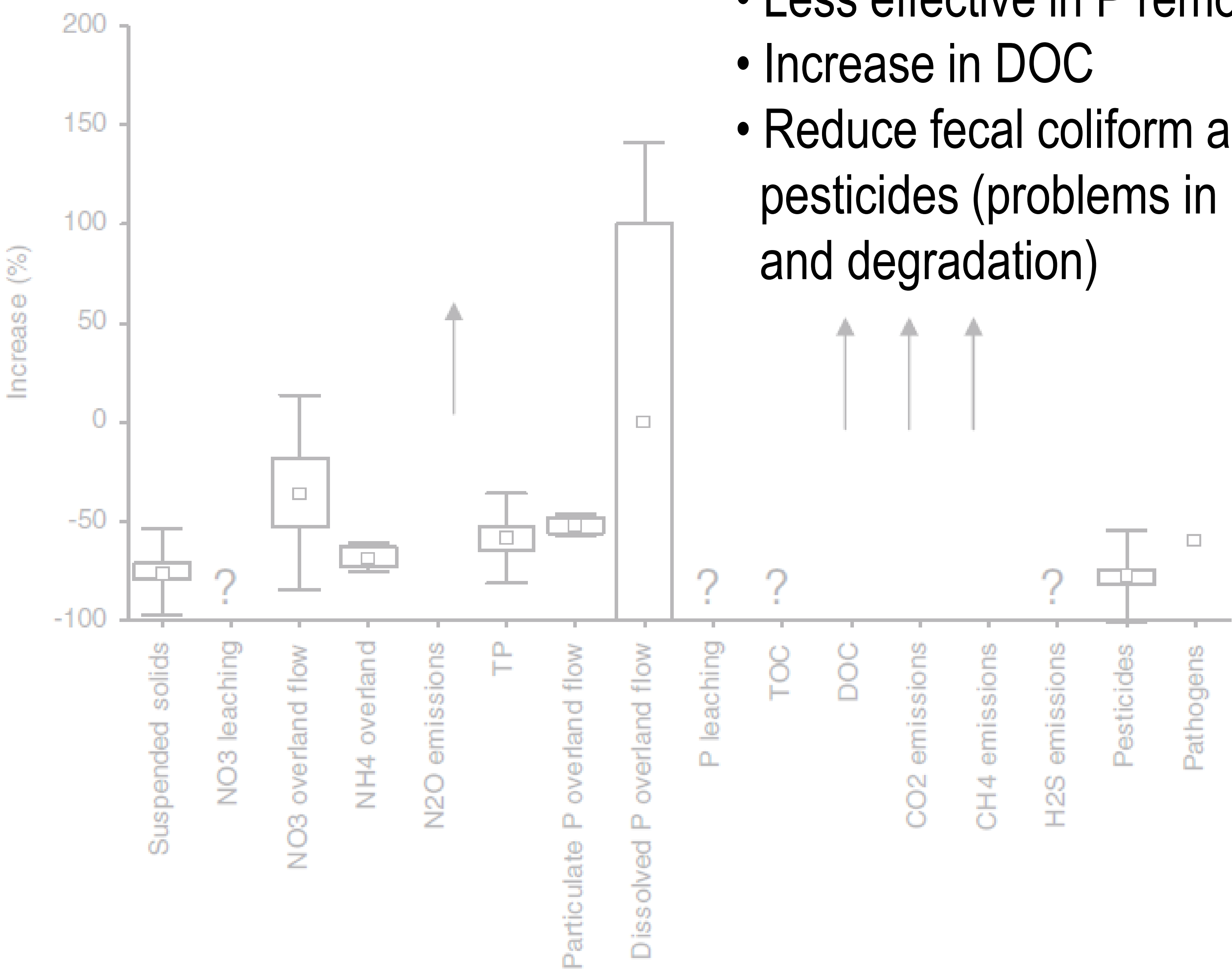
- Reduction in soil erosion (69%) and in overland flow
- Higher [dissolved P, NT] – more losses
- C stock (om and crop residues)
- Not clear leaching losses
- CH_4 and N_2O losses do not differ



Riparian Buffer zones

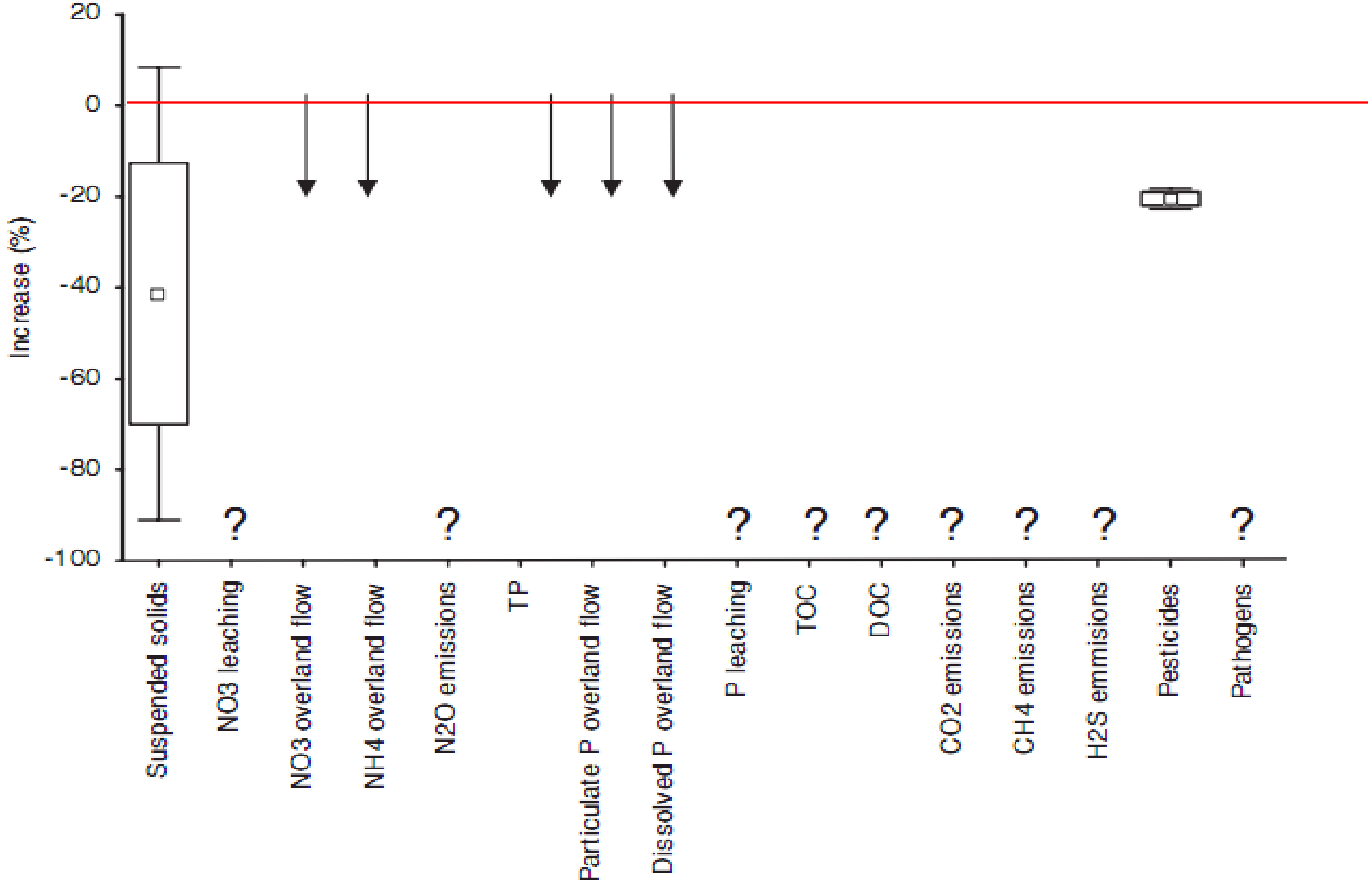
Band of vegetation bordering surface water

- Remove $N0_3$ (overland flow and groundwater)
- N reduction (89% vs. 8% cropland)
- Nutrient removing depends of buffer length
- N_2O greenhouse gas (denitrification)
- Remove sediments (need management to prevent sediment increase)
- Trapping depend on vegetation type (forest>grass)



- Less effective in P removal (clay)
- Increase in DOC
- Reduce fecal coliform and pesticides (problems in rainfall and degradation)

Contour grass strips

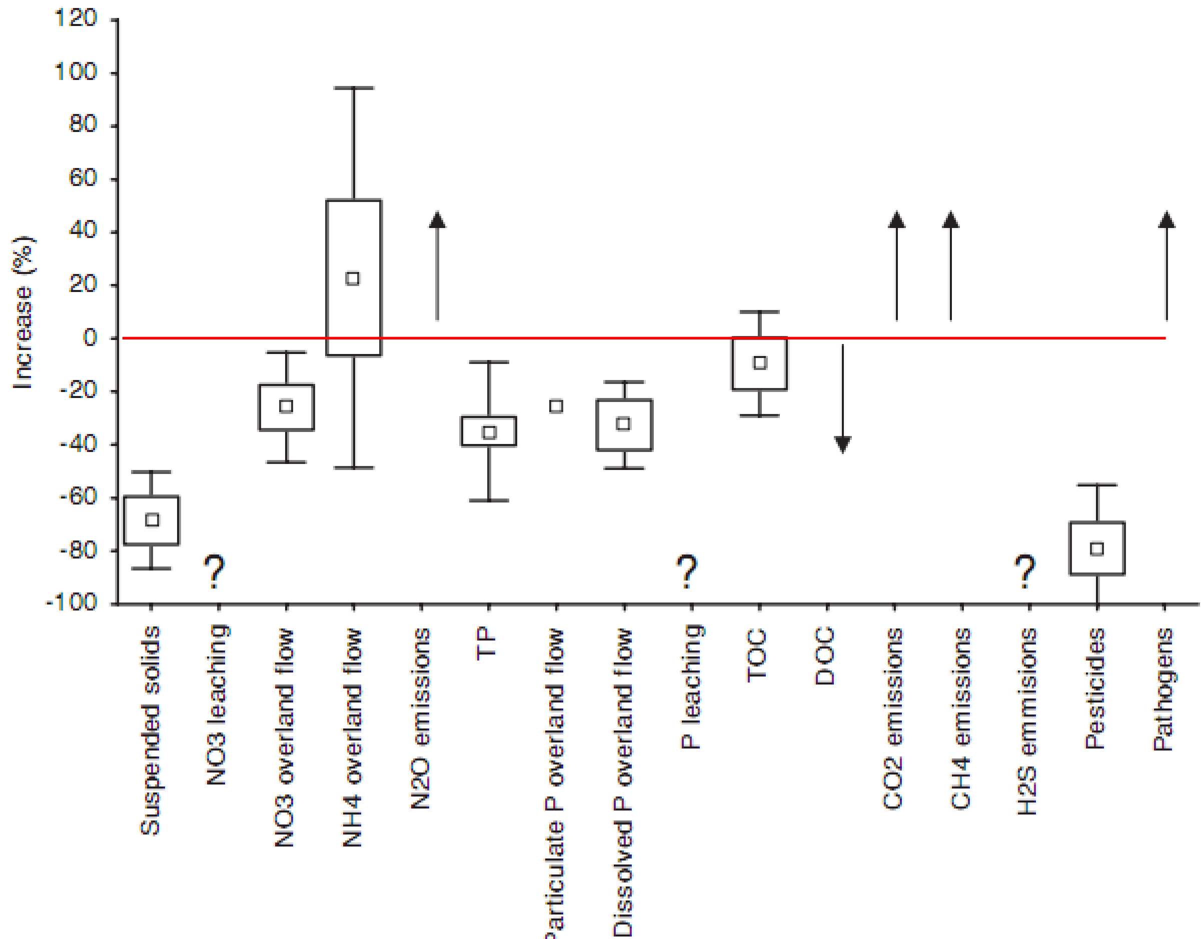


- Percent reduction (−) or increase (+) from **contour grass strips** when compared with control plots.

Contour grass strips

- Good potential to reduce sediment losses.
- Can reduce nitrogen and phosphorus in runoff.
- A reduction in pesticide losses is possible (but not large).

Constructed wetlands

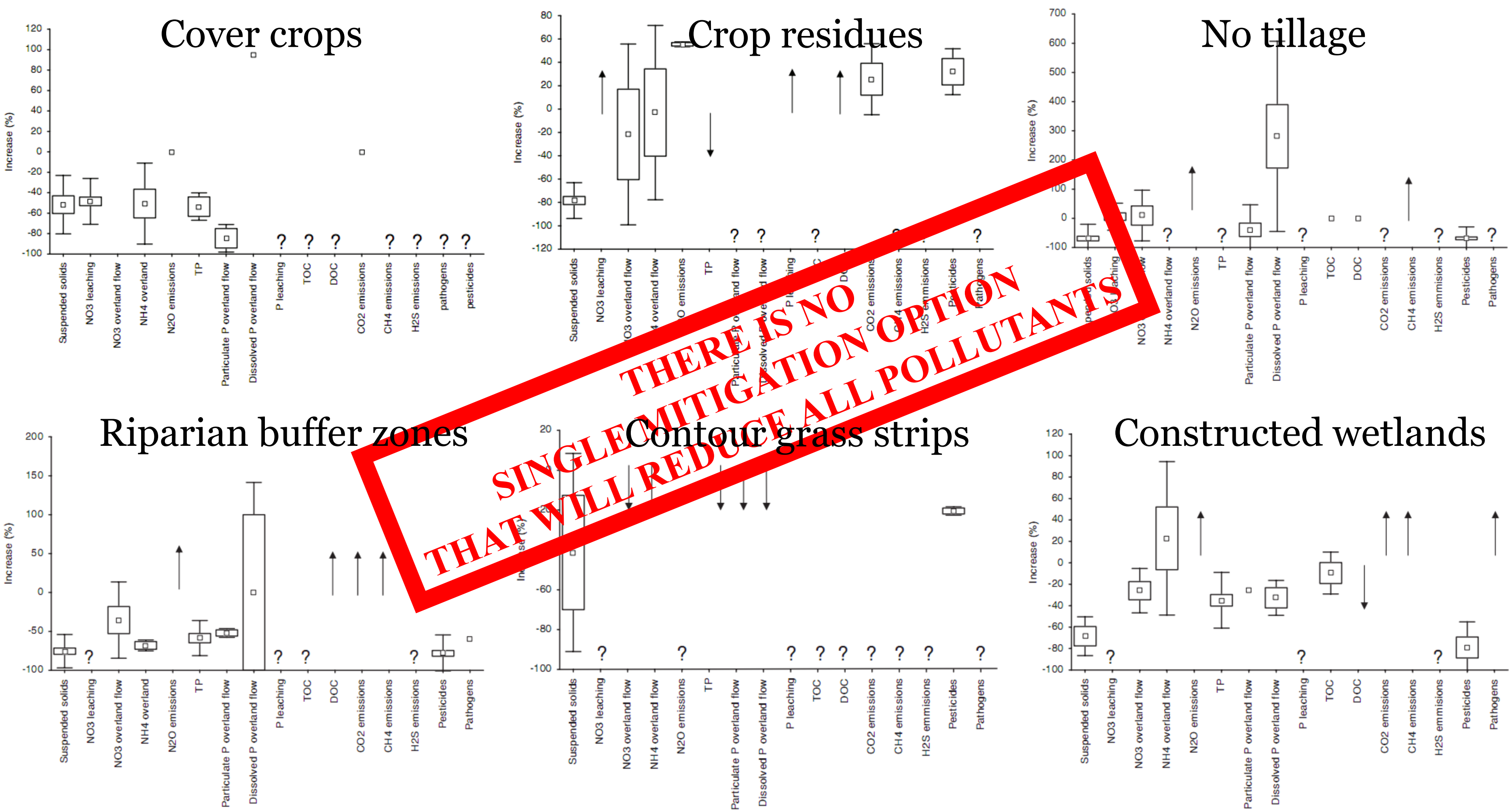


- Percent reduction (−) or increase (+) from **constructed wetlands** when compared with control plots.

Constructed wetlands

- Effective in removing sediments by sedimentation (efficiency decrease with time).
- P is generally retained (effectiveness is variable).
- N is removed by microbial processes (but retention rates are not generally high)
- Wetlands constructed for pollutant retention emit greenhouse gasses.
- Potential to remove pesticides (over short periods)

Conclusions



Conclusions

- It is a very challenging task to compare the relative impacts of the different pollutants, as their effects are apparent over differing temporal and spatial scales.
- Pollution swapping should be considered when selecting a mitigation option, and the most appropriate option should be selected on a site-by-site basis
- the first consideration should be which pollutant(s) is the target of concern: some may be more pressing than others, and mitigation options should be applied to tackle this. However, longer-term implications should be considered as well as short-term ones

Questions

1. What are the main findings of BS functioning in your paper?
2. Can BS's in your opinion after reading the paper assist in reducing N and P loadings to surface waters (rivers, lakes and estuaries) – and how efficient?
   - If yes, to answer 3 is there any requirements about how to install and manage the BS's?
3. Can BS's assist in giving other services to ecosystems and if yes, please mention what kind of services and the eventual requirements of installation and management of BS's?
4. Is there any doubts about the functioning of BS's as an ecosystem services given in your paper?

Thanks !!

Questions ????