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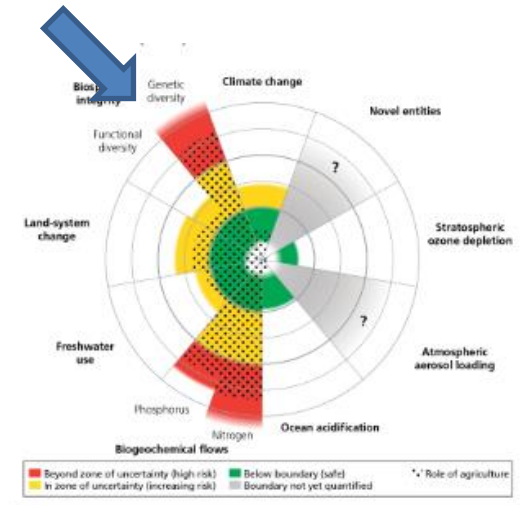
Assessing impacts of cropping systems on biodiversity: comparison of indicators for four systems along an intensity gradient

T. Denoirjean, V. Tossier, F. Angevin, C. Bockstaller



Introduction

- ❖ Biodiversity a major concern at planet level
- ❖ Every action supporting biodiversity
- ❖ e.g. design of innovative cropping systems
- ❖ needs assessment methods



(Campbell et al., 2017)

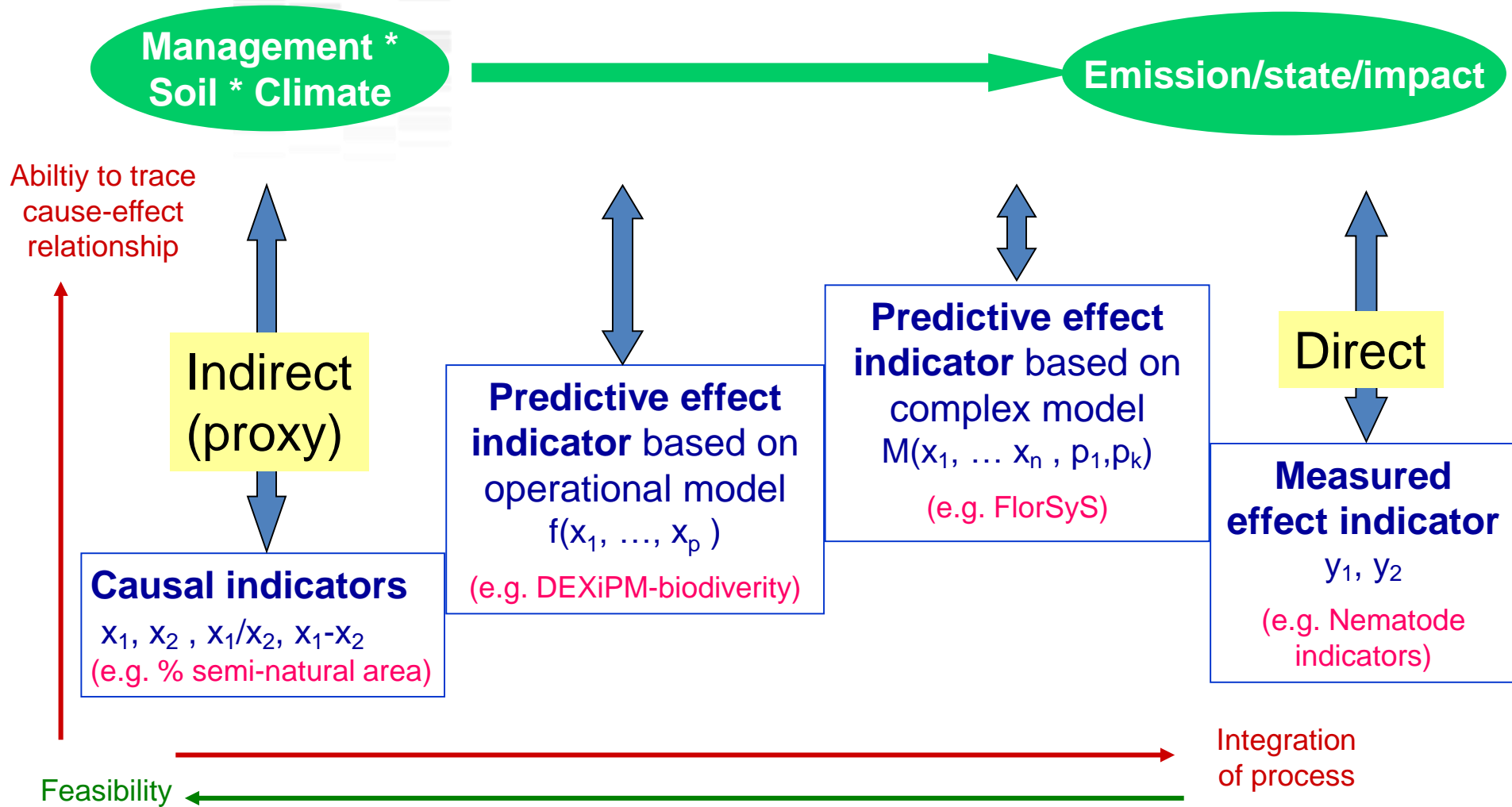


IPBES 7/10 Add.1
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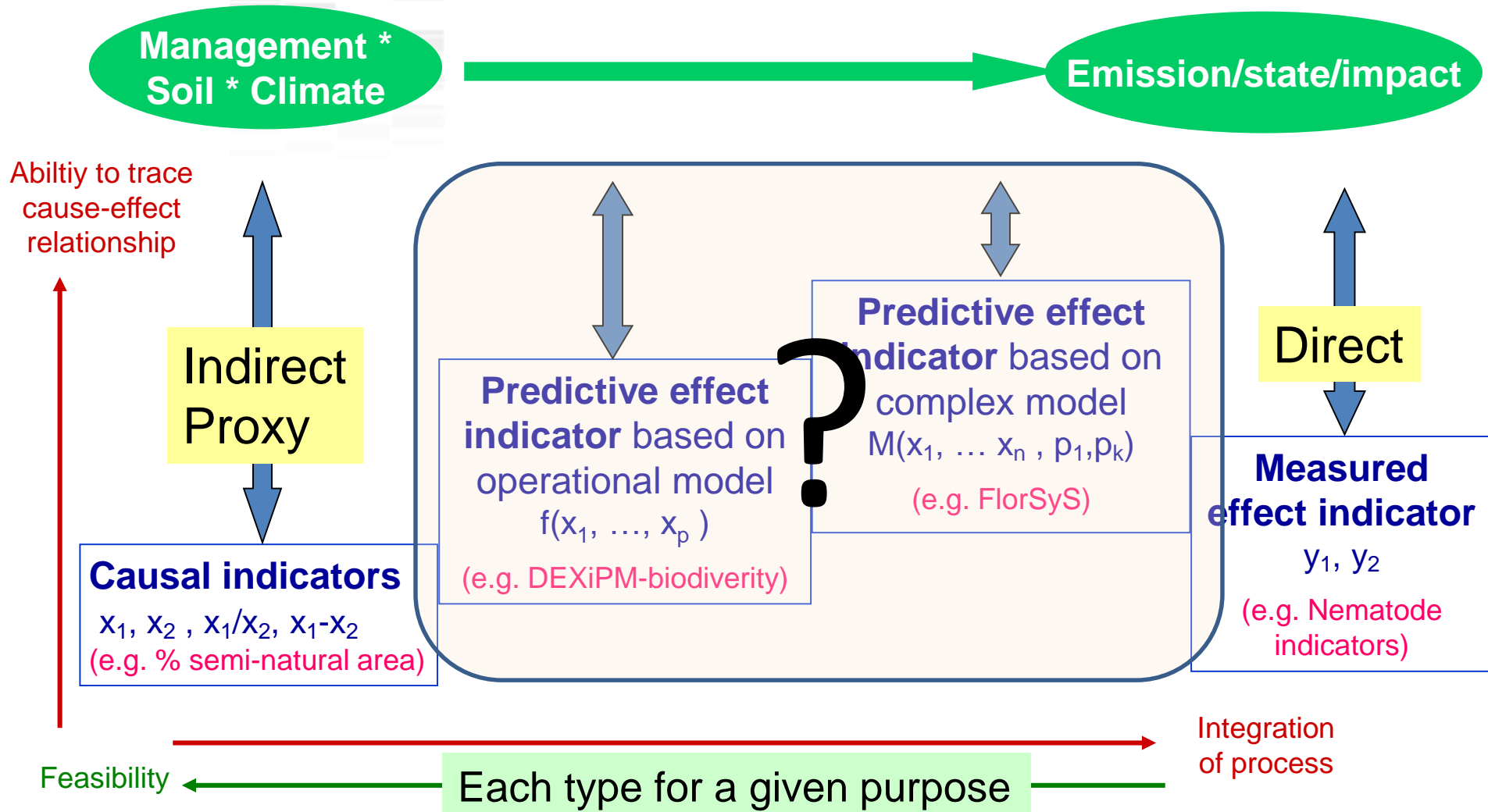
Report of the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services on the work of its seventh session
Addendum
Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
At its seventh session, in conjunction with the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Plenary of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) approved the summary for policymakers of the global assessment of biodiversity and ecosystem services as set out in the annex to the present addendum.

(IPBES, 2019)

Different types of indicators *(Bockstaller et al. 2015 OCL)*



Different types of indicators *(Bockstaller et al. 2015 OCL)*

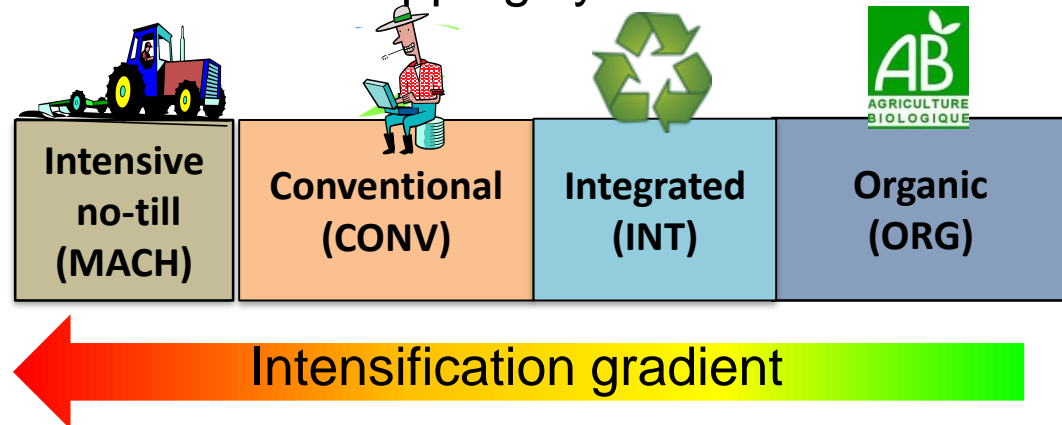
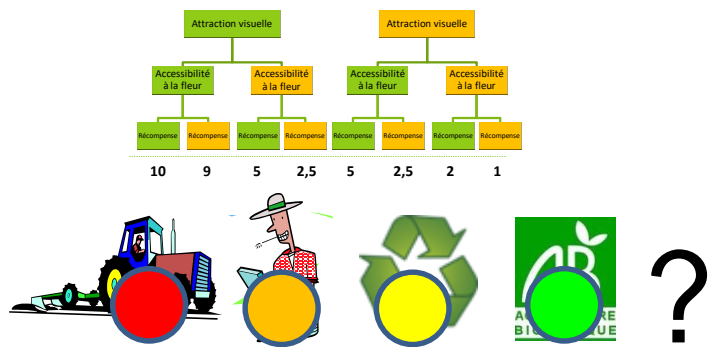


Aim of the presentation

- ❖ Any implementation of indicator
- ❖ Relevance of their outputs?
- ❖ Different approaches (Bockstaller *et al.*, 2008).
- ❖ Here comparison

Causal & predictive indicators

vs. 4 cropping systems



Material & methods: Indicators selected

- ❖ Review of biodiversity indicators in the French INDIC database (Thomas-Delille 2015) and of ≈ 15 methods
- ❖ A set of indicators and 4 methods included in the study

| Author | Method | Aggregation | Indicator type | Theme | Scale |
|------------------------------------|------------------|-------------|----------------|-----------------|-------------------------|
| Billeter <i>et al.</i> 2007 | No | No | causal | Biodiversity | Landscape/field |
| Chabert 2015 ^a | Auximore | with DEXi | Predictive | Natural enemies | Field/crop. System (CS) |
| Craheix <i>et al.</i> 2012 | MASC 2.0 | with DEXi | Predictive | Biodiversity | Field/CS |
| Pelzer <i>et al.</i> 2012 | DEXiPM V1 | with DEXi | Predictive | Biodiversity | Field/CS |
| Demade 2014 ^b | DEXiPM V2 | with DEXi | Predictive | Biodiversity | Field/CS |

^a report, ^b master thesis

The DEXi tool (Bohanec et al. 2008 EM)

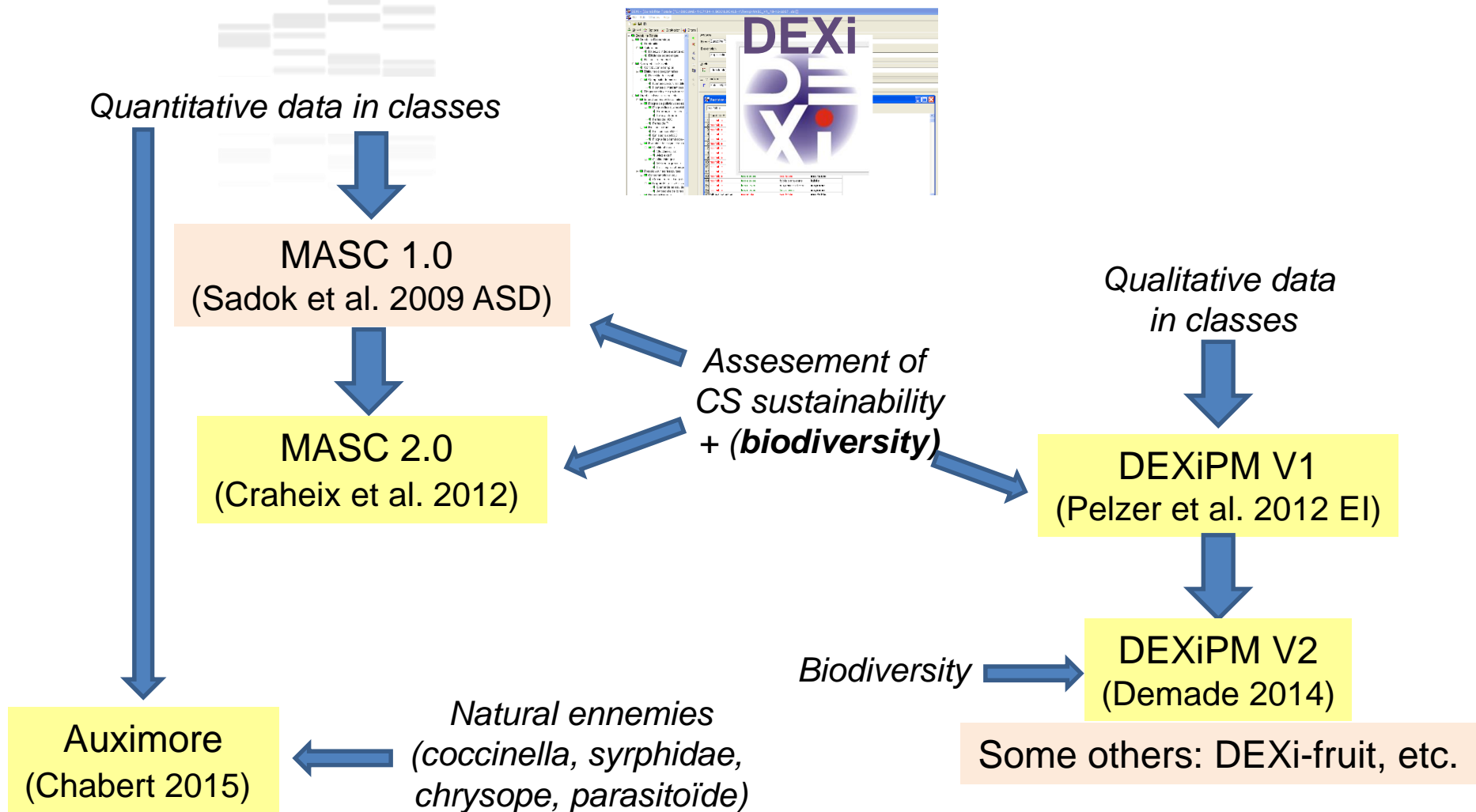
Definition of decision tree

Parametrization of input variables (e.g. classes)

Elicitation of decision rules (if then): manually or automatically with weighting

| | Durabilite Economique | Acceptabilite Sociale | Durabilite Environnementale | Durabilite Totale |
|----|-----------------------|-----------------------|-----------------------------|-------------------|
| 1 | tres faible | tres faible | tres faible | tres faible |
| 2 | tres faible | tres faible | faible a moyenne | tres faible |
| 3 | tres faible | tres faible | moyenne a elevee | tres faible |
| 4 | tres faible | tres faible | tres elevee | tres faible |
| 5 | tres faible | faible a moyenne | tres faible | tres faible |
| 6 | tres faible | faible a moyenne | faible a moyenne | faible |
| 7 | tres faible | faible a moyenne | moyenne a elevee | faible |
| 8 | tres faible | faible a moyenne | tres elevee | faible |
| 9 | tres faible | moyenne a elevee | tres faible | tres faible |
| 10 | tres faible | moyenne a elevee | faible a moyenne | faible |
| 11 | tres faible | moyenne a elevee | moyenne a elevee | faible |
| 12 | tres faible | moyenne a elevee | tres elevee | moyenne |
| 13 | tres faible | tres elevee | tres faible | tres faible |
| 14 | tres faible | tres elevee | faible a moyenne | faible |
| 15 | tres faible | tres elevee | moyenne a elevee | moyenne |
| 16 | tres faible | tres elevee | tres elevee | moyenne |
| 17 | faible a moyenne | tres faible | tres faible | tres faible |

DEXi implementation in France (Bockstaller et al. 2018)



Cropping systems tested

- ❖ Système expérimental à Arvalis-Institut du Végétal station (South of Paris)
- ❖ 4 cropping systems : rotations \approx similaires (in ORG 2 alfafa ley)



**Intensive
no-till
(MACH)**



**Conventional
(CONV)**



**Integrated
(INT)**



**Organic
(ORG)**

| | | | | |
|-------------------|------|------------------|----------------|---------------|
| Tillage | No | Optimized | Reduced | Plough |
| N | High | Optimized | Reduced | No |
| Pesticides | High | Optimized | Reduced | No |

Intensification gradient

Results: Some causal indicators relevant

| Indicator | MACH | CONV | INT | ORG |
|---|---------------|---------------|---------------|---------------|
| Average N rate | Inconsistent | Inconsistent | intermediate | consistent |
| % cropped area with > 150 kg N/ha | Inconsistent | Inconsistent | consistent | consistent |
| Number of crops in the rotation | not concerned | not concerned | not concerned | not concerned |
| Diversity of crop families | intermediate | intermediate | intermediate | consistent |
| % of semi natural habitats in 1 km buffer | Inconsistent | intermediate | intermediate | consistent |
| Diversity of semi natural habitats in 1 km buffer | not concerned | not concerned | not concerned | not concerned |



Inconsistent
 intermediate
 consistent
 not concerned

Results

DEXiPM V1 & V2 performing for fauna



| Criterion | Indicator | Auximore DEXi | MASC 2.0 | DEXiPM v1 | DEXiPM v2 |
|---------------------|--------------------------|------------------------------|----------------------------|------------------------------|-----------|
| Global biodiversity | | | Inconsistent with gradient | Consistent with the gradient | |
| Flying insects | Flying insects | | CONV = INT | | |
| | Flying natural enemies | (MACH, CONV) and (INT, ORG). | | Consistent with the gradient | |
| Soil fauna | Soil macro fauna | | Only MACH is ≠ | | |
| | Soil natural enemies | | | Consistent with the gradient | |
| | Crawling natural enemies | | | Consistent with the gradient | |

Inconsistent
 intermediate
 consistent
 not concerned

But for flora (weeds) DEXiPM V2 needs enhancement




| Criterion | Indicator | Auximore DEXi | MASC 2.0 | DEXiPM v1 | DEXiPM v2 |
|-----------------|----------------------|---------------|---------------|------------------------------|----------------------------|
| Flora | Weeds | | | Consistent with the gradient | Inconsistent with gradient |
| | Semi natural flora | | Only ORG is > | Only ORG is > | Only ORG is > |
| Micro organisms | Soil micro organisms | | Only ORG is > | | |

Inconsistent
 intermediate
 consistent
 not concerned

Discussion & conclusion

- ❖ Some causal indicators (N management) consistent with gradient data

 Easy to implement

 Low integration of processes

- ❖ DEXiPM V1 and V2 : able to provide consistent results with intensity gradient

- Exception for weeds: this indicator should be enhanced

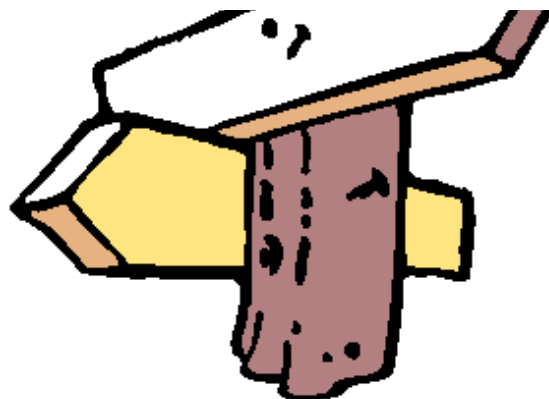
 *Ex ante* assessment: simulation

 Very qualitative

- ❖ Need to repeat such study
 - with datasets of several locations
 - taxon diversity/abundance measurements



Thank you for your attention



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