



## Environmental assessment of contrasting French organic vegetable farms

Antonin Pepin, Hayo van Der Werf, Kevin Morel, Dominique Grassely, Marie Trydeman Knudsen

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HORTICULTURAL PRODUCTION

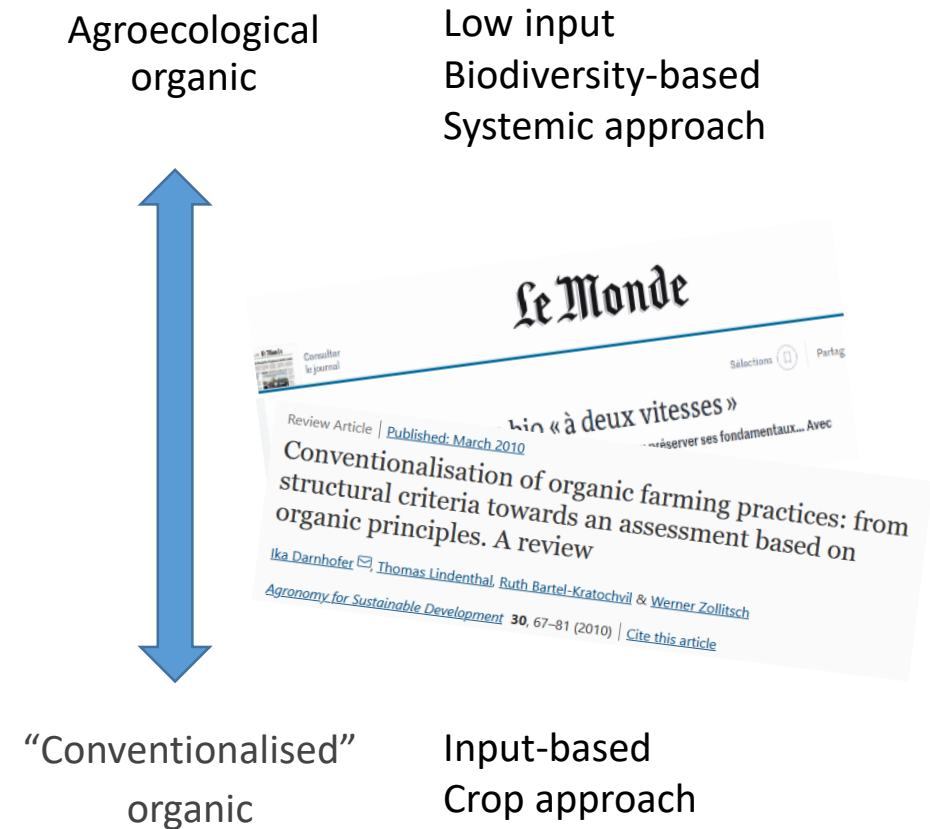
# Environmental assessment of contrasting French organic vegetable farms

Antonin Pépin \*, Hayo van der Werf, Kevin Morel, Dominique  
Grasselly, Marie Knudsen  
Contact: *antonin.pepin@ctifl.fr*

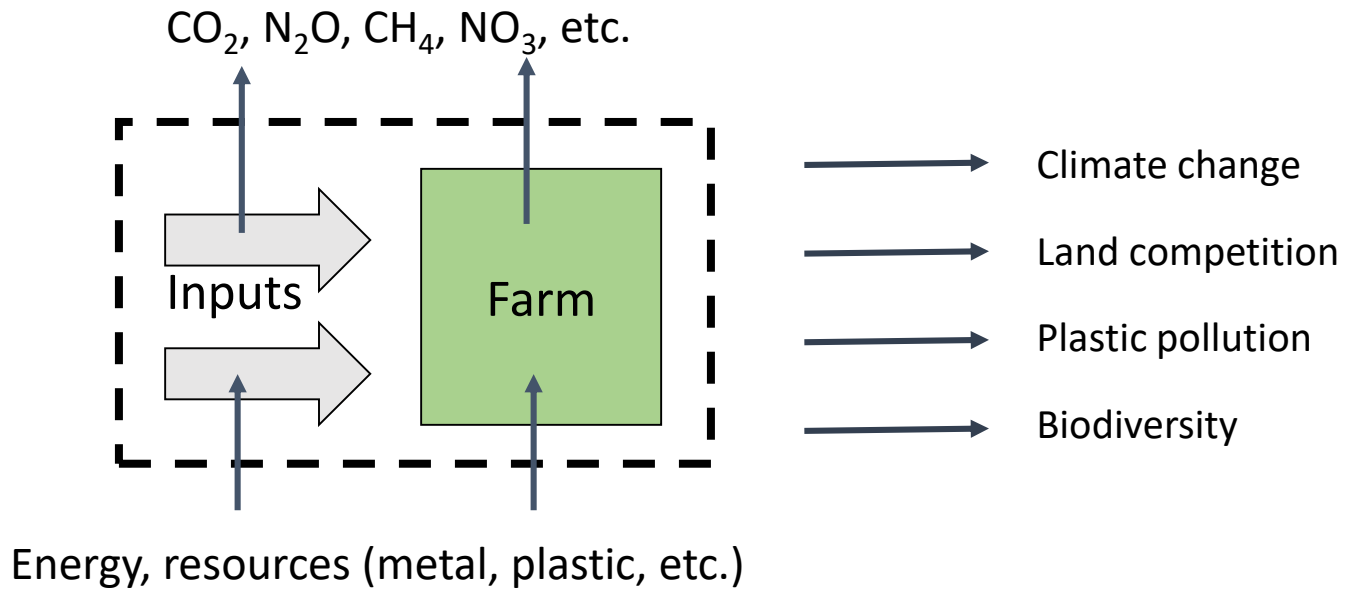


# Context

- Diversity of organic vegetable farms (Pépin et al., 2021)
- What are the environmental performances of organic vegetable farms that are contrasted by their agroecological functioning?



# Method : Life cycle assessment (LCA)



Farming system approach of LCA

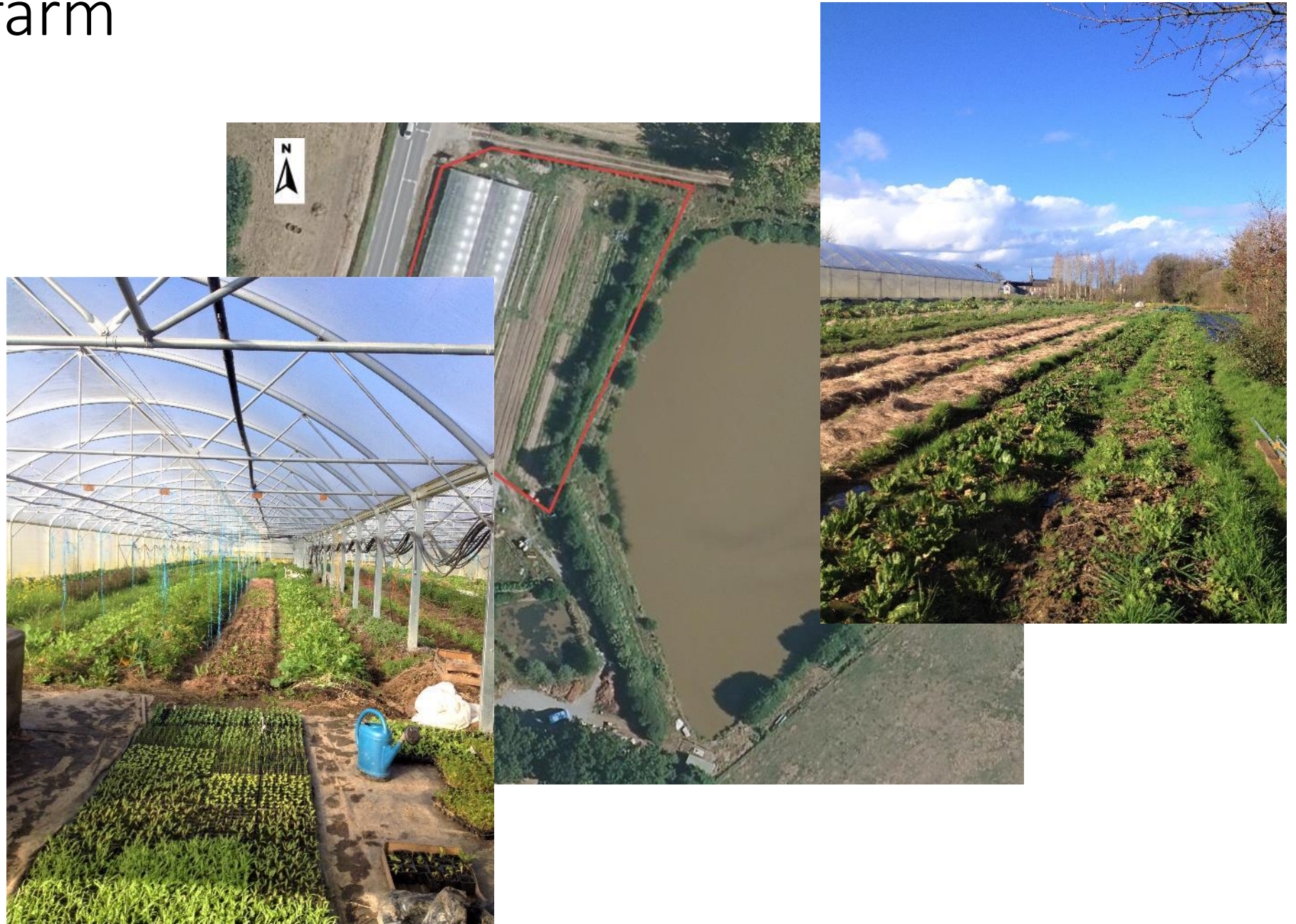
- All inputs and operations are estimated for the entire farm
  - The output is the total production of vegetables
- Comparison of 3 contrasting farms

after Jolliet et al. (2015)



# MF: microfarm

	Microfarm (MF)
Outdoor	0.16 ha
Tunnel	0.12 ha
No. of veg.	35
Yield	35 t/ha/yr
Agroecology	Agroeco ++ Inputs -





# SP: specialised in sheltered production

	Microfarm (MF)	Sheltered production (SP)
Outdoor	0.16 ha	0 ha
Tunnel	0.12 ha	2.0 ha
No. of veg.	35	6
Yield	35 t/ha/yr	67 t/ha/yr
Agroecology	Agroeco ++ Inputs -	Agroeco - Inputs ++





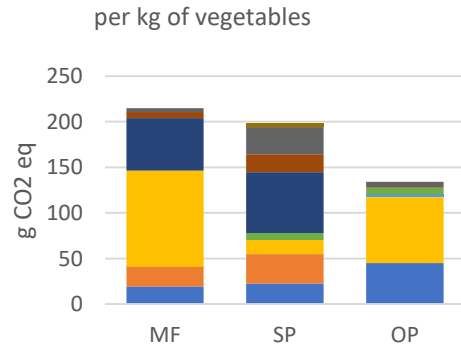
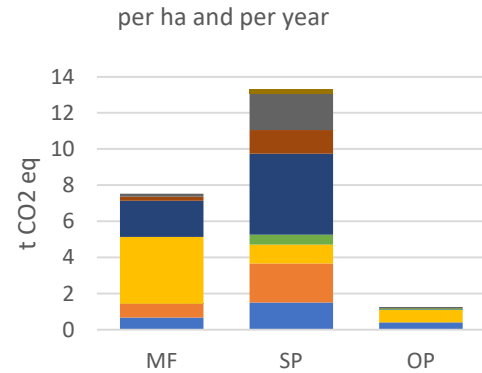
# OP: specialised in outdoor production

	Microfarm (MF)	Sheltered production (SP)	Outdoor production (OP)
Outdoor	0.16 ha	0 ha	17.5 ha
Tunnel	0.12 ha	2.0 ha	0 ha
No. of veg.	35	6	20
Yield	35 t/ha/yr	67 t/ha/yr	9 t/ha/yr
Agroecology	Agroeco ++ Inputs -	Agroeco - Inputs ++	Agroeco + Inputs +



# Climate change

Greenhouse gas emissions  
Method: IPCC  
Unit: kg CO<sub>2</sub> eq.



## Total values

- Ranking depends on functional unit
- Per ha, OP << MF << SP
- Per kg, OP < MF & SP, but smaller differences
- Higher productivity per ha does not fully compensate the higher impact of SP

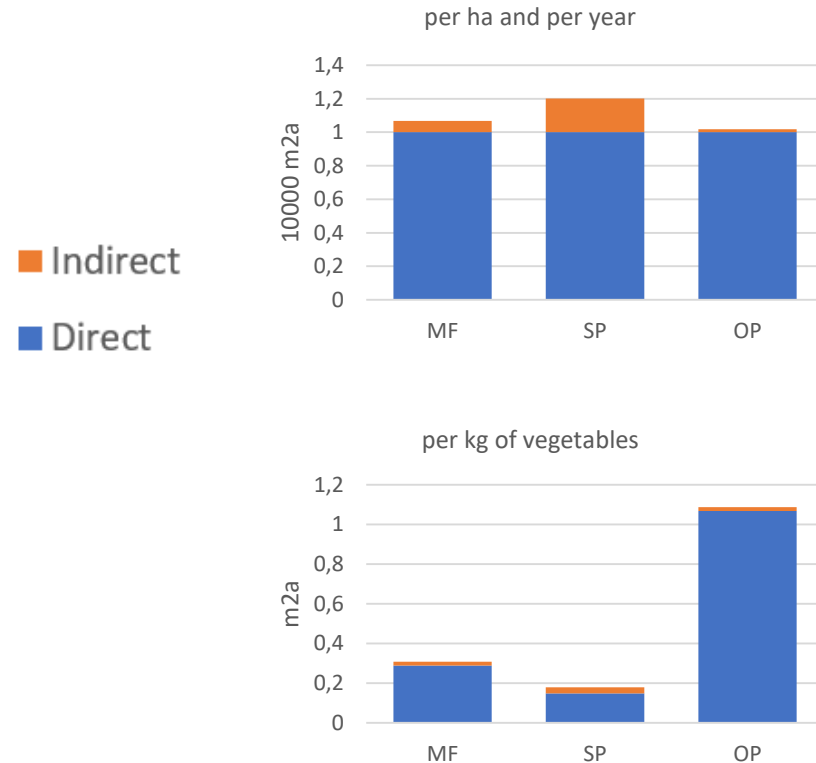
## Contribution analysis

- Microfarm (MF):
  - Diesel 49% (irrigation + tractor)
  - Tunnel 27% (steel + plastic)
- Sheltered farm (SP):
  - Tunnel 34% (steel + plastic)
  - Fertiliser 16% (fabrication)
  - Seedling production 15% (gas heating of nursery)
- Open field farm (OP):
  - Diesel 54% (tractors)
  - Field emissions 34% (N<sub>2</sub>O)
- Different environmental profiles → different hints for eco-design / redesign



# Land competition

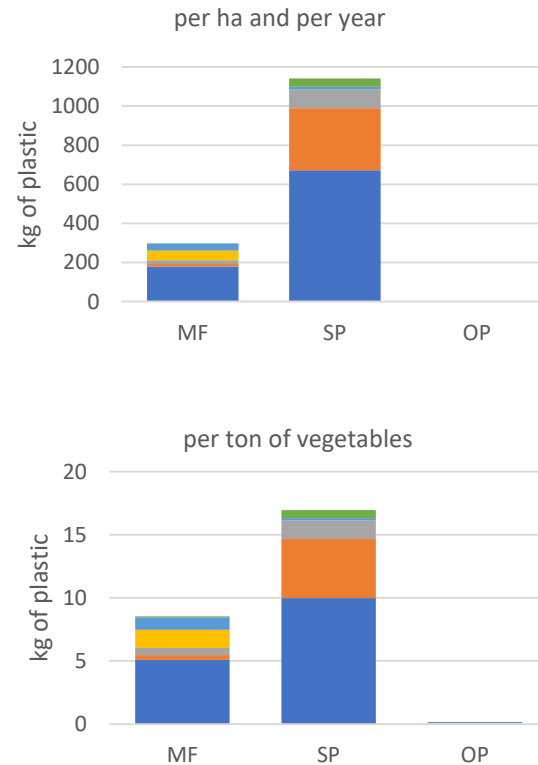
Land occupied by the system  
Method: CML-IA non-baseline  
Unit: m<sup>2</sup>a



- Per ha, same impact: little indirect land
- Per kg, OP has the largest impact
  - 1 cycle/year
  - Lower yields
- Trade-off: land competition vs. climate change

# Plastic use

Method: the sum of plastic used on the farm or contained in its inputs  
Unit: kg of plastic



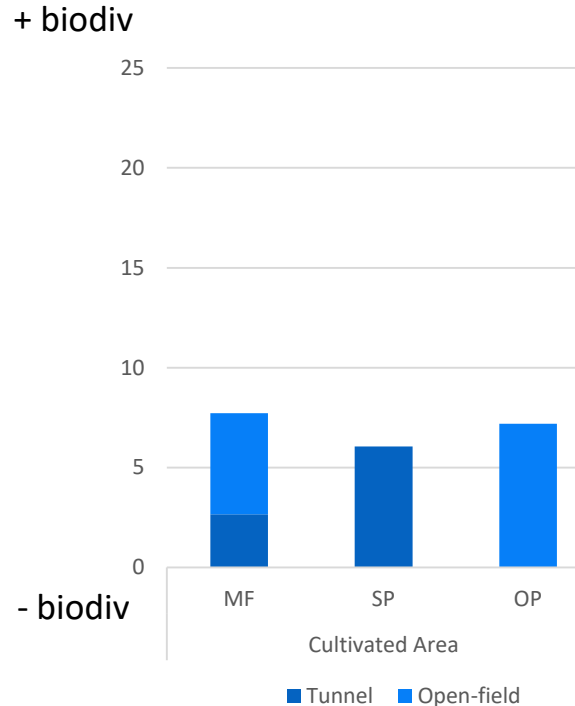
- Growing concern in horticulture
- Plastic pollution in LCA: emerging topic
  - Recognising the long-term impacts of plastic particles (Gontard et al., 2022).
  - Create LCA indicators for plastic pollution (Lavoie et al., 2021; Saling et al., 2020; Woods et al., 2021).
- SP >> MF >> OP
  - Tunnel (SP & MF)
  - Single-use plastic (mulch, pipes) (SP)
  - Reusable plastic (MF)
  - Scale issue?
- Indicator combining all types of plastic and uses (single-use, hardware, in/out of soil, etc.)
  - Probably not the same impact
  - Indicator to be improved
- Not an LCA indicator: use, not impact
  - Microplastics in soil and water

# Biodiversity

SALCA-BD (Jeanneret et al., 2014)

An expert system based on scientific literature

Based on a detailed inventory of farming practices



- On cultivated areas, small differences: MF & OP > SP
  - Sensitivity of SALCA-BD?
- On whole farms, including semi-natural areas: SP > MF > OP
  - Large fields → low field perimeter:area ratio (OP)
  - Large area of ruderal areas between tunnels (SP)
- Importance of semi-natural areas (hedges, extensive grassland, etc.) for biodiversity
- Question of spatial farm boundaries (MF)

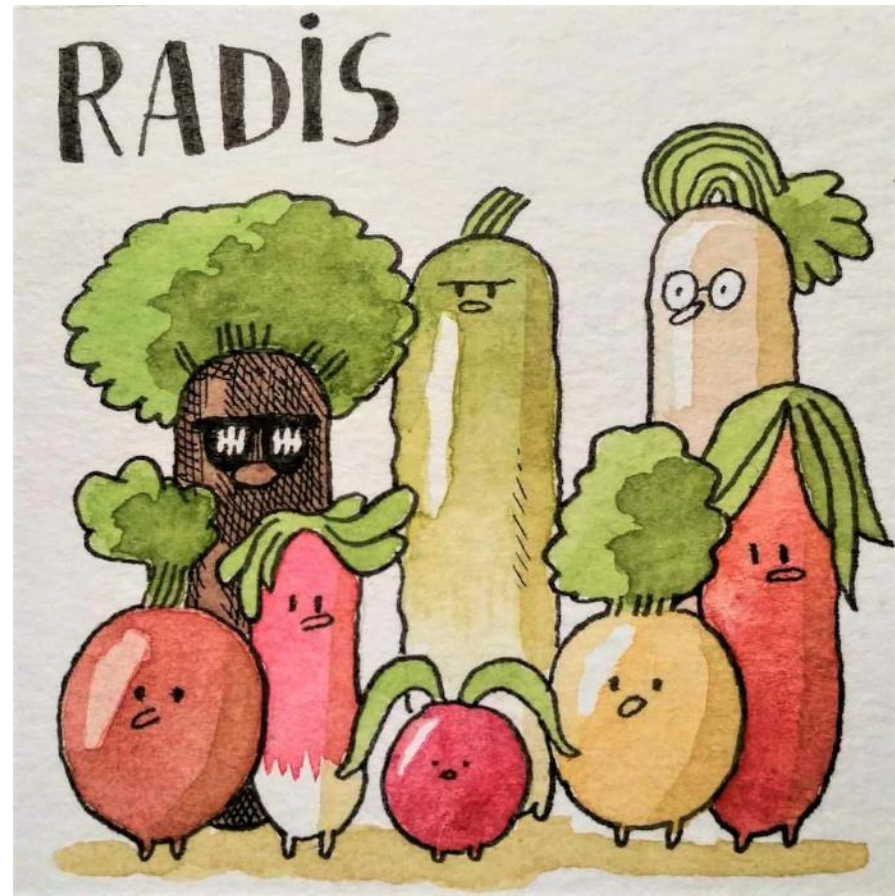


# Conclusion

- No clear ranking of the farms, depends on the indicator and the FU
  - Climate change & plastic: inputs
  - Land occupation: yield
  - Biodiversity: semi-natural areas, field size
- Complementarity of the systems
  - Vegetables / Markets
  - Responses to different environmental issues
  - Matter of choice : vision of farming
- Farm-specific effects / case study
  - MF: diesel vs. electric pump
  - SP: plastic tunnel vs. glasshouse
  - OP: use of plastic mulch



Find the best trade-off  
Design of farming systems



Guillaume Long

Thank you !