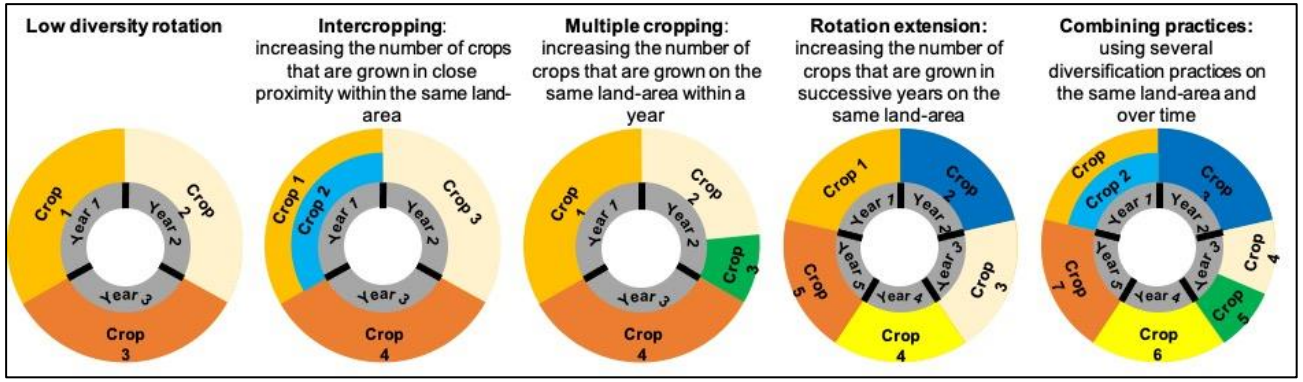
This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727482 (DiverIMPACTS)

Diversification through Rotation, **I**ntercropping, **M**ultiple cropping, **P**romoted with **Act**ors and value-**C**hains **T**owards **S**ustainability **(2017-2022)**

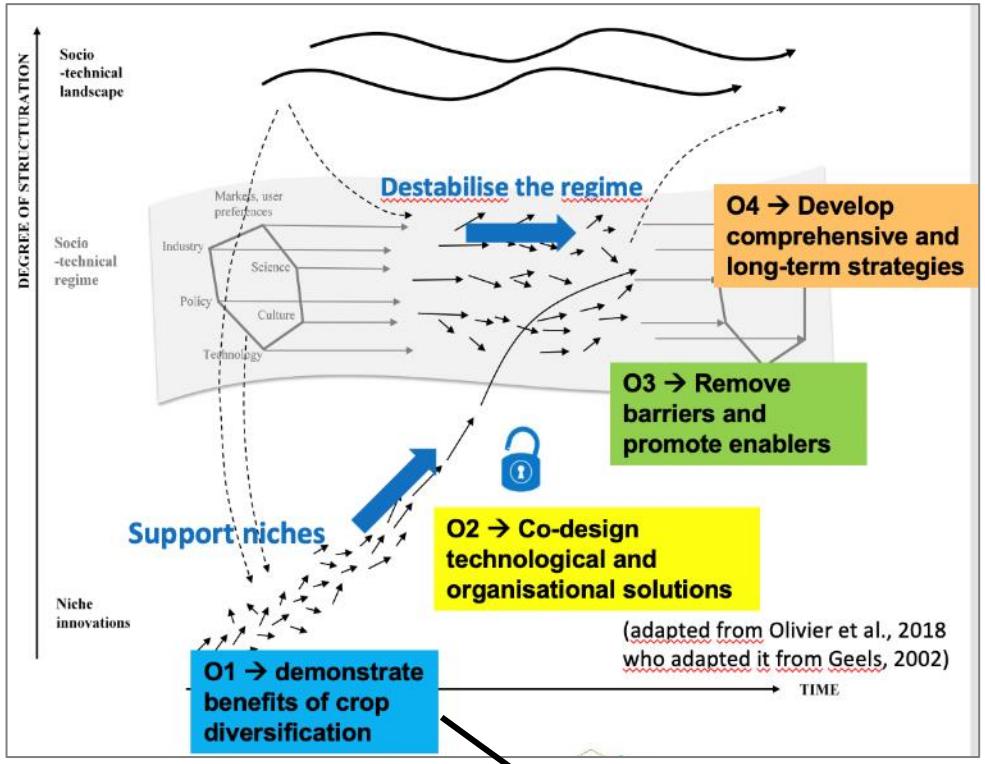
Antoine Messéan, INRAE



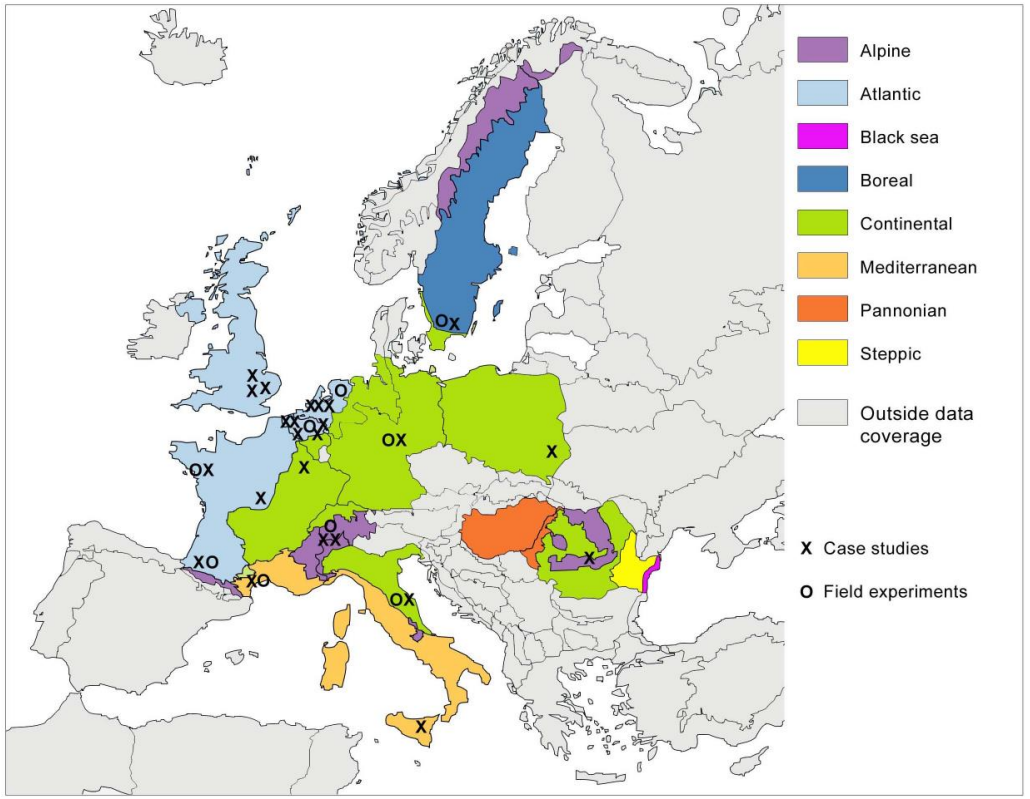
Content of the presentation

- Background /concepts
- Indicators used in field experiments (FE)
- Field experiments database
- Additional assessment tools
- Relevance for monitoring and evaluation
- Links to complementary projects

Unlocking the potential of crop diversification to support sustainability transitions requires systemic changes



WP3 Quantification of the benefits from diversified cropping systems through field experiments



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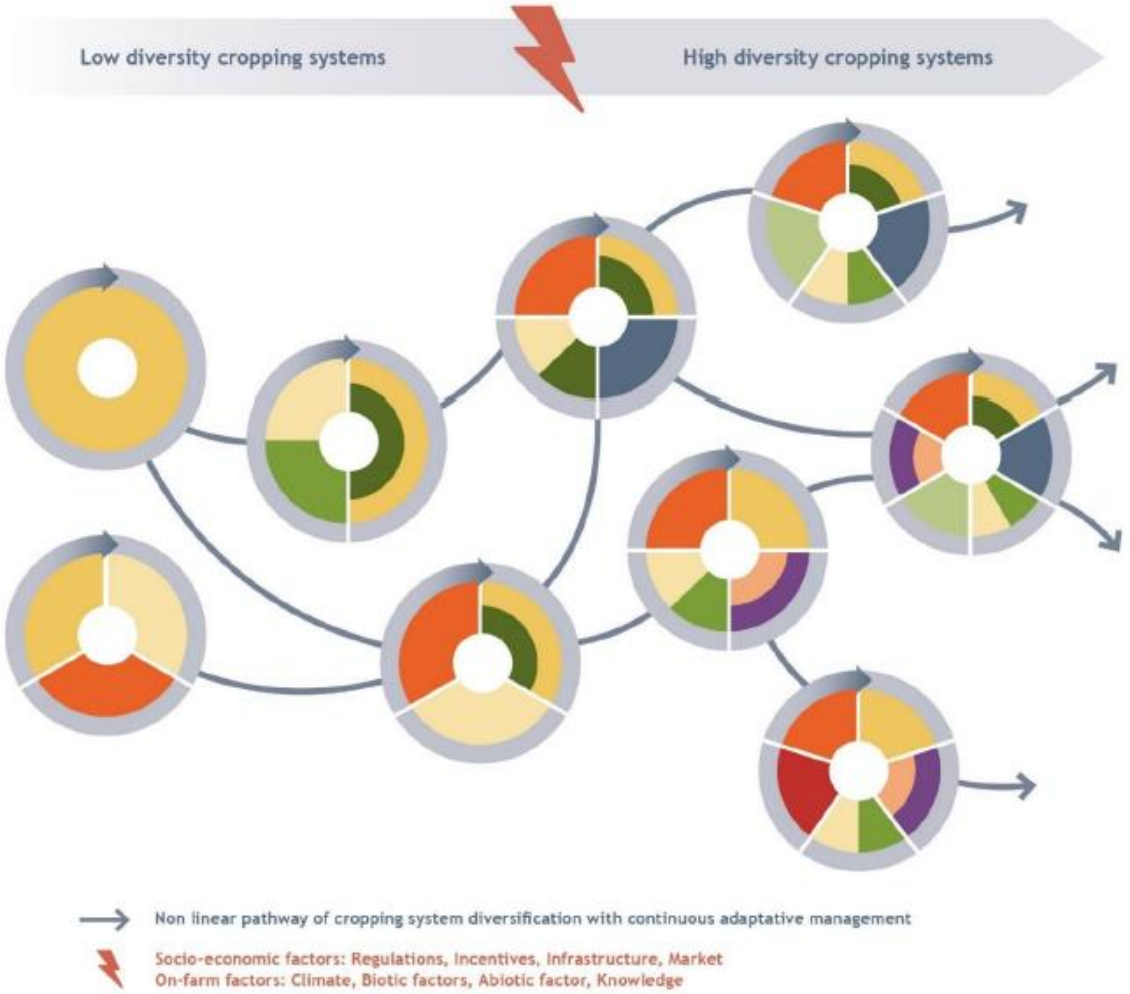
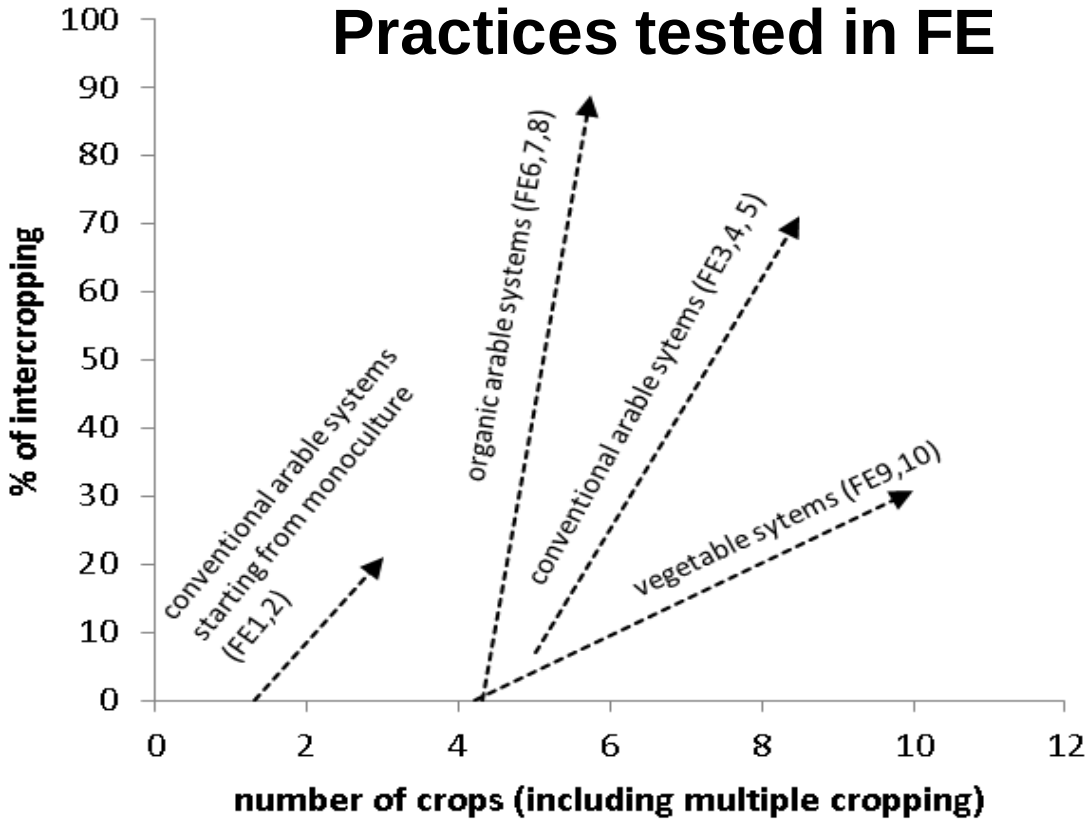
Crop diversification is a dynamic process



Practices tested in FE



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Indicators used in the Field Experiments (FE)

Indicators ultimately available in all FEs

Indicators available only in several FES

1 Higher arable land productivity	2 Diversification and increase of farmers revenues	3 Lower environmental impact of diversified cropping systems	4 Improved delivery of ecosystem services
▪ Yield. ▪ Quality of harvested products (% protein, % oil). ▪ Aboveground biomass of harvested and not harvested products. ▪ LER for intercrops. ▪ Variability (min Yield, max yield during the rotation; number of crops with a yield lower than…). ▪ Energy efficiency. ▪ Total energy production.	▪ Gross margins. ▪ Input costs. ▪ Mechanization costs. ▪ Production costs. ▪ Economic efficiency. ▪ Diversity of type of products. ▪ Number of species with a high added value. ▪ Salary costs and family labour remuneration. ▪ Direct and Net margin.	▪ Water use. ▪ Pesticide use (Active ingredient, Treatment Frequency Index). ▪ Energy use (Primary, Useful). ▪ N use. ▪ Yield/water use, /pesticide use, energy use, fertiliser use. ▪ N balance. ▪ GHG emissions. ▪ Risk of N leaching. ▪ Fuel consumption.	▪ Earthworm abundance and diversity. ▪ Decomposition of organic matter. ▪ Arthropod abundance and diversity. ▪ Weeds, pest and disease control. ▪ (Weed biomass, Weed diversity, Pests and diseases) ▪ N capture by catch crops. ▪ N2 fixation. ▪ C sequestration. ▪ Soil cover. ▪ N capture by catch crop.

- Not all indicators are available in all FEs
- The rotation scale requires gathering several growing seasons both in its spatial and temporal dimensions.
- The multi-site analysis for this global assessment has started in September 2021

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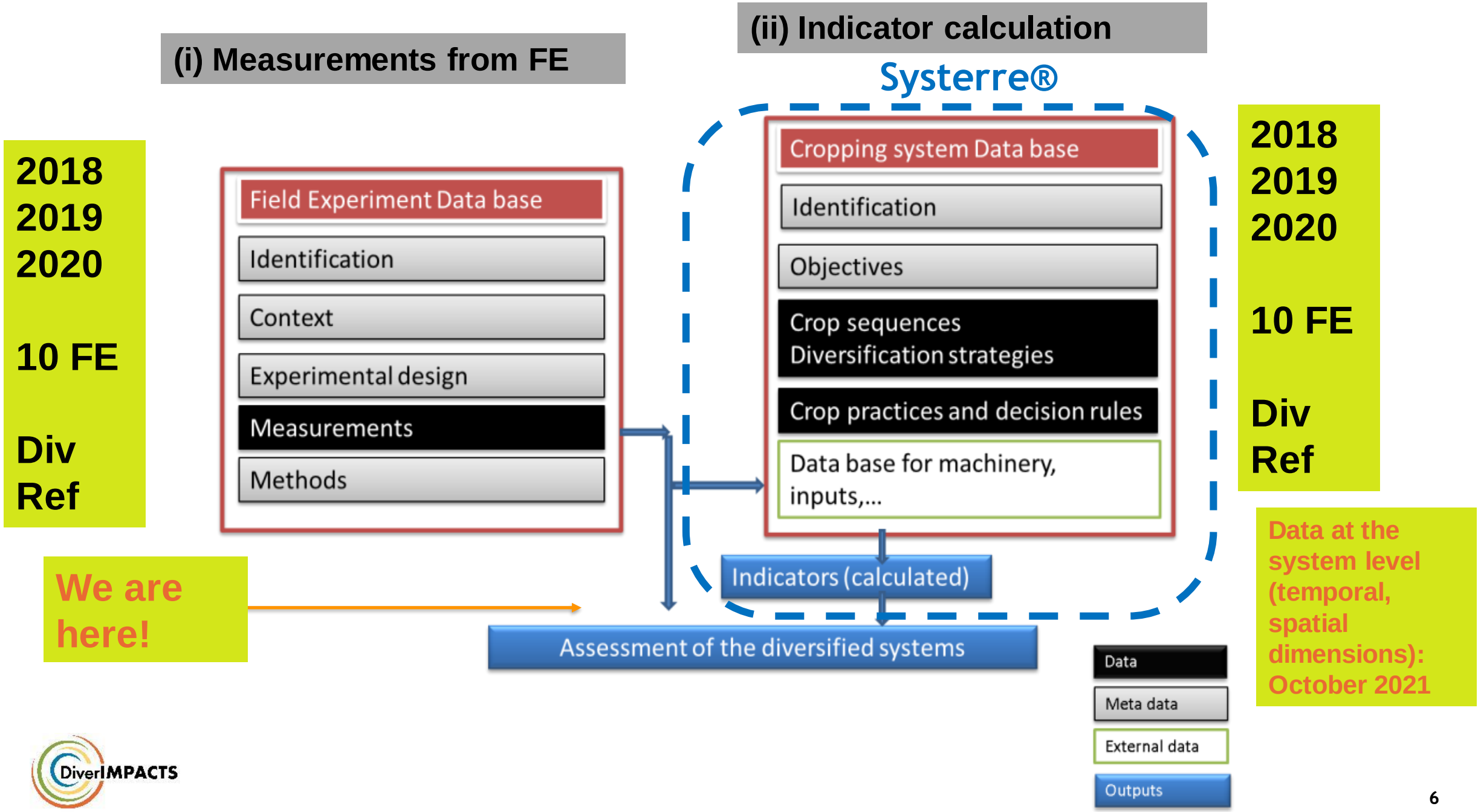
Structure of the FE database



Example of FE data analysis

RESULTS
FE 4 - ACTA, Berry - FRANCE

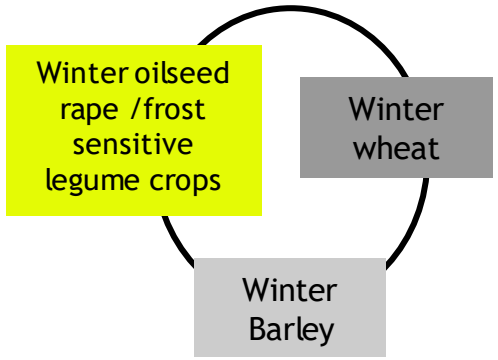
FE DESIGN :

- 2 systems : Control and diversified system.
- All the rotation terms present each year.
- 3 replicated blocks.

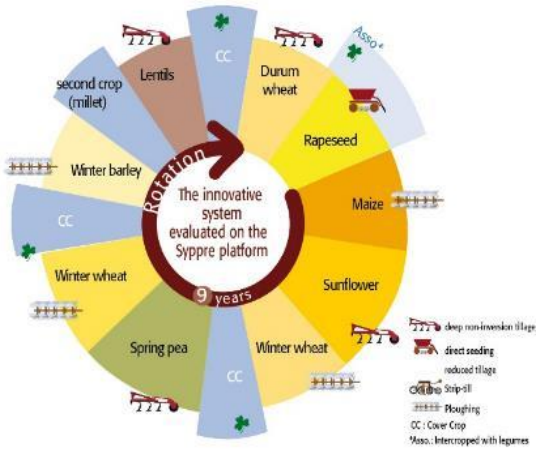
SYSTERRE DESIGN :

- 2 farms.
- Surface are : 150 ha
- 1 labour
- Replications : 3

Control system



Diversified system



	Social Indicator	Productivity		Profitability		Environment		
	Working time	Gross energy production exported	Energy Efficiency	Turnover	Direct Margin without financial support	Total GHG Emissions	Nitrogen balance	Total primary energy consumption
	h/ha	MJ/ha	MJ/MJ	€/ha	€/ha	kgeqCO2/ha	Kg/ha	MJ/ha
CONTROL	2.66	83748	7.2	790	208	2051	49.8	11644
DIVERSIFIED	**+11%**	**-26%**	**-13%**	**-17.5%**	**-57.9%**	**-25%**	**-37.4%**	**-15.7%**

Additional assessment tools developed by DiverIMPACTS

smart
sustainability monitoring and assessment routine

Indicator name	Performance (%)				
	Farm 1	Farm 2	Farm 3	Farm 4	Farm 5
Habitats: Share of near natural habitat area	13	99	8	78	6
Habitats: Woodlands share of agricultural area	0	25	0	0	0
Arable land: Share of legumes in the rotation	0	25	100	50	75
Arable land: Intercropping area	0	0	100	75	0
Arable land: Share of temporary grasslands	75	100	100	0	75
Arable land: Crop residues	100	75	100	67	100
Energy: Direct energy consumption per ha	0	75	0	0	0
Energy: Total non-renewable energy consumption per ha	0	0	0	0	0
Fertilization: N from fertilizers	0	0	0	25	0
Fertilization: P from fertilizers	0	0	0	0	0
Profit stability	75	75	100	100	100
Debt level	100	100	97	75	30
Local procurement: producer level	67	82	100	80	100
Local procurement: supplier level	100	100	100	100	67
Local sales	100	75	100	100	50
Full-time jobs per hectare	25	25	25	50	50
Further training of employees	0	50	0	0	0
Workers: Work overload	63	48	44	55	55

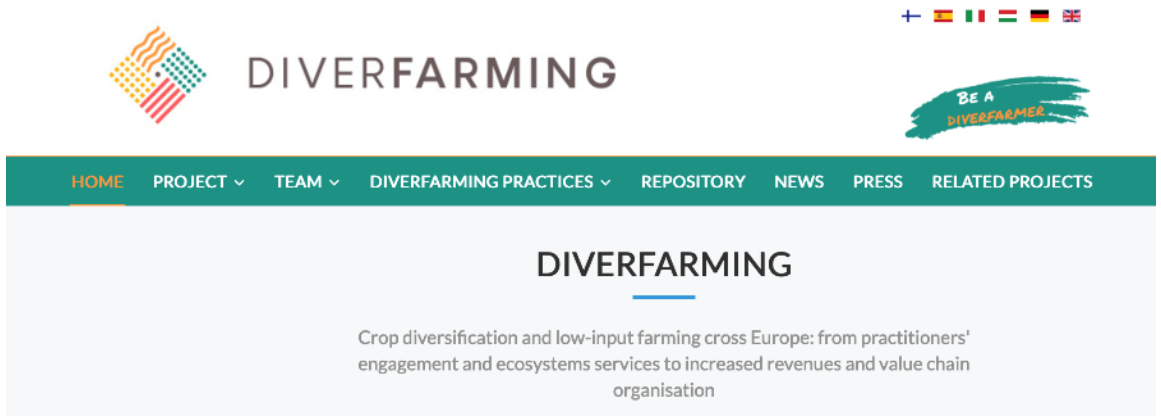
MAELIA

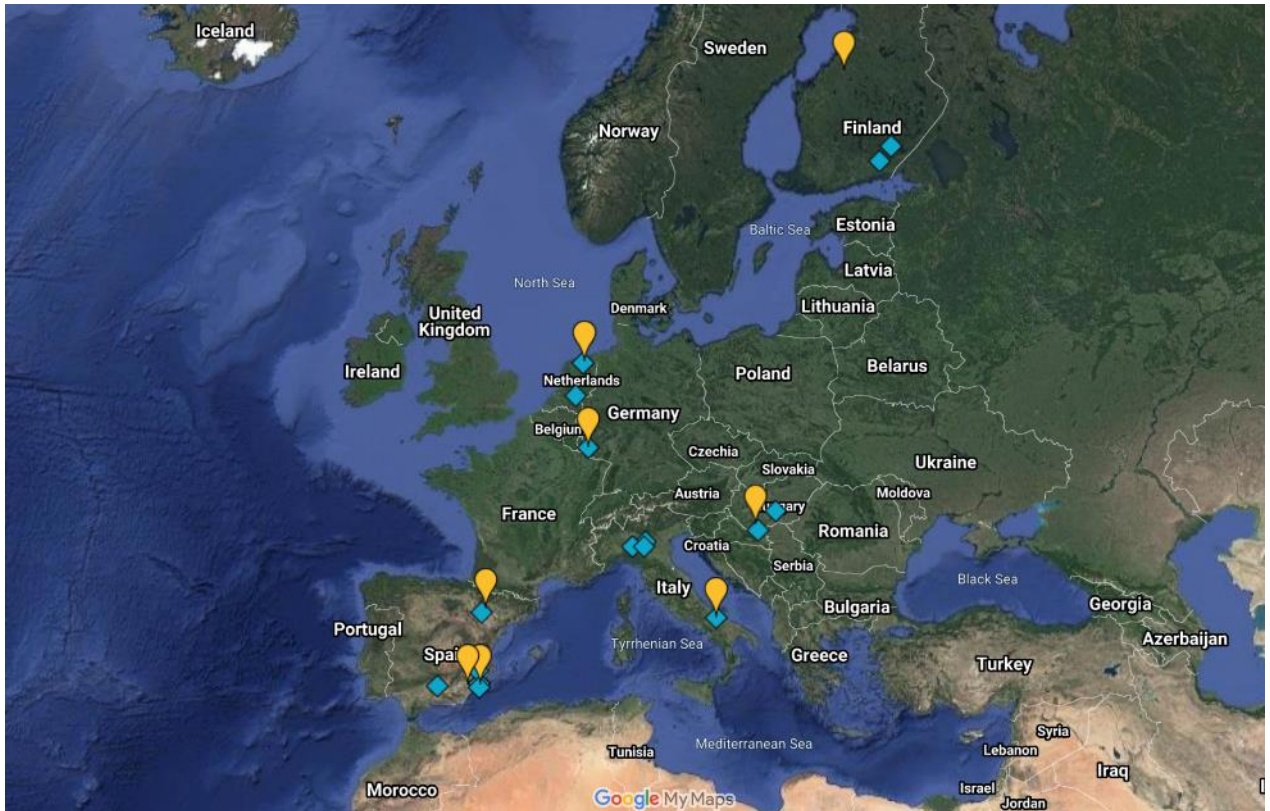
Generic platform for integrated assessment and modelling (IAM) of social-ecological systems (SES) at territory level for landscape design/planning and management

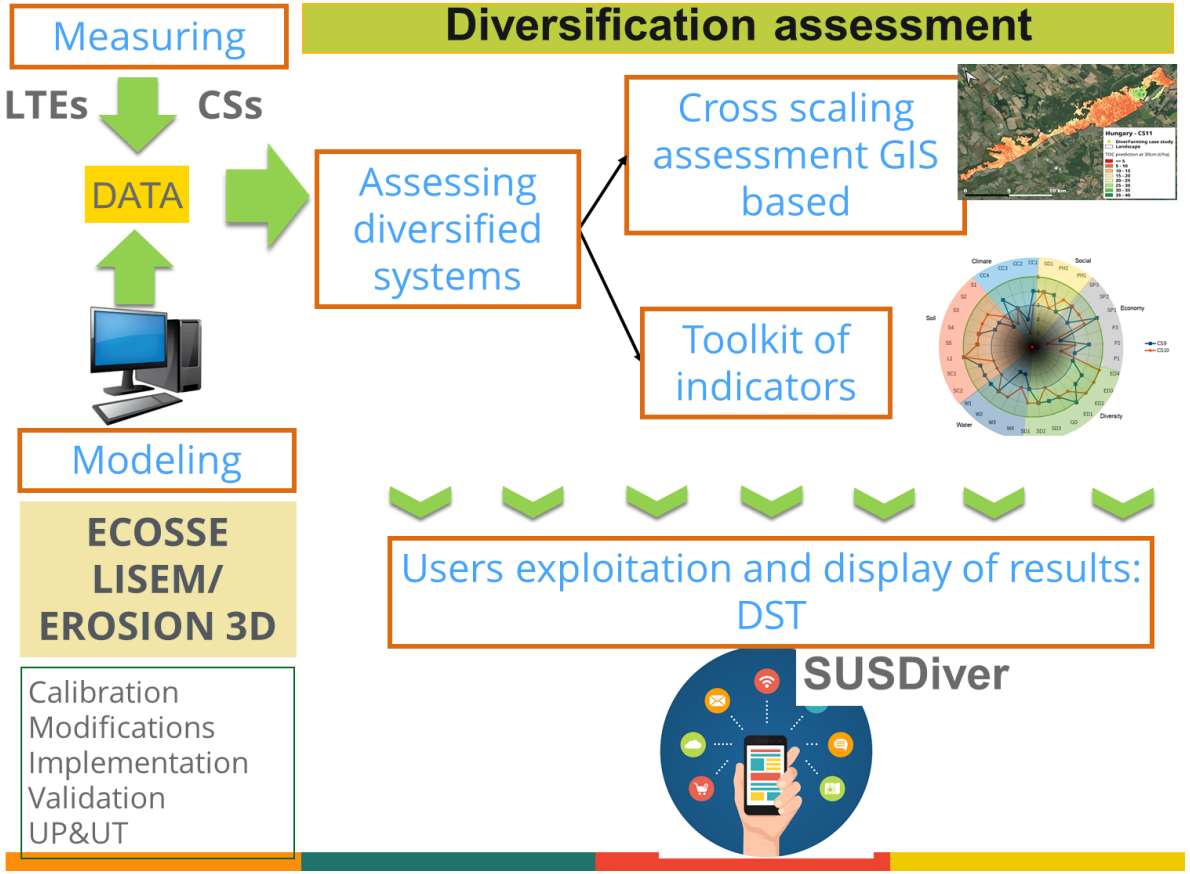
Relevance for monitoring and evaluation

- The database of field experiments provides information on the possible impacts of diversification through a range of indicators;
  - It includes references on measured impacts under typical receiving environments (pedo-climatic conditions and cropping systems)
- DiverIMPACTS Field experiments may or may not be representative of all possible cropping systems and all regions or countries;
  - But can be used as references
- The final user interface to search in the database is still under discussion and should be made public end of 2022;
  - Inclusion of other field exper
- Besides the database, assessment tools at field, farm and territory levels are developped and can be used to support ex-ante assessment of alternative management scenarios.

Diverfarming addressing the same objectives







http://www.diverfarming.eu/

Thank you for your attention

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Swiss Confederation

Federal Department of Economic Affairs, Education and Research EAER
State Secretariat for Education, Research and Innovation SERI

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Slides for the breakout groups

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 727482 (DiverIMPACTS)

Structure of the FE database

- **The final database will combine 2 databases :** (1) Measurements from the field and (2) Indicators from SYSTERRE®.

1

Database with measurement from the field :

- **Data collection :**

Raw data is collected at the crop level per year. FEs are responsible for the data entry.

Data were collected for a period of three crop year (2017-2020).

- **Database configuration :**

One column per the variable. Unit of each variable is given.

Different level of hierarchy to structure the description database (Field experiment number, System number, year of harvest, temporal replications, spatial replication, crop).

Field experiment number	system number	year	temporal replication	spatial replication	rank of the crop	crop name
-	-	-		-	-	-
6	1	2018	A	1	1	winter rye
6	1	2019	A	1	1	spring oat
6	1	2019	A	1	1	red clover
6	1	2020	A	1	1	red clover
6	1	2021	A	1	1	winter wheat
6	1	2022	A	1	1	spring pea
6	1	2023	A	1	1	winter oilseed
6	2	2019	A	1	2	spring oat
6	2	2019	A	1	2	lupin
6	2	2019	A	1	2	red clover
6	2	2020	A	1	1	red clover
6	2	2021	A	1	1	wheat
6	2	2022	A	1	1	ray-grass
6	2	2022	A	1	1	vetch
6	2	2022	A	1	1	oil radish
6	2	2022	A	1	2	spring pea
6	2	2022	A	1	2	spring barley

Structure of the FE database

2

Database with indicators from SYSTERRE ®

Field experiments are scaled up at a farm level.

- **Data collection :**

Descriptive data are collected at the crop year level (Machinery, parcels/areas, workforce, crops and cropping practices, in**puts,** economic data).

Data was collected for a period of three crop year (2017-2020).

1 cropping system = 1 farm on Systerre.

Output database configuration (excel file) :
- One column per variable.
- Different level of hierarchy (crop year, cropping system, farm)

ID	System	Farm	ID-Farm	Crop year	ID-Crop System	Plot	Lot	Actual crop
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L1_101	101	L1	Grain Maize
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L1_107	107	L1	Winter Barley/Soya
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L1_110	110	L1	Soft winter wheat/Sorgum
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L2_219	219	L2	Grain Maize
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L2_215	215	L2	Winter Barley/Soya
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L2_212	212	L2	Soft winter wheat/Sorgum
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L3_323	323	L3	Grain Maize
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L3_325	325	L3	Winter Barley/Soya
FE04_S1	DIV	1	DIV_FE04_S1_1	2018	DIV_FE04_S1_1_2018__L3_329	329	L3	Soft winter wheat/Sorgho

Structure of the FE database : the final database

Database with measurements from the field + **Database with indicators from SYSTERRE®**

FINAL DATABASE :

- Combination of the two databases.
- One row per system.
- Choices on the final indicators are still under discussion. It will depend on the relevance of each indicator during the multisite analysis.

Still under di...

Indicators from the WP3 database | Indicators from SYSTERRE® | Indicators from SYSTERRE® also available

1 Higher arable land productivity	2 Diversification and increase of farmers revenues	3 Lower environmental impact of diversified cropping systems	4 Improved delivery of ecosystem services
▪ Yield. ▪ Quality of harvested products (% protein, % oil). ▪ Aboveground biomass of harvested and not harvested products. ▪ LER for intercrops. ▪ Variability (min Yield, max yield during the rotation; number of crops with a yield lower than…). ▪ Energy efficiency. ▪ *Total energy production.*	▪ Gross margin. ▪ Input costs. ▪ Mechanization costs. ▪ Production costs. ▪ Economic efficiency. ▪ Diversity of type of products. ▪ Number of species with a high added value. ▪ *Salary costs and family labour remuneration.* ▪ *Direct and Net margin.*	▪ Water use. ▪ Pesticide use (Active ingredient, Treatment Frequency Index). ▪ Energy use (Primary, Useful). ▪ N use. ▪ Yield/water use, /pesticide use, energy use, fertiliser use. ▪ N balance. ▪ GHG emissions. ▪ Risk of N leaching. ▪ *Fuel consumption.*	▪ Earthworm abundance and diversity. ▪ Decomposition of organic matter. ▪ Arthropod abundance and diversity. ▪ Weeds, pest and disease control.(Weed biomass, Weed diversity, Pests and diseases). ▪ N capture by catch crops. ▪ N2 fixation. ▪ C sequestration. ▪ Soil cover.

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