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# **INRAE Farming system experiments : Orchard redesign towards pesticide free fruit production - Designing an experimental agroecological mixed crop livestock farm in marshland**

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HAL Authorization

# ➤ Designing an experimental agroecological mixed crop-livestock farm in marshland



# ➤ Short introduction





## An INRAE experimental unit

A team of 25 people including 6 engineers covering the disciplines of ecology, animal, agronomy and water science, naturalist and information systems, a "farm" team and a research technicians = THE COLLECTIVE

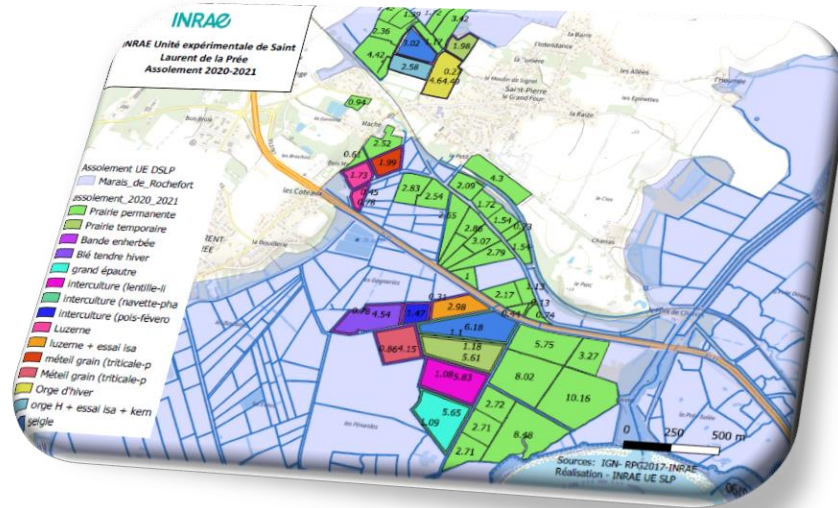
An experimental farm of 156 ha in marshland with 52 ha of arable land and 104 ha of wet grasslands and a herd of about 100 cows of the local Maraichine breed

# ➤ An experimental farm in a marsh with a system experiment: TRANSI'MARSH



## Agroecological infrastructures

4 ponds, 5 hectares of grass strips, 1 reed bed, 100 hectares of natural meadows with water drops, 9 km of hedgerows



## Dense hydraulic network

- 90% of land in marshland
- 3 hydraulic management units
- 25 km of ditches and collectors, 2 sluice gates
- 3 pumps, 50 crossings
- 5 devices to retain water on meadows,
- 170 drains on crops



- 50 local Maraîchine cows
- Two calving periods
- Herd adjusted to 100 hectares of natural meadows
- Stocking density: 0.6 LU/ha
- Feeding with hay and pasture
- Production of rose veal and adults fattened with farm-grown cereals



## 100% organic farming



- 100 hectares of permanent meadows
- 60 hectares of drained arable land: 3 long crop rotations, soil cover in winter
- Plant species and variety diversity
- Small parcels

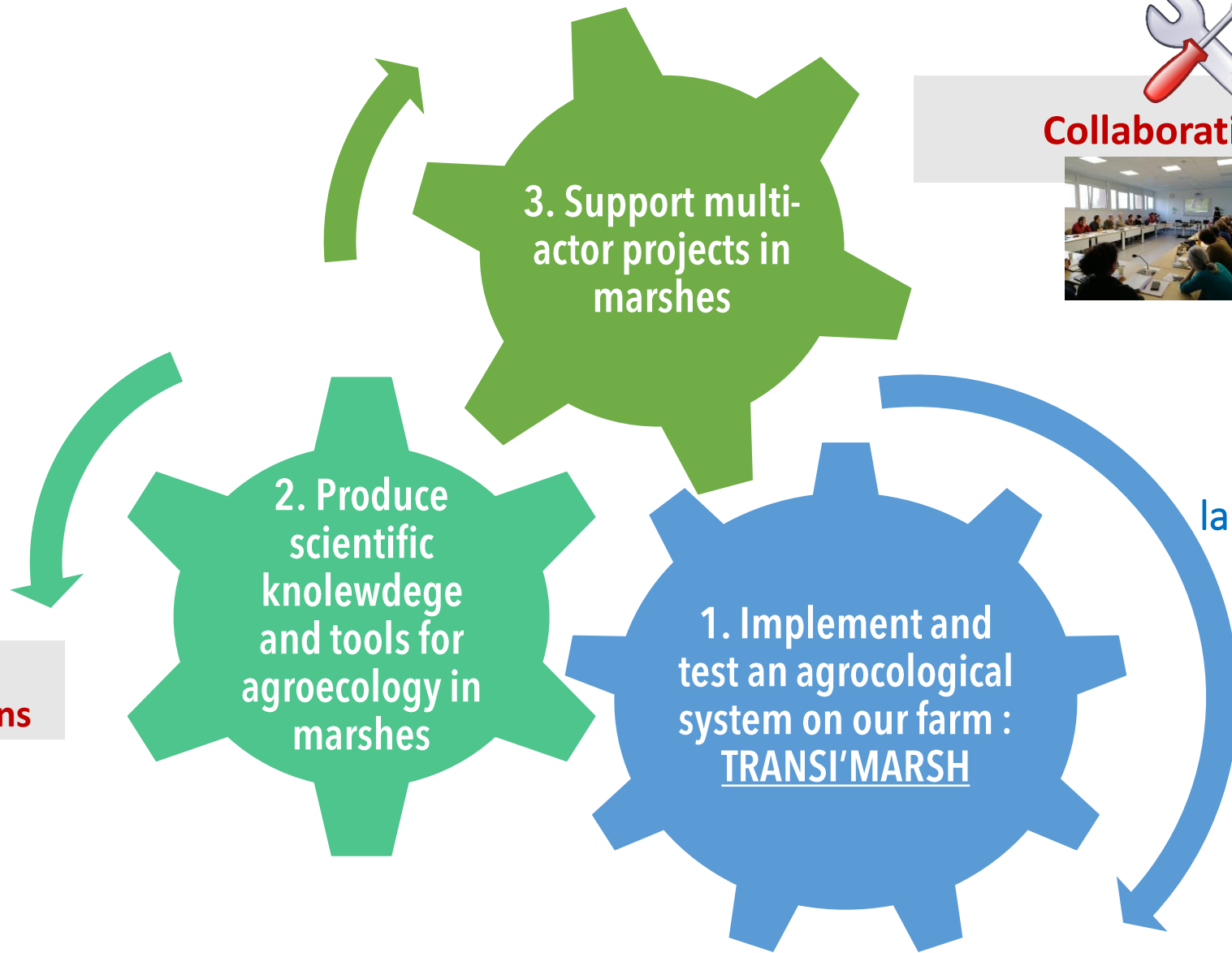
## Open Innovation

Visits for citizens and farmers

Training for students and schoolchildren



# ➤ Aim of our project : to support and tool the agroecological transition in marshlands



## Collaborative research



The experimental farm as a laboratory of the agroecological transition

## Systemic approach



## Factorial experimentations



## ➤ Marshes of French atlantic coast



❖ Cover an area of 200,000 ha of wetlands from Morbihan to Gironde

❖ Marshes are devoted to agriculture, with many conventional farms that are crops farming systems, mixed crop-livestock farming systems or grassland-based suckling farms.

Few crops farms are organic which poses major water quality problems and a multiplication of children cancers

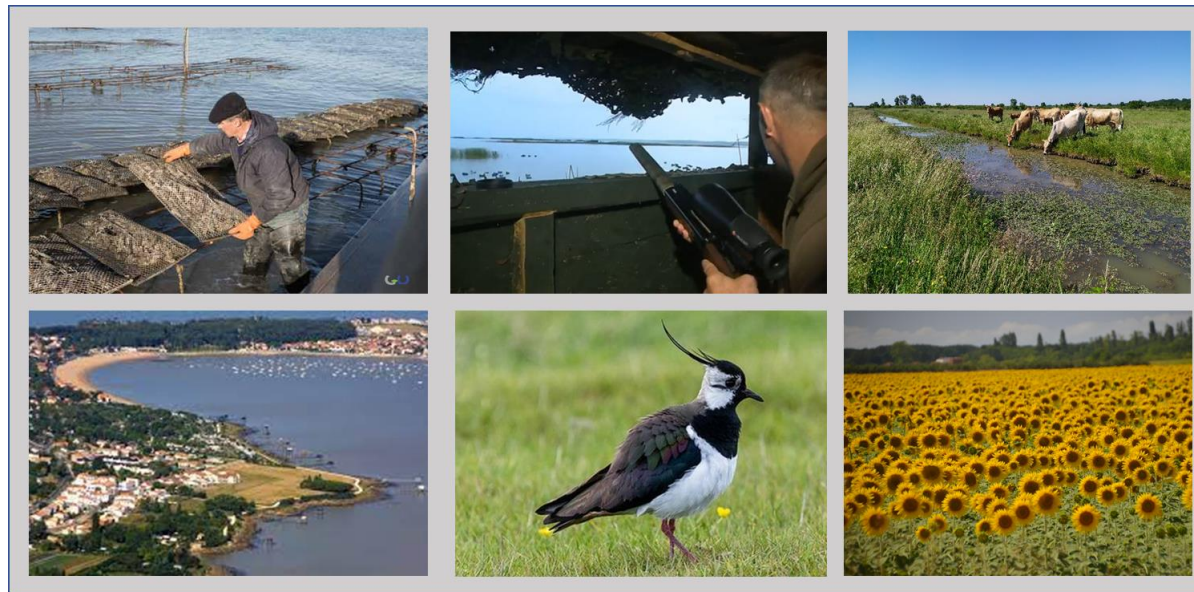
❖ The environmental services they provide are essential for natural and territorial balance

➔ **Our researches are deeply rooted in this territory**

# ➤ A few words on the specificities and constraints for agriculture in marshes



➤ Remarkable biodiversity and landscape recognised as being of national and European interest in the framework of various regulatory measures (bird migratory road)

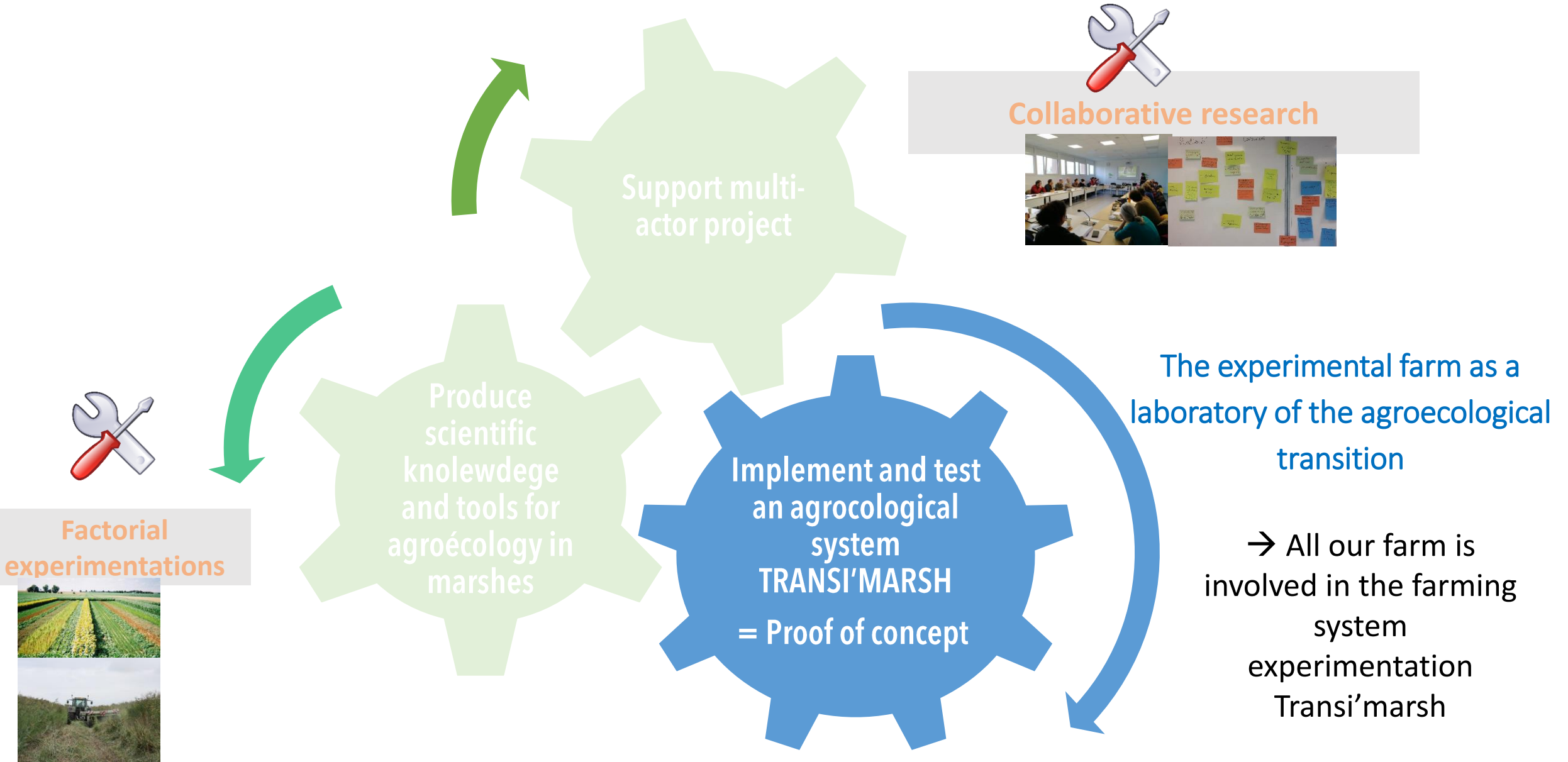


➤ Many actors and stakeholders linked by water

➤ The design of our system experiment and the first feedbacks



# > Our scientific project



## ➤ Farming system experimentation specificities

### **Set up a farming system experiment is:**

- ❖ Experimenting consistent and innovative systems rather than just techniques or new varieties
- ❖ Designing new ways of farming to valorise natural resources while being economically sustainable
- ❖ Changing scale, space and times by no longer working at plot or animal scale on one year
- ❖ Evaluating the sustainability and providing data on the long term
- ❖ Understanding the processus of transition

## ➤ What theoretical framework do we use?

We operate with a 'step-by-step' approach, well adapted to manage the agroecological transition



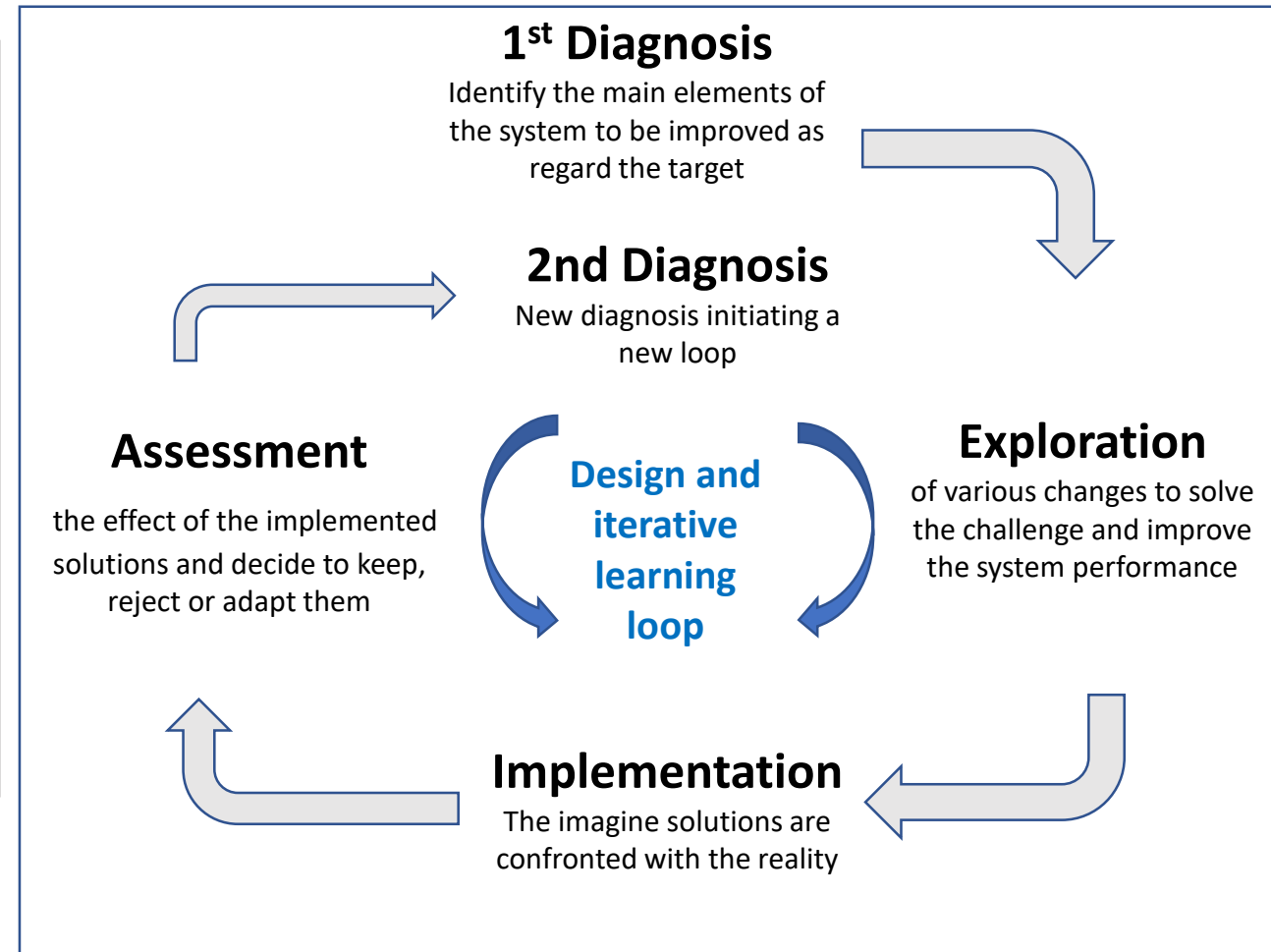
European Journal of Agronomy

Volume 150, October 2023, 126948

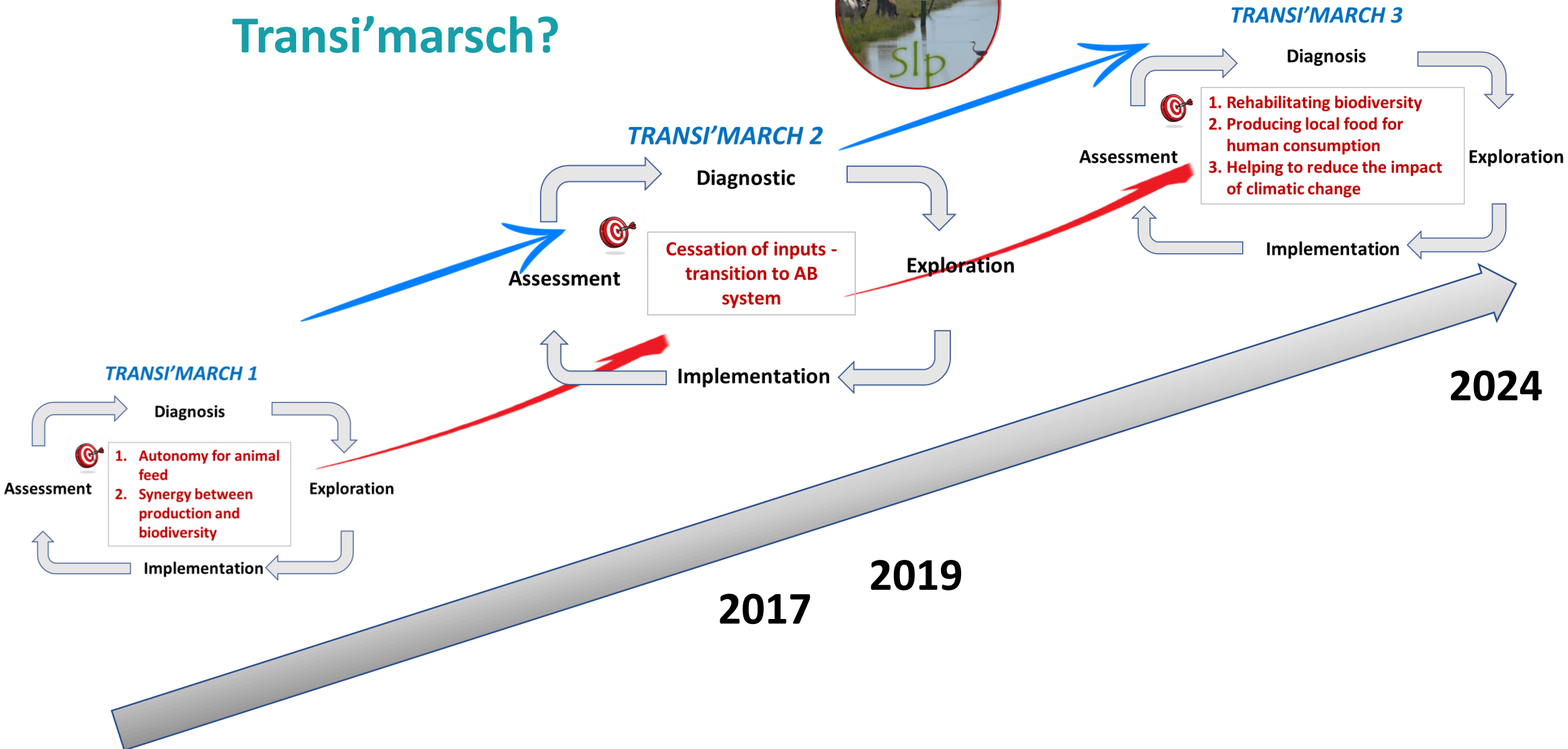


### Unravelling the step-by-step process for farming system design to support agroecological transition

Jean-Marc Meynard <sup>a</sup> ✉, Marianne Cerf <sup>a</sup>, Xavier Coquil <sup>b c</sup>, Daphné Durant <sup>d</sup>,  
Marianne Le Bail <sup>a</sup>, Amélie Lefèvre <sup>e</sup>, Mireille Navarrete <sup>f</sup>, Jérôme Pernel <sup>g</sup>, Anne Périnelle <sup>h</sup>,  
Benjamin Perrin <sup>e</sup>, Lorène Prost <sup>a</sup>, Raymond Reau <sup>i</sup>, Chloé Salembier <sup>a e</sup>, Eric Scopel <sup>h</sup>,  
Quentin Toffolini <sup>i</sup>, Marie-Hélène Jeuffroy <sup>i</sup>



# How do we proceed to design Transi'marsch?



*D'après Meynard et al., 2023*

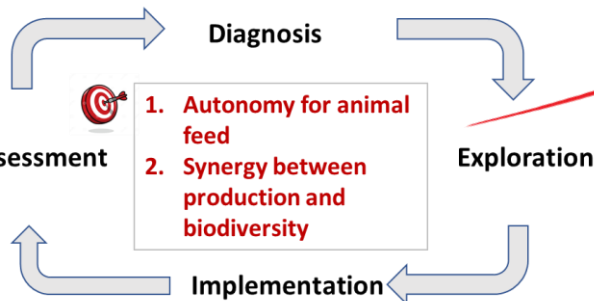
# Step by step design of Transi'marsch

2024



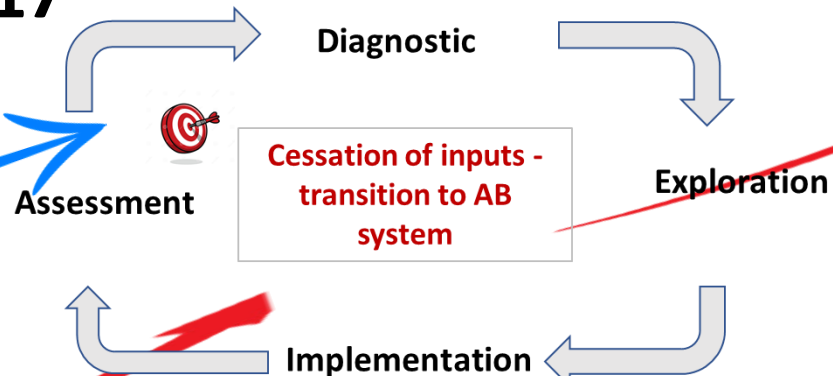
2009

## TRANSI'MARCH 1



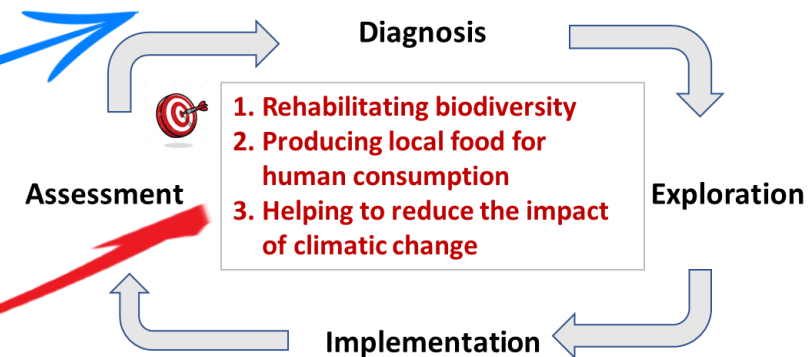
2017

## TRANSI'MARCH 2



2019

## TRANSI'MARCH 3



IMPLEMENT AND TEST THE PRINCIPLES OF AGROECOLOGY AND THE RESULTS OF SCIENTIFIC LITERATURE

**PRODUCTION SYSTEM**

**"Improving the agro-ecosystem"**

**SCALE**

**AGRI-FOOD SYSTEM**

**"Acting on the transformation of the food system".**

**SCALE**

# The learning loop: examples of Transi'marsh 3

## DIAGNOSIS

1. Animals use too much arable land for human food
2. Feed for our hardy cows too expensive (wrapping)
3. Poor economic valuation of our animals
4. Animals sent abroad by lorry (welfare)
5. Production for export
6. Biodiversity issues are not clearly explained
7. Our attention for biodiversity only linked to permanent grassland

## ASSESSMENT/LEARNING

- An effective reduction in the herd and an increase in the amount of arable land used for human consumption
- All our meat is sold locally to a wide range of buyers (0 exported animals abroad) with increasing economic margins → Requires a great deal of interactions with stakeholders
- 11 target species identified with 11 dashboards → positive results for some species
- All the large plots of arable land were cut, 4 types of strips were set up and 1 hibernaculum was planted.

## EXPLORATION

1. Reduce the number of animals to fit the ha of natural grassland
2. Stop wrapping and produce alfalfa hay to replace it
3. Sell our products locally to a wide range of buyers and invest in selective catering
4. Diversify our crops for human consumption in 3 fixed rotations
5. On a plot-by-plot basis, set targets for results on target wild species using an adaptive management approach
6. On the scale of our arable land, create a mosaic and increase the number of semi-natural habitats for wildlife

## TRANSI'MARCH 3 3 TARGETS



**Rehabilitate biodiversity**



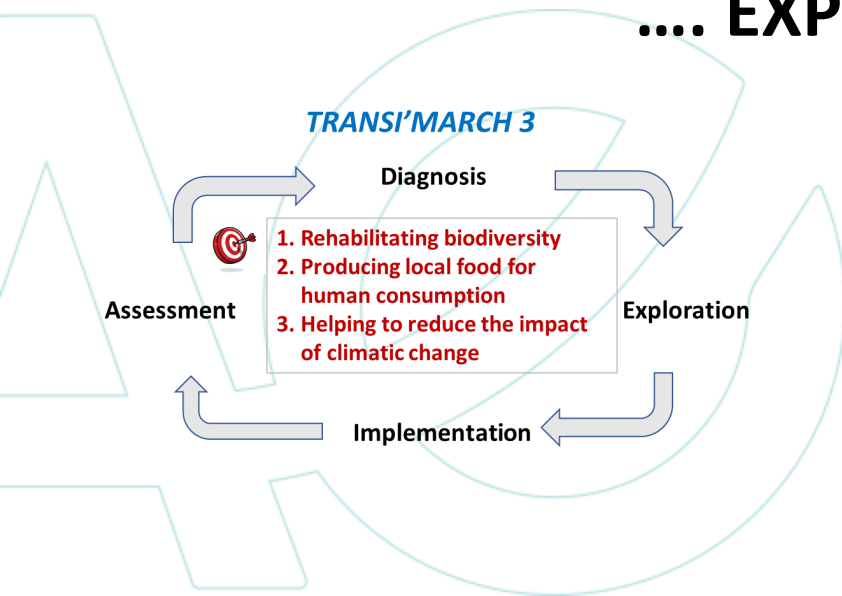
**Produce local food for human consumption**



**Contribute to reduce the impact of climatic change**

## ➤ A focus on our approach on biodiversity

### .... EXPLORATION of the two paths to improve biodiversity



1. On a plot-by-plot basis, set targets for results on target wild species using an adaptive management approach
2. On the scale of our arable land, create a mosaic and increase the number of semi-natural habitats for wildlife

# How to implement biodiversity-based agriculture to enhance ecosystem services: a review

Michel Duru<sup>1,3</sup> · Olivier Therond<sup>1,3</sup> · Guillaume Martin<sup>1,3</sup> · Roger Martin-Clouaire<sup>2,3</sup> · Marie-Angéline Magne<sup>1,4</sup> · Eric Justes<sup>1,3</sup> · Etienne-Pascal Journet<sup>1,3,5</sup> · Jean-Noël Aubertot<sup>1,3</sup> · Serge Savary<sup>1,3</sup> · Jacques-Eric Bergez<sup>1,3</sup> · Jean Pierre Sarthou<sup>1,3</sup>

## FARM SCALE

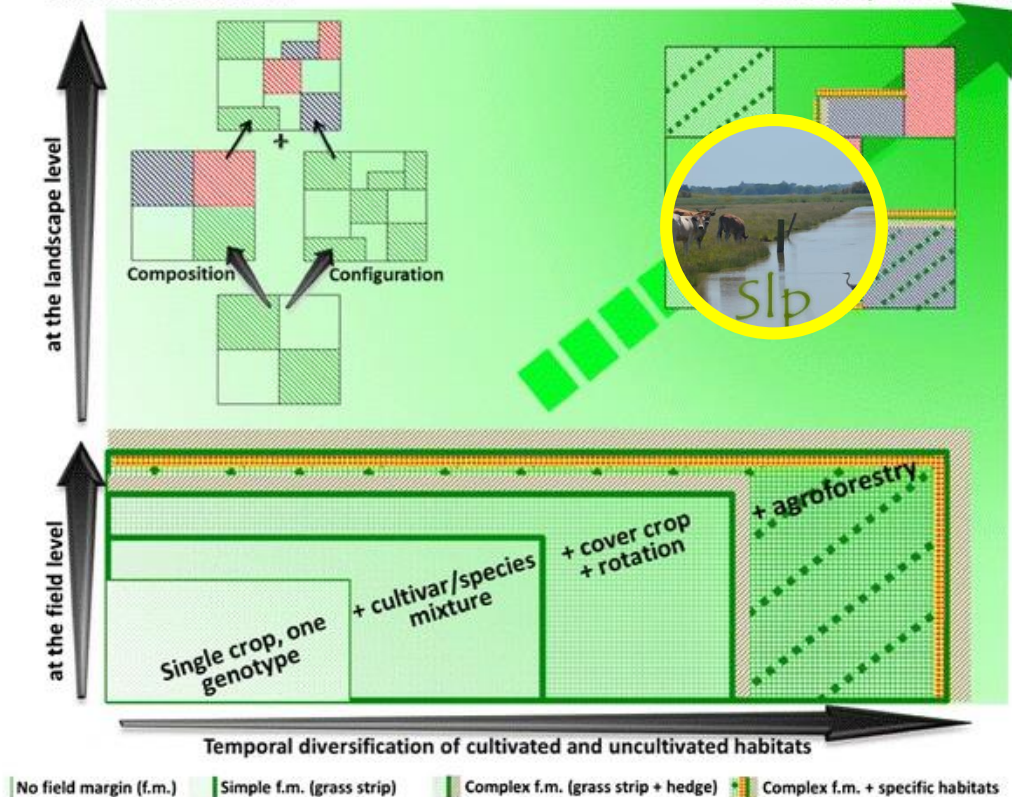
## PLOT SCALE

Creating a mosaic and heterogeneity of habitats across the farm

A target-based approach for biodiversity management at plots scale

Spatial diversification of cultivated and uncultivated habitats

Management of diversity, connectivity and slow variables



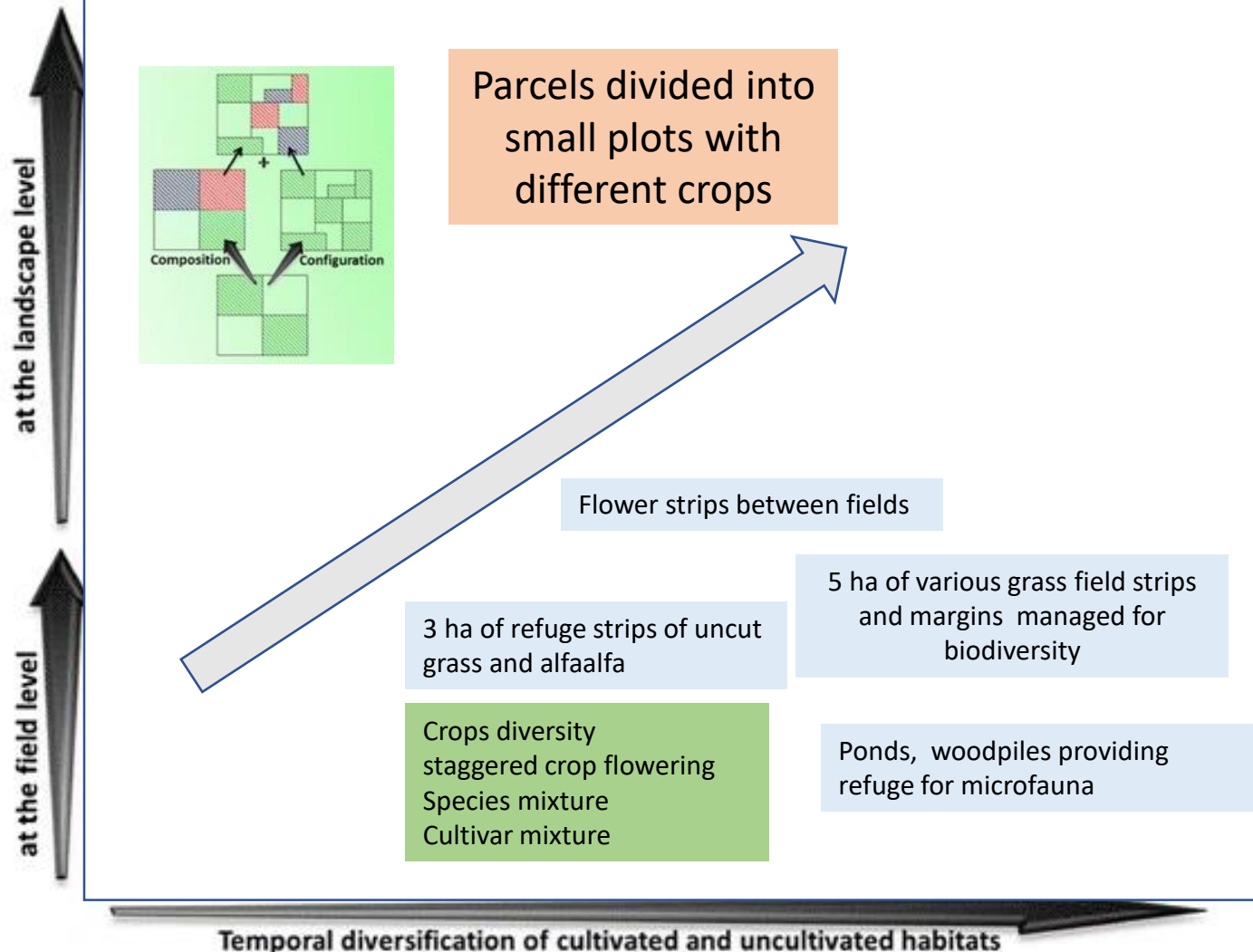
SLP : Mares, bandes refuges, hibernaculum, ITK BE spécifiques



# ➤ Towards a biodiversity-based farm

Spatial diversification of cultivated and uncultivated habitats

Management of diversity, connectivity and slow variables



No field margin (f.m.)

Simple f.m. (grass strip)

Complex f.m. (grass strip + hedge)

Complex f.m. + specific habitats

# ➤ Towards a target-based approach for biodiversity management at plots scale

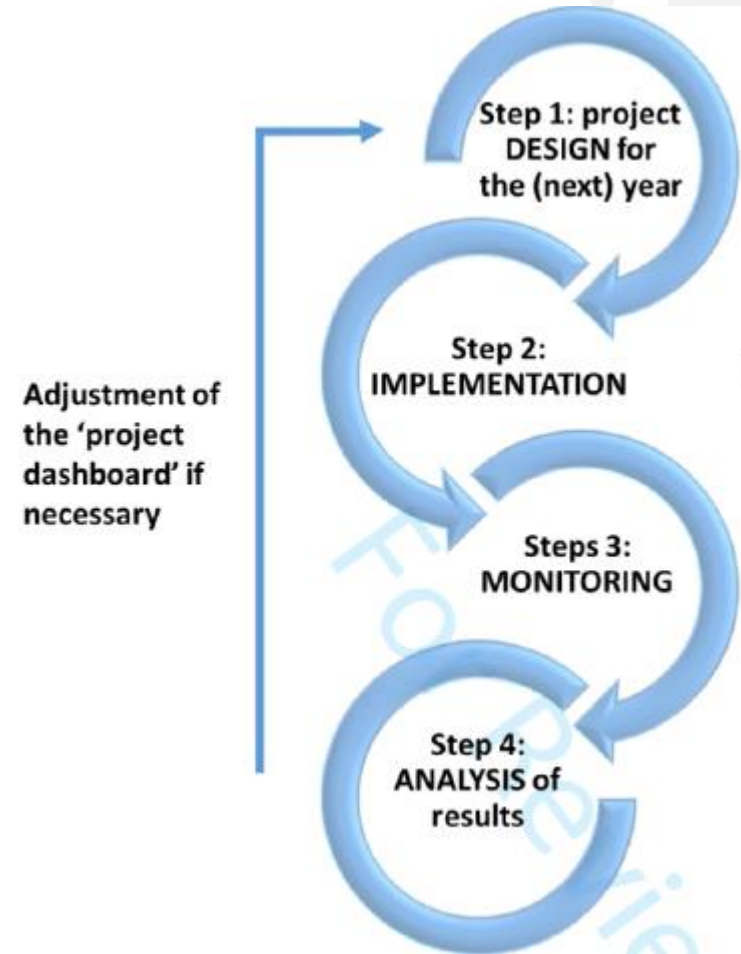
STEP 1: the collective of the farm highlights of **target species** and the identification of their habitats and the agricultural practices favourable to these species

This phase is based on **the construction of dashboards**

STEP 2: the implementation of the “roadmaps” of practices on the plots

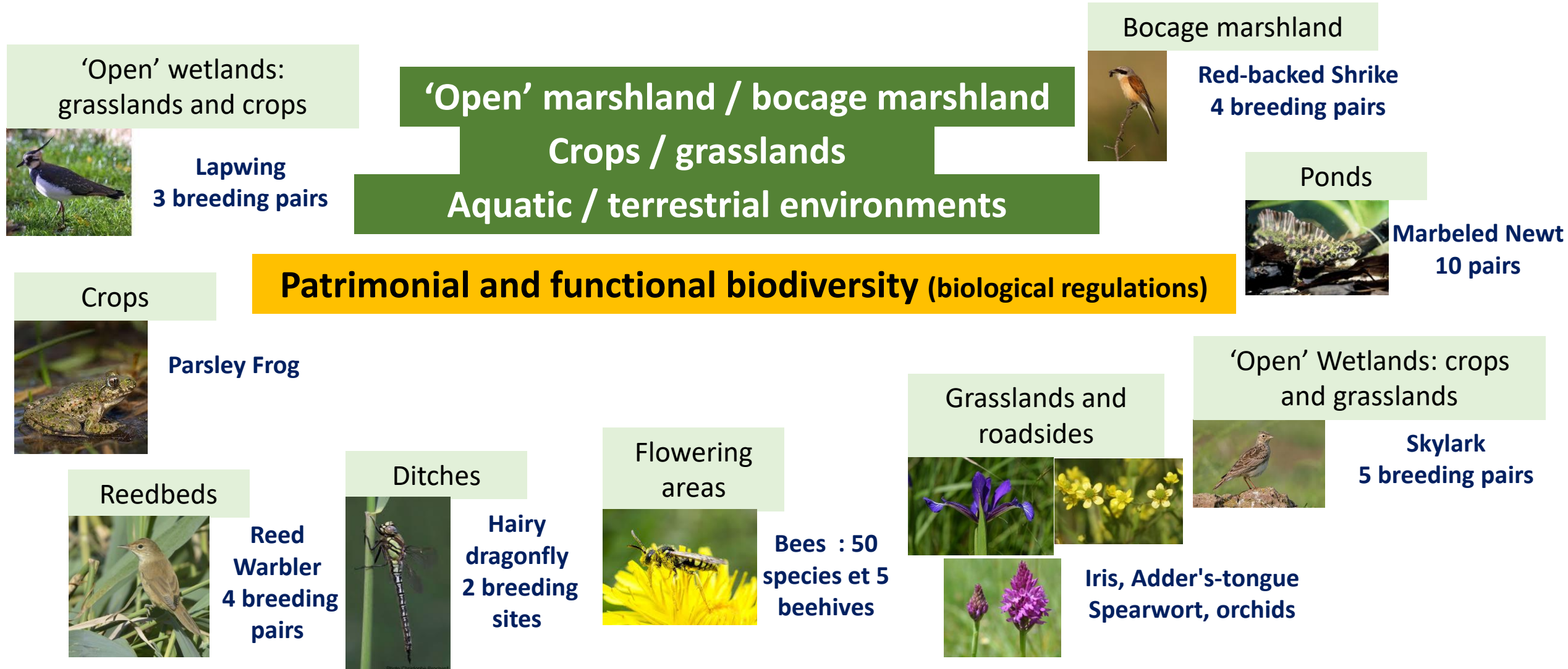
STEP 3: monitoring : observation and measurements

STEP 4: The collective examines **each year** the results and explained the gaps between obtained and expected results and between realized and intended practices



# 11 target species

- species at various conservation stake
- species from several taxa (to cover the food chain)
- covering the various environments existing on the farm



# The example of the skylark dashboard

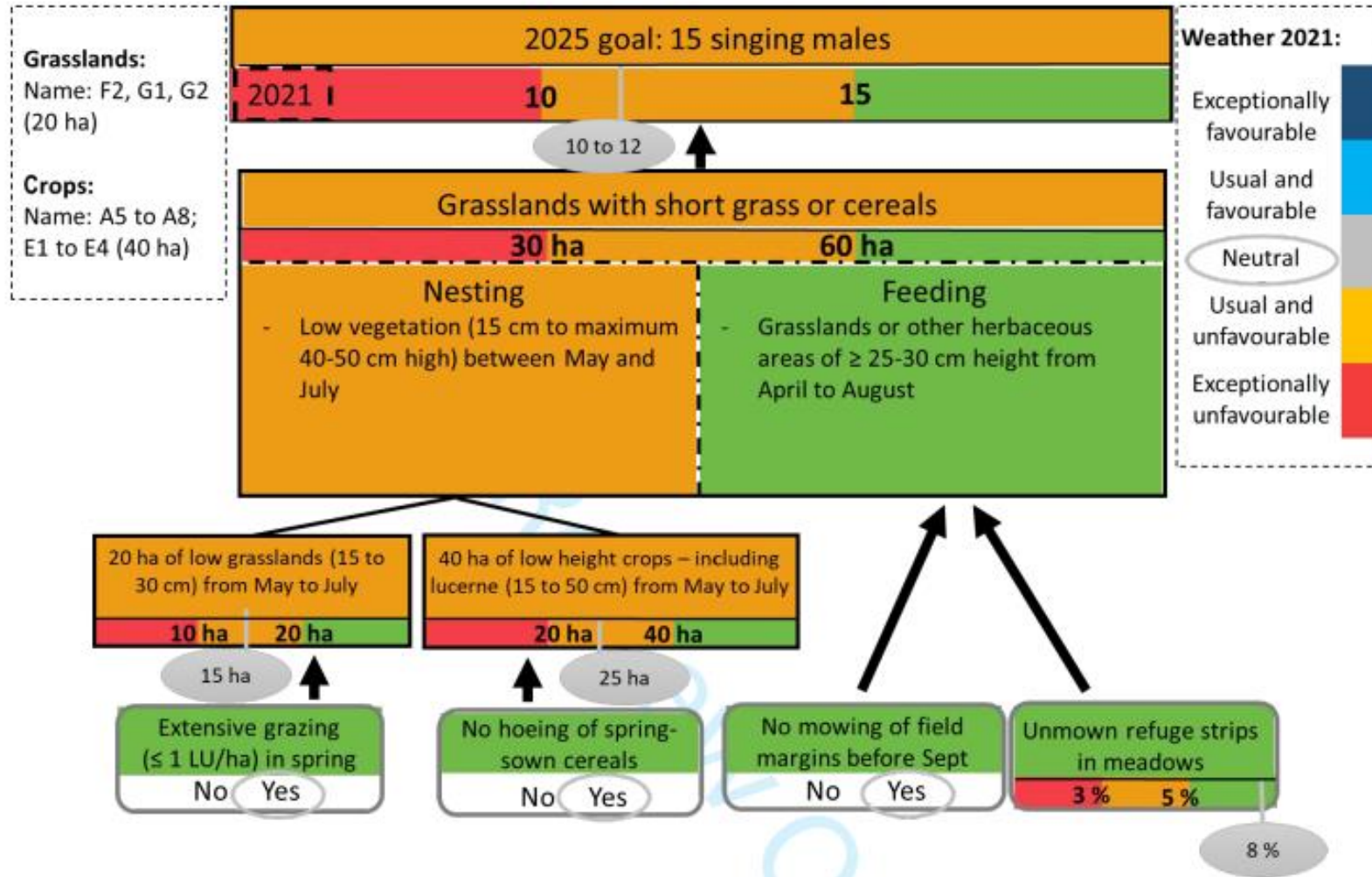
Goal:  
expected  
results for  
the species



Habitat  
needed and  
expected



Practices to  
create this  
habitat

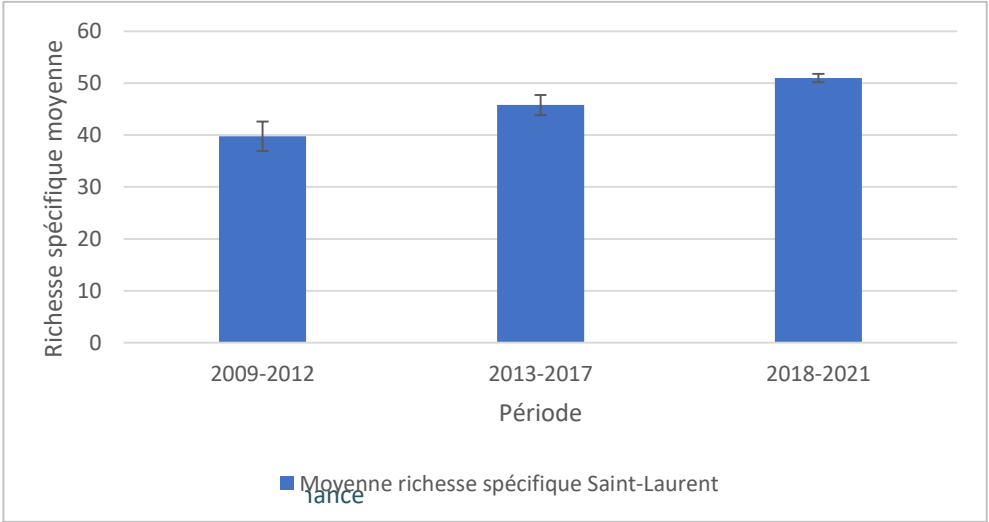
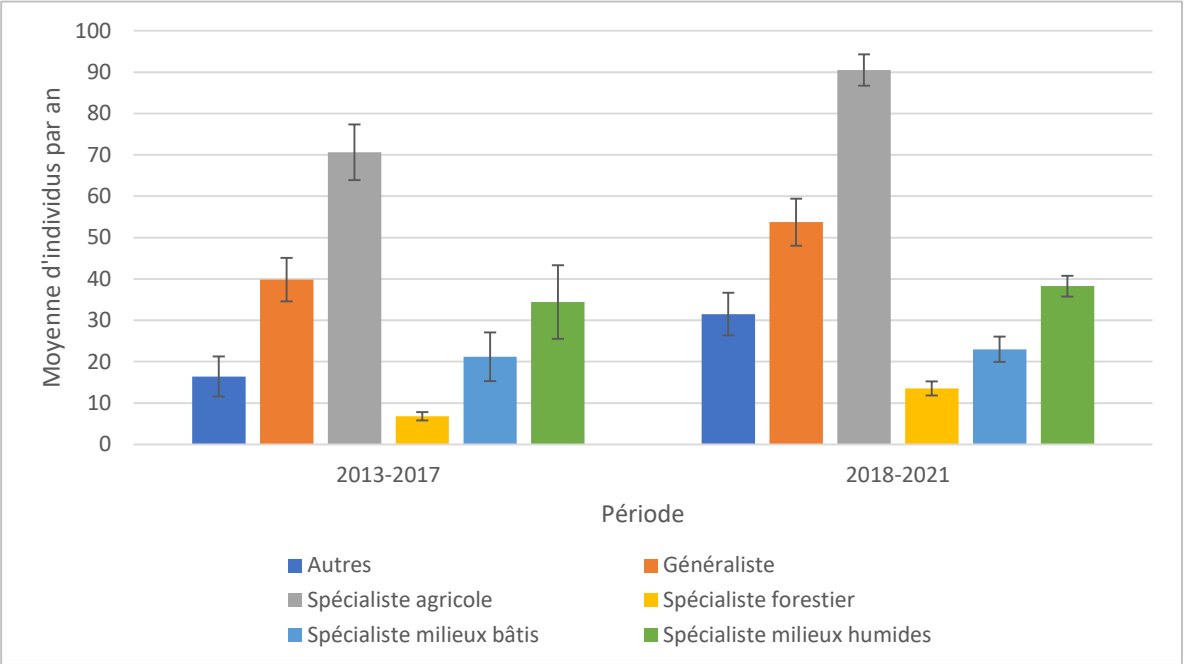


## ➤ The first feedbacks



# Birds example

Analyses préliminaires – stagiaire 2021 - dans le cadre du projet ADORE (MP Biosefair)

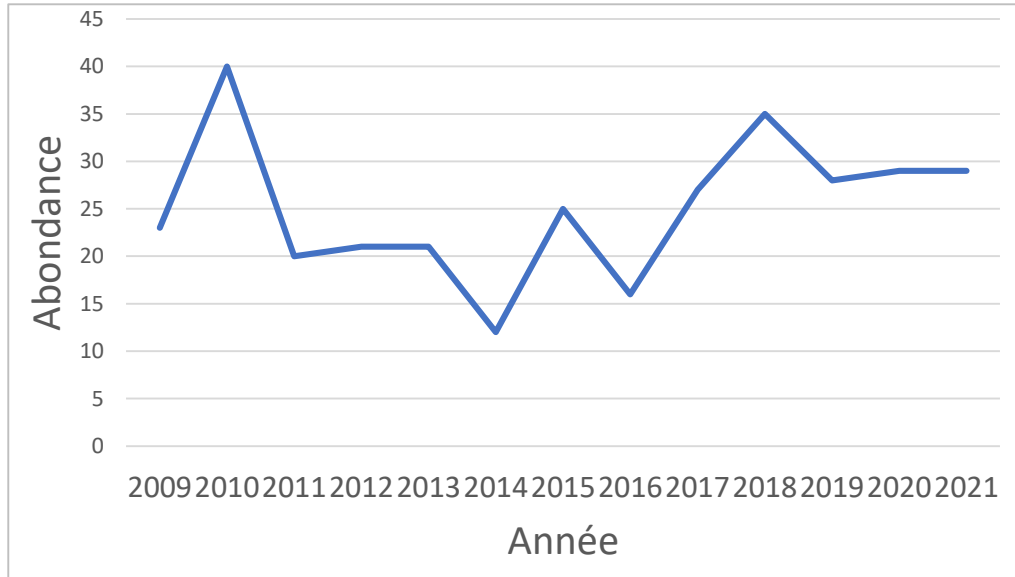


→ Increase in the abundance and number of bird species.

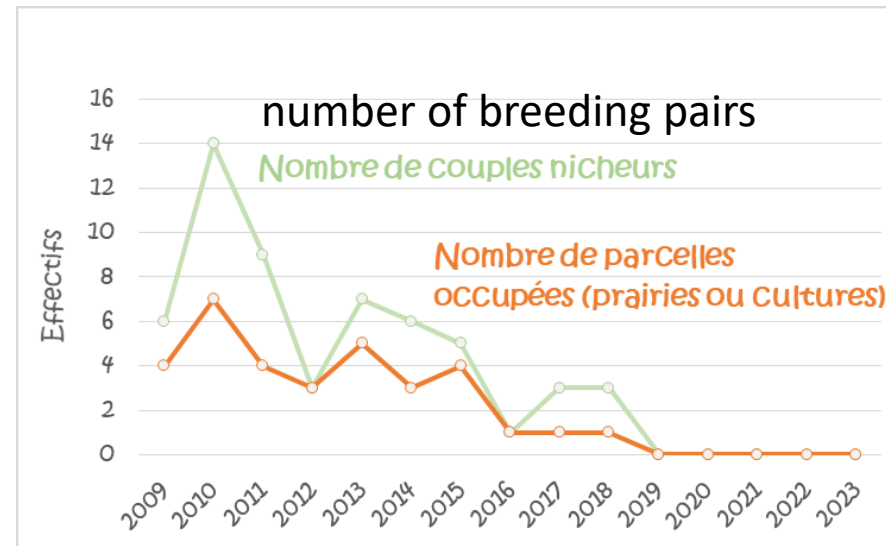
# Birds example



Some species are doing well..



... and others not at all...



# What are the mid-term results? 4 main types

① " A winning strategy "



Iris maritime



Orchidées



Alouette des champs

② " Habitat successful but abundance not achieved "



Pélodyte ponctué



Pie grièche écorcheur



Pollinisateur



Vanneau huppé

③ " Failure to carry out planned actions "



Aechne printanière



Triton marbré



Renoncule à feuilles d'Ophioglosses

④ " Compliance with planned actions but unsatisfactory habitat "



Rousserolle effarvatte

## ➤ To conclude

- ✓ We are also committed to an open innovation approach
  - ✓ We produce a lot of knowledge transfer documents
  - ✓ we are involved in a lot of participative projects with a wide range of non-academic partners
- 
- ✓ we have a different posture as researchers from our colleagues: we're between doing and science
  - ✓ it is often more difficult to publish the results of this type of approach than of analytical experiments