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Session Socio-ecosystems and ecological services-1

# An integrative multi-scale approach to regional agriculture to support the assessment and benefit of pest-regulation services delivered by biodiversity

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# Research study context



## SEBIOPAG

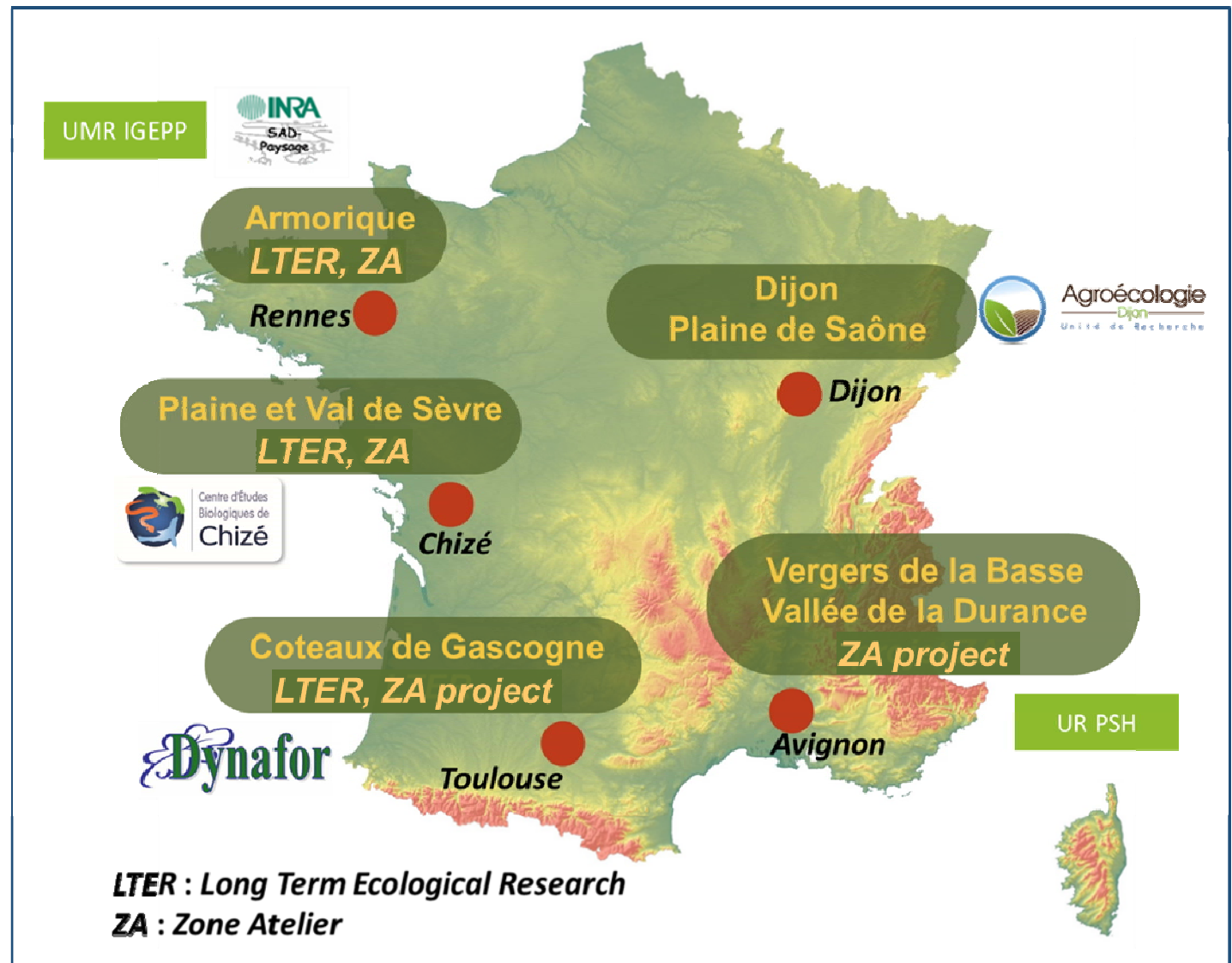
An INRA-CNRS long-term research network on ES, biodiversity & landscape interactions

[www.sebiopag.inra.fr/](http://www.sebiopag.inra.fr/)

## SEBIOPAG-Phyto

(2014-2017): An ongoing research on the effects of phytos on biodiversity & ES

*100-parcel network over the 5 regions*



# Research questions

SEBIOPAG-Phyto



⇒ *pesticide use to benefit pest-regulation ecosystem services (ESs)*

- Effect of reduced pesticide application on pest-regulation and crop yield
- Effect of cropping system and landscape context on pest regulation
- Operational knowledge for supporting farmers' consideration of pest-regulation ESs in their cropping system management



# Research assumptions and design

Tscharntke et al. 2012; Baudry et al. 2003; Petit et al. 2013

## Pest-regulation ESs depend on

- cropping system  
*intensity of pesticide use*
- landscape context
  - *parcel-surrounding landscape*
  - *regional current/past landscape*



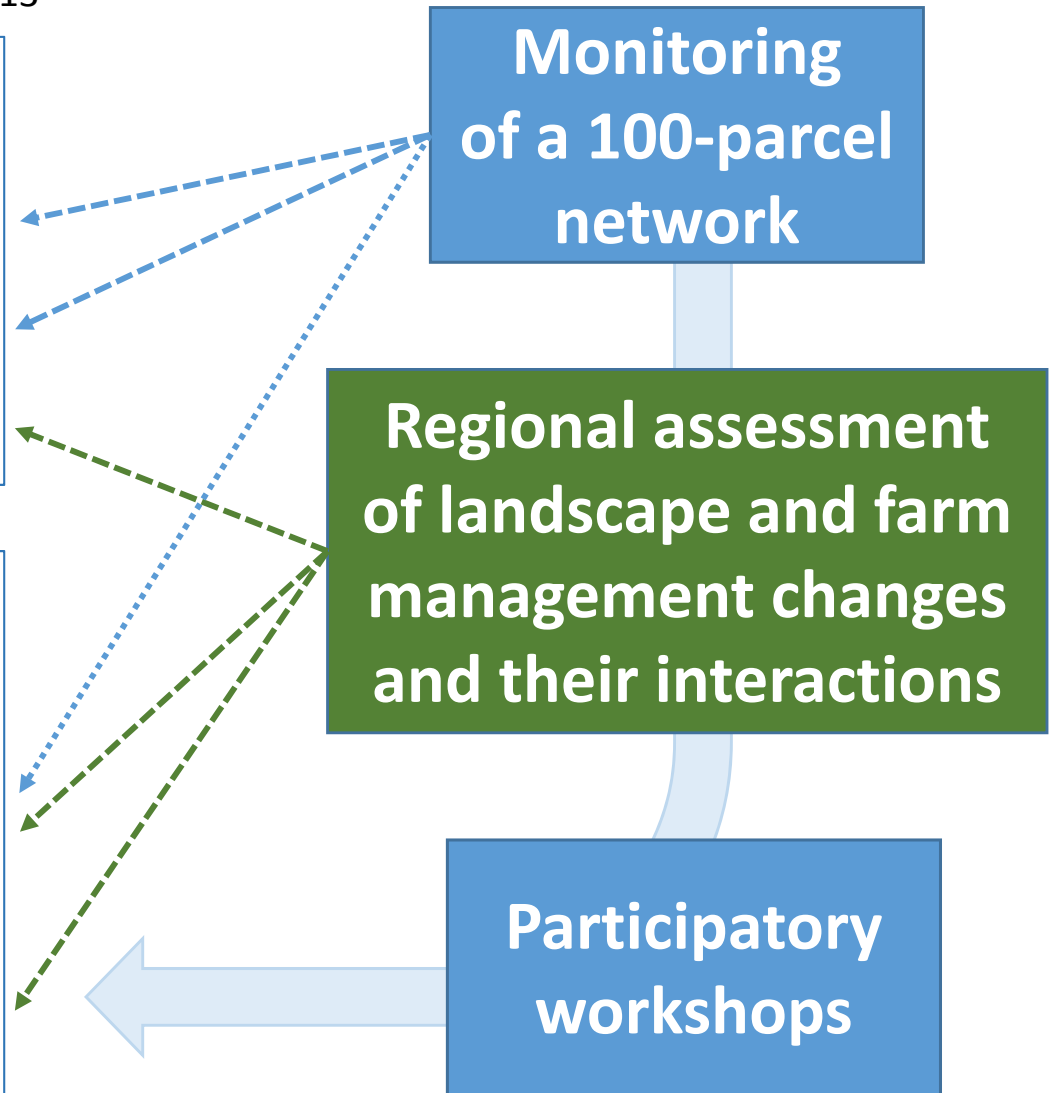
## Support to adoption of new crop-management practice

- farm level  
*adaptive management behaviour of farmer (short & long-term strategy)*
- regional level  
*diversity of farming systems operation and dynamics*

Monitoring  
of a 100-parcel  
network

Regional assessment  
of landscape and farm  
management changes  
and their interactions

Participatory  
workshops



# Integrated assessment of interactions between landscape, ESs & land management

- **a wide-spreading view of methodological requirements**

- a social-ecological conceptual framework
  - a multiscale and spatially-explicit approach
  - an explicit address of long term dynamics
- Wu & David 2002  
Liu et al. 2007  
Pelosi et al. 2010  
Burgi et al. 2015  
Lescourret et al. 2015

- **a lack of methods for regional application**

- few comprehensive regional studies in literature
- heavy and time-consuming implementation designs [e.g. Gibon et al. 2015]

⇒ **choice of a proven generic method with a distinct purpose**

- **'Agrarian System Diagnosis' (ASD)** [Cochet & Devienne 2006]  
UFR Agriculture comparée et Développement agricole, AgroParisTech
  - techno-economic assessment of change in regional agricultures
  - aim: supporting regional choice of agricultural development orientations
  - usual implementation: MSc research projects monitored by a professor

# ASD conceptual framework

- **a production system:** a set of production units (farms) with
  - similar resources
    - agricultural land condition, surface area, equipment, workforce
  - comparable socioeconomic conditions of operation
  - a same combination of crop and livestock productions
- **Regional agriculture:** a set of production systems (farm types)
  - resulting from an **historical process of farm differentiation**
  - driven by: technological change, agricultural economics and public policies, and resource availability at the farms

# Method for ASD application in a region

- Generic design: field-assessment & systemic modelling

Components	Results	Data collection
<b>Landscape analysis</b>	<i>Delineation and characterisation of landscape units within the region</i>	field observations + geological and topographical maps
<b>Assessment of historical change in prod. systems</b>	<ul style="list-style-type: none"> <li>- regional types of production systems at a reference date (1940-50)</li> <li>- respective trajectories of change, their main drivers and processes</li> </ul>	interviews of retired farmers, advisors,... + regional literature
<b>Assessment of current types of prod. systems</b>	<ul style="list-style-type: none"> <li><i>Techno-economical operation</i></li> <li><i>Economic performance</i></li> <li><i>Prospects for change</i></li> </ul>	interviews of active farmers

[source: Cochet & Devienne 2006; Moreau et al. 2012]

- **SEBIOPAG-Phyto** : emphasis on significant indicators / biodiversity: *hedges and forests, grasslands & grazing lands, ponds; parcel size ...*

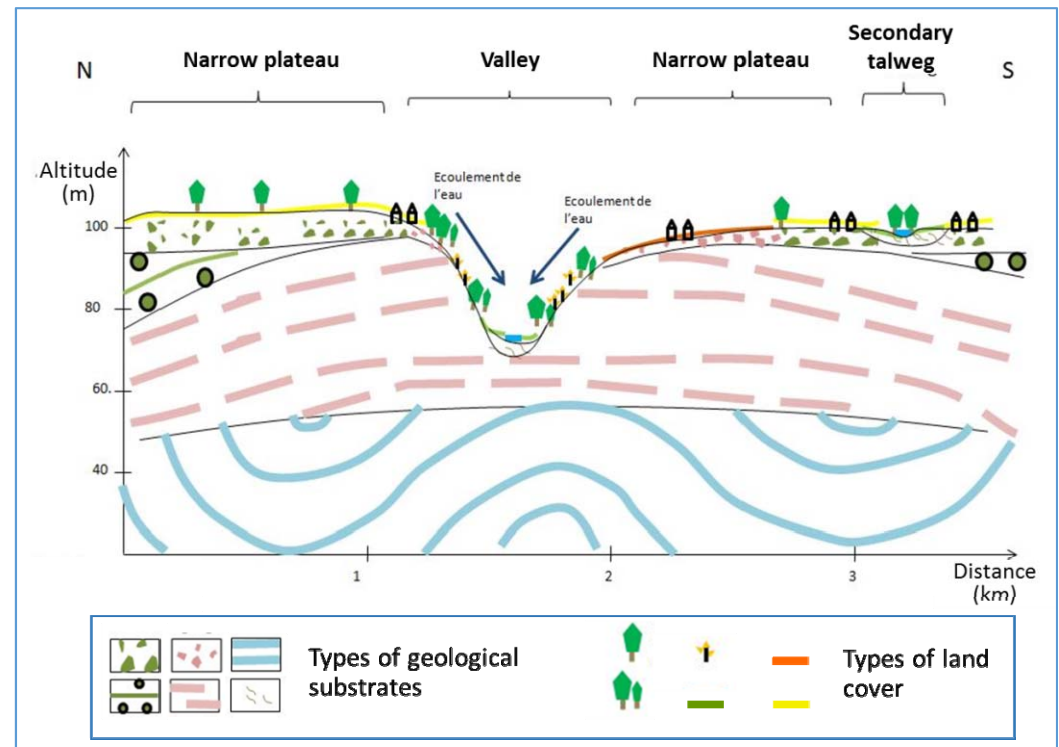
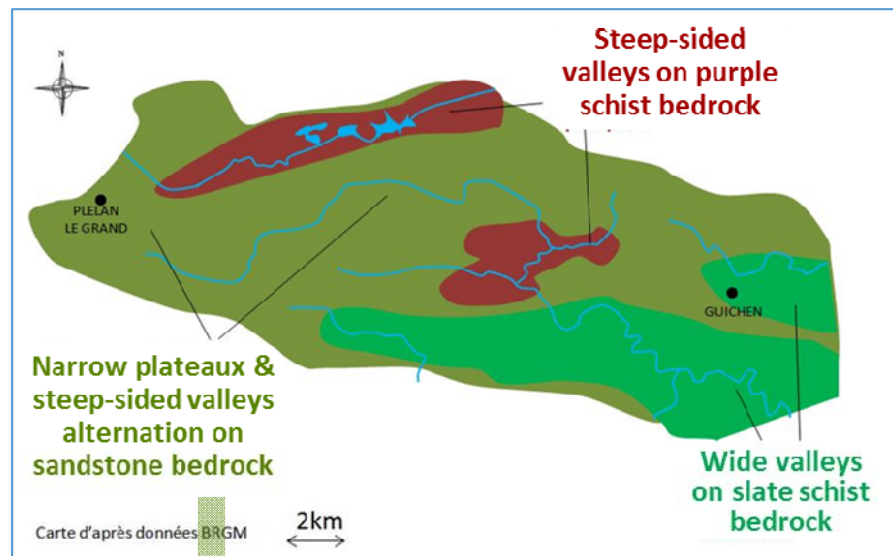


# Results – Ecological landscape

- agroecological areas and inner landscape organisation

*Ex: agroecological areas (left) and a landscape unit (right) in the Brittany study region*

[Valory 2015]



- main temporal phases, processes and drivers of past change in ecosystem-mosaic composition and configuration
  - semi-natural elements, agroecosystem types and sizes within landscape units

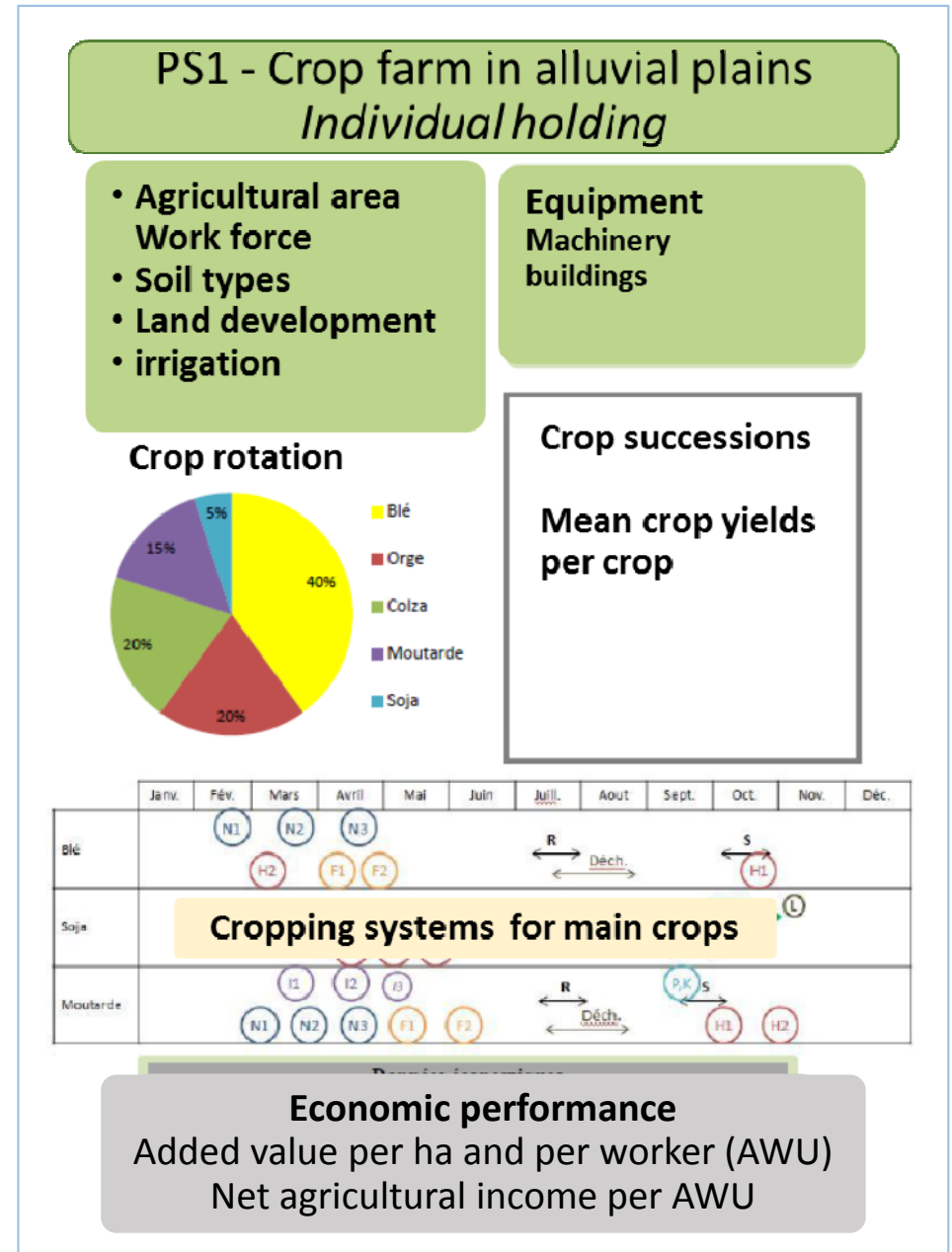
# Results- Farming systems and their dynamics

- Types of production systems within each region (12 to 16)
  - farm structure
  - techno-economic operation
  - cropping systems
  - economic performance

*Ex.: synopsis PS1 - Dijon plain*

[Villefranche 2015]

- Trajectories of change (↔ 1940s)
  - successive phases in their evolution
  - drivers of change (region/farm level)
  - types of farmer adaptive decisions over time and techno-economical rationales
  - farmland and landscape changes and their technological & economic drivers



# Results- operational knowledge (*under progress*)

## Farm level

### *Support to adoption of ESs-based practices of pest control*

Integration of parcel-monitoring and ADS results to assess desirable & applicable changes according to farm type & farmer strategy

- Effect of crop management practice on pest regulation
  - *assessment of farms owning monitored parcels for locating them within production-system typology*
  - *correspondence between monitored crop management systems and those identified in ADS according to farm types*
- Levers & barriers to innovation adoption according to farm type
  - *whole-farm biotechnical operation and management*
  - *farm socio-economics and LT farm development strategy*

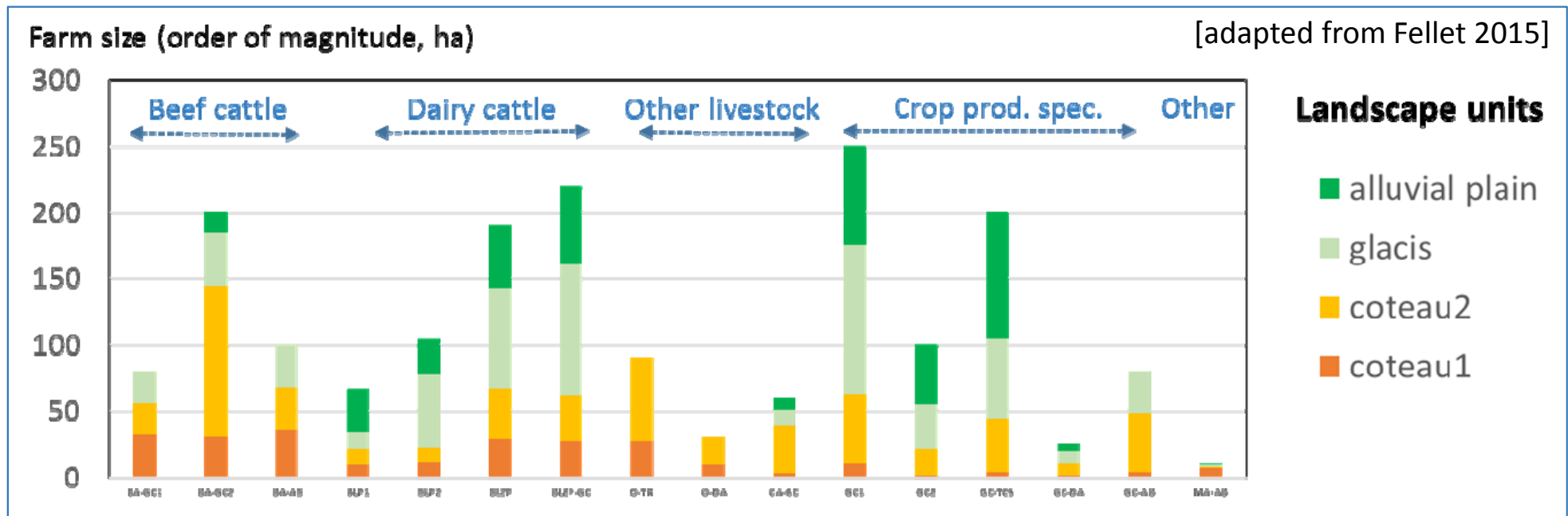
# Results- operational knowledge (*under progress*)

## Region level

*Place-specific challenges and ways for action towards more sustainable pest-control management*

- Landscape and its change; level and trends for change in pesticide use /farm types; individual farm contribution to and dependence on landscape units, ...

*Ex. farm territory composition according to farm types -coteaux de Gascogne*



# Conclusion and outlook

ASD : a valuable contribution to ESs-focused research

- progress in interdisciplinary research group / common understanding of nested interrelationships between natural and agricultural systems at the region level
- operational tool to overpass methodological stumbling blocks in multiscale assessment of interactions between ecological processes and management practice
- avenues to be pursued
  - frameworks and indicators to facilitate integration of results of set of approaches applied within region
  - ASD application in projects on landscape functions and ESs in landscape ecology for enhancing knowledge /functional relationships between landscape and agricultural activities



# Thank you for your attention

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