Modelling adaptation strategies to climate change in Mediterranean small ruminant systems

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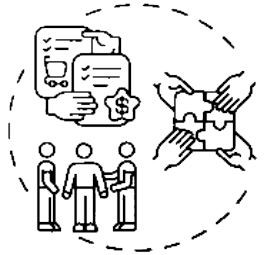
Modelling climate change adaptations of pastoral farming systems

Mediterranean context : agropastoral livestock farming systems specificities heterogeneity of animals, diversity in land use and flock mobility

➔ more particularly affected by climate change

To design efficient & resilient LFS ➔it is necessary to be able to design strategies in **anticipation** and to **consider the agropastoral specificities**

Modelling as a tool to describe, to understand impacts and to design adaptations strategies



⇒ **The objective is therefore to evaluating the multi-level implications of adaptation levers on the expected performances with regard to the issues of CC**

Method combining focus group & modelling

Describing — The initial system characterisation

Case-studies

Explaining — The system through the climate change impacts assessment

Workshop on climate change impacts & modelling

Designing — New adaptative strategies to cope with climate change

Workshop on adaptation strategies

DEED method

Exploring — Possible adaptation levers and their associations

Interviews / Serious game * & modelling

Rangeland Rummy –
A board game to support adaptive management of rangeland-based livestock systems (Farrié et al., 2014)

Multi-agent based model developed in GAMA language

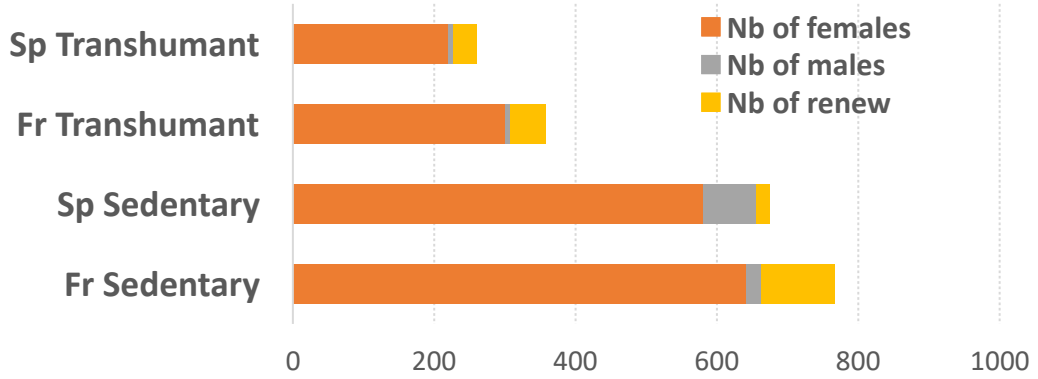
DEED method in Descheemaeker et al., 2019

DESCRIBING EXPLAINING EXPLORING DESIGNING

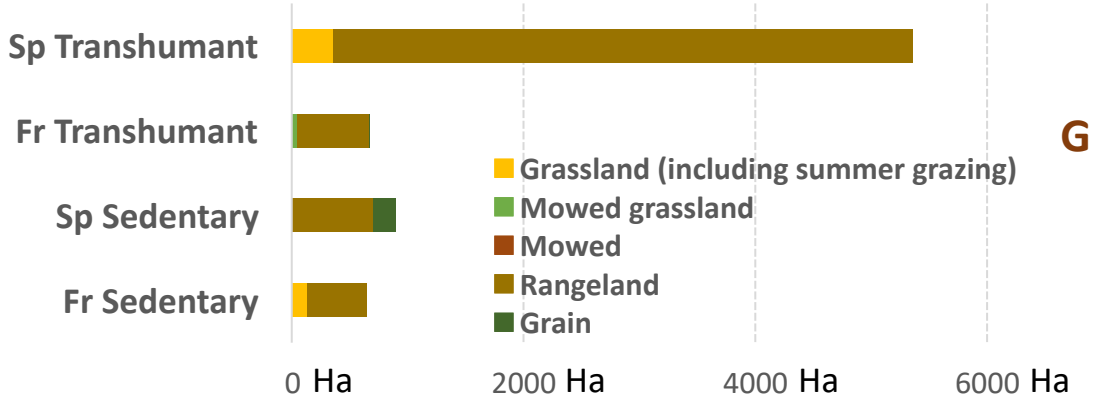
	Transhumant systems	Sedentary systems
Spanish Case studies		
French Case studies		

DESCRIBING EXPLAINING EXPLORING DESIGNING

Flock size



Farming area

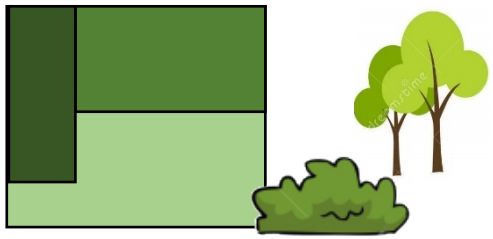


	Sp. Transhumant	Fr. Transhumant	Sp. Sedentary	Fr. Sedentary
Lambings	APRIL-DECEMBER	FEBRUARY-MARCH	MARCH JUNE SEPTEMBER	JANUARY JUNE SEPTEMBER
	Less Intensive		More Intensive	
Production / sales				
Culled ewes	31	47	87	112
Heavy lambs	0	356	0	0
Ligth lambs	328	2	149	219
Grazing and autonomy				
Grazing rate	69%	85%	78%	63%
Fodder autonomy	69%	85%	78%	85%
Grain autonomy	0%	0%	293%	13%

DESCRIBING EXPLAINING EXPLORING DESIGNING

The livestock farming system conceptual model

Resources model



Land use
- Plot type
- Surface
- …

Crop Management
- Agricultural practices
- Growth Yield
- Cutting yield
- …

Feeding ressources
- grains / forage / grass
- yearly / seasonal
- …

inputs / outputs

Flock management
- Batching
- Diet calendar
- Buildings use
- Pastures/rangelands use

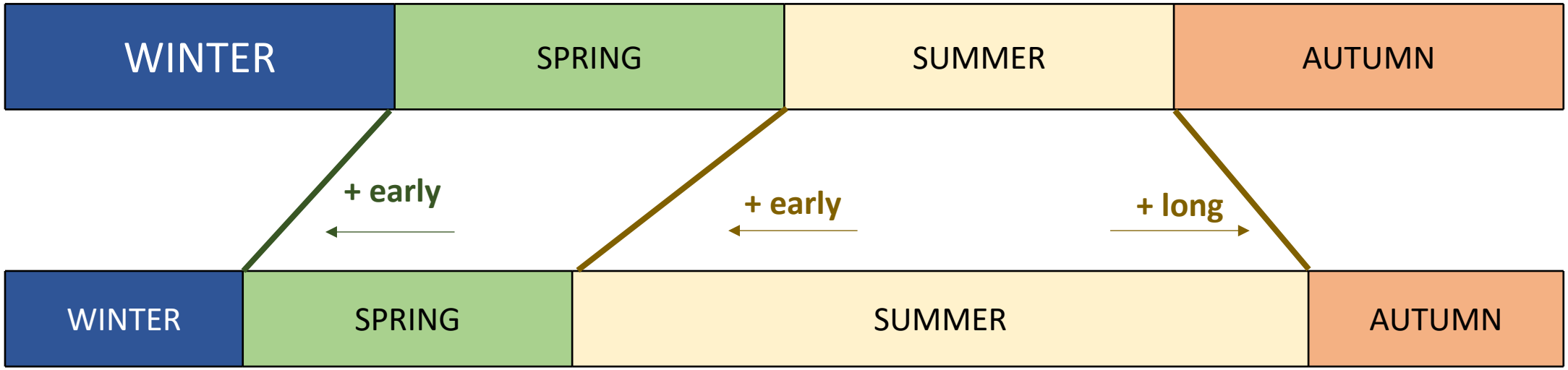
Feeding needs
- Feed type
- Yearly / seasonal
- …

Flock composition
- Flock size
- individual variability
- Zootechnical parameters
- …

inputs / outputs

Flock model

Current and expected Climate Change effects for agro-pastoral systems



Choppy and irregular growth

Thermal stress
Threat to the survival of plant species

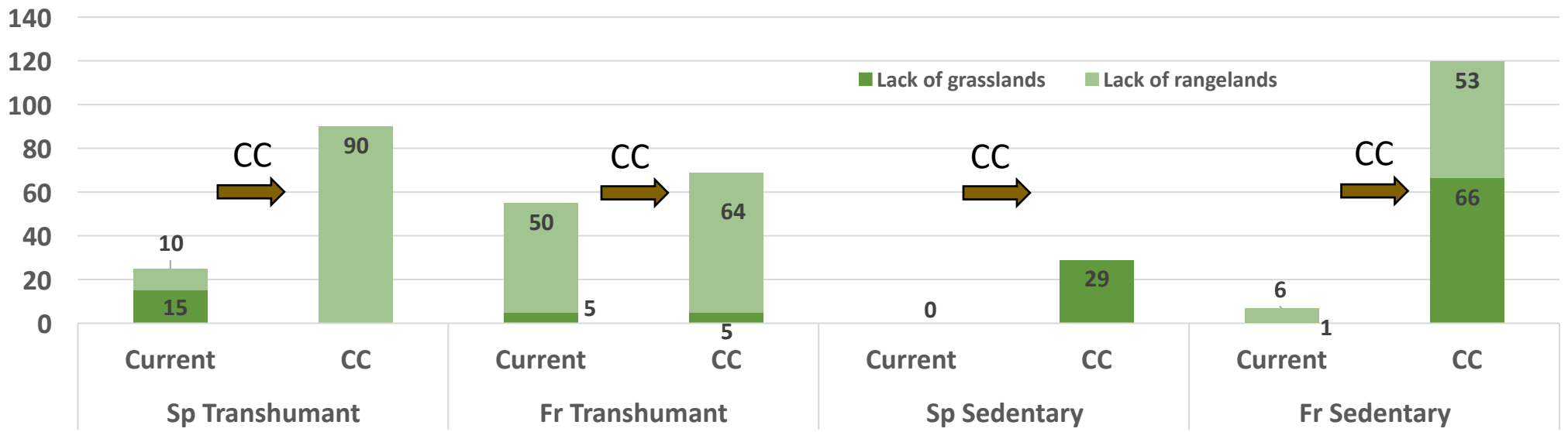
? Uncertain autumn rebound

=> Assumption: - 15% decline in forage production yields

Climalait, 2018 ;
Lelievre et al., 2008 ;
Ruget et al., 2013

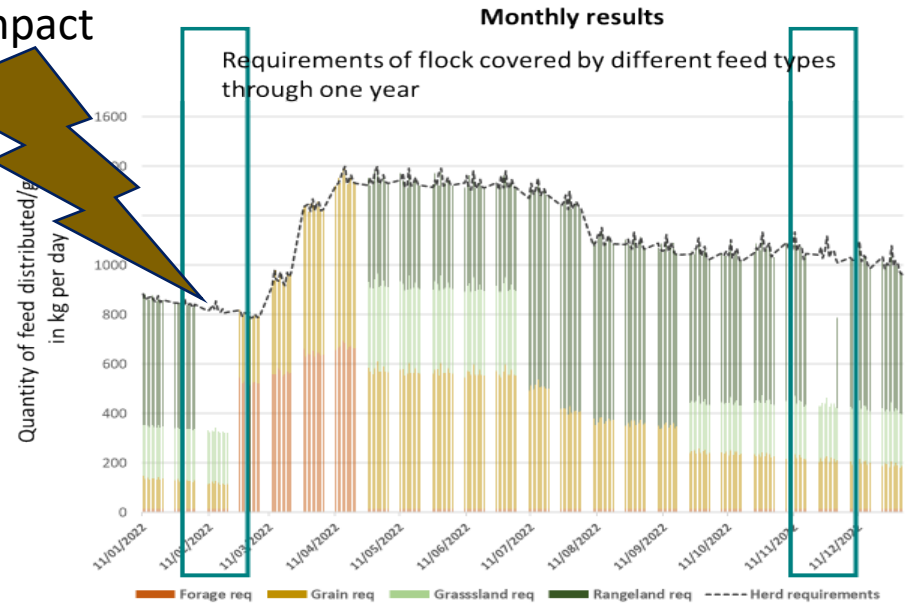
DESCRIBING EXPLAINING EXPLORING DESIGNING

Nb of days where Flock requirements are not covered by grasslands and rangelands



French Transhumant

CC impact



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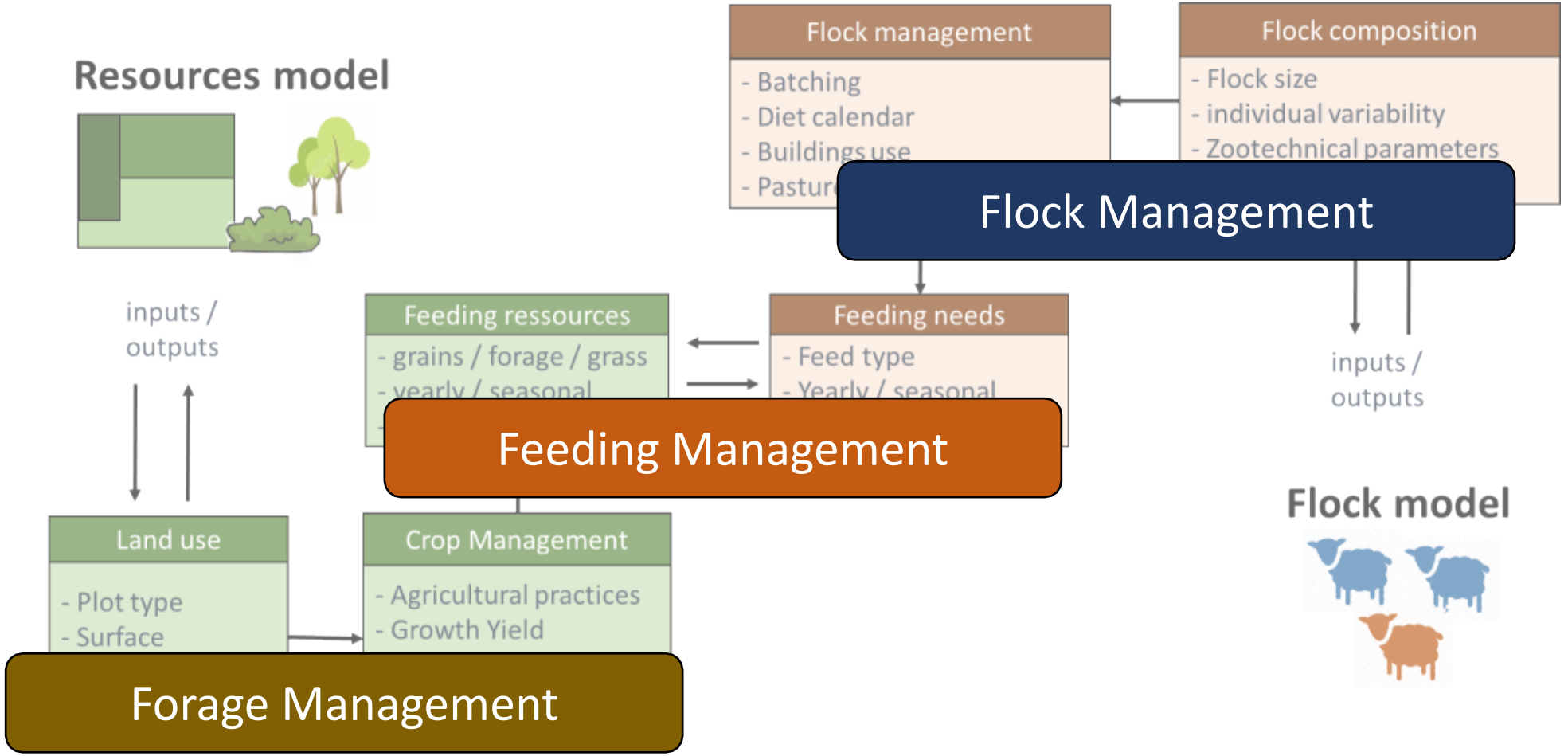
Levers to mobilize involved the **same components** for all case studies :



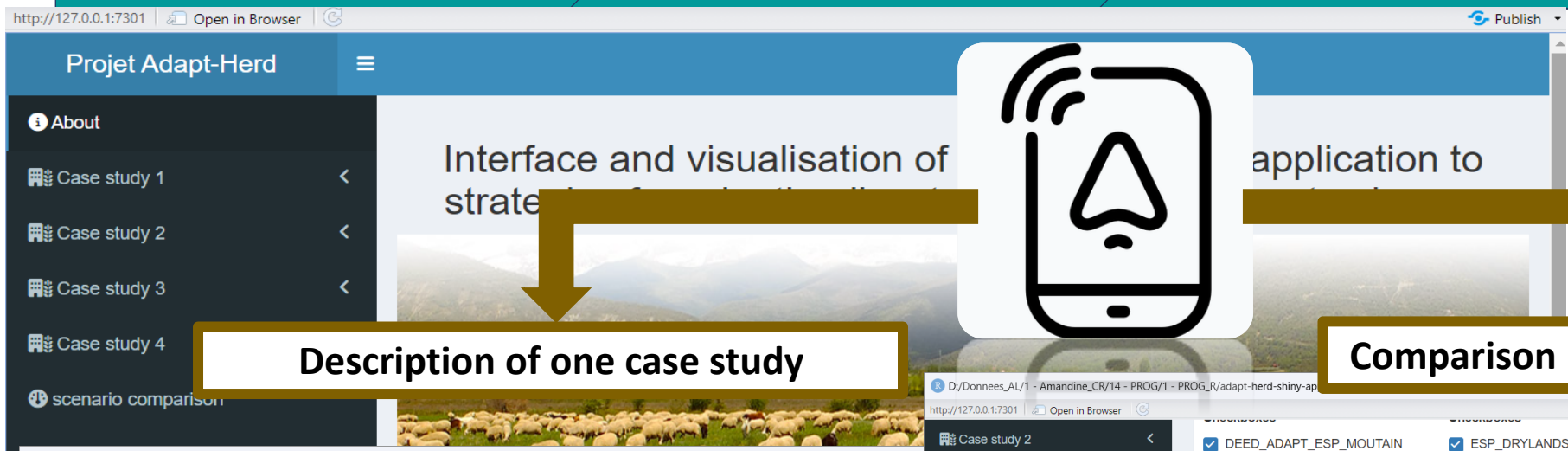
…. but with **different ways of implementation**

French Transhumant	Heavy lambs	Light lambs	Lack of grasslands	Lack of rangelands	Fodder automony	Grazing rate
Initial under CC	***356 (+/-5)***	***2***	***5***	***64***	***85%***	***85%***
+18Ha mowed grassland ***Forage management***	360 (+/-5)	0	5	64	**102%**	**85%**
					+7%	

DESCRIBING EXPLAINING EXPLORING DESIGNING

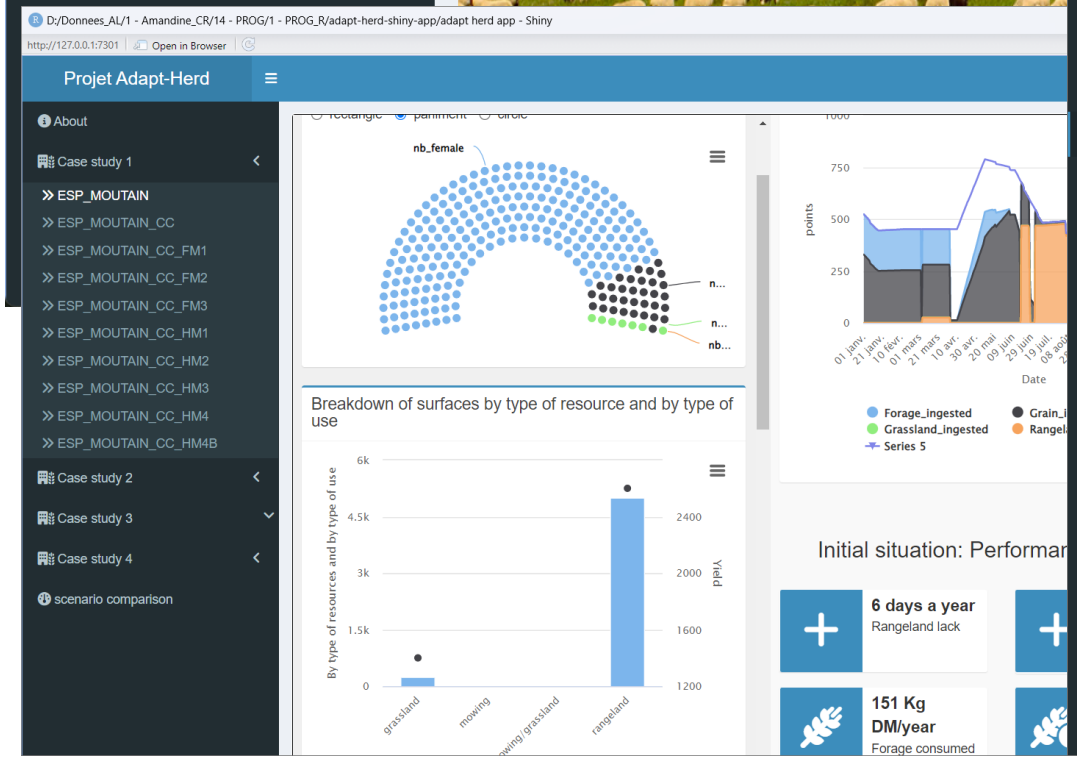
Spanish Transhumant	Heavy lambs	Light lambs	Lack of grasslands	Lack of rangelands	Fodder automony	Grazing rate
Initial under CC	***0***	***328 (+/-4)***	***90***	***0***	***69%***	***69%***
+20Ha vineyard in winter ***Forage management***	0	330 (+/-4)	90	0	**73%**	**73%**
					+4%	***+4%***
Only heavy lambs ***Flock management***	**319**	**0**	90	0	**71%**	**71%**
	+319	***- 328***			***+2%***	***+2%***

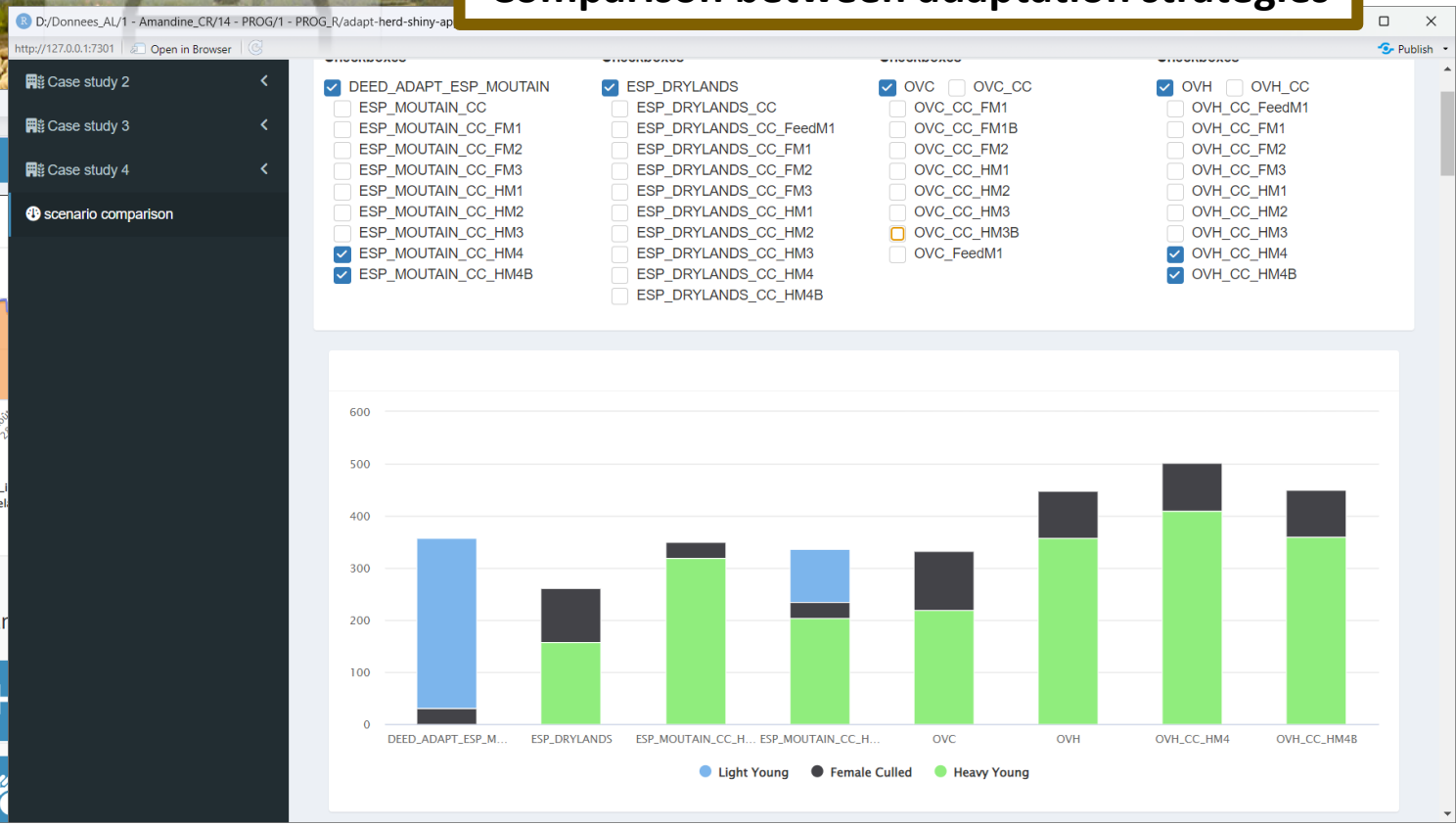
DESCRIBING EXPLAINING EXPLORING DESIGNING



Description of one case study

Comparison between adaptation strategies





Modelling as a tool to explore adaptation of Mediterranean sheep farming systems to climate change

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