Improving the performances of a pastoral system : simulation results against field data

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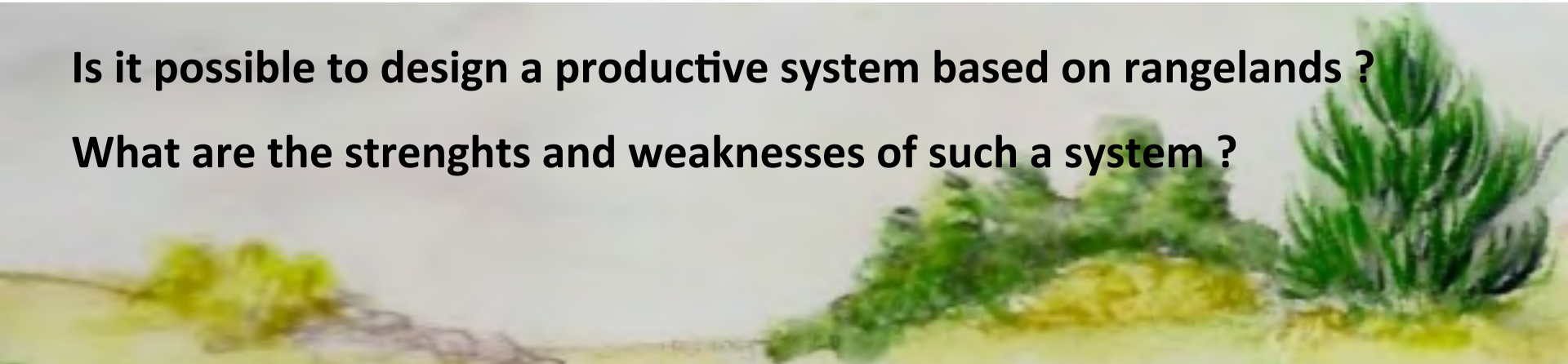
Context and objectives of the study

Major issues for the livestock production sector :

- Reduce the negative impact on the environment => but keep producing
- Avoid competition with agriculture => more mouths to feed worldwide

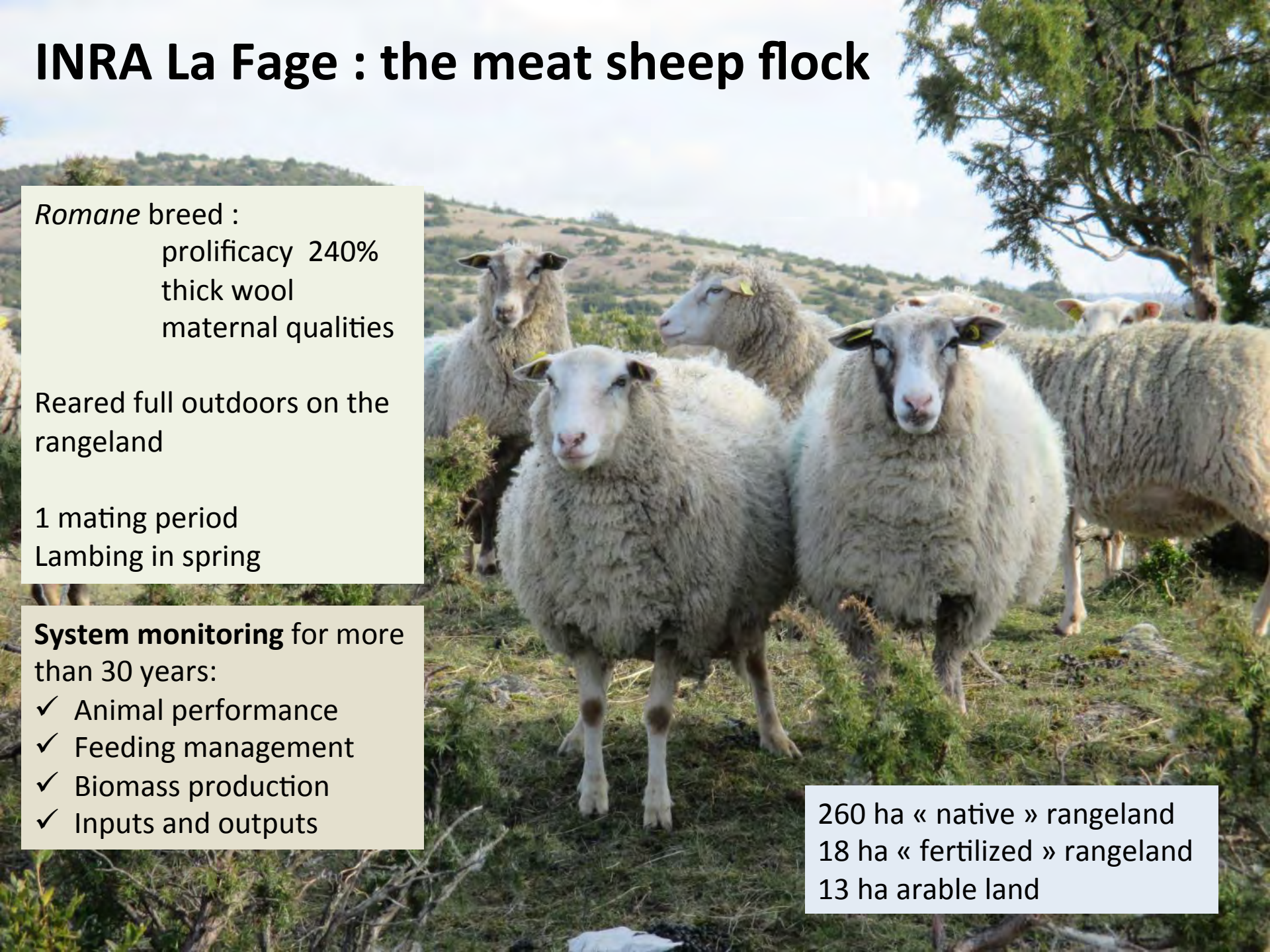
To address these issues, one of the challenges is to make better use of rangelands as a forage resource for herbivores.



Is it possible to design a productive system based on rangelands ?

What are the strenghts and weaknesses of such a system ?

INRA La Fage : the meat sheep flock



Romane breed :
- prolificacy 240%
- thick wool
- maternal qualities

Reared full outdoors on the rangeland

1 mating period
Lambing in spring

System monitoring for more than 30 years:
- ✓ Animal performance
- ✓ Feeding management
- ✓ Biomass production
- ✓ Inputs and outputs

260 ha « native » rangeland
18 ha « fertilized » rangeland
13 ha arable land

Designing and testing a new system

Bio-technical analysis of the system *(Jouven et al., 2009)* => only 59% of forage from the rangeland; 75% possible

Implementation of the changes simulated in the real farm + monitoring

2000 (…) 2009 2010 2011 (…) 2014 2015

Modelling analysis *(Jouven et al., 2011)* => test of system changes to improve the performances of the system

Comparison of field data and simulation results

The re-design of the system was based upon scenarios build with the local staff on the basis of the former analysis . The options of re-design were tested with a modelling analysis in order to evaluate their consequences and decide upon their adoption.

The changes implemented

- ✓ 1) Organize and adapt grazing management with total consumption of the standing biomass => secure the forage resource over year(s)
- ✓ 2) Align lambing period with the onset of grass growth => reduce to ε conserved feed distribution during lactation
- ✓ 3) Delay 1st lambing at 2 years => reduce concentrate for replacement lambs
- X 4) Fatten lambs on grass => reduce forage and concentrate consumption
- ✓ 5) Grow cereals on the farm => reduce inputs

Figures in No	Simul BEFORE	Simul AFTER	2006-2009	2011-2014
Lambing date	1 /04	**16 /04**	56% /04	**92% /04**
Flock size (ewe >12M)	280	**280**	274 *± 10*	**271** *± 10*
Females mated	330	**280**	334 *± 17*	**238** *± 19*
Replacemt	50	**100**	149 *± 11*	**162** *± 5*

The results expected vs obtained

1) Slight decrease in **flock productivity**

✓ Increase in average prolificacy
✓ Decrease in females mated (too much)
X High mortality due to predation
(+ risk of hyper-prolificacy)

Figures in %	Simul BEFORE	Simul AFTER	2006-2009	2011-2014
Prolificacy	242	**250**	220 *±7*	**237 *±27***
Lamb mortality	19	**19**	20 *±5*	30 *±8*
Productivity (ewe >12M)	196	**184**	196 *±28*	138 *±13*

The results expected vs obtained

1) Slight decrease in flock productivity
2) Steady decrease in **concentrate consumption**
3) High **feed self-sufficiency**
4) Higher reliance on **grazed forage**

   ✓ Decrease by half of concentrate
   ✓ Feed self-sufficiency over 90%

	Simul BEFORE	Simul AFTER	2006-2009	2011-2014
Concentrate (kg/ewe>12M)	171	**86**	206 *±10*	**95 *±4***
Feed self-sufficiency (%)	73	**93**	75 *±4*	**90 *±2***

The results expected vs obtained

1) Slight decrease in flock productivity
2) Steady decrease in concentrate consumption
3) High forage and feed self-sufficiencies
4) Higher reliance on grazed forage
5) Improvement in **gross margin** : not comparable to simulations
6) Decrease in consumption of **non-renewable energy**

✓ Less inputs

X Lower flock productivity

X Experimental constraints (↗ replacement , ↗ conserved feed)

(X) non-measurable aspects, e.g. carbon sequestration

Conclusion

- The availability of technical data enabled to produce a realistic simulation, which was used to re-design successfully an existing system
- The changes implemented in the real system were slightly different from the simulation due mainly to (other) experimental constraints
- A few factors which were omitted in the simulation proved to be of high importance in the field (ex. predation)
- A new monitoring system supports adaptive management and enables the local staff to learn about the agroecosystem and its behaviour
- The performances of the new system shoud improve with time, with the development of specific skills and ecological knowledge by the staff

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