Resilience of ruminant livestock organic systems to climatic hazards

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Livestock farming under uncertainty

Specialized grass-based ruminant farming systems: 1 main feed ressource, no chemical

PRIMARY FUNCTIONS

Produce food that meets societal standards

Ensuring income for the work unit

HAZARDS

Health

Economic

Human

Climate

Climate change => ↗ frequency

Adaptation to climatic hazards

The concept of resilience for livestock systems

Responses to climatic hazards

« The capacity of a system to absorb disturbances and reorganize itselve under change, so as to continue to perform the same functions. » (Walker et al. 2004)

RESILIENCE

From what to what?

→ Resilience of the farm

→ To climatic hazards

Indicator ?

Indicators of resilience and climatic hazards

Value-added €

Wealth created by the farm in one year

=

Gross output – intermediate consumption

Securing food production

Ensuring income for the work unit

Agro-climatic indicators

Météo France data

247 stations: °C max, °C min, rainfall

AP3C

Agro-climatic variables

- Risk of frost in early spring *(no. of days with minimum t° <-4°C between 20/02 and 10/04)*
- Risk of maize scald in summer *(no. of days with maximum t° >32°C between 01/06 and 30/09)*
- Favorable sequences for hay *(no. of days with 4 days without rain followed by 5 days<20mn from 1100°day)*
- Favorable sequences for grass silage *(No of days with 2 days without rain followed by 5 days<20mn from 7500°day)*
- Water status in late summer/autumn *(rainfall/evapotranspiration between 15/09 and 30/10)*

Farms network and data

Collectif BioRéférences — Pôle AB Massif Central → inosys

Techno-economic data

36 farms

surveyed each year

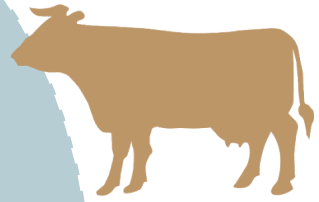
2014 to 2020

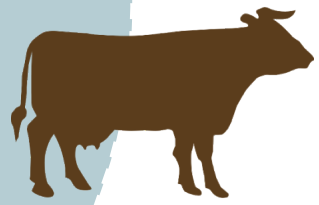
Dairy cattle (12)

Beef cattle (11)

Dairy sheep (9)

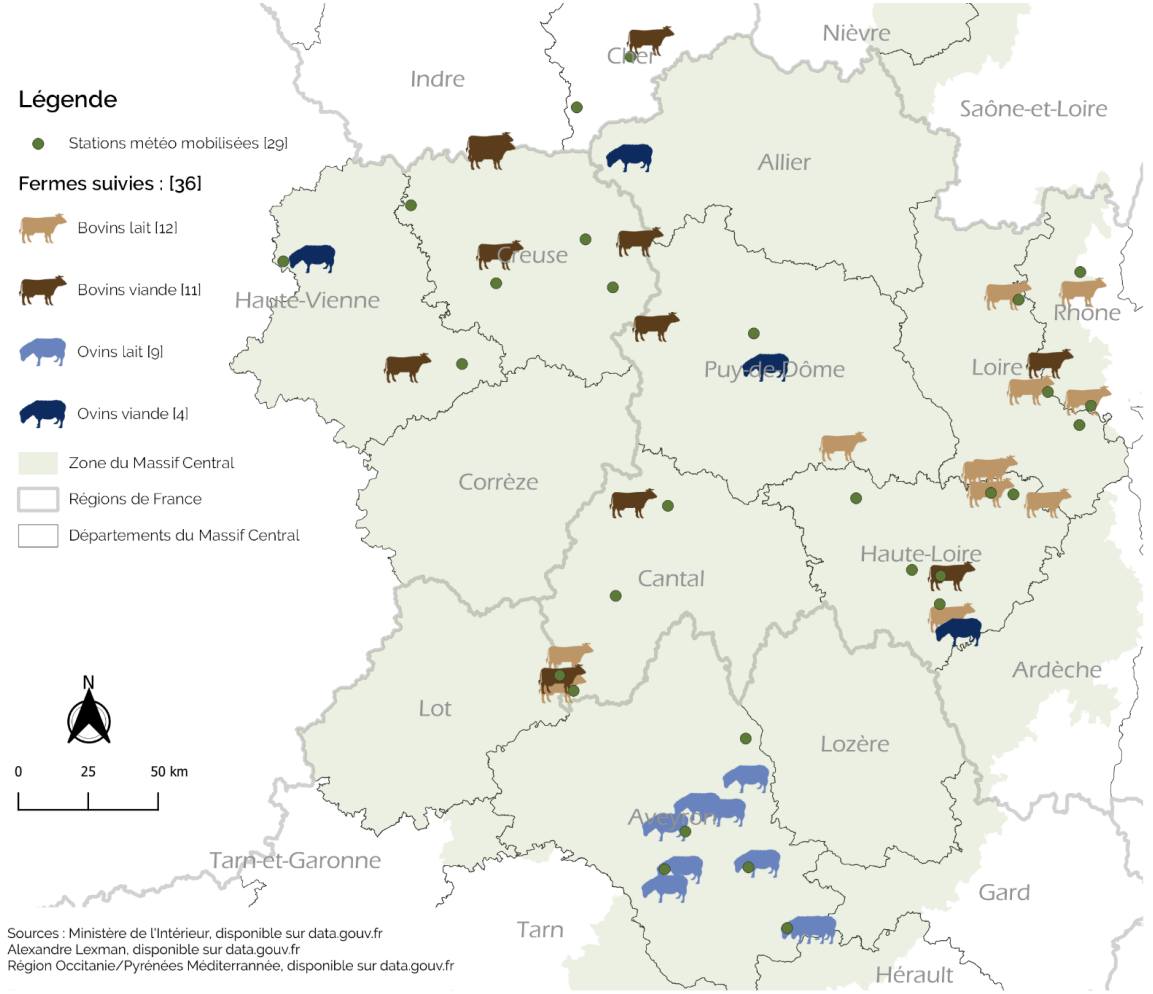
Meat sheep (4)





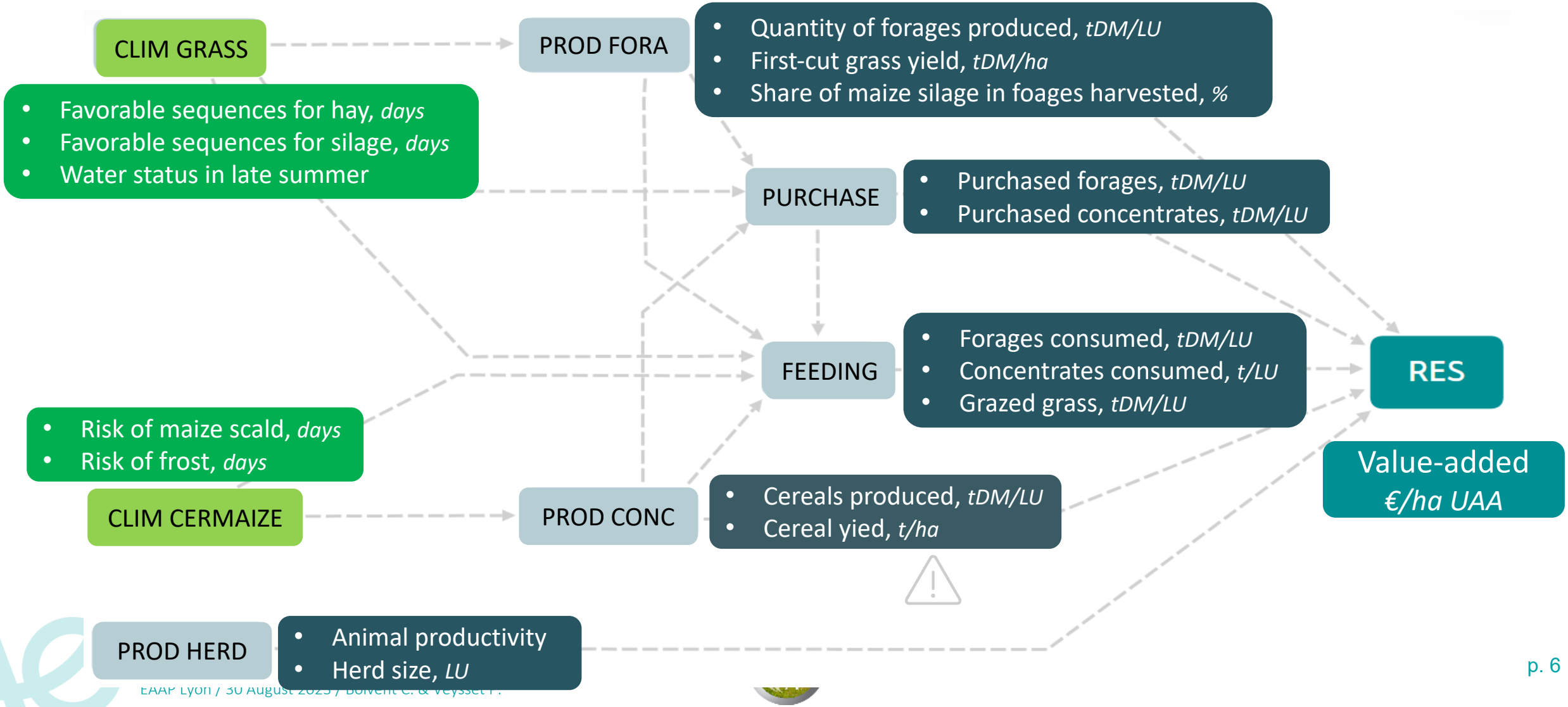
METEO FRANCE

Each farm is paired with a local weather station (daily weather data 01/01/2014 - 31/12/2020)



Multiple linear regression model: Partial Least Squares path modeling

Estimation of complex causal relationships between latent variables, which are themselves measured by observed variables (manifest variables)



Standardisation of variables and indicators

RESILIENCE, a dynamic concept

Inter-annual variability ✓

Inter-production variability ✗

Inter-farm variability ✗

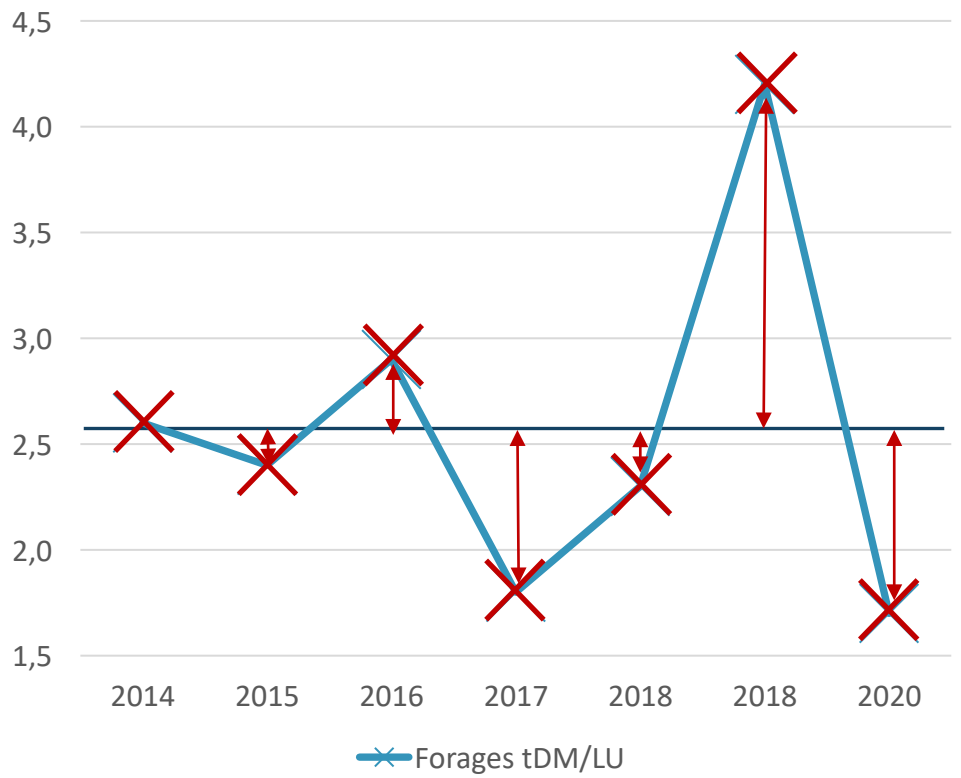
Standardization of each technical, economic and agro-climatic variable specific to each farm relative to the 7-year average of this variable for this farm

$$x_s = \frac{x - \mu}{\sigma}$$

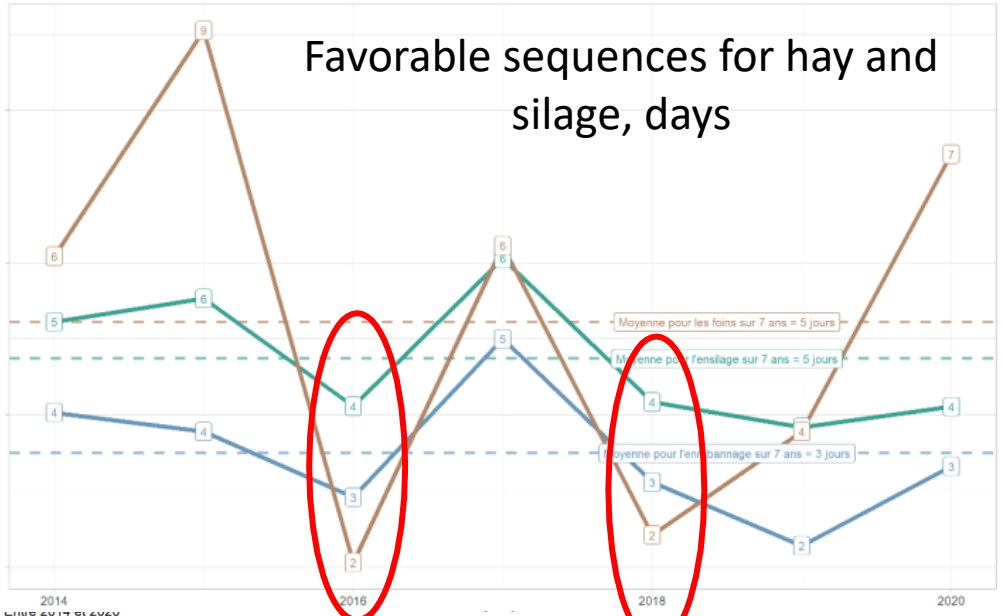
Observation for a farm-year

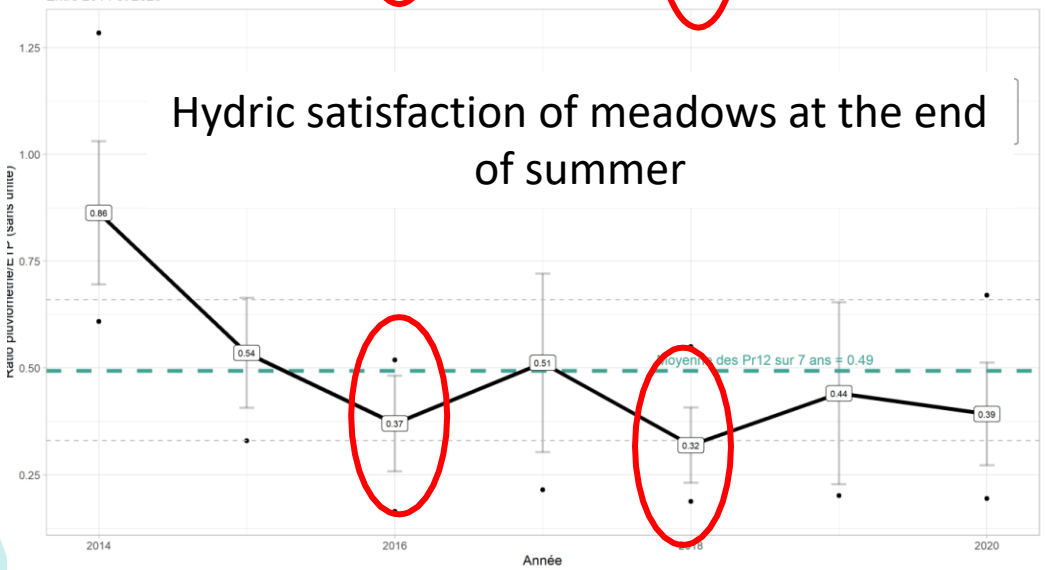
Average of this variable over 7 years for this farm

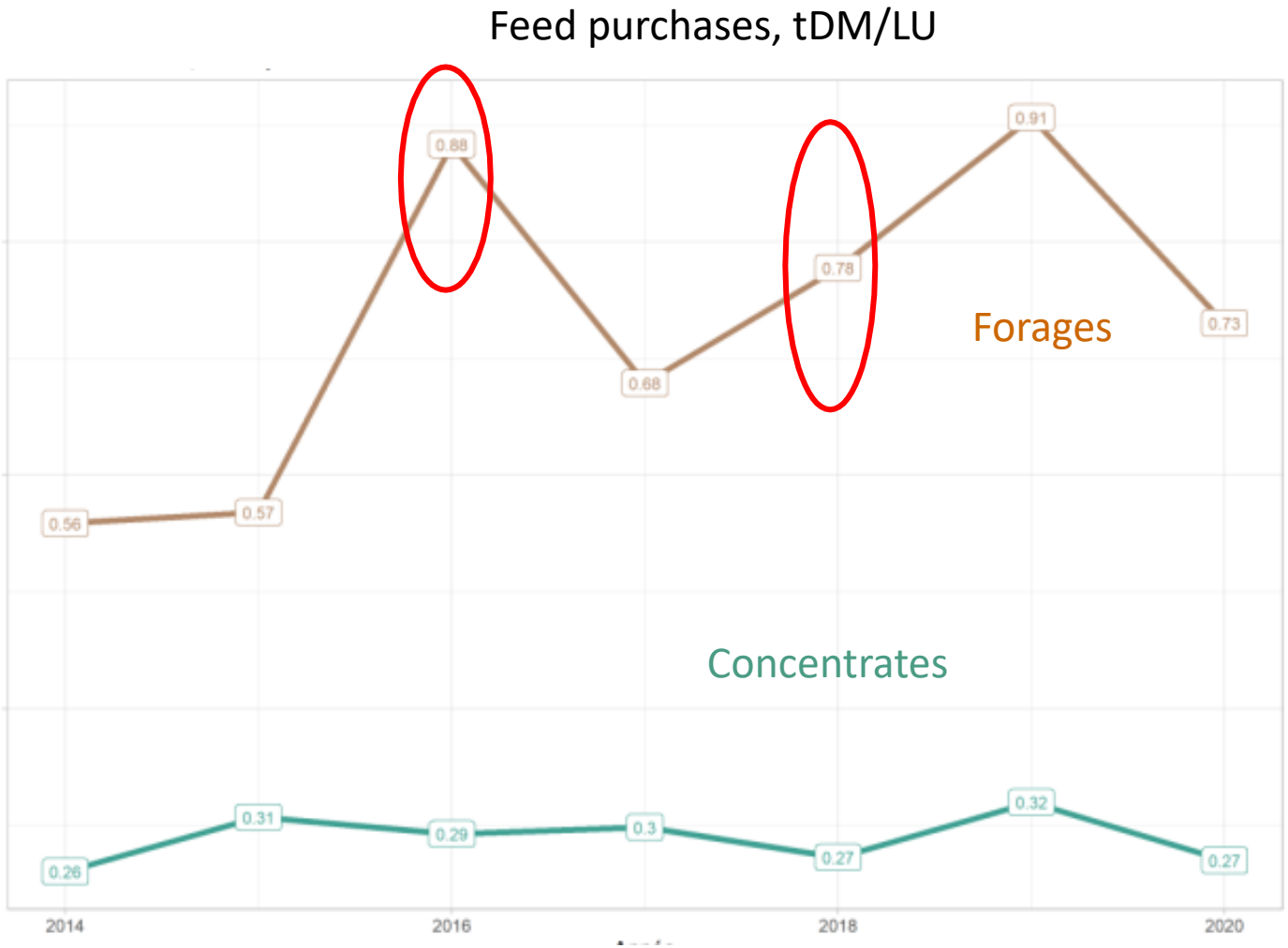
Standard deviation of this variable over 7 years for this farm



Some evolutions to better understand the model's results

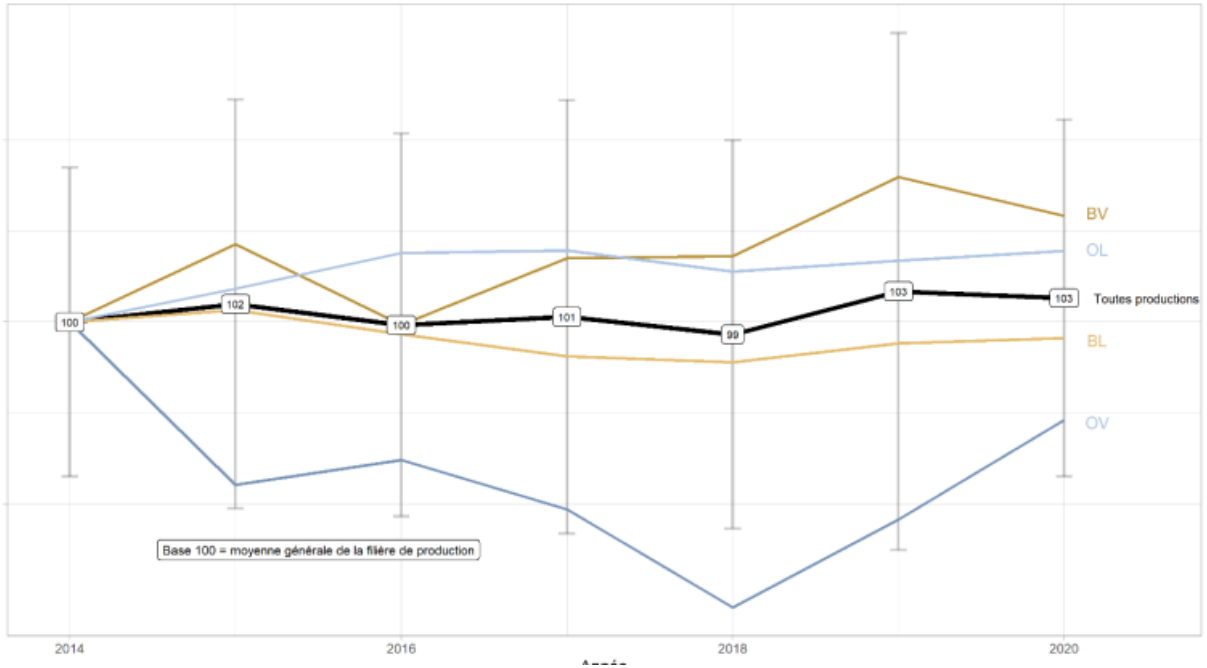




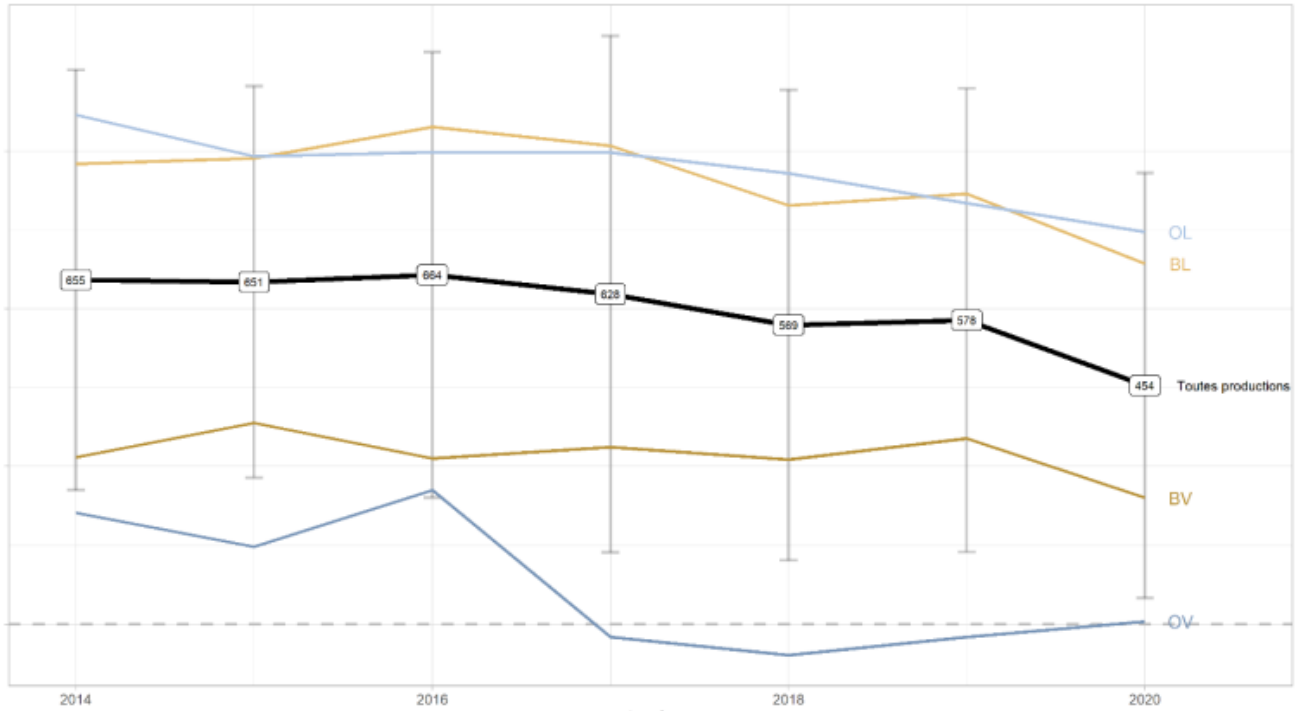


Some evolutions to better understand the model's results

Animal productivity, index 100 2014

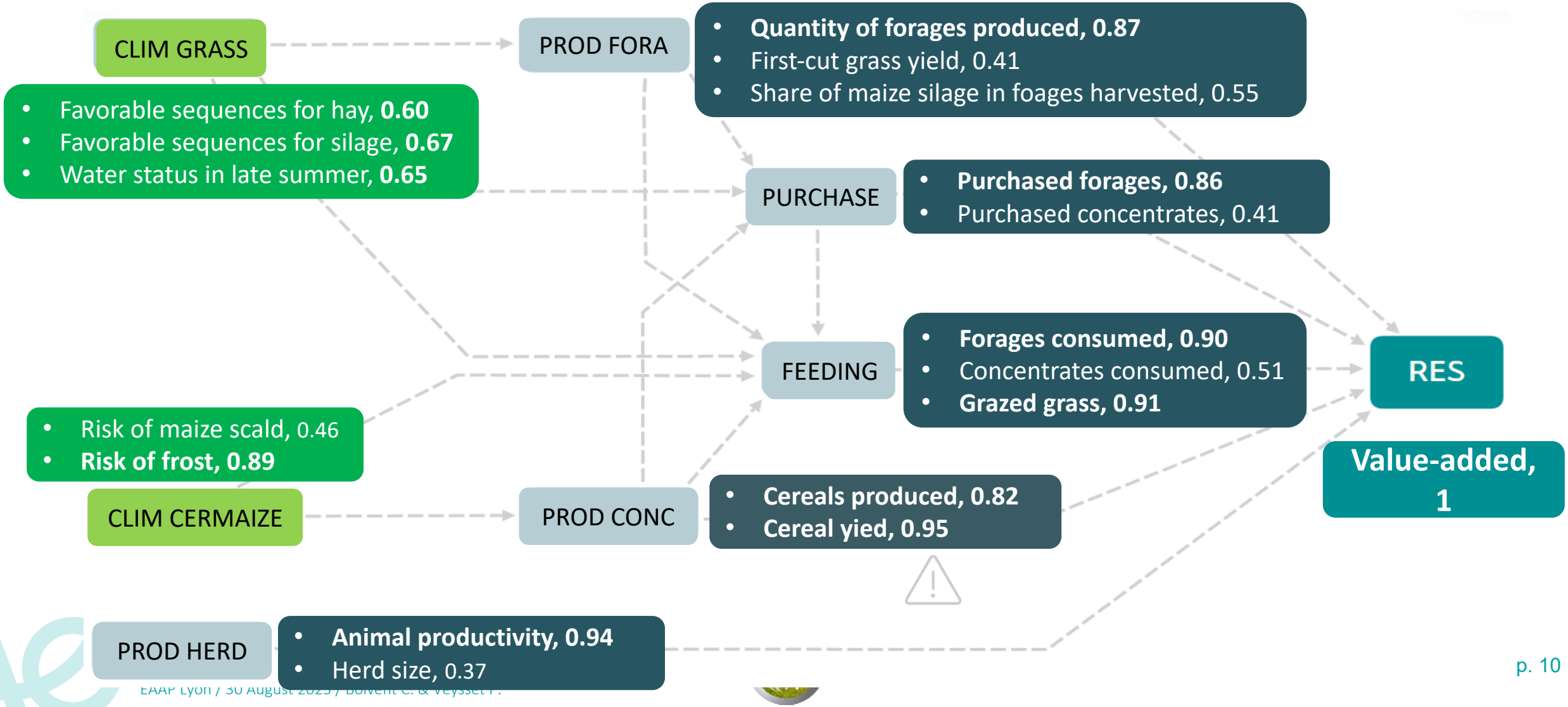


Added-value, €/Ha UAA

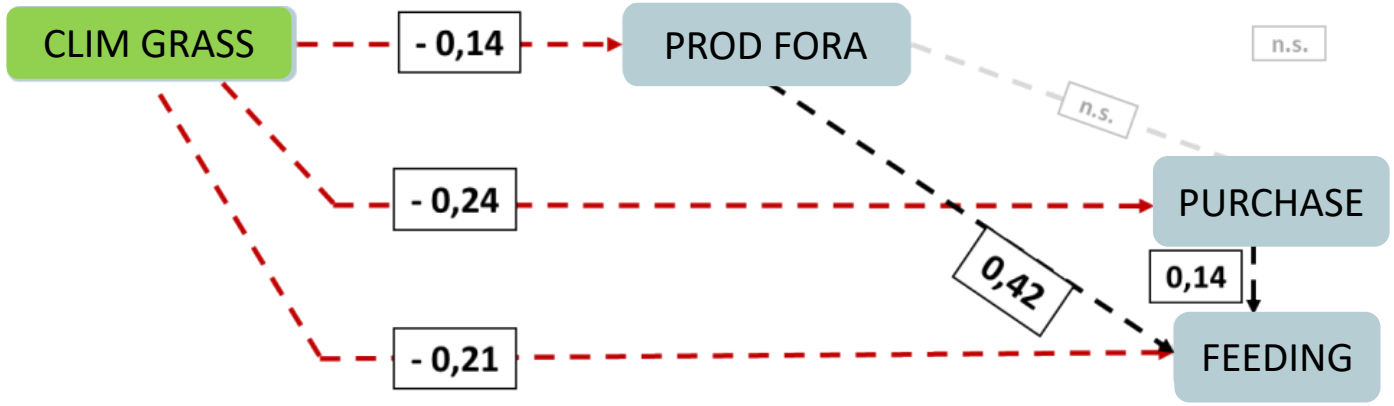


PLS model: correlations between observed and latent variables

Forages are more important than concentrates



Grazing *vs* forages production and purchases



Good climatic conditions for grass

Little forage production

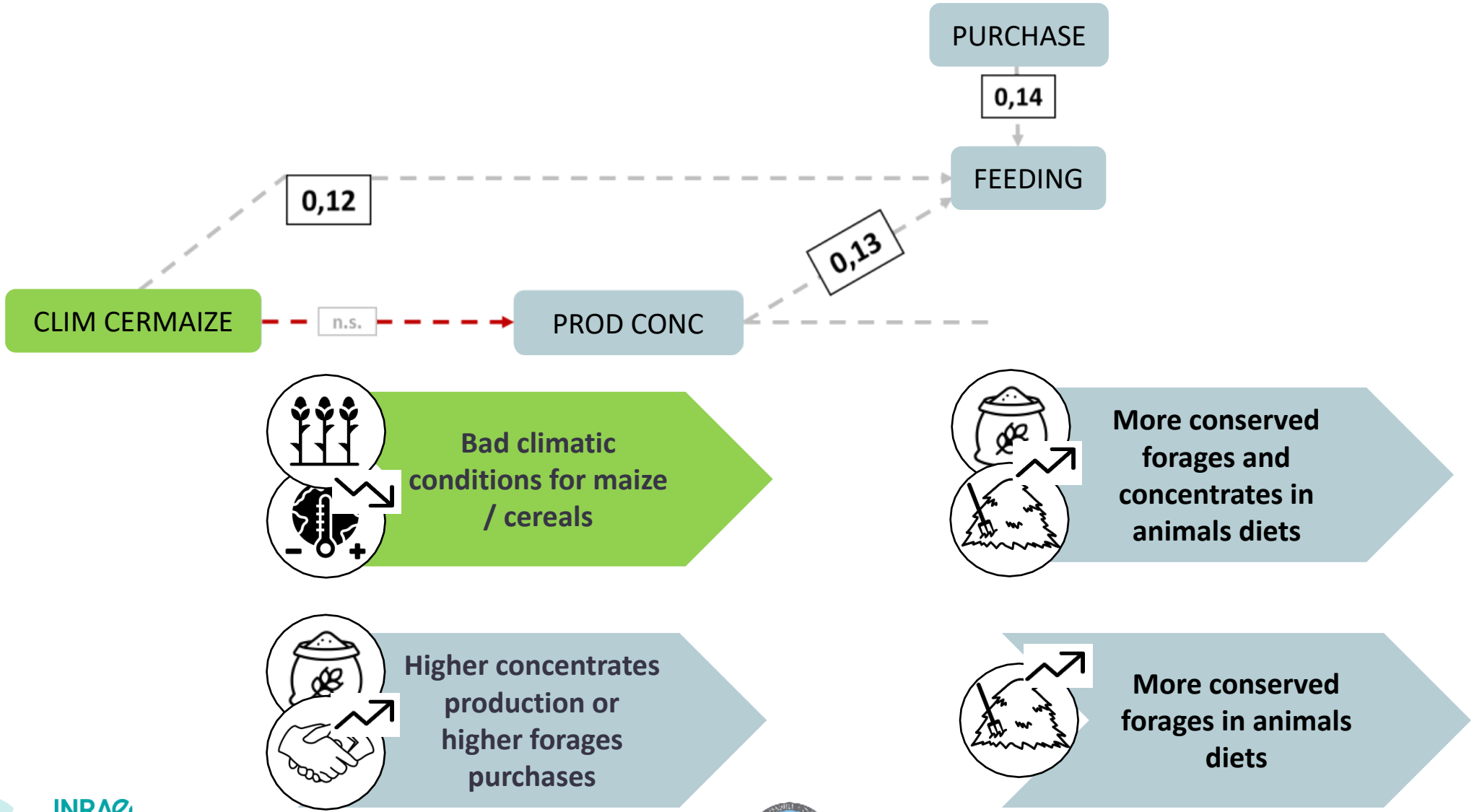
Less purchases

Preference for grazing

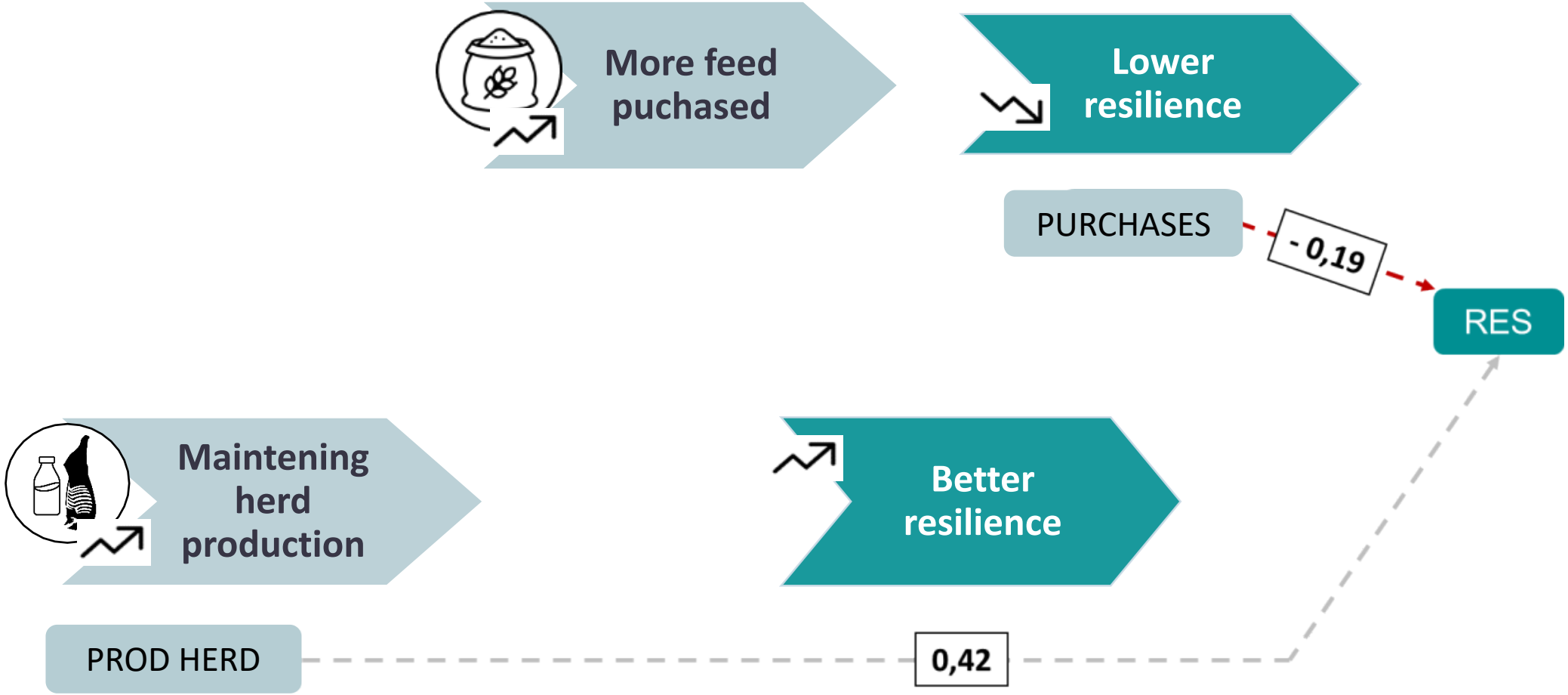
More forage production and feed purchases

More conserved forages in animals diets

Weather, maize, grain and consumption of forages and concentrates



Animal productivity and feed purchases: a compromise to find



Conclusion

- Grazing-based livestock farming systems
  - Forages purchases is the main adaptation face a lack of grass
  - Thinking about forages stores security
- Animal productivity and forage self-sufficiency are crucial, trade-off
  - Production system efficiency is key
  - Herd size vs. forage self-sufficiency?
  - Animal productivity vs. purchased feed?
  - Forage self-sufficiency *vs.* mechanization?
- Consideration of system adaptation to climatic trends
  - Over the 7 years studied, farmers did not adapt their forage system
  - Forage purchasing strategy can be dangerous in the event of a climatic shock
  - Don't confuse trends with hazards or shocks!

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Thank you!