GenTORE

Genomic management Tools to Optimise Resilience and Efficiency

'Farm system characterization across Europe, and climate change impacts on farm system resilience

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This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement No 727213

Dairy in Europe with climate change

- Winners :
  - nordic countries and alpine regions
- Loser
  - Italy, France, Nothern Spain Hungary, lowland Poland

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Resilience of European dairy?

- Most European dairy systems are forage based
- Climate change will/is already impacting forage production
- Impacts likely to vary according to climatic region and farm system
- **We aimed identify area in which current farming system will be mostly under pressure from climate change**

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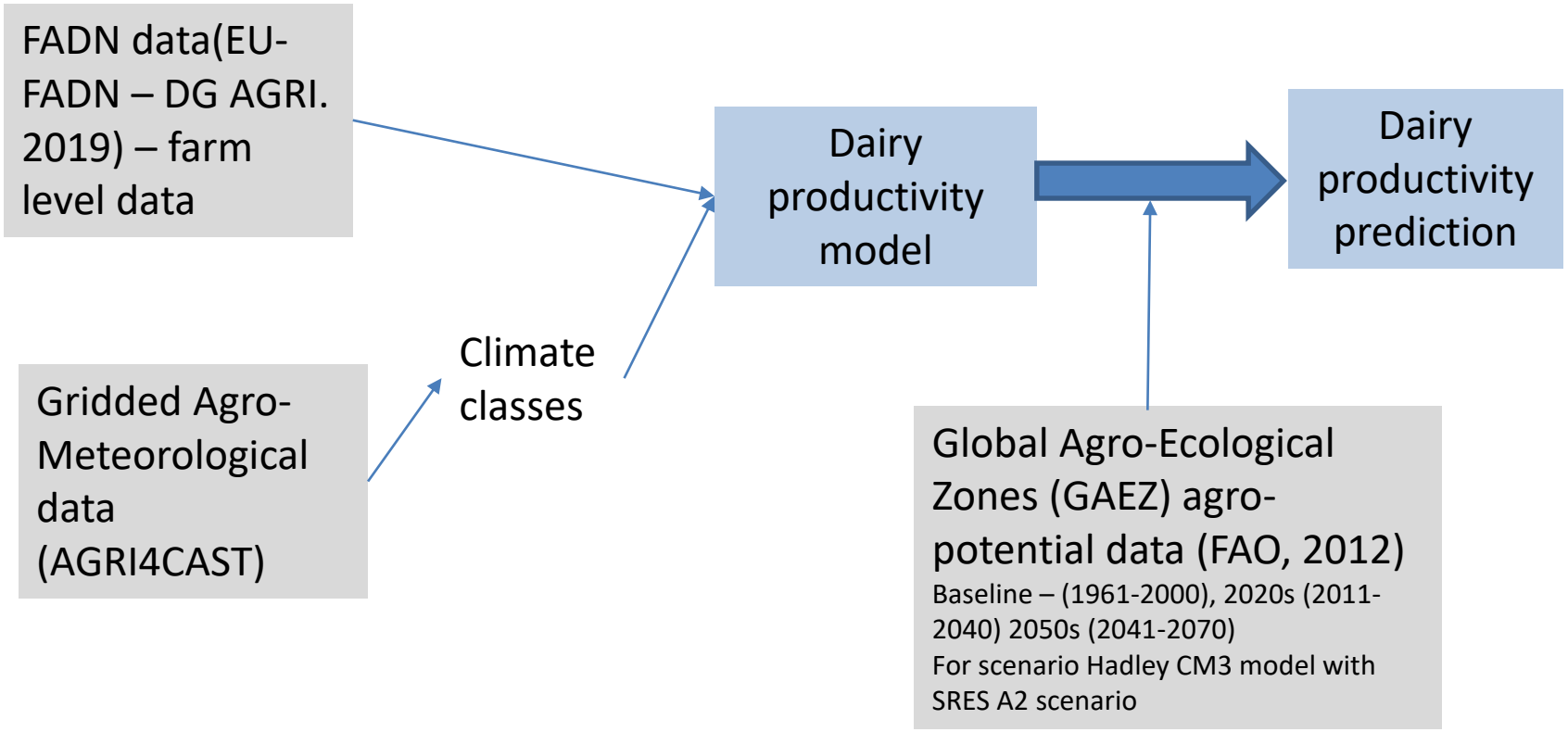
Methodology



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Estimation equation

- *PROD =* *forage_bl*a +*
  *non_fodder_bl*b + ce_conc_ha*c + ce_coarse_ha*d + ce_mach_ha*e + ce_oth_ha*f +*
  *i.cl*g* + constant

  - Where
    - PROD is the production of milk (kg) per forage hectare,
    - *i.class* the climatic class *cl* (a fixed effect to account for major differences in the "technology" across different regions),
    - *forage_bl* is the forage yield (individual weight for maize, pasture, grass legume, alfalfa)
    - *non_fodder_bl* is the home-grown non-fodder costs,
    - *ce_conc_ha* is the purchased concentrate costs,
    - *ce_coarse_ha* is the purchased fodder costs,
    - *ce_mach_ha* is the maintenance costs
    - *ce_oth_ha* are the other costs.

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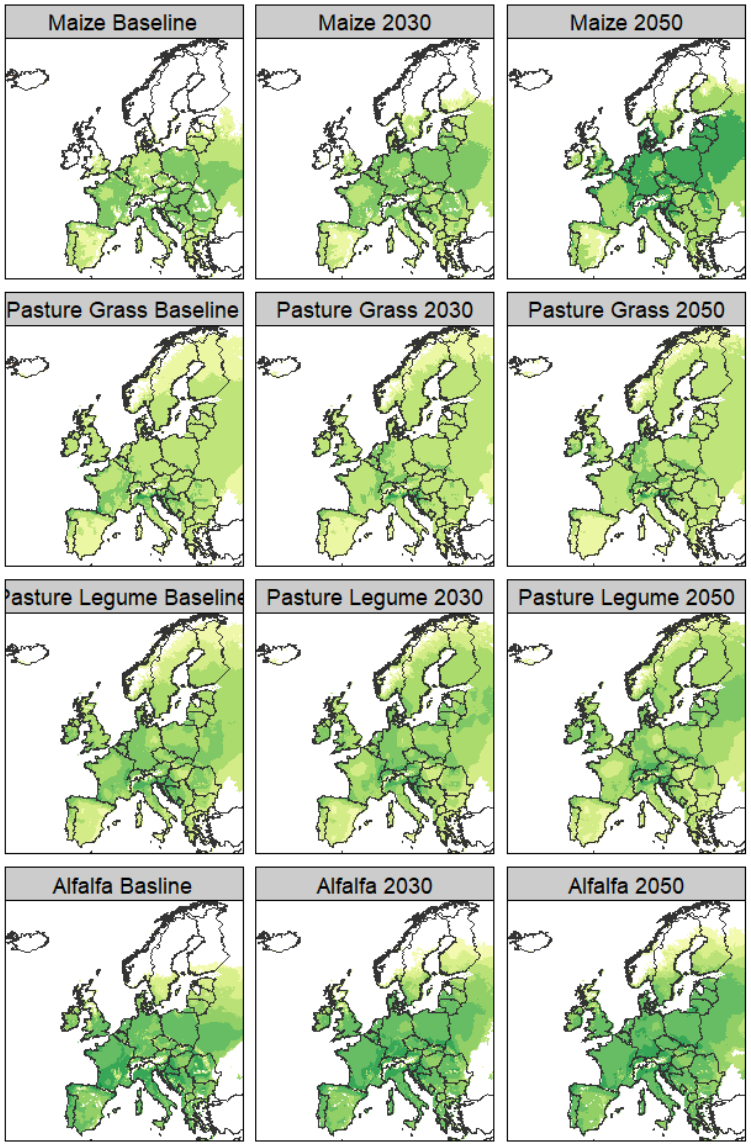
Forage productivity (ton DM ha^{-1})



Based on :
agro-ecological potenial from GAEZ v3
HadCM3 model
SRES A2 scenario
assuming
Rainfed high intensity production

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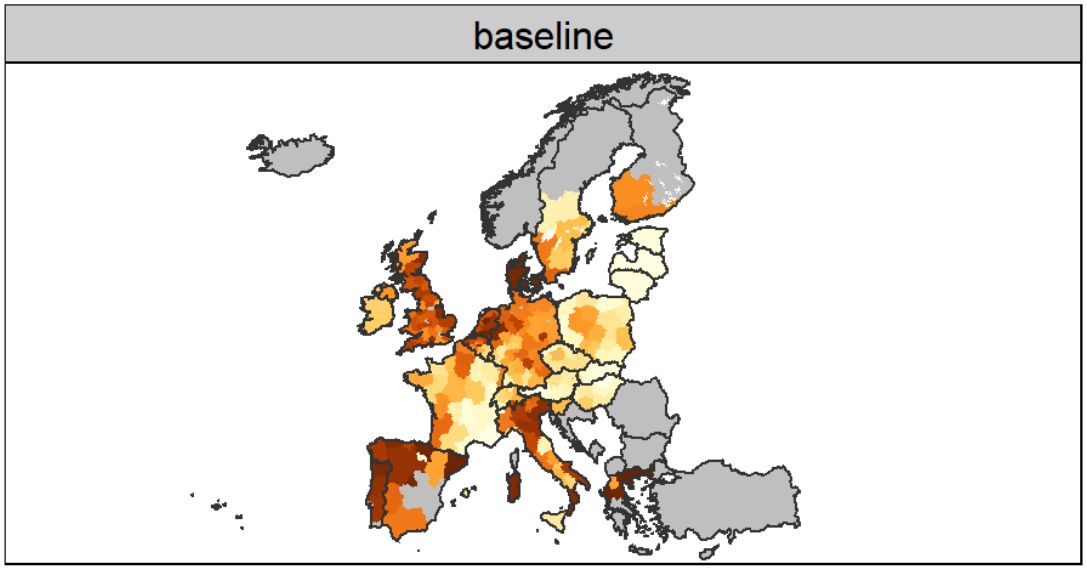
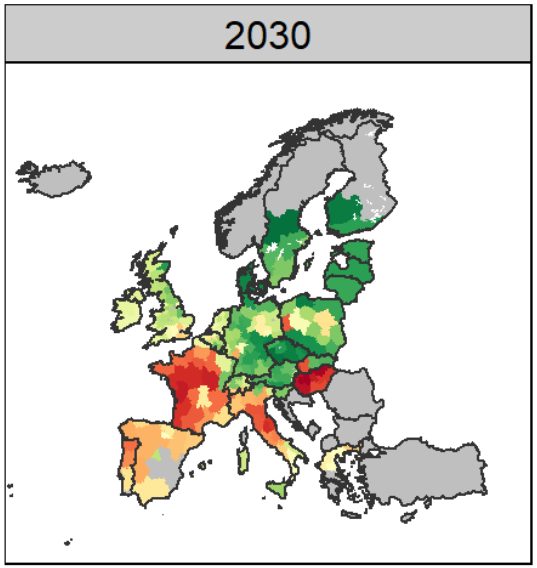
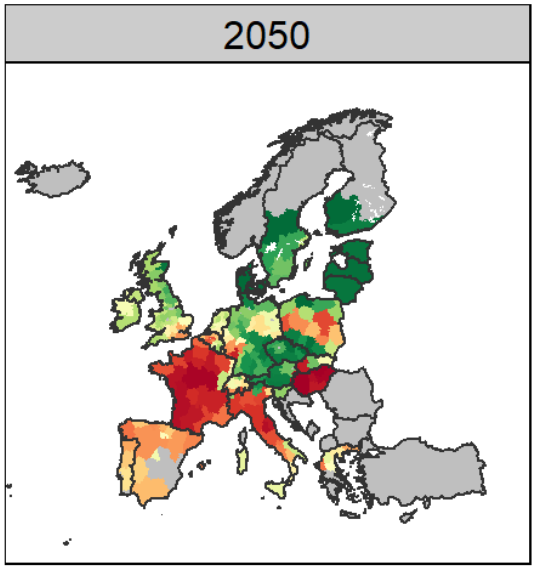
Milk productivity (kg ha^{-1})



milk productivity baseline

- 3,735
- 7,758
- 10,028
- 11,955
- 27,287
- Missing





milk productivity change (%)

- -17
- -1
- 1
- 3
- 17
- Missing

orizon 2020
: No 727213

Results

- Some regions are expected to suffer reduced forage productivity and therefore milk productivity – Southern areas, especially France, Italy, but also Hungary in the East
- However, Northern regions and upland areas can expect to see improved productivity, through higher forage yields

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Discussion & Conclusions

- Results provide an indication of priority regions for system re-design – red warning lights
- Mitigation options
  - Adapt forage crop choice to suit the future environment
  - When farmers utilize the highest yielding forage crops for their region that their productivity can remain above their current levels in virtually all regions and farm types (though of course there may be local difficulties in achieving this).
- Limitation
  - other factors such as the potential of more erratic weather and damaging heatwaves

  => Need to adapt livestock productions systems as a whole.

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THANK YOU

FOR YOUR ATTENTION!

https://www.gentore.eu/

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- **Quiédeville, S., Moakes, S., Leiber, F., Burns, J., Casasús, I., Cozzi, G. (2019a).** Deliverable number: 1.1. Expected challenges to the resilience and efficiency of cattle farming in various European regions – stakeholder views and analysis. GenTORE - Genomic management Tools to Optimise Resilience and Efficiency (727213). https://doi.org/10.5281/zenodo.3860683
- **Quiédeville, S., Moakes, S., Leiber, F., Pfeifer, C. (2019b).** Deliverable number: 1.2. Dairy database for prediction of main environmental challenges to resilience and efficiency in cattle production systems at regional resolution. GenTORE - Genomic management Tools to Optimise Resilience and Efficiency (727213). https://doi.org/10.5281/zenodo.3860704

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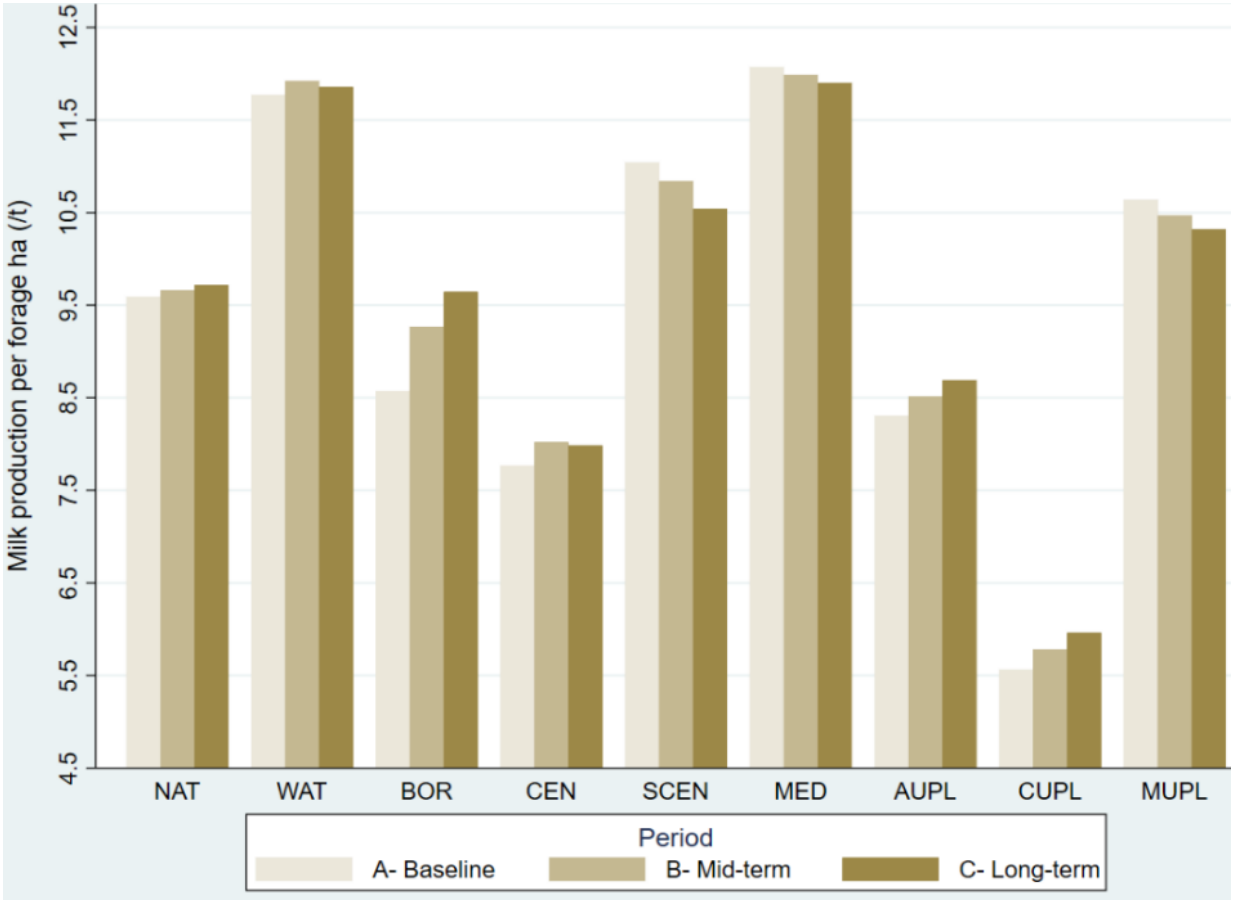
Predicted milk yield per climate class



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How to describe environments?

- We all have an understanding of the production environment, but how did we describe it?
  - Climatic environment zone
  - Forage type – grass, maize, forage crops?
  - Concentrate feeding level and type
- How to define this production environment in a consistent way?

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Nine environmental zones across Europe

Classes	Description	tmax_summ	tmin_wint	sd_tavg	dry (days 0-1mm)	Rainfall (mm/d)	Milk prod/cow (2010-2013)
1	North Atlantic	18.3	2.7	4.7	206.1	2.8	6075
2	West Atlantic	21.8	1.7	6.1	241.2	2.1	7450
3	Boreal	18.9	-9.6	9.4	252.2	1.7	8530
4	Central Europe	23.3	-2.6	8.0	252.0	2.0	6311
5	Southern Central Europe	27.6	-0.9	8.1	279.4	2.0	6652
6	Mediterranean	29.9	5.3	6.6	301.7	1.6	6490
7	Atlantic Mountain	17.0	1.3	4.8	186.3	2.8	7526
8	Central Mountain (Alpine)	20.7	-4.2	7.7	239.3	2.5	6150
9	Mediterranean Mountain	27.1	1.3	6.9	286.9	1.9	6647

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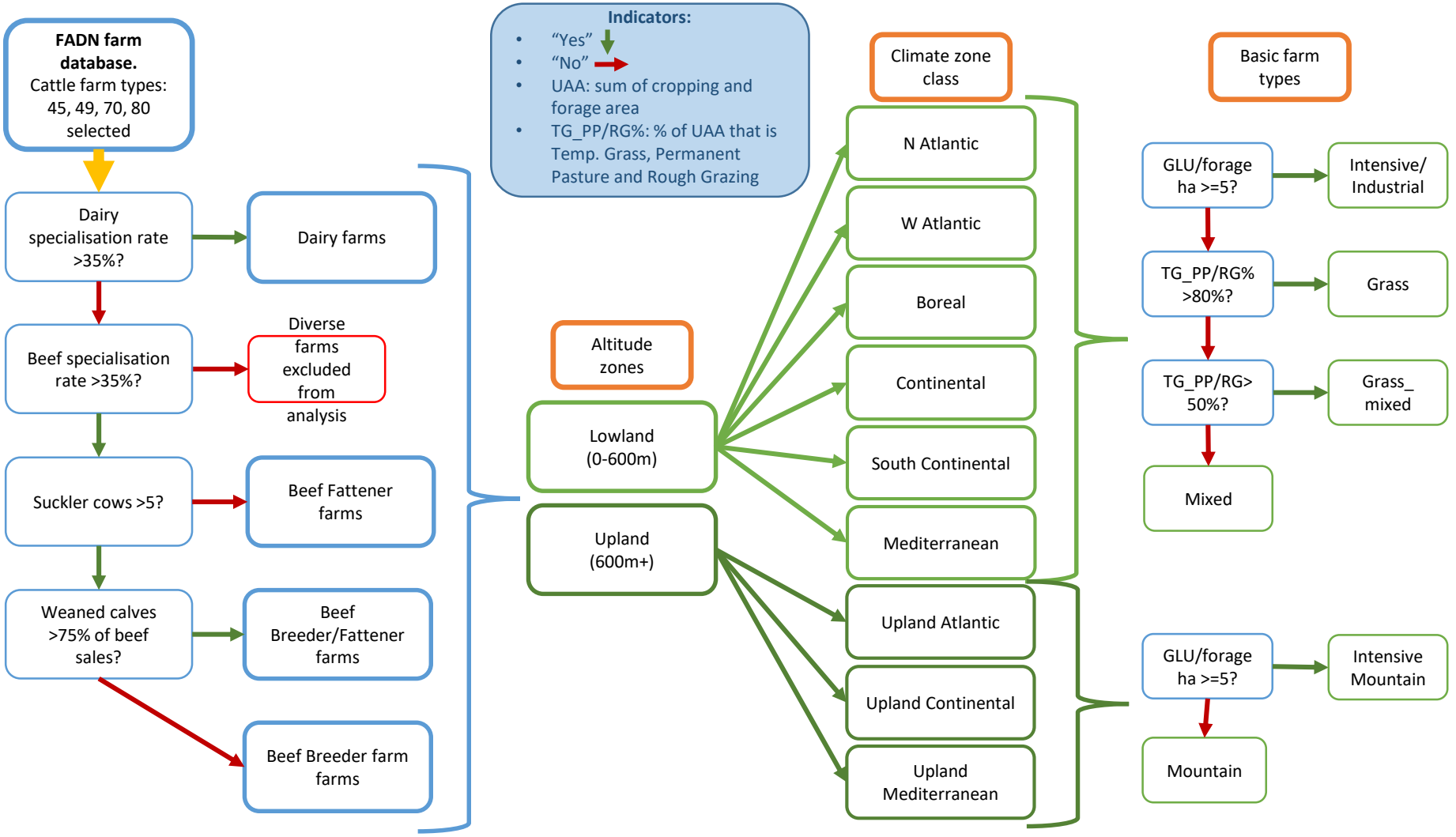
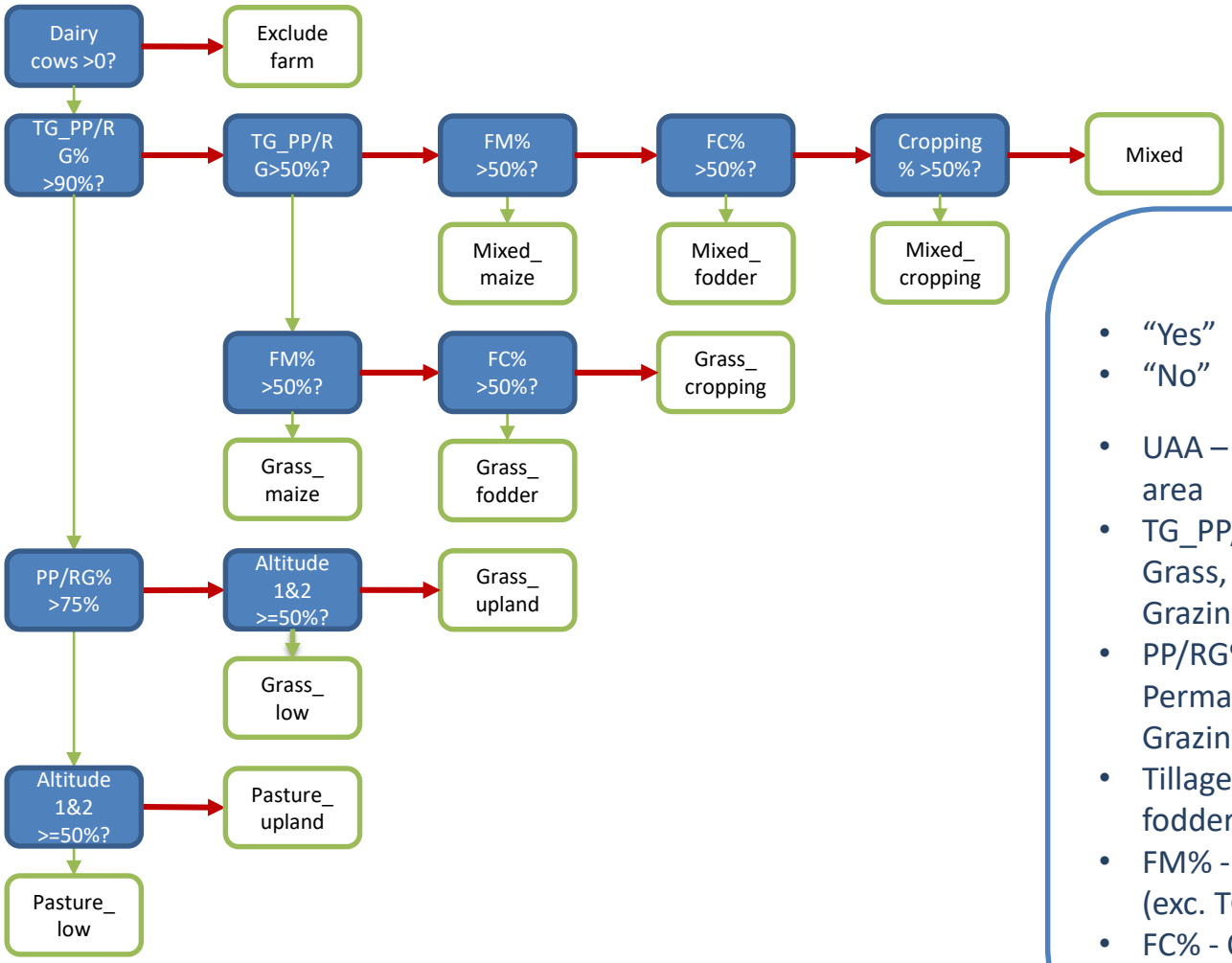
T1.1. Database development



Detailed farm typology



Indicators:

- "Yes" ↓
- "No" →

- UAA – sum of cropping and forage area
- TG_PP/RG% - % of UAA that is Temp. Grass, Permanent Pasture and Rough Grazing
- PP/RG% - % of UAA that is Permanent Pasture and Rough Grazing
- Tillage area – sum of cropping, fodder crops (exc. Temporary grass)
- FM% - Fodder Maize % in tillage area (exc. TG)
- FC% - Other Fodder Crops % in tillage area (exc.TG)
- Cropping% -

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Why describe environments?

- The production environment strongly influences gene expression – G*E interaction
- Two Swiss dairy systems…

Source: Ian Grant

Source: Stefan Wermuth

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