

GenMon: a Web-GIS platform for the monitoring of farm animal genetic resources in Switzerland

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Context

- Loss of genetic diversity in Farm Animal
- FAO protocol (2007): monitor genetic diversity of farm animal
- Need for a tool to identify endangered breed
→ Development of **GenMon**, a Web-GIS application

Introduction

Method

Criteria

Pedigree

Cryo-
conservation

Introgression

Geography

Agric sus-
tainability

Aggregation

Data

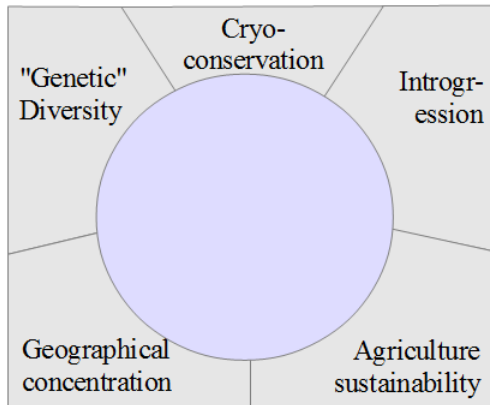
Results

Demo

Conclusion

References

Criteria to consider?



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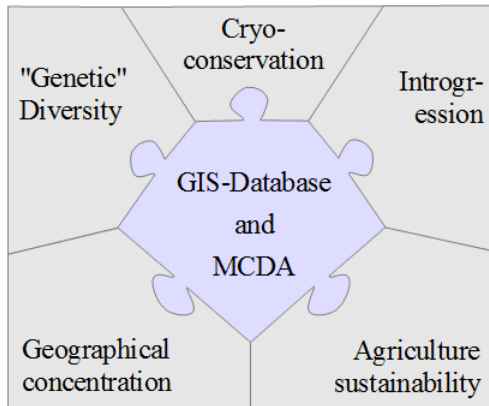
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Demo

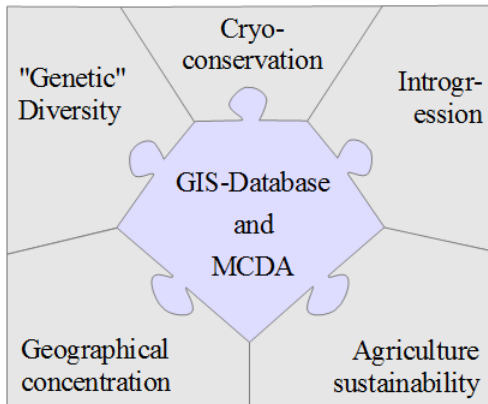
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Criteria to consider?



Goal: build **global index** integrating all 4 criteria

Pedigree analysis

- Consider:
 - Total number of animals
 - Trend number of animals
 - Inbreeding coefficient
 - Effective size of the population (N_e)
 - Pedigree completeness
- PopRep from Institute of Farm Animal Genetics (FLI) (Groeneveld et al., 2009)
- Future improvement: inbreeding on DNA-analysis

Cryo-conservation

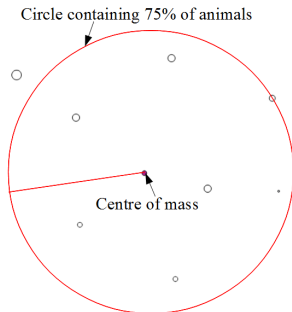
- → Restore genetic diversity after severe event
- Consider:
 - Are there frozen semen?
 - Is there a true cryo-conservation plan?
- Entered directly by the user

Introgression

- → avoid mixing of traits
- Consider:
 - Mean introgression rate
- Entered directly by the user

Geographic concentration

- → Important to restrict the spread of diseases
- Consider:
 - Smallest circle containing at least 75% of animals, centered around the centre of mass of the breed (Alderson, 2010)
- Computed from PLZ of animals (GIS analysis)

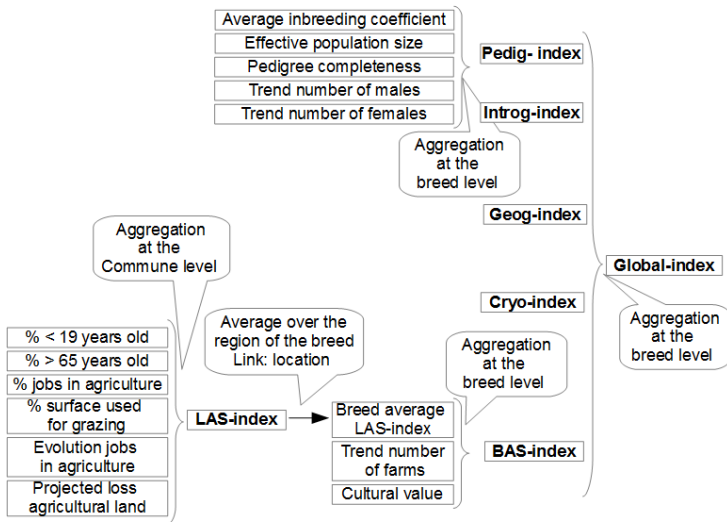


Agriculture sustainability

- → Assess the sustainability of agriculture where studied population is bred
- Consider:
 - Socio-Economic Criteria (demographic balance, % young and old)
 - Relative importance of agriculture (% farmer and evolution, % surface for grazing)
 - Projected landuse (Price et al., 2013)
 - Evolution number of farms
 - Cultural value and its evolution
- Statistics available at the commune level and info of the breed

Criteria Aggregation

- **Data integration:** Link through Geography → Need of GIS-analysis
 - Aggregation using MCDA-technique: MACBETH (Costa et al., 1994)
 - Weighted average
 - using satisfaction thresholds
- Expert-based approach



- Animal information
 - Pedigree info
 - Introgression
 - Geographic location (Postal Code)

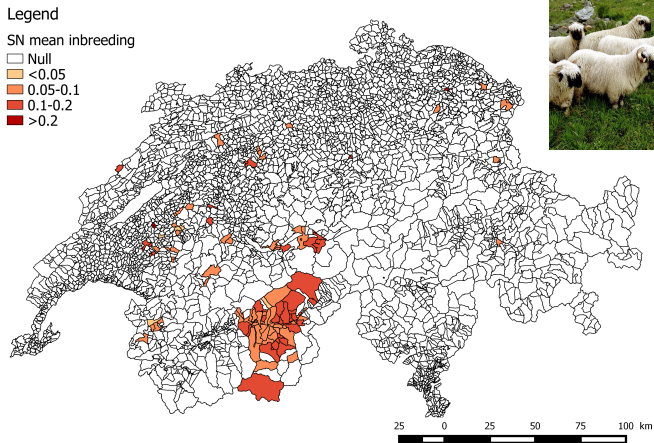
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animal_ID;sire_ID;dam_id;birth;sex;plz; intro; inb; cryo_cons  
73400;70335;358651;1951;M; 3057;0;;0  
398242;16590;7756462;1994;F;1971;0.1;;0
```

- Stats (Socio-Economic/Enviro) at the commune level
- Shapefile of Communes and Postal Code

Ranking of breeds

Breed name	Mean F	N_e range	pedig- index	Cryo- index	Introg- index	Geog- index	BAS- index	Global- index
SN	0.10	50-70	0.44	0	0	13.02	0.6	0.43
FM	0.06	50-70	0.41	0	0.11	58	0.6	0.51
BVO	0.03	70-100	0.65	1	0	59	0.6	0.79

Mean Inbreeding Blacknose sheep



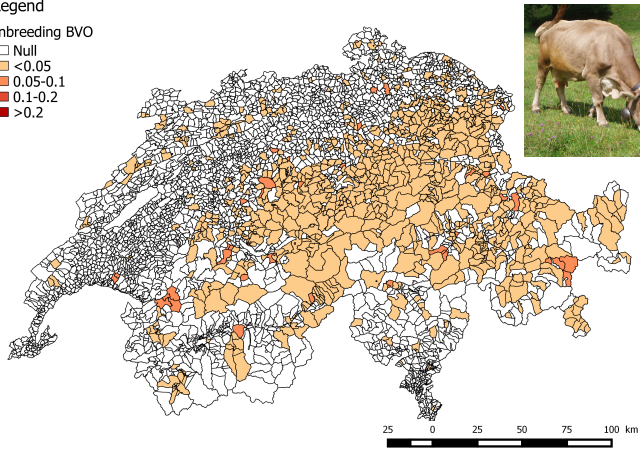
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Mean Inbreeding Original Braunvieh cows

Legend

- Inbreeding BVO
- Null
 - <0.05
 - 0.05-0.1
 - 0.1-0.2
 - >0.2



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`lasigsrv2.epfl.ch/genmon-ch`

Conclusion

- Easy-to-use Web-GIS application
- Integration of various criteria
- Ranking of endangered breed + Identification of problems
- Maps available
- **Geography** needed for:
 - Link/Integration of different data types
 - Calculate geographical concentration

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- Costa, E., Bana, C. A., & Vansnick, J.-C. (1994). Macbeth an interactive path towards the construction of cardinal value functions. *International transactions in operational Research*, 1(4), 489–500.
- Groeneveld, E., Westhuizen, B., Maiwashe, A., Voordewind, F., Ferraz, J., et al. (2009). Poprep: a generic report for population management. *Genetics and Molecular Research*, 8(3), 1158–1178.
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