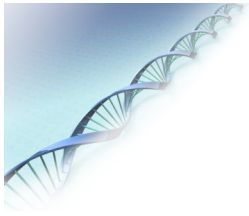# Optimization of dairy cattle breeding programs using genomic selection

Sabrina Bütler

Master thesis, 2014

Content

1. Background (1)

- New breeding strategies by using GEBV

- Earlier selection decision by higher accuracy of the GEBV

- Model calculations have shown, that genomic selection has an influence on **breeding progress** and **genetic gain** (Schaeffer, 2006)

- A. I. Organizations only buy bull calves with GEBV

- A. I. Organizations distribute semen from selected bulls which do not have yet second crop daughters (Optimis)
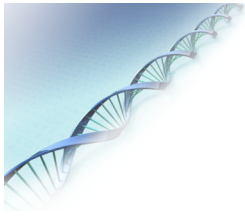
Background (2) – Number of genotyped animals in Switzerland
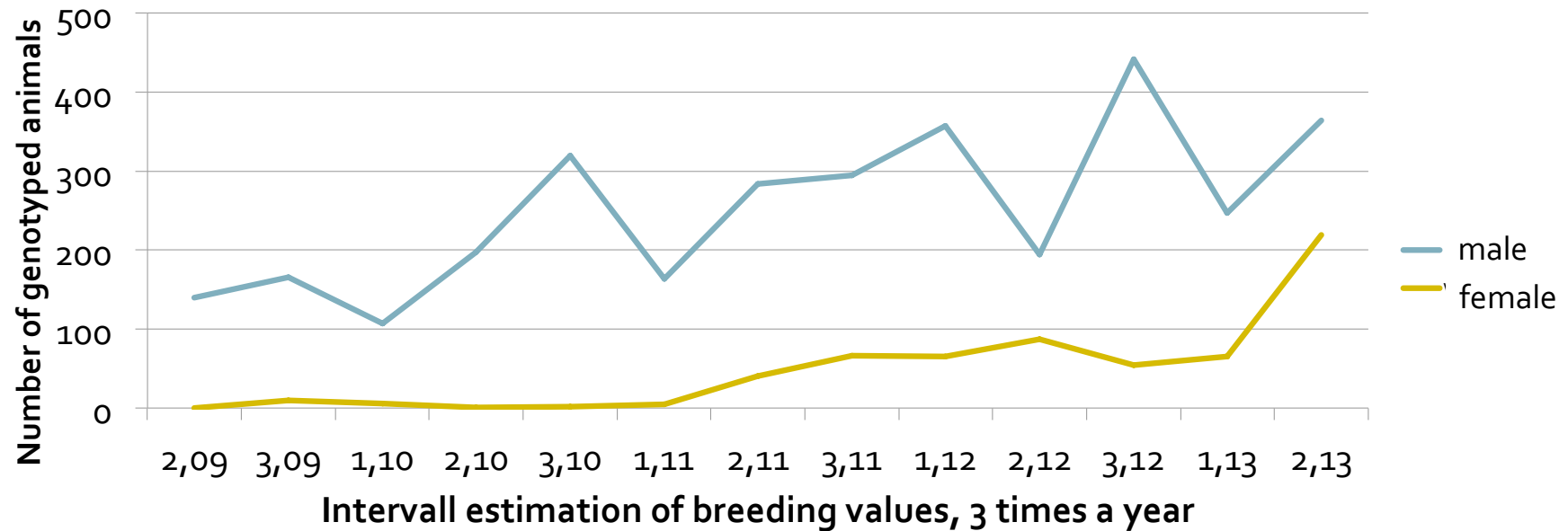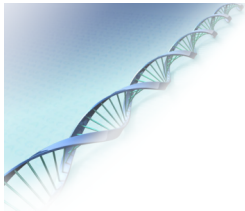
Background (3) – Breeding program Braunvieh 2013

Population: 215'000

Proportion of insemination 30%

Cows (Breeding): 172'000

Proportion of insemination 70%

Young bulls as bull sires: 6

50% of inseminations

Bull dams: 1'090

50% of inseminations

Proven bulls as bull sires: 16

Bull calves: 420 (7% from ET)

Young bulls: 60

Proven bulls: 20

Cows (Production): 43'000
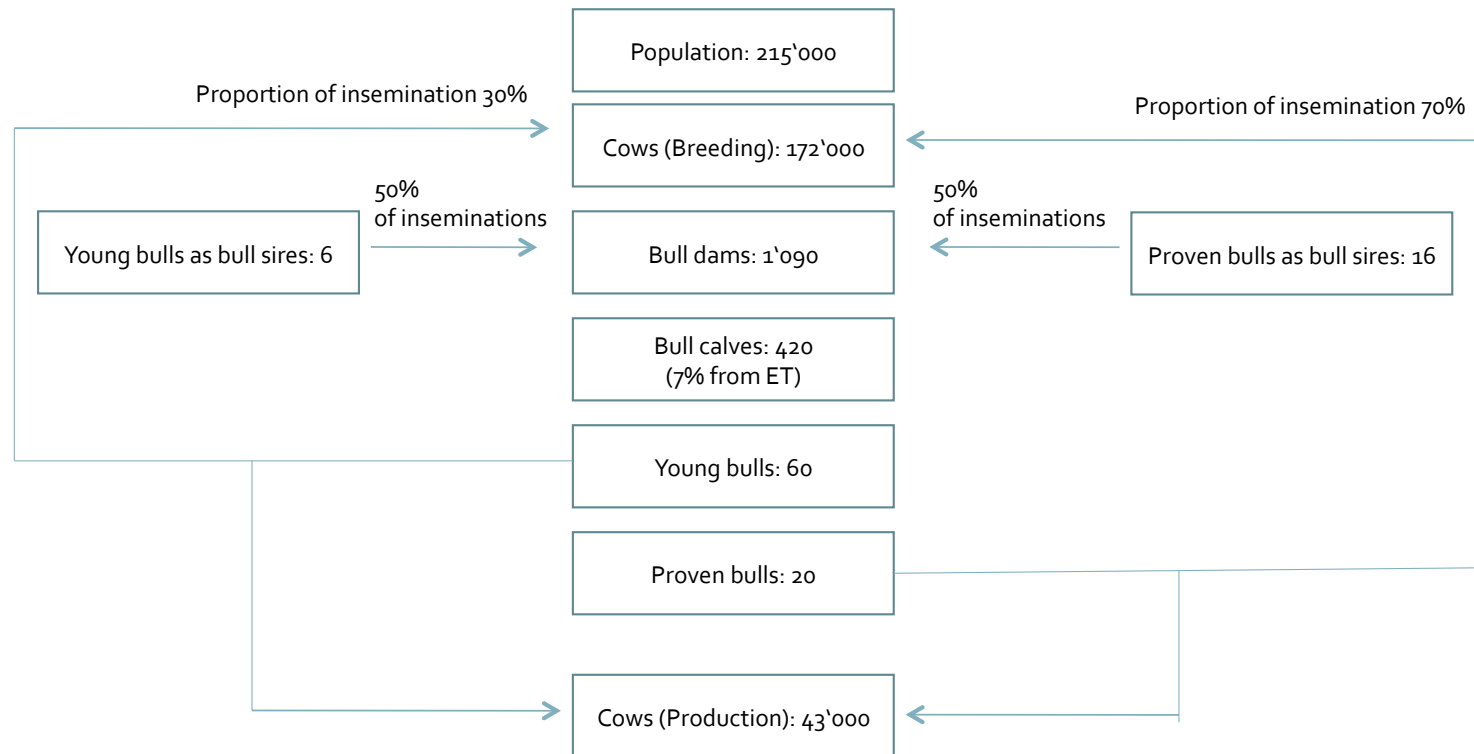
2. Objective of the master thesis: Effect of variation of five parameters on the breeding program:

2. Proportion of young bull inseminations on cows in the breeding group (172'000 cows)

3. Calving age bull dams

4. Genotyping of all bull dams

Proportion of insemination 30%

Proportion of insemination 70%

Population: 215'000

Cows (Breeding): 172'000

50% of inseminations

50% of inseminations

Young bulls as bull sires: 6

Bull dams: 1'090

Proven bulls as bull sires: 16

Bull calves: 420 (7% from ET)

1. Proportion of genotyped to selected bull claves

Young bulls: 60

Proven bulls: 20

5. Increased accuracy of DGV

Cows (Production): 43'000

3. Evaluation criteria

- **Genetic gain (GG)** (only breeding unit)
  - <u>Natural</u>: Average superiority of the progeny of selected animals compared to previous population (natural units per year)
  - <u>Monetary</u>: natural genetic gain expressed in monetary units (Swiss Francs per year)

$$GG\ /T = \frac{i * r * \sigma_a}{GI}$$

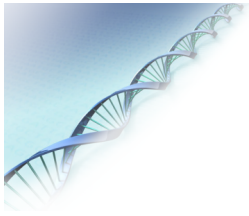i: Selection intensity
r: Accuracy of breeding values
σ_a : additive genetic standard deviation
GI: Generation interval

- **Breeding profit** (breeding and production unit)

  Breeding profit = Breeding return – Breeding costs
  - Return: monetary genetic gain over the whole investment period, discounted return per cow
Costs: fixed or variable

4. Method

- The computer program ZPLAN (Karras, 1974), Version „z10.for" (Willam et al., 2008) was used

- ZPLAN optimizes selection strategies based on a deterministic approach

- Core parts of the software are gene flow method (Hill, 1974) and selection index contstruction (Hazel et al., 1949)

- 14 Selection groups were defined

- Cost and biological parameters have to be defined for each selection group

- Inclusion of genomic information by calculating daughter equivalents based on heritability
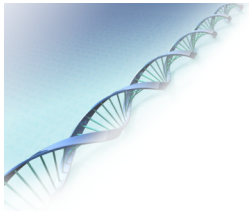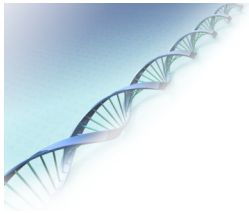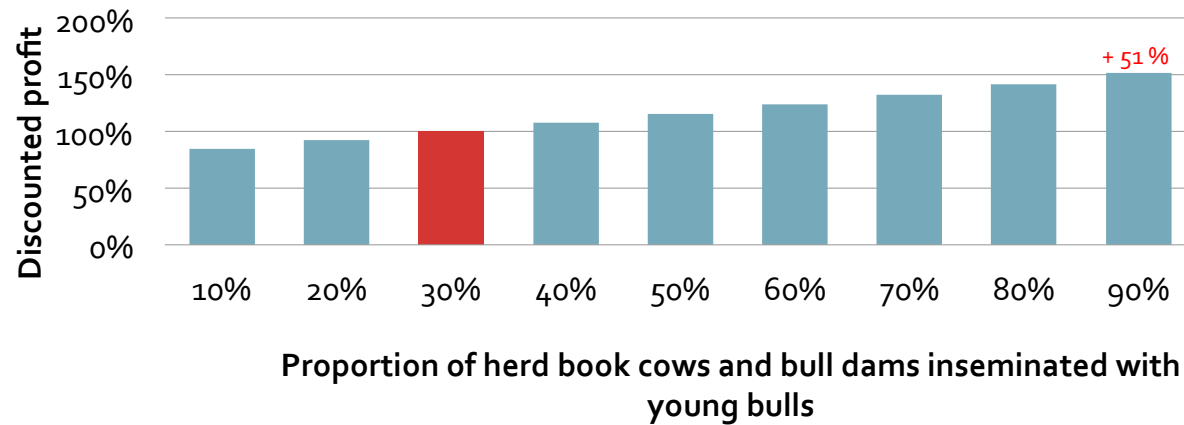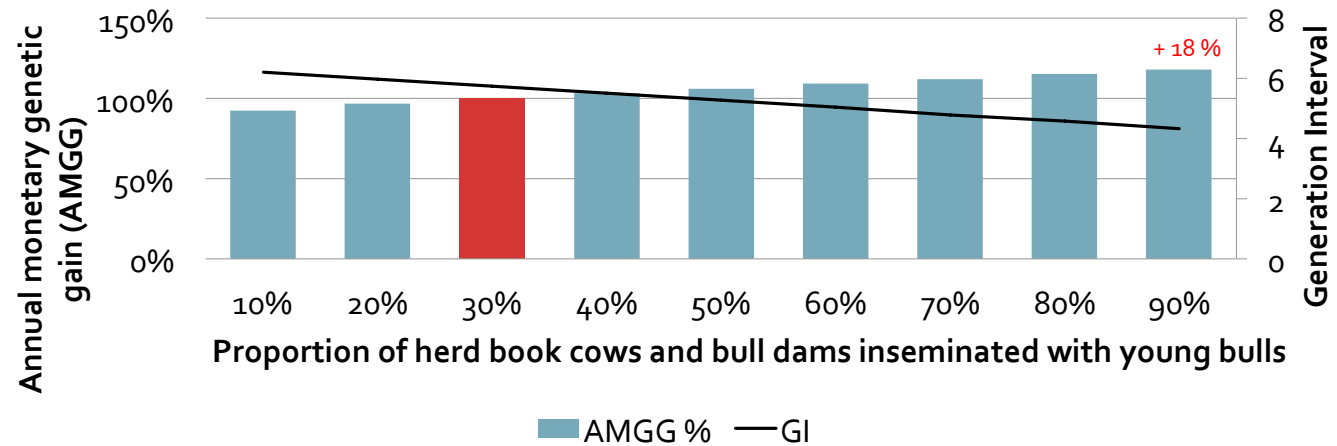
5. Total Merit Index

- Index
  - Heritabilities and genetic correlations are considered between all traits in the total merit index

  - Weighting of traits according to total merit index of Braunvieh Schweiz

Trait	Weight
Production	54%
Milk kg	13%
Protein kg	33%
Protein %	8%
Fitness	30%
Persistency	3%
Length of productive life	10%
Somatic cell count	8%
NRR	6%
Days to first service	3%
Milking speed	6%
Conformation	10%

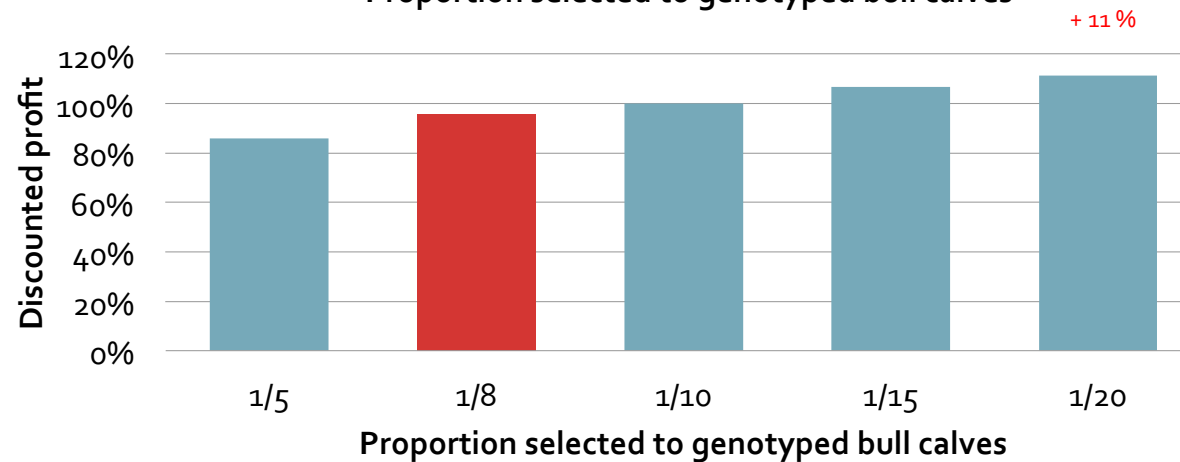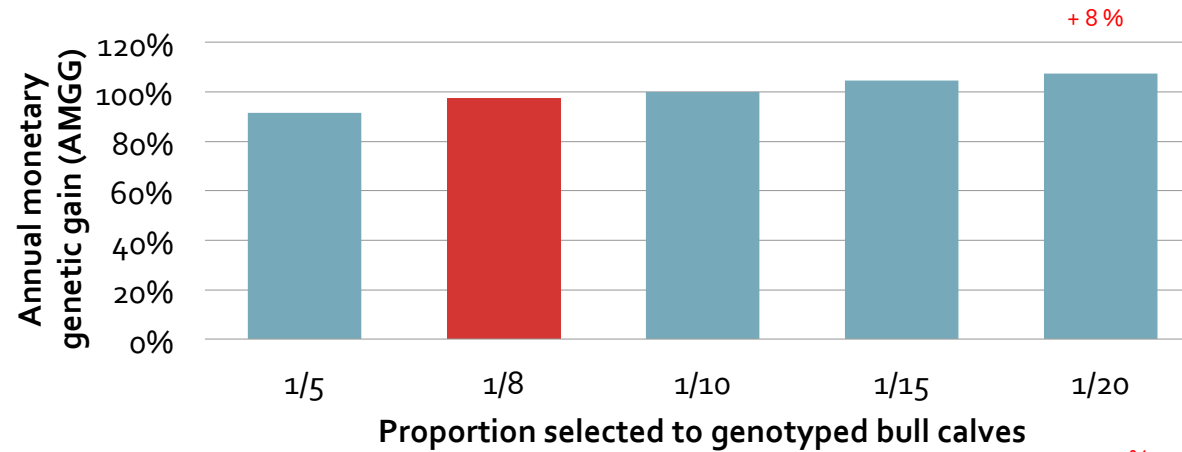# 6. Results (1): Proportion of young bulls

Annual monetary genetic gain (AMGG) / Generation Interval

+ 18 %

Proportion of herd book cows and bull dams inseminated with young bulls

AMGG %   — GI

Discounted profit

+ 51 %
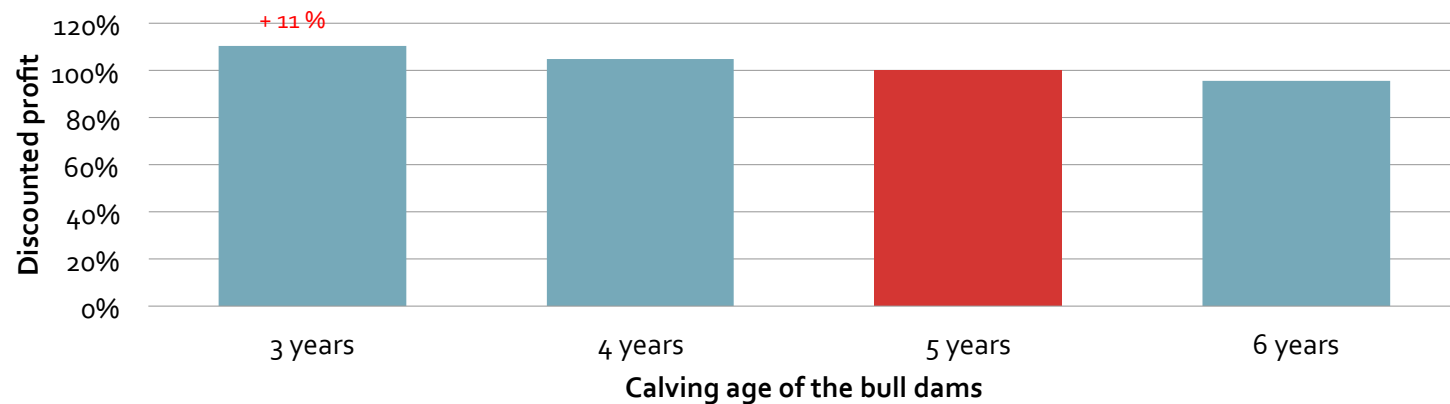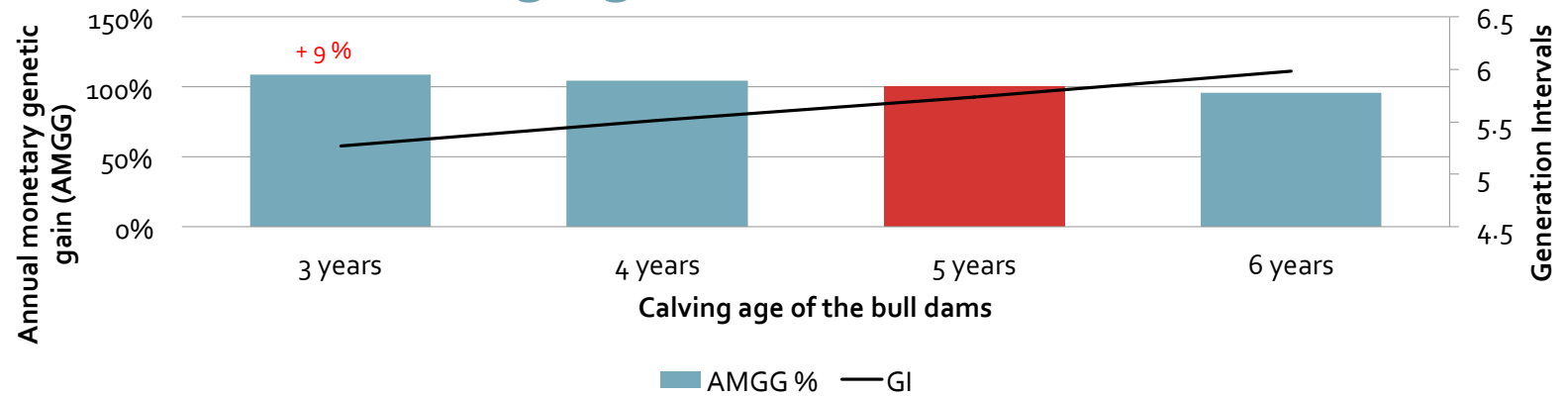
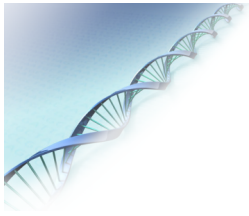Proportion of herd book cows and bull dams inseminated with young bulls
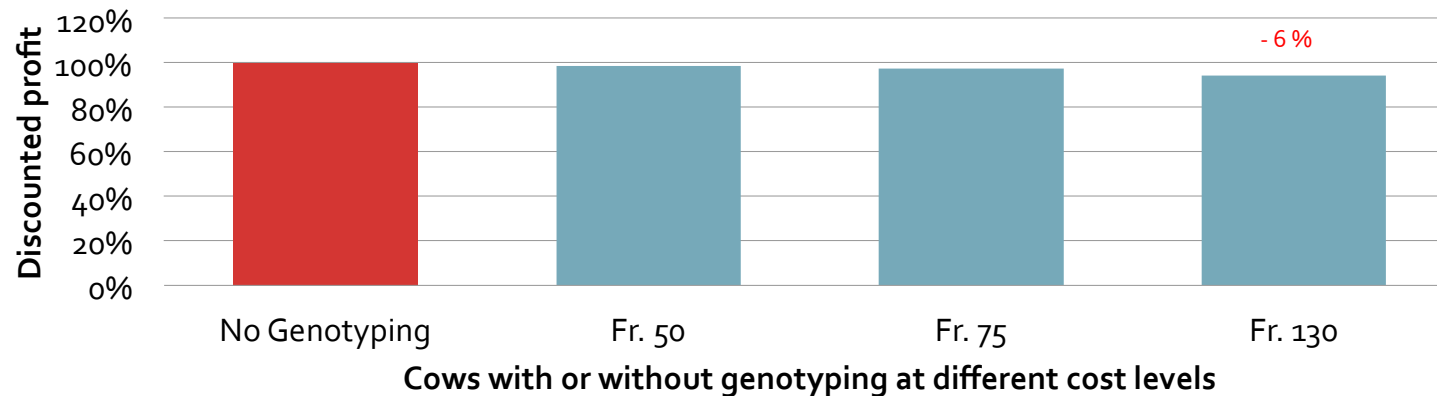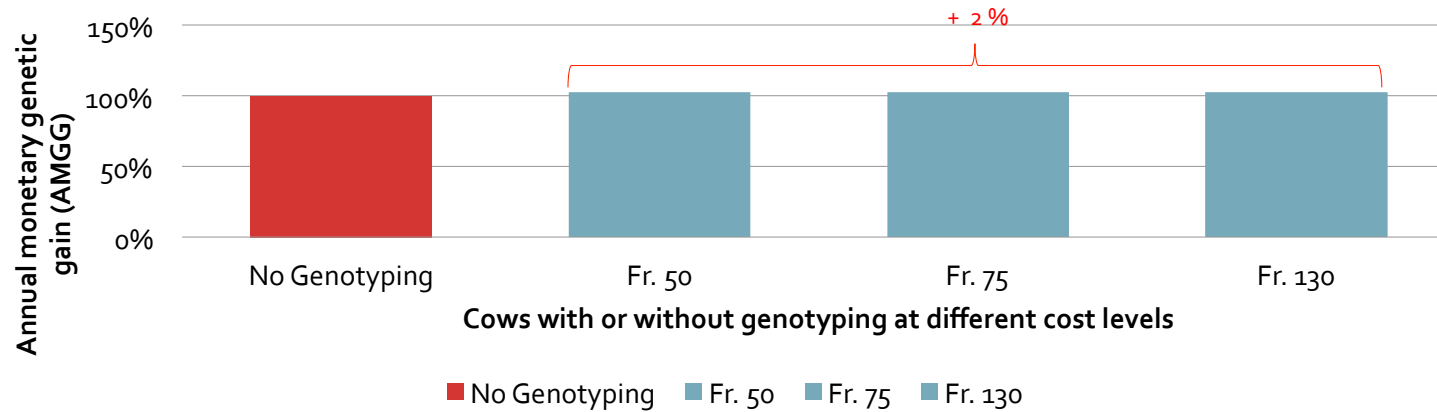
6. Results (2): Proportion selected to genotyped bull calves
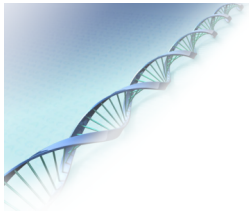
6. Results (3): Calving age of bull dams

6. Results (4): Genotyping of all bull dams *

Annual monetary genetic gain (AMGG)

+ 2 %

150%
100%
50%
0%

No Genotyping | Fr. 50 | Fr. 75 | Fr. 130

Cows with or without genotyping at different cost levels

■ No Genotyping ■ Fr. 50 ■ Fr. 75 ■ Fr. 130

Discounted profit

- 6 %

120%
100%
80%
60%
40%
20%
0%

No Genotyping | Fr. 50 | Fr. 75 | Fr. 130

Cows with or without genotyping at different cost levels

* Increased selection intensity could not be taken into account due to limitation of ZPLAN

7. Conclusion

- <u>Increased</u> **annual monetary genetic gain** and **discounted profit** by
  - **Increased proportion of young bull inseminations**
  - **Increased number of genotyped bull calves**
  - **younger calving age of bull dams**

- Higher risk by using young bulls, as bulls with GBVs have lower accuracies as proven bulls
- Intensity of the use of genotyped young bulls in practice depends on the
  - Acceptance of the GBVs
  - Accuracy of the GBVs
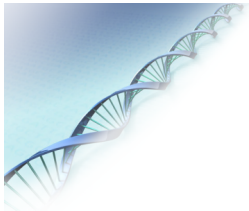
Questions?
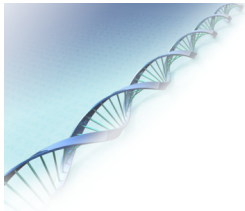
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