LowInputBreeds

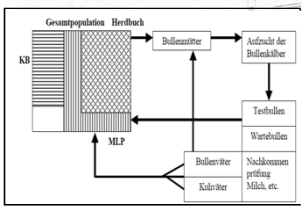
Development of integrated livestock breeding and management strategies to improve animal health, product quality and performance in European organic and 'low input' milk, meat and egg production

Ethical problems and breeding goals
Subproject 1: Dairy cattle

Henner Simianer **Department of Animal Sciences**
Georg-August-University Göttingen, Germany

Wageningen, March 16, 2011

The animal breeding process



Definition of the breeding goal

External (economy, society, law, global trends)

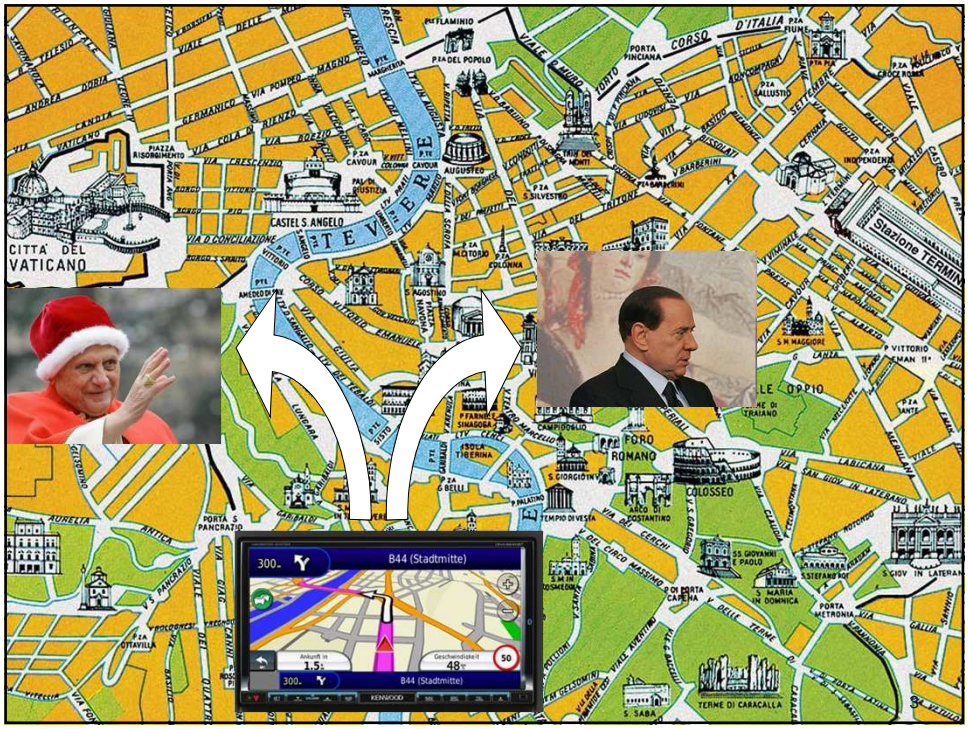
Design and optimization of the breeding program

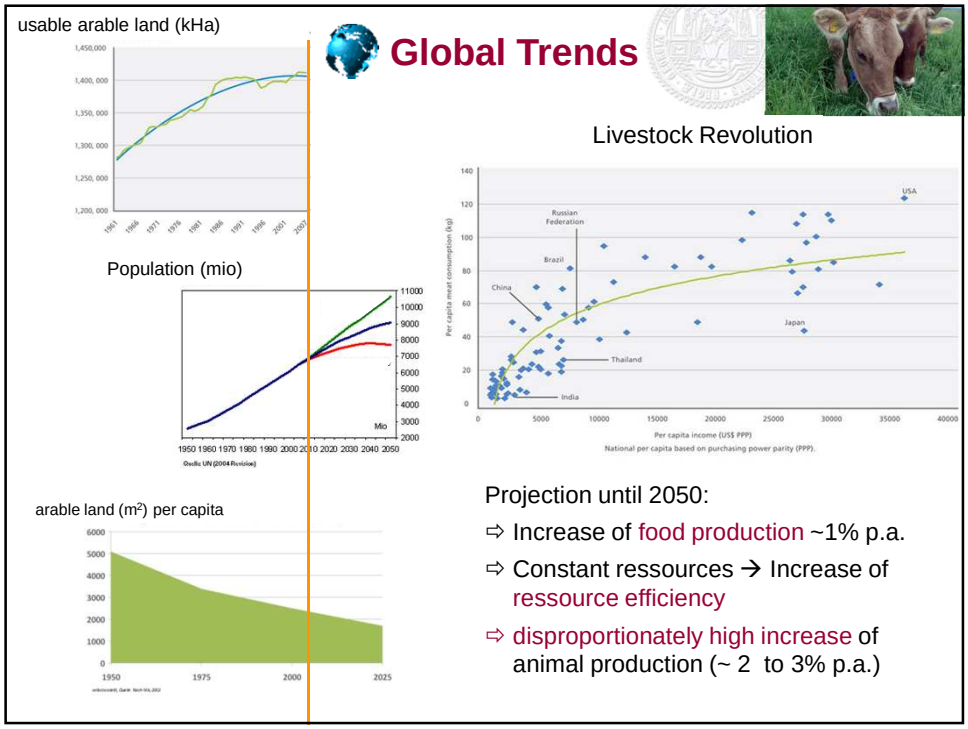
incl. choice of breeding technologies

Implementation

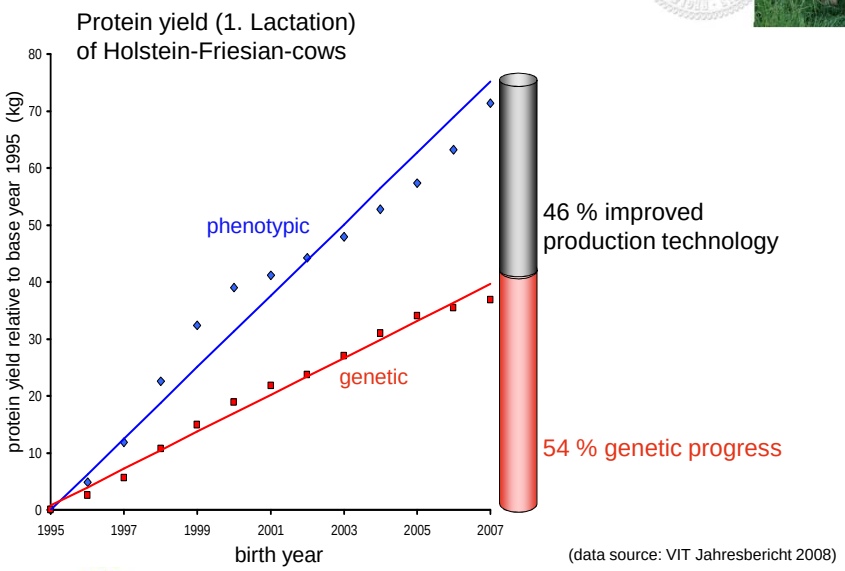
Breeding process

2


CITTA' DEL VATICANO
CASTEL S. ANGELO
T E V E R E
FORO ROMANO
COLOSSEO
Stazione TERMINI
B44 (Stadtmitte)


usable arable land (kHa)
Global Trends
Livestock Revolution
Population (mio)
arable land (m²) per capita
Russian Federation
Brazil
China
Thailand
India
USA
Japan
Per capita income (US$ PPP)
Projection until 2050:
⇨ Increase of food production ~1% p.a.
⇨ Constant ressources → Increase of ressource efficiency
⇨ disproportionately high increase of animal production (~ 2 to 3% p.a.)

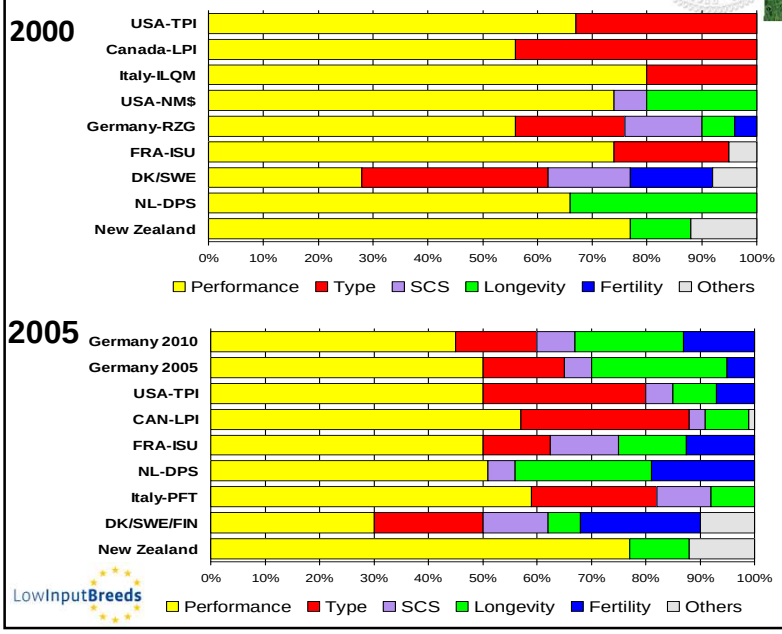
> 50 % of increase of productivity through breeding



(data source: VIT Jahresbericht 2008)

LowInputBreeds

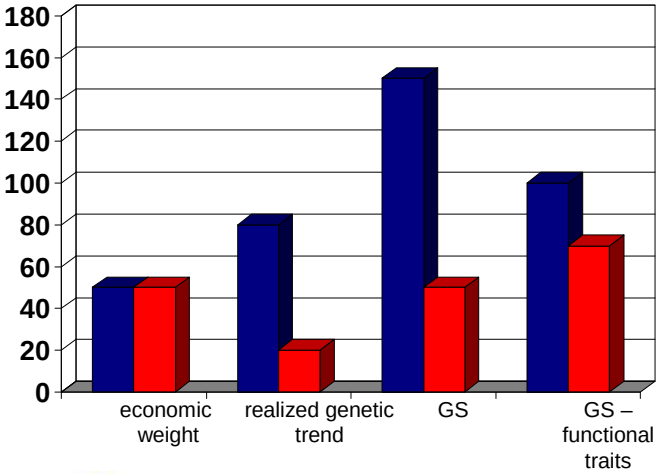
Breeding goals in Holstein Friesian



LowInputBreeds

Genomic selection for fuctional traits

Production traits vs. functional traits – options for genomic selection



Why is this so?

- ⇨ low heritability of functional traits
- ⇨ unfavourable genetic correlations to production traits
- ⇨ difference in quantity and quality of performance test data

LowInputBreeds

Technologies in dairy cattle breeding

- ⇨ Artificial insemination (> 80% of matings)
- ⇨ Sperm sexing (< 1% of matings)
- ⇨ Embryo transfer (< 1% of cows)
- ⇨ Ovum pick up/in vitro fertilization (< 1% of cows)

- ⇨ 54k SNP chip genotyping (~1000 to 2000 male calves per month in Germany) based on DNA-containing tissue (blood, semen, hair, milk)

All technologies socially accepted and in routine use

Use of AI: no difference between conventional and ecological dairy breeding (Schmidtko, 2007)

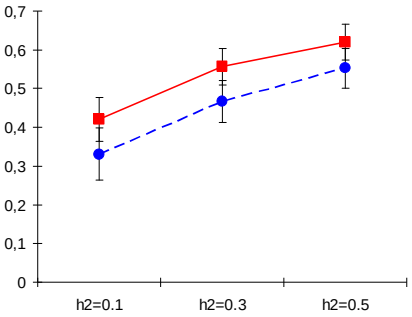
54k genotyping quantitatively ‚exploded' within no time

LowInputBreeds

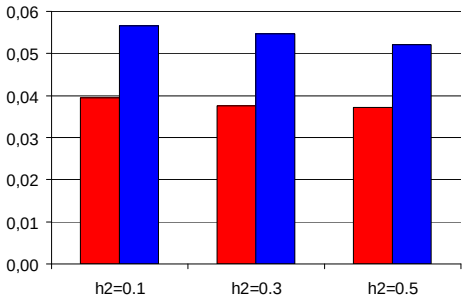
Relationship under genomic selection

Simulation study (Chen et al., 2011): 5 generations of selection on pedigree-based BLUP or on genomic breeding values

Accuracy of estimated breeding values



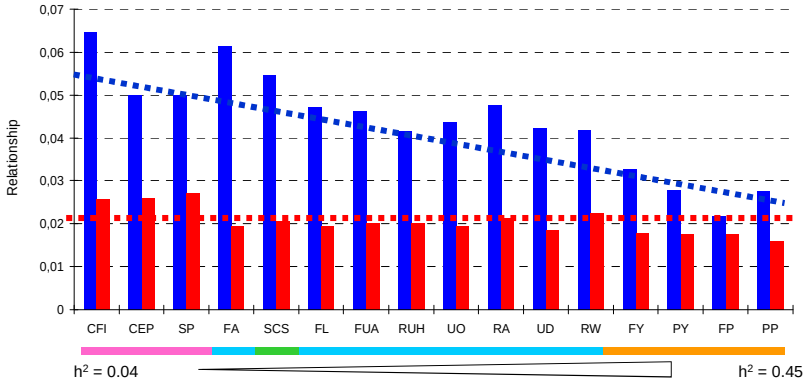
Average relationship of top 10% animals



LowInputBreeds

Relationship under genomic selection

Empirical study (Chen, 2011): average relationship of the top 50 out of 816 young Holstein bulls selected based on pedigree-based BLUP or on genomic breeding values for different traits



LowInputBreeds

Conclusions and theses

- Global trends require an increase of animal production per year by ~ 2 to 3 per cent until 2050
- Due to limited ressources (land, water, minerals etc.) the increase has to be ressource-neutral (or ressource-saving), improving ressource efficiency will be most relevant (also, or even especially, true for low input systems)
- Breeding makes up for > 50 per cent of the progress in productivity
- With conventional breeding tools, a genetic progress of ~ 1 per cent per year seems to be the limit (under favourable conditions)
- Genomic breeding approaches have the potential to boost the level of genetic progress towards the necessary rate
- Potential to genomically select very good young bulls to be used for natural service on farm

LowInputBreeds

Conclusions and theses

- Technologies used in genomic breeding programs (AI, ET, OPU/IVF, SNP-genotyping) are well established and socially accepted
- Additional genetic progress through genomic selection provides options to over-proportionally improve traits related to fitness, fertility and animal welfare
- Genomic selection has a ‘built-in’ mechanism to reduce the inbreeding rate (esp. when selecting for functional traits)
- Both breeding goals and breeding technologies need an ethical assessment
- Waiving the possibility to increase productivity and/or ressource efficiency by an (‚ethically‘ motivated) non-use of technological options also has an ethical dimension and needs justification

LowInputBreeds

The authors gratefully acknowledge co-funding from the European Commission, under the Seventh Framework Programme for Research and Technological Development, for the Collaborative Project LowInputBreeds (Grant agreement No 222623)

LowInputBreeds

13