Strategy building in farm animal practices – a look into the future

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2005

Introduction

- future challenges for livestock production:
  - The climate crisis
  - The food/feed crisis
  - The energy crisis
  - The water crisis
  - The land crisis

AIM

- Discuss impact of these crises
- Discuss animal breeding strategies to address these crises
- Perspective: global with special emphasis on Nordic countries
  - (Globalisation makes these crises also affect us even if some do not primarily affect us)

The climate crisis

- Global warming : 3 degrees in 21st century
  - Difference: Amsterdam (10)– Madrid (13)
- Direct problem: for already hot climates
- Nordic countries: feed prices increase
  - livestock production still affordable?
- Puts costs on GHG emissions
  - Reduces efficiency of livestock production

The food/feed crisis

- World population: 7 => 9 billion by 2050
- Climate change
  - Best land => urbanisation; plant food production
  - marginalises land
- Feed prices increase dramatically
  - Partly compensated by increased food prices
  - danger: livestock products => niche products
  - Costs of low quality feeds remain low

Water crisis

- Temperature rises → irrigation → water crisis
  - Mainly a problem in hotter climates
  - Drive up feed prices
  - Marginalises agricultural land

Energy crisis

- Energy dramatically more expensive
- Fertiliser more expensive
  - Marginalises land
- Competion feeds use as biofuels

Land crisis

- Result of other crises:
  - Much of livestock-land becomes more marginal
  - Temperature rise
  - Water shortage
  - Fertiliser shortage
  - Current fertile land
  - Used for crop/food production
  - urbanisation

Challenges for livestock production

- Production ↑
  - Keep pace with population growth Nordic countries
- Cost-effectiveness ↑
  - Prices of inputs ↑
  - Competition with plant products
  - E.g. meat ingredients in foods are replaced by plants
- Use waste products as input and marginal land
- Reduce environmental impact
  - GHG emisions ↓ (currently 7% of total emissions)
- Animal welfare & health

Animal Breeding aims:

- Adapt genetics of animals to these challenges
  - Cost effectiveness
  - Feed efficiency
  - Use of waste products (Gxfeed interactions)
  - GHG emissions down
  - Contribute to general emission reductions
  - Disease resistance
  - Challenge due to poorer feeds / marginal conditions
  - Improves also welfare

Animal Breeding Strategies

- Animal breeding
  - one of the tools for mitigation & adaptation
  - slow process
  - Important due to its accumulation improvements
- Challenges demand rapid changes:
  - Envisage new breeding directions asap
  - Need the fastest animal breeding techniques
  - Breed or cross substitution (use of AnGR)
  - Genomic selection (GS)
  - GS-intogression (combination of GS and AnGR)

Breed or cross substitution

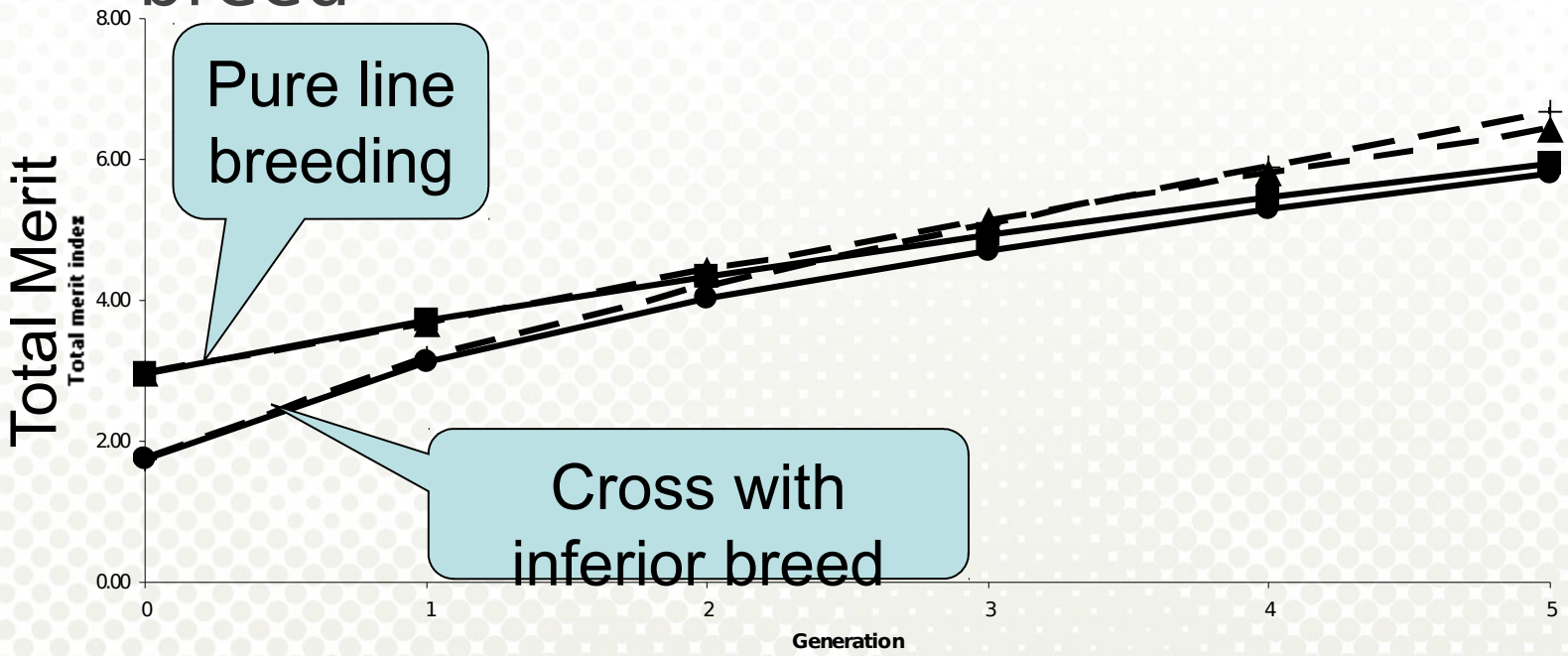
- Requires Animal Genetic Resources (AnGR)
- In view of the crises:
  - Need efficient low input breed
  - Use of low quality & quantity of feeds
  - Use of marginal land
- Many endangered breeds fullfill these requirements
  - Were replaced by high-input / high output breeds
  - May see a come-back

Genomic selection (GS)

- Speeds up selection process dramatically
  - When generation interval can be reduced
  - When trait cannot be measured on candidate
- Usefull to address GxE issues
  - E.g. production under low-input environment
  - Detect animals suited for low input environment without having records in such an environment

GS-introgression

- Introgression of 1 trait from 'inferior' breed



__Tradit. Selection; _ _ _Genomic selection

Odegard et al. 2008

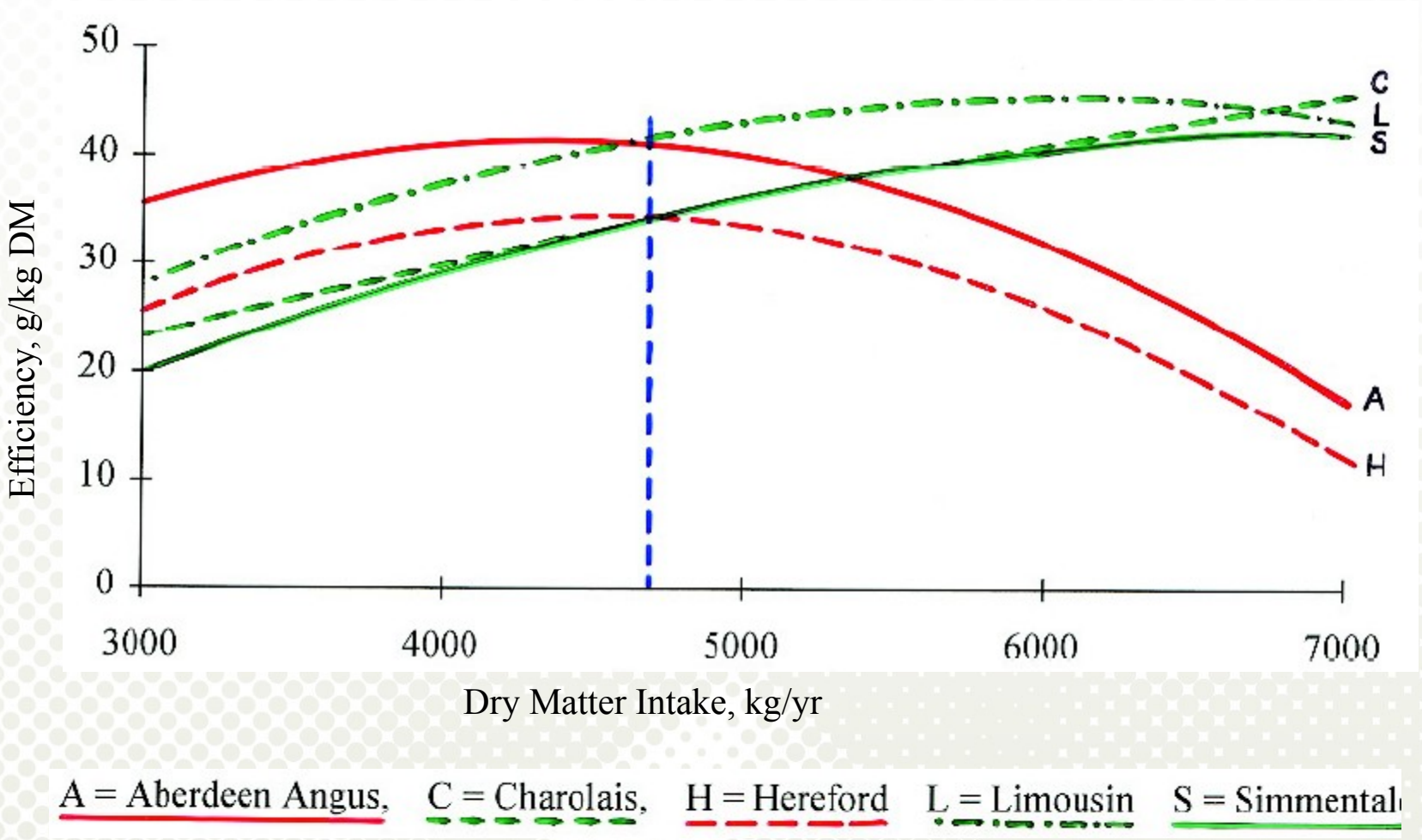
Animal Breeding & mitigation

- Selection against GHG emissions
  - Need large scale recording tools
  - Need estimates of genetic parameters
  - GS may be particularly useful
  - Since GHG emission are difficult to record
  - AnGR may be useful
  - Compare different breeds/ crosses for GHG emission
  - Possible use of GS-introgression

Animal Breeding & adaptation: GxE

- Strategy:
  - adapt animals to the changing environments
- Investigate GxE:
  - Temperature (hot climates)
  - Water availability
  - Feed quality
- Breed comparison with respect to GxE
  - Within breed compare (sire) families

Biological efficiency of different cattle breeds (Jenkins and Ferrell, 1994)



Adaptation : new production systems

- Rapidly changing production environmnts
  - Re-think the production system
  - Eg. Dual purpose production of milk & beef instead of using specialised dairy and beef breeds?
  - Feed processing technology: feeds come in many forms
  - Low input & High efficiency
- Will require different animals
  - Need AnGR (possibly GS-introgression)
  - Need rapid genetic change

Conclusions

- Future challenges in the form of 5 crises
  - The climate crisis
  - The food/feed crisis
  - The energy crisis
  - The water crisis
  - The land crisis
- Many challenges ahead of livest. prod:
  - Need to redesign the production system
  - Need research into the challenges / new design
  - Incl. changing genetics of animals

Conclusions (Anim. Breed.)

- Animal breeding : rapid genetic change
  - Breed/cross substitution : AnGR
  - Genomic selection
  - GS-introgression : get 1 trait out of AnGR
  - Foresee new breeding goal asap
- Disease resistance and animal welfare
  - Maintain a high level

Conclusions (anim. Breed.)

- Reduce environmental footprint:
  - Direct selection against GHG emissions
  - Possibly by breed substitution or GS-introgression
  - Indirect by increasing efficiency
- Animal Breeding : Adaptation
  - GxE interactions : select for changing environm.
  - For animals that are robust to environm. changes
  - Re-designing the livestock production systems
  - Includes changing genetics of animals

Main future challenge for Animal Breeders:

Breed animals which produce under poor and very variable environmental conditions (feed quality, marginal land usage) with an efficiency that exceeds the current.