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

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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
- Competition 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 emissions (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

- Useful 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

![Graph showing comparison between traditional selection, genomic selection, and crossbreeding with an inferior breed.](image-url)

- Tradit. Selection; _____ Genome selection

Odegard et al. 2008
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)

Efficiency, g/kg DM

Dry Matter Intake, kg/yr

A = Aberdeen Angus,  C = Charolais,  H = Hereford  L = Limousin  S = Simmental
Adaptation: New production systems

- Rapidly changing production environments
  - 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.