Data Requirements for Management and Breeding Purposes in Dairy Cattle

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Why data recording?

Data base for

- **Herd Management**
  - Management reports (within herd) ➔ farmers, advisors, vets
  - Benchmarking across herds ➔ farmers, advisors, vets, administration
  - Cross compliance, quality assurance systems (QA)

- **Breeding**
  - Genetic evaluation (comparison accross herds)
  ➔ Selection of sires and dams (mating programs)
  ➔ Marketing of animals (Total Merit Index, TOP lists)

Farmer: **Herd Management > Breeding**

BO: **Herd Management < Breeding**
Different focus on traits

- Society
  - Animal health
  - Animal behavior
  - Animal wellness
  - Robust animals
  - Methane emission, …

- Consumer
  - Healthy food
  - Cheap food
  - QA, traceability

- Farmer and breeding organizations
  - All classical traits (production, functional & economic traits)
  - Product quality, contents, composition
  - Health traits
  - Feed efficiency, …
Performance recording in the genotyped world

>> We need both Phenotypes and Genotypes ! <<

Phenotype ↔ Genotype

- Today: Genomic evaluation (GE) → Genomic selection (GS)

- Future: For selection and management decisions
  - Unselected cow reference samples
    (complete herds: genotyped & phenotyped)
  - New IT services have to be developed
  - To motivate farmers for genototyping
Performance recording in the genotyped world

In future still valid (more important):

>>>>>> Who knows the phenotypes is king!! <<<<<

- Genotyping (SNP marker) will become cheaper

but

- Recording of reliable and unselected phenotypes will become more expensive (traditional and new traits)

- High data quality for reference samples!!
Integrated data base and IT solutions

Traditionally data are collected and provided by:
- Milk recording organizations
- Herdbook associations
- A.I. organizations
- Linked to national I & R system

In the future:
- Less data from organizations
- More data directly from the farmer (automatic on-farm recording)
- New traits
- Mass data from automatic devices

Great challenge to expand/assure integrated data basis
Integrated IT-Services for dairy breeding (vit)

Dairy farm

- Milk recording
- Registration
- Classification
- Animal sales
- A.I. service
  - natural service
- Identification

Milk recording association

Herdbook association

A.I. stud

Authority respons. for I&R

Identification

Monthly report

Yearly report

Pedigree info

Sales info

A.I. data

Accounting data

Genom data

Performance data

Pedigree data

Mating data

Accounting data

Breeding values

Cattle database

Herdbook association

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Future challenges

- New Phenotypes
  - Animal health and welfare traits recorded on-farm
  - Monitoring system for genetic defects
  - Additional traits from labs
    (spectrometry profiles, methane emission, ketosis, pregnancy tests, ….)

- Automatic on-farm data recording
  - Classical performance data
  - New traits (milking robots, heat detection, pedometer, ….)

- Herd environment information
  (feeding, housing, milking, prophylaxis…. Systems)

- Genotype: Genomic data (customized LD, …… sequence data)
ICAR - CoQ - issues

- **How can we check automatic on-farm data recording and processing?**
  - Compliance with ICAR recommendations?
  - Who is responsible for calibration? (manufacturer, DHI, BO ?)
  - Who is responsible for data analysis? (dito)
  - For all farms?

- **How can we check labs?**
  - Labs have already ISO-CoQ, in which lab processes are audited much more in detail

- **How can we check completeness and correctness of new data for GE?**
  - Health data: Do we get all cases, diagnoses?
  - Consolidation of mass data → Consistent data without loss of information
  - Are all possible plausibility cross checks carried out (just in time)?
Data for breeding programs

Past:
- Breeding organizations got phenotypic data for GE (mostly without costs)

Future:
- Different groups of farmers
  - Production herds (only on-farm recording and analysis) ➔ management
  - ....
  - Herdbook herds ➔ management & selection
  - ....
  - Test/Contract herds with complete and high quality data ➔ cow reference sample for unbiased GE ➔ management, selection, breeding program

- Diversification of recording systems and IT services
- Breeding organisations have to pay (subsidise) farmers for phenotypic data
- Different costs for recording, different data quality requirements
Additional aspects

- International exchange of data and results
  - Harmonisation of trait definitions
  - Unique (life time) animal identification
  - International verification of pedigree data (IDEA)
  - Basis of parentage verification (GenoEx)
  - Exchange of additional individual information (IDEA)
  - Fixed data transfer protocols

- Data security / data protection
  - Authorized access to farmers and BO
  - Data backups
Genetic evaluation (I)

Classical and genomic evaluation will be merged

- Single Step approach

- Bull → Cow reference sample to avoid selection bias

- We need unselected, complete herds genotyped and phenotyped (with high data quality, new traits)

- „Calibration“ of genomic evaluation

- We don’t need EBV for all animals/herds
Genetic evaluation (II)

More focus on „real“ functional traits

- Less conformation, more lab information

- Better (more reliable) data of classical functional traits
  (fertility, mastitis, calving traits, …)

- Survival of calves and cows

- New traits to distinguish culling reasons
  (Health traits, claw disorders, metabolic traits, behavior traits)

⇒ To meet economic demands of industry and animal welfare demands of the society/consumers
International comparison of Total Merit Indices

Holstein 2014: Balanced breeding goal for production and functional traits

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<td>Production (35%)</td>
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<td>Production (30%)</td>
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<td>ESP-ICO</td>
<td>Production (25%)</td>
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</tbody>
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Genetic evaluation (III)

Genomics

- Identification of causal mutations and carriers of recessive genetic characteristics (positive & negative)
- Variability in inheritance (uniform / variable progeny groups)
- **Genomics for management decisions**
  (based on genotypes, phenotypes and more environmental info)
  - G x E
  - Feeding
  - Behavior
  - …
Main issue

Additional benefit for farmers from official milk recording and integrated data bases compared to stand alone herd management systems connected with on-farm recording

Additional traits
Additional analyses / figures (within and accross herds)
Additional management and breeding web-based tools
What expects a farmer?

Integrated (complete but diversificated) IT solutions for management and breeding decisions

- Automatic data recording
- Automatic and secure data exchange with integrated data bases
- Herd data linked to all other data sources
- Just in time data processing
- Comprehensive and significant statistics and figures
- Benchmarking

- Mating programmes considering all available information
- Cows for replacement, beef crosses
- Which genetic fits best to my management system/environment
  - …
Breeding Organizations

- Trend to fully integrated breeding companies
- Covering all fields
  - R&I, data recording, HB, GE, breeding programs, AI, international marketing

- Marketing of AI bulls
  - **Unique selling proposition**
    - New traits, genetic characteristics
    - New indices (Robot, Health, …)
    - More sophisticated mating programs
    - Additional services (pregnancy tests, mastitis tests, …)
    - Consulting services for management and breeding
    - ….
Conclusions

- An integrated data base is a precondition for intelligent integrated IT solutions for the benefit of farmers and breeding organizations.

- Modern communication technologies (web-based, mobile access) enable:
  - Access to all current data at any time and place.
  - Shared simultaneous work on the same data.
  - Access to “unlimited” computer capacities.
  - Decentral use of information with central data/software.

- Phenotypes and genotypes are important:
  - New traits and data sources for breeding and management.
  - High data quality for cow reference samples.
  - Use of genomic information for management purposes.
IT-Solutions for Animal Production