Potential applications of genomic information beyond breeding

DairyCo

Marco Winters
Agenda

• Introduction to DairyCo Breeding+
• Genomics in the UK
• Genomics beyond Breeding
• What does this mean for ICAR members
DairyCo Breeding+

- Responsible for Genetic Evaluation in UK
  - Independent and Paid for by dairy farmers

- All breeds and crosses:
  - Production traits
  - SCC
  - Lifespan
  - Fertility Index
  - Type (excl. B&W)
  - Calving Ease
Impact of genetics

• Very powerful tool

• Seen in cow performance
  – Production traits
  – Fitness traits

• Ensure we get the balance right
  – Constantly evolving knowledge and needs
Genomics in the UK

• Cooperation of:
  – Milk recording (CIS, NMR, UDF)
  – Herdbooks (HUK)
  – Breeding Companies (Cogent, Genus)
  – SAC
  – DairyCo

• Collaboration with North America
  – April 2011

• R&D on Sequencing and across-breed

• Genomic Evaluations – December 2011
Application - Breeding

• Selection of Elite breeding animals
  – Increased Genetic gains

• Males
  – Pre-selection in Young-bulls
  – Higher use of Younger bulls
  – Increased reliability for Older bulls

• Females
  – Higher accuracy of Genetic ability
  – Adding value for marketing
Application – more widespread

• Different density SNP-Chips
  – 3K, 6K, 50K, High Density,…….

• Able to ‘Impute’ genotypes to higher density

• Lower cost Chips
  – Achieving similar accuracies to higher density
  – Enables low cost application beyond Elite animals
Application – Beyond breeding

• Genomic testing soon Routine
  – All cows will have genotype
  – Traceability

• What doors does this open?
  – How can we add value to the farmer

• What could this mean for your business?
• In terms of:
  – Data capture
  – Service provision
Application – Beyond breeding

• Parentage Verification
  – Confirm parents
  – Using ~100 SNPs

• Parentage Discovery
  – Identify parents without prior information
  – Using >1000 SNPs

• ICAR working with ISAG (Int. Soc. Animal Genetics)
  – ICAR WG Genetic Analysis (Paolo Ajmone-Marsan)
  – ICAR WG Parentage (Suzanne Harding)
Application – Beyond breeding

• Screening of all Young stock

• Used for pre-selection for Rearing
  – Ability to save cost by Culling poorest heifers

• Used for more targeted breeding approach
  – Breed Best to Elite sexed semen
  – Bottom end to Beef semen
Application – Beyond breeding

• **Mating Programmes**

• Current Mate Selection done on Phenotype
  – Sometimes combined with Genetic (Pedigree) info
  – Complementary mating on Phenotype

• Future Mate Selection incorporates Genomic data
  – Identify ‘weakness’ in Genetic Make-up
  – Complementary mating on Genotypes

• Ability to better estimate and manage Inbreeding
  – Offer opportunity for Genome targeted ‘cross breeding’?
Application – Beyond breeding

• Management of genetic abnormalities
  – Screening all animals for known defects
  – Tests included as part of Genotyping

• Discovery of ‘new’ genetic abnormalities
  – Need for recording of abnormalities
  – Need for storage of DNA
Application – Beyond breeding

• Revisit ‘old’ and Explore ‘new’ traits
  – Protein fractions (K-casein, Beta-lac.)
  – Fatty acids
  – Disease resistance
  – Feed Efficiency
  – Green House Gas emissions
  – ….
Application – Beyond breeding

- Nutritional Genomics
  - (Nutrigenomics)
  - Interaction Genes x Diet

- Application examples:
  - Personalised feed advice (using better norms)
  - Response to Concentrate Feeding
  - Which cows are pre-disposed to Milk fever
    - Supplement feeding for individual cows
Application – Beyond breeding

- Personalised Genomic Medicine
  - Determine disease risk (Predisposition)
  - Appropriate therapeutic options

- For example
  - Vaccine response
    - Drug application based on Genomic profile
- This knowledge can also help us to:
  - Improved Vaccine manufacturing
  - Breed better ‘responders’ to vaccination
Opportunities and Threats

• Rapid development of Opportunities beyond breeding

• Large R&D investments needed
  – Start-up costs are high and a barrier for some

• Who has access to R&D results?
  – Patents (ICAR-PSAS)

• Need to ensure that the benefits are able to be used cost effectively by the industry
Requirements

• Accurate data needed (lots of it!)
  – Contract recording herds?
• Accurate animal identification
• Harmonised trait definitions
• Sharing (pooling) of Data
• New tools
What does this mean for ICAR

• What should we be recording?
  – More detailed phenotypes

• What services can we build around this?
  – Sample collection
  – Results interpretation

• Herd management software requirement?
  – Storing, Central pooling and Reporting
What should we consider?

• Think about ‘new’ applications

• Also consider;
  – Who owns Genotypes
  – Who owns Phenotypes
  – Who owns Calibration equations

• Can we do this (efficiently) on national level?

• Should we store DNA on recorded cows?
Genomics - Summary

• Faster genetic gains
  – Ensure we get right balance of traits

• Data recording critical
  – Harmonisation of Definition and Recording

• Exciting new opportunities beyond breeding
  – Both for Farmers and Support industries