26/08/2013: Interbull workshop

Genomic selection: impact on the organisation of the breeding sector

Genomic Selection in Kazakhstan:

An example of a country without existing selection program

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Content

- Country situation: dairy production and animal breeding
- Project of genomic selection: the choice for female reference population
- Project implementation
- Benefits on short and long-term
- Conclusion: direct and indirect impact of GS in KZ

Agriculture in Kazakhstan

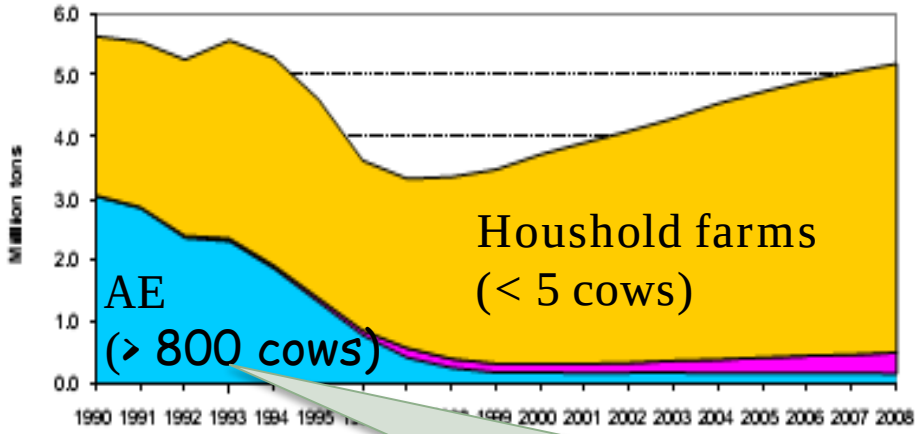
- A large country (4 times France), with a great potential: not only for energy resources but also for agriculture:
  - ⇒Crop (rank 8 for wheat exportation)
  - ⇒Good perspectives for cattle production

82% of agricultural lands

- Current situation:
  - 2 millions of cows (1/3 milk, 2/3 beef),
  - 700,000 IA (2 local AI centres, 10% imported semen)
  - Yearly milk production: about **5 million tons** per year

Dairy production

Milk production from 1990 to 2008



Source: Statistics A

Driven by :

- The
- Kaz
- Loca
- Bree

About 3% of the total milk is delivered by Agricultural Enterprises (corporate farms or cooperatives in an adapted continuation of the Soviet system)
=> better practices: herd management and genetics

- Increase of the milk production of 4.5% in 10 years, due to:
  - Increase of the cattle population
  - Increase of semen import , foreign bulls import for local production of semen
  - Investment in breeding improvement programs, e.g., Genomic Selection

E)

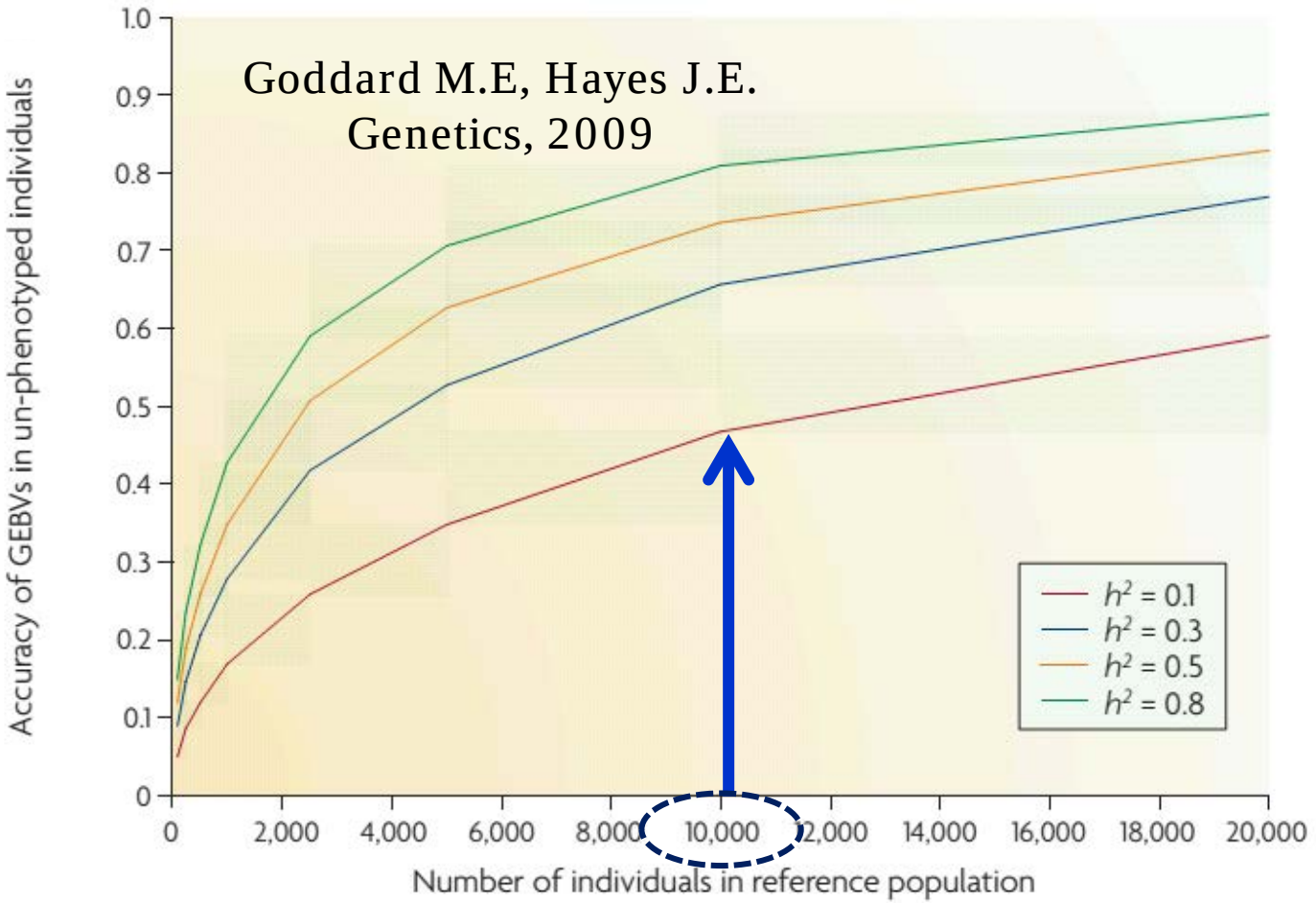
r agriculture) and universities

ally with large farms (AE)

Genomic Selection in Kazakhstan

- **Why?**
  - Need for breeding values to evaluate imported bulls and semen in their local (KZ) environment and be able to use them (by law)
  - Foreign bulls with GEBV (marketing, genetic gap)
- **How?**
  - The choice for genomic evaluations based on a **female reference population = genotyping and phenotyping 10,000 cows in 3 to 5 years**
- **Challenges:**
  - No organized recording system
  - Process of genetic evaluations to be drastically improved (almost inexistant)

A first step towards genetic improvement



Not to be compared with the situation involving existing genetic evaluation s and GS

KazAgroInnovation: project coordination

Genotyping

Having access to genotyping facilities

Molecular lab

Genotyping lab (outsourced)

Targeting farms and animals

Phenotyping

Trait recording

Encouraged by state policies (subsisdies)

Database management

Genetic analyses

Need for data and competences

Targeting farms and animals

Genotyping

Having access to genotyping facilities

Molecular lab

Gentoyping lab (outsourced)

Phenotyping

Trait recording

Encouraged by state policies (subsisdies)

Database management

Genetic analyses

Building a national and international network

Foreign support: research centres, expertises from technical institutes, AI companies…

Having access to genotyping facilities

Molecular lab

Gentoyping lab (outsourced)

Trait recording

Encouraged by state policies (subsisdies)

Database management

Genetic analyses

Kazakhstan – France collaboration: project implementation

Genomic predictions for 40 traits routinely evaluated in France

4 large FARMS
From 1,000 to 4,000 cows

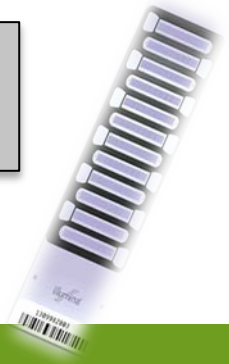
*Blood sample from **1,120** Holstein **cows** (in 2012)*

University

Extract DNA

LABOGENA

Genotyping (54k, Illumina)



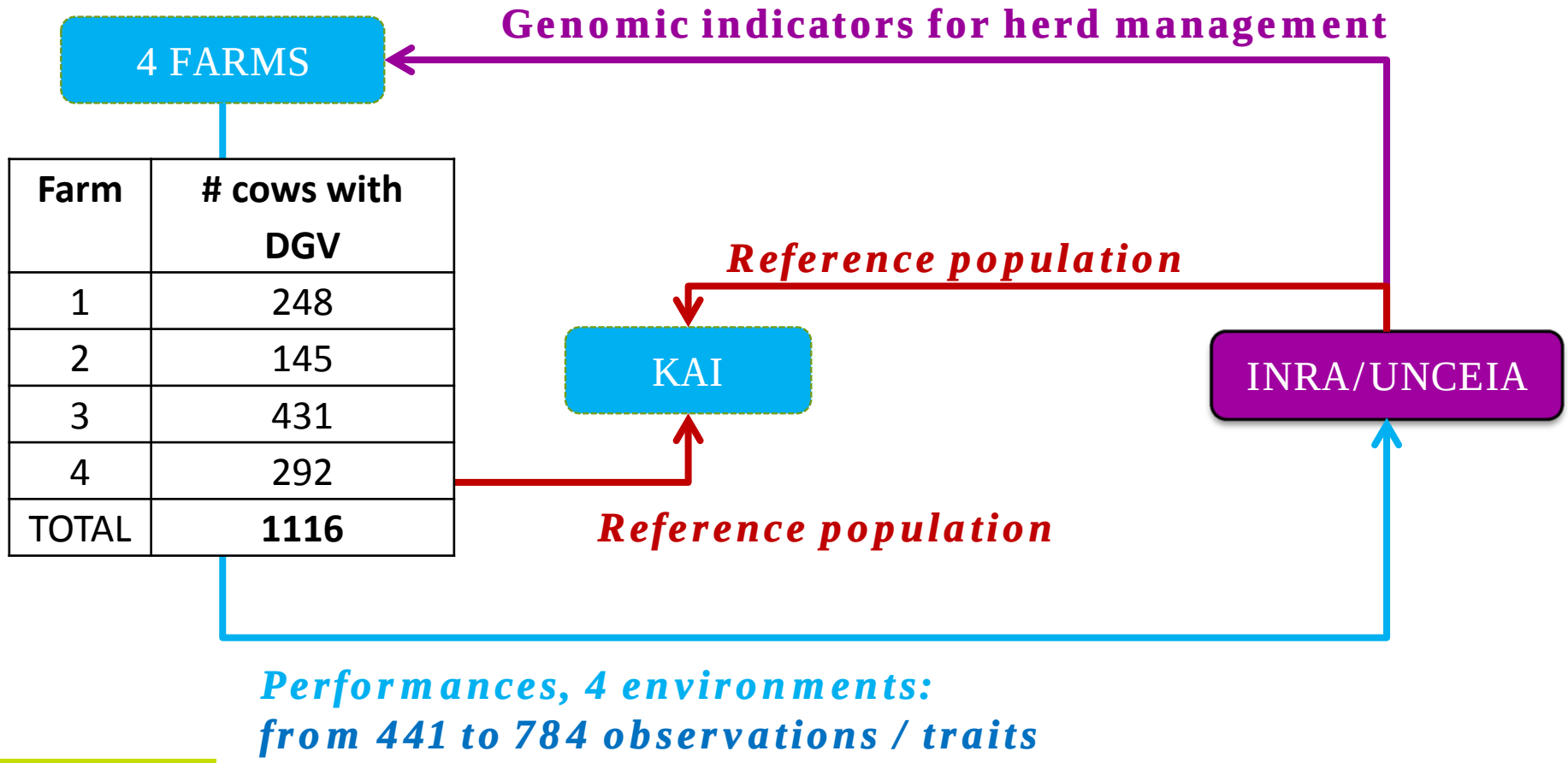
+ 1,000 to be genotyped in 2013

INRA/UNCEIA

Computation of genomic breeding values

(QTL-BLUP model, no pedigree information => DGV)

Kazakhstan – France collaboration: project implementation



Farm	# cows with DGV
1	248
2	145
3	431
4	292
TOTAL	**1116**

Issues

1. **Are the « French » genomic predictions relevant for cows in Kazakhstan?**
   - Equations developed from « French » phenotypes, while:
     - very different environmental and practices in livestock management
     - different definitions of traits
     - different ways of trait measurement
     - not the same genetic structure of the population (genetic diversity)
   - Missing information: pedigree

2. **Is the quality of the KZ phenotyping (recording system) reliable?**

⇒ ***Correlation between observations on farm and genomic predictions?***

Correlations between observations (KZ) and predictions (FRA)

Contrasted ρ levels

lower ρ levels

higher ρ levels

Traits	h^2 (French parameters)	Farm 1	Farm 2	Farm 3	Farm 4
Milk yield	~0.35	0.09	0.15	0.11	0.27
Fat percentage	~0.35	0.19	*NA*	-0.07	-0.02
Protein percentage	~0.35	0.14	*NA*	0.02	-0.14
Height	*0.51*	0.21	0.26	0.27	0.50
Body depth	*0.36*	0.11	0.09	0.19	0.32
Sacrum Angle	*0.33*	0.28	0.26	0.27	0.23
Hind legs side view	*0.10*	0.11	0.05	0.31	-0.01
Hoof Angle	*0.10*	-0.05	0.23	0.10	0.08
Udder Depth	*0.36*	0.15	0.26	0.27	0.19

Consistency ?

- Results:
  - For some traits: somehow high correlations whereas the performances were not yet corrected for any environmental effect
  - Big contrasts between farms, correlations sometimes close to zero

  ⇒ Variability of the levels in between farms, quality of the data collected? Variability of the recording practices

- Lessons

  ⇒ Difficult to conclude on the relevancy of the genomic predictions according to the French equations

  ⇒ Harmonization/ improvement of the recording systems (ICAR)

Benefits from foreign genomic predictions for cows in KZ

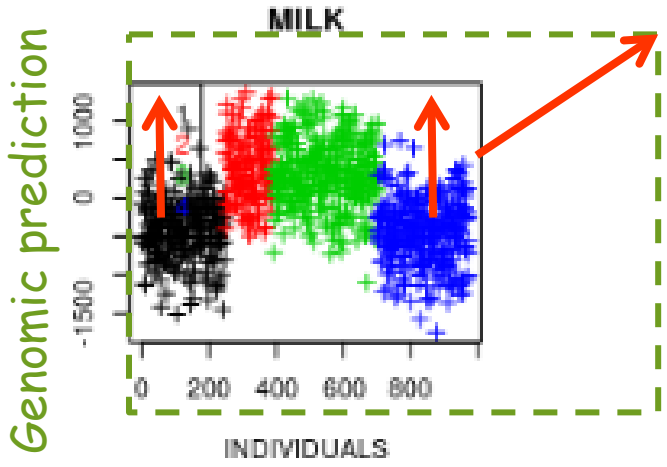
- On the long term: **provides genotypes for the female reference population**
  - ⇒ However, it is a large investment to be maintained along the years
  - ⇒ Need to be encouraged to keep all the actors motivated and involved (farms, Ministry, KAI)

- On the short-term: **provides « indicators » for herd improvement**

⇒ between herds comparison : strength and weakness of a herd

⇒ within herd comparison : mating and culling management

⇒ Encourage the improvement of the phenotyping and the database management



Impact on the organisation of the breeding sector?

- Genomic Selection is a project difficult to implement, with benefits on the very **long-term**: **local and adapted genetic improvement program: genetic trend especially on new traits (of interest for KAI)**

- **Initial stimulus and speeding up** of all the process for genetic improvement due to the opportunities offered by Genomic Selection, at different levels:
  - Global level: Federating actors in a network for breeding improvement
  - Technical level: Adoption of international standards
  - Academic level: Training in Animal breeding
  - Farm level: better management practices

- Challenges:
  - Extend to a larger number/type of farms
  - **Maintain motivation and investments over the years** // political situation in KZ (unstability)

Genomic Selection in Kazakhstan

THANK YOU ! Спасибо!

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