

# NATIONAL GENETIC IMPROVEMENT PROGRAMS: CHALLENGES AND REWARDS

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Why Are National Genetic Evaluations Needed?

What are the challenges?

What are the rewards?

Results from DPO Field Data set

Final Thoughts

## Why Are National Genetic Evaluations Needed?

Provide a Uniform Comparison Tool Across a Country

Maximize Accuracy of Prediction and Animal Rankings

Selection and Mating Tool Uni & Multibreed

Marketing Tool Increase Economic Value of Animals

## What Are the Challenges?

Well-Connected Population

Adequate Nutrition & Management

Data Collection & Maintenance System

Genetic Evaluation System

Continuity & Dynamic Goals

Flexible Organization & Resources

## Well-Connected Population

Dairy

Beef

Holstein  
Thai Brahman  
Thai Native  
Red Sindhi  
Friesian x Sahiwal F1 (Austr, New Zealand)  
Indian Friswal  
Jamaica Hope

Charolais  
Simmental  
Limousin  
Brangus  
American Brahman  
Thai Brahman  
Thai Native  
Red Sindhi

## Thai Mating Strategies

Primarily Crossbreeding

Upgrading (e.g., to Holstein)  
Intermediate Crossbred Groups

Straightbred and Crossbred Sires

Straightbred and Crossbred Dams

## Multibreed Population

Population composed of purebred and crossbred animals that interbreed

Complete

Incomplete



## Numbers of Sires



	BGS					
BGD	A	.75 A	.50A	.25A	B	Br
A	27	9	15	17	26	26
.75 A	20	12	15	15	27	20
.50A	27	11	15	17	31	29
.25A	20	9	13	13	24	16
B	19	11	13	16	42	21
Br	19	8	13	15	21	31



## Dairy Matings



	Breed Group of Sire				
BGD	H	.75H	.50H	.25H	T
H	X				
.75H	X	X			
.50H	X	X	X		
.25H	X	X	X	X	
T	X	X	X	X	X



## Beef Matings



	Breed Group of Sire				
BGD	C	.75C	.50C	.25C	T
C	X				
.75C	X	X	X	X	X
.50C	X	X	X	X	X
.25C	X	X	X	X	X
T	X	X	X	X	X

## DPO Multibreed Population

Incomplete Multibreed Population

Holstein, Native, Brahman, Red Sindhi, Sahiwal, Jersey, Red Dane

*Bos taurus - Bos indicus*

Holstein - Other

(Native, Brahman, Red Sindhi, Sahiwal, Jersey, Red Dane)



## Numbers of Sires



	BGS	
BGD	H	(.63-.99)H
(.8-1.0)H	78	4
(.6-.79)H	103	6
(.4-.59)H	76	5
(.2-.39)H	17	2
(0-.19)H	14	1



## Numbers of Dams



BGD	BGS	
	H	(.63-.99)H
(.8-1.0)H	115	9
(.6-.79)H	168	12
(.4-.59)H	92	7
(.2-.39)H	15	2
(0-.19)H	15	2



## Numbers of Daughters



BGD	BGS	
	H	(.63-.99)H
(.8-1.0)H	127	9
(.6-.79)H	178	12
(.4-.59)H	106	7
(.2-.39)H	17	2
(0-.19)H	15	2

## Multibreed Contemporary Groups



Sex Calf  
x  
Age Calf  
x  
Environment



## Connectedness



Contemp Group			
1	X		
2	X	X	
3	X	X	X
4		X	X
5	X	X	X
6	X	X	
7	X		

## Multibreed Group 1



## Multibreed Group 2



### Multibreed Group 3



### Multibreed Group 4



### Multibreed Group 5



### Adequate Nutrition & Management

- Nutritional Level -> Increase
- Management -> Intensive
- Health Care -> Intensive
- Production Costs -> Increase
- Returns -> Increase or else ...

### Data Collection & Maintenance System

- Reproduction, Production, Health, Pedigree
- Accurate & Efficient Data Collection
- System Responsive to Changes in Biology and Technology
- Periodic Equipment Upgrades

### More specifically ...

- Data for Current and Future Traits
- Data on All Effects Related to All Traits
- Complete Pedigree (Animals, Sires, Dams)
- Breed Identification and Breed Composition (Animals, Sires, Dams)
- Date1, {Measurements1}, ...

## Genetic Evaluation System

Structure and Size of the Population

Large, Unbalanced, Multibreed

Genetic-Statistical Models

Traits, Effects, Linear, Nonlinear

Computational Strategies

Direct, Iterative

Resources

Human, Hardware, Software

Implementation

## Identify Traits and Effects

Number and Type of Selection Traits  
(continuous, categorical, biological, synthetic)

Genetic and Environmental Effects

Additive

Nonadditive

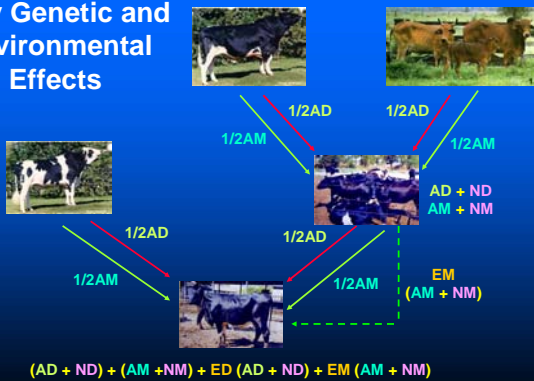
Direct

Maternal

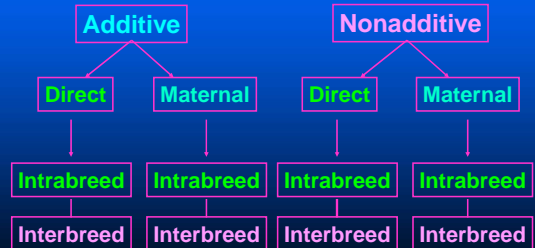
Intrabreed

Interbreed

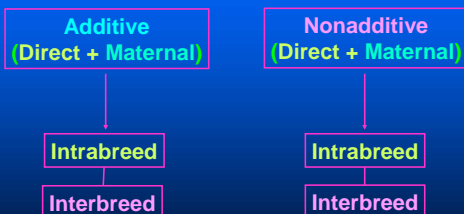
## Dairy Genetic and Environmental Effects



## Chart of Genetic Effects



## Chart of Environmental Effects



## Statistical-Computational Strategies

Effects	Prediction	Covariance Components
Additive	Subclass	Regression
Nonadditive	Regression	Regression
Environmental	Subclass	Regression

## DPO Multibreed Model

Record

Herd-Year-Season  
Regression (Age Dam/ H or BT)

Regression (UnkMgs & Mgd/H or BT)

Sire and Mgs Additive Direct

Sire Intra & Interbreed Nonadditive Direct

Residual

## DPO Multibreed Genetic Bases

Additive Genetic Base

=

Mean of Holstein Alleles from  
Purebred and Crossbred Animals

Nonadditive Genetic Base

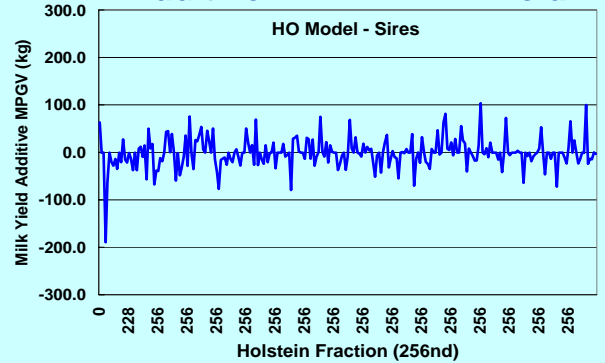
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Mean of H/H and O/O Intralocus Interactions  
from Purebred and Crossbred Animals

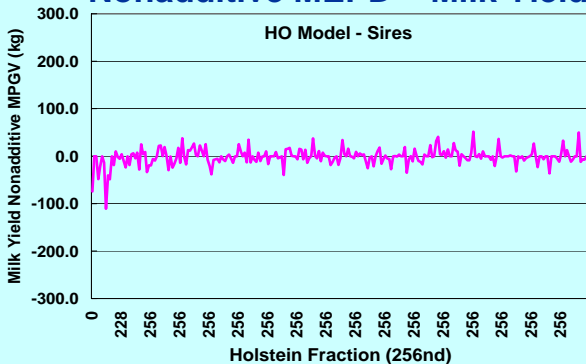
## DPO Multibreed Genetic Predictions

MEPD	Direct (D)
Additive (A)	AD
Nonadditive (N)	ND
Total (T=A+N)	TD

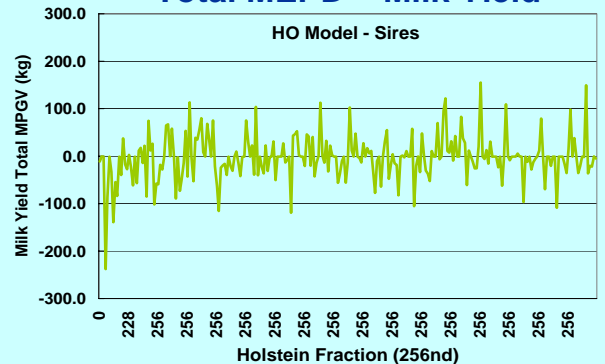
## Additive MEPD – Milk Yield



## Nonadditive MEPD – Milk Yield



## Total MEPD – Milk Yield



## Publication of MEPD

Paper Multibreed Sire Summaries  
Additive (Feasible)  
Nonadditive, Total (Unfeasible)

Electronic Multibreed Sire Summaries  
Additive, Nonadditive, Total

Mating Program Service

## Continuity & Dynamic Goals

Long-Term Genetic Program  $\leftrightarrow$  Continuity

Production Goal  $\Rightarrow$  Increase Production

Economic Goal  $\Rightarrow$  Increase Returns

Genetic Objective  $\Rightarrow$  Identify & Multiply  
Desirable Animals

Dynamic Goals  $\leftrightarrow$  Dynamic Genetic Strategy

## Flexible Organization & Resources

Dynamic Goals  $\leftrightarrow$  Flexible Org & Resources

(Future) Wider Variety of Target Traits  
(Economic, Biological)

Additional Sampling Procedures  
(Hair, Microchips)

Research-Development Partnerships  
Technological & Equipment Upgrades

## What Are the Rewards?

Genetic Trends

Objective Decisions  
Genet, Prod, Econ

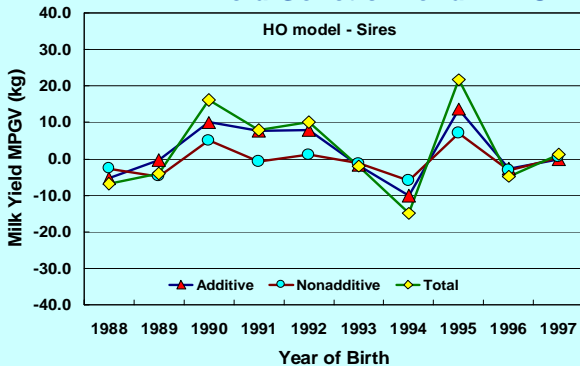
Improvements  
Nutrition  
Management  
Health

Well-Documented  
Population

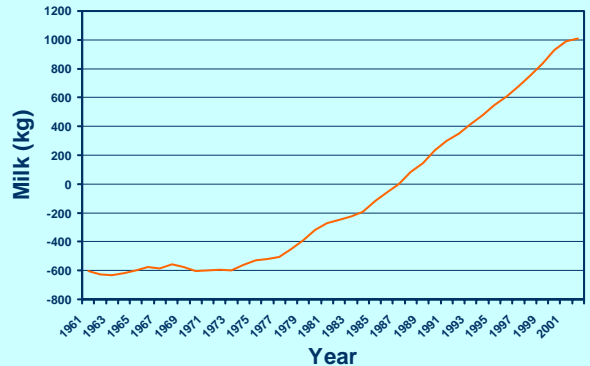
Realistic Projections

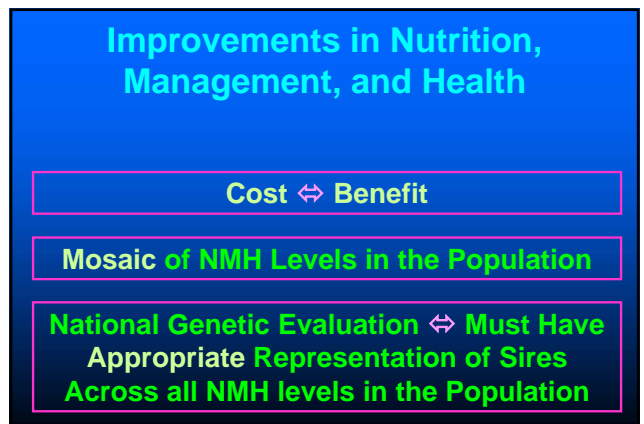
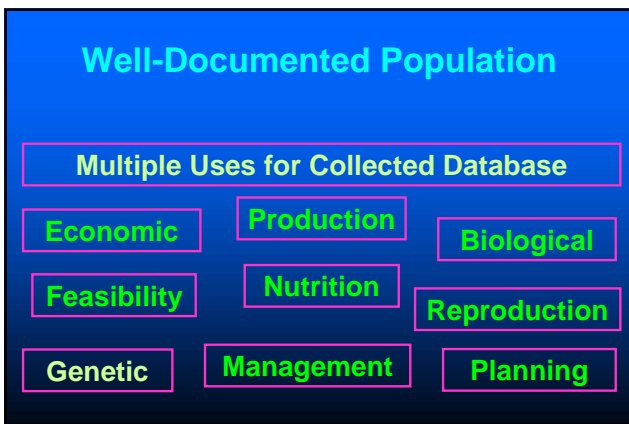
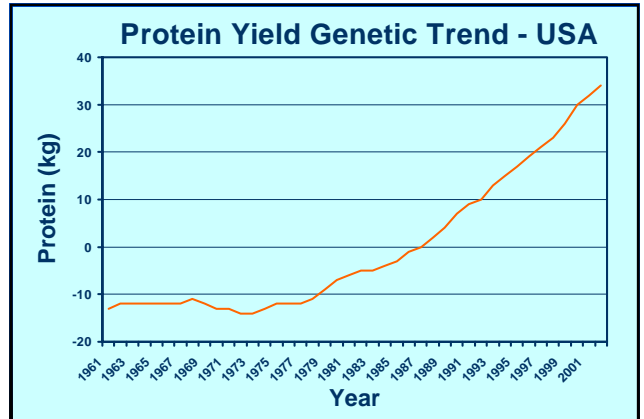
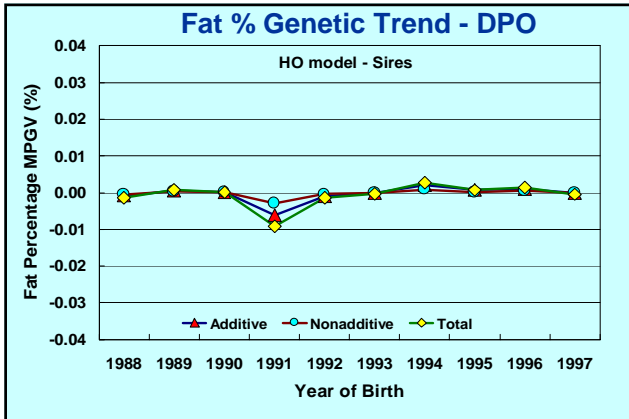
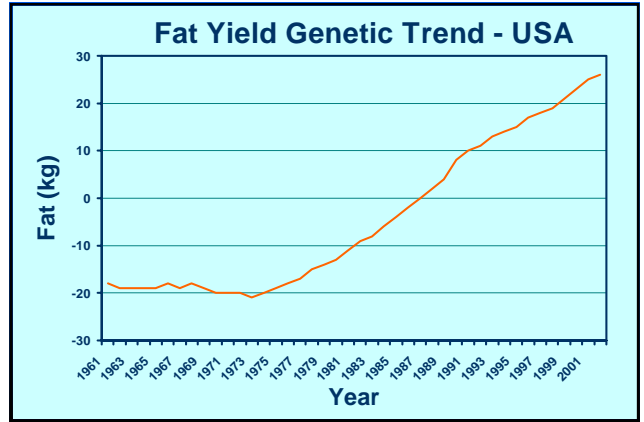
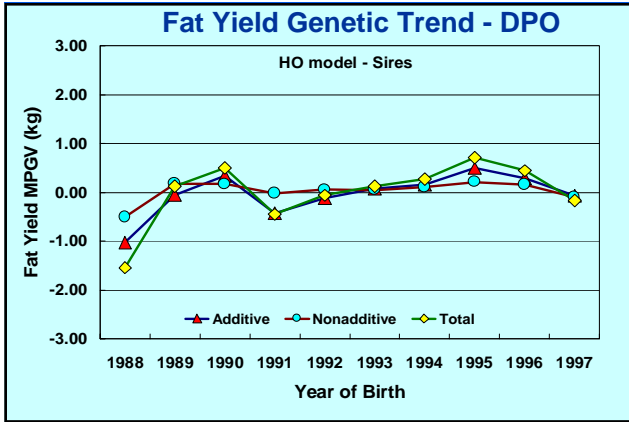
Organization  
Responsive to  
Market Changes

### Milk Yield Genetic Trend - DPO



### Milk Yield Genetic Trend - USA







## Objective Decisions: Genetic, Managerial, Economic

Decisions Can Be Evaluated Iteratively



Current Decisions



Revised Results

Current Results



Revised Decisions



## Realistic Projections

Realistic Expectations

Minimize (Projections – Actual Results)

Increase Trust and Cooperation

Better Planning and Allocation of Resources

## Organization Responsive to Market Changes

Research & Development Alliances  
and Partnerships

Facilitate Development of Innovations

Help Keep Cattle Industry Competitive

## Final Thoughts

Basic Structure for a National Dairy Cattle  
Genetic Evaluation already in place

Reorganization, Alliances, Partnerships,  
Collaboration ↔ Research & Development

Dairy Only ↔ Dairy & Beef