

# DEVELOPMENT AND UTILIZATION OF GENOMIC INFORMATION FOR EFFECTIVE PIG PRODUCTION

## - RECENT ACHIEVEMENTS AND FUTURE PROSPECTS

Masaaki Taniguchi Aisaku Arakawa Satoshi Mikawa

Animal Genome Research Unit

National Agriculture and Food Research Organization



## Reproduction

Comparison of reproductive performance between countries

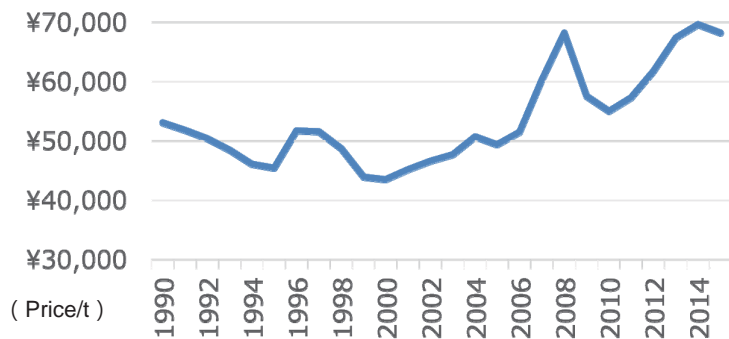
	JPN	USA	CAN	DNK
Piglets/litter (B/A)	9.2	10.5	10.2	13.0
Deliveries (A)	2.2	2.37	2.32	2.27
Piglets weaned/year (B)	20.2	24.94	23.59	29.62

JPN: Japan Pork Producers Association (2009)  
Other: BPEX "2012 Pig Cost of Production in Selected Countries"

Breeds	Piglet weaned/year	
	2010	2020
Landrace	9.9	10.8
Large White	10.0	10.9
Duroc	8.9	9.4

A-23

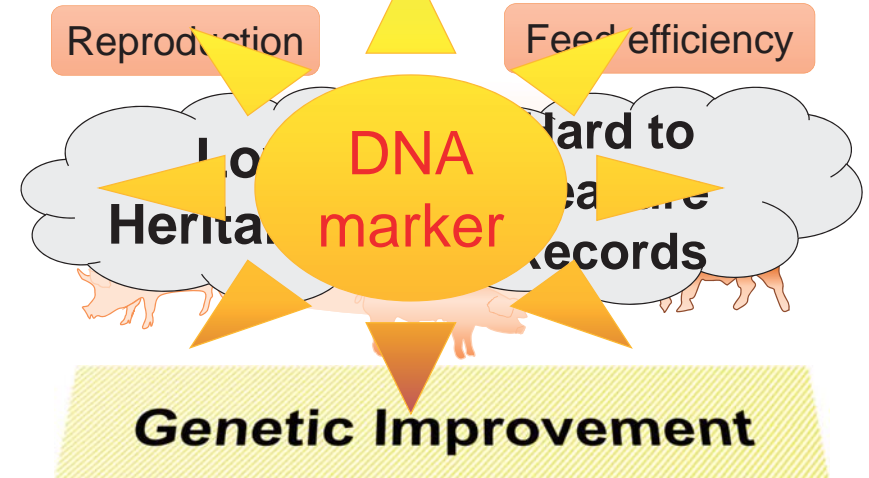
## Feed efficiency



Ministry of Agriculture, Forestry and Fisheries "Index of agricultural cost"

Breed	Average Daily Gain		Feed conversion ratio		Feed 300kg Bw 100kg
	2010	2020	2010	2020	
Landrace	800	900	3.0	2.9	
Large White	800	910	3.0	2.9	
Duroc	870	1,000	3.1	2.9	

## Breeding scheme using DNA-marker assisted selection



## What's Genome? DNA marker?



size **3Gb** = DNA **3 billion**

**1%** ( 30 million ) **Species** difference

**0.1%** ( 3 million ) **Individual** difference

Polymorphisms

Single nucleotide polymorphism **SNP**

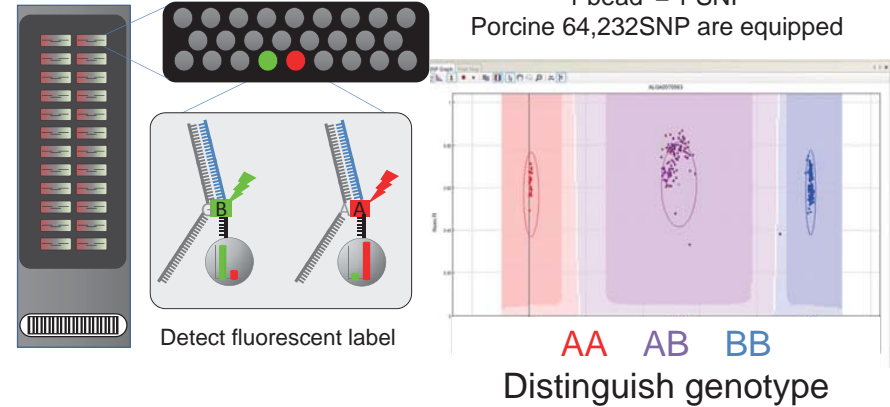
Development of useful tool to analyze genetic aspect

allows to analyze 64,000 SNPs simultaneously

## Genotyping by SNP array

PorcineSNP60 v2 BeadChip (Illumina Inc.)

1 bead = 1 SNP  
Porcine 64,232SNP are equipped

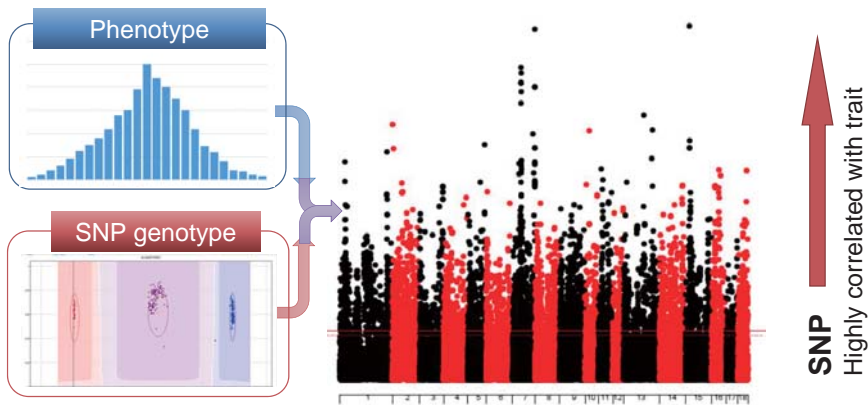


~ **¥20,000**/sample

(~\$180US, ~4M VND) including DNA preparation etc...

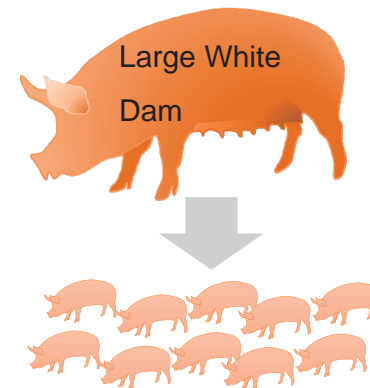
A-24

## Genome-wide association study (GWAS)



Pig Genome **3 Gb** / **60K** SNP = **50 kb**  
Average interval between 2 SNPs

## Reproduction: Total number of piglets



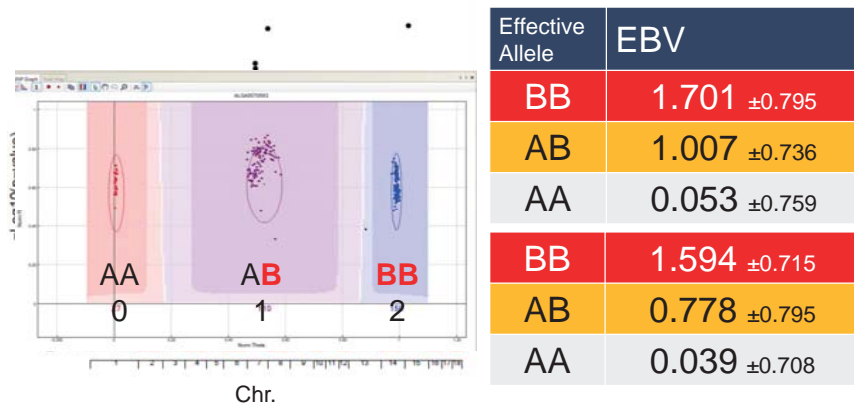
**Dams records**

15,121 litters

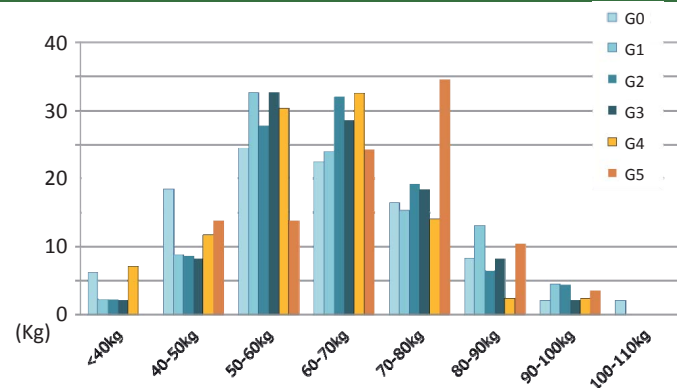
**SNP genotyping**

474 heads

## DNA marker: total number of piglets



## Comparison of total bodyweight of piglet at weaning between generations [Landrace]

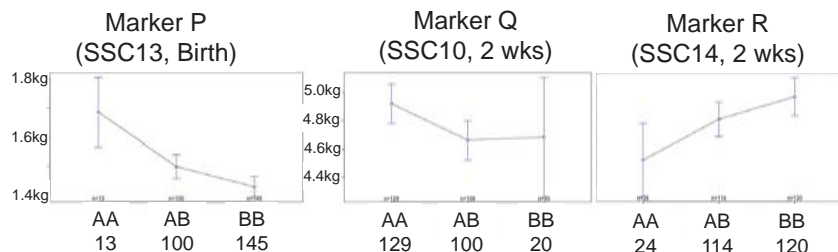


Trait	G0 generation	G5 generation
Total bodyweight of piglet ( Primiparous )	55.4kg 9.9 piglets avg. <b>5.6kg</b>	<b>67.3kg</b> <b>10.4 piglets</b> <b>avg. 6.5kg</b>

A-25

## GWAS & DNA marker detection: Growth rate of piglets

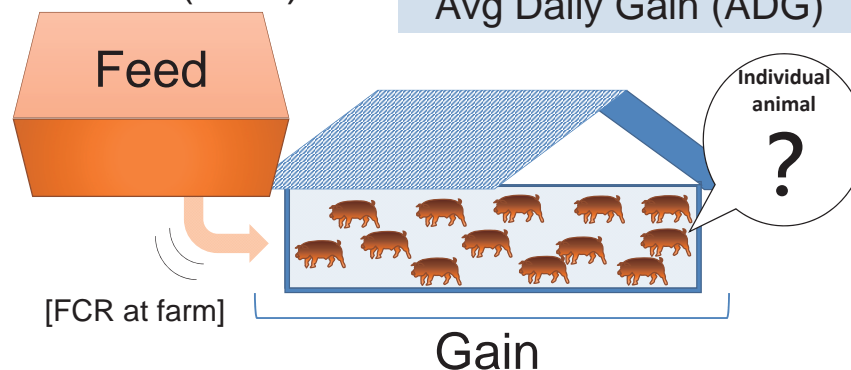
### Comparison of average body weight of piglets between genotypes of DNA markers



Using progeny generation,  
**similar effect of SNPs was observed**  
=> Available DNA marker for breeding scheme

## Feed efficiency

$$\text{Feed conversion ratio (FCR)} = \frac{\text{Avg Daily Feed Intake (AFI)}}{\text{Avg Daily Gain (ADG)}}$$



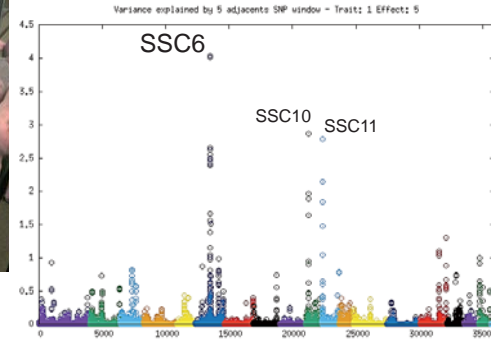
# FIRE® system: Automated recording



Feed Intake Recording Equipment (FIRE®)  
OSBOURNE Industries Inc.

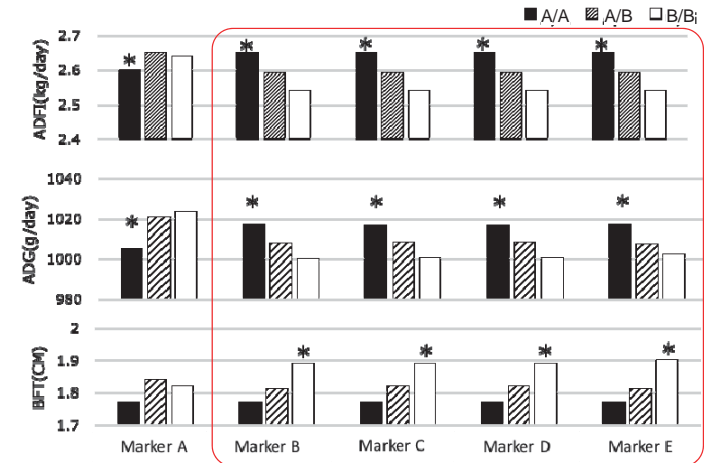


Duroc population  
1622 feeding records with SNP genotyping data  
GWAS



A-26

# DNA marker for feed efficiency

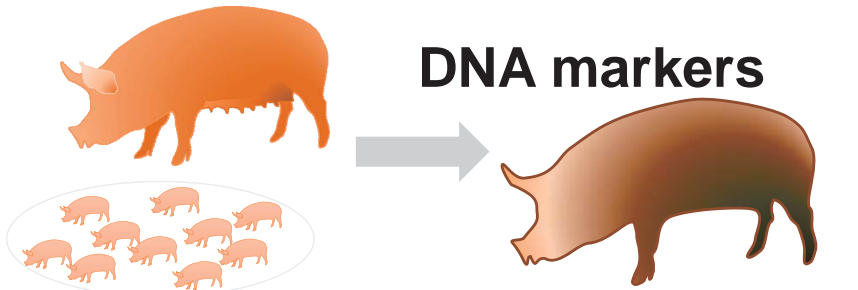


**Figure 3 Effect of genotypes on feed efficiency traits**  
ADFI, average daily feed intake; ADG, average daily gain; BFT, backfat thickness.  
Genotypes are shown in A/A, c and B/B.  
Asterisks show significant difference.  
Markers B-E are linked together (400kb).



# DNA marker for Reproductive performance

Dam's SNP data

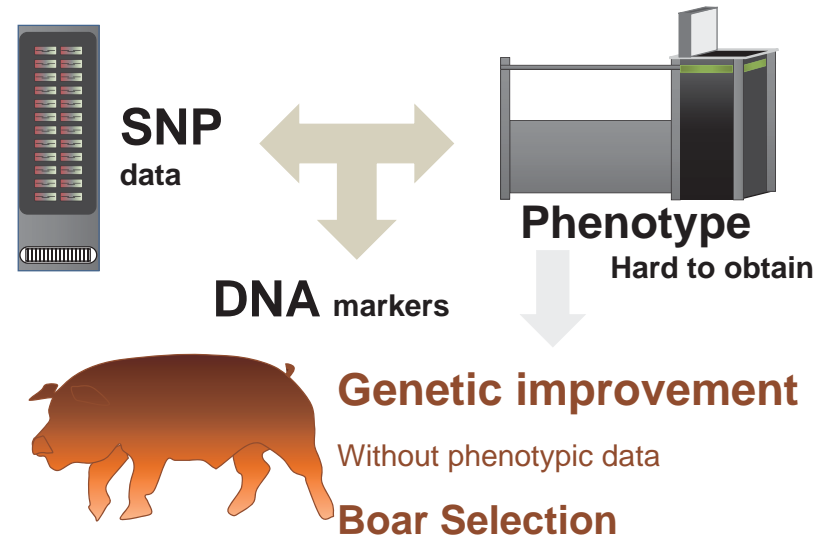


Total No. Piglets

Boar Selection

Growth rate of piglets

# DNA markers for Feed efficiency

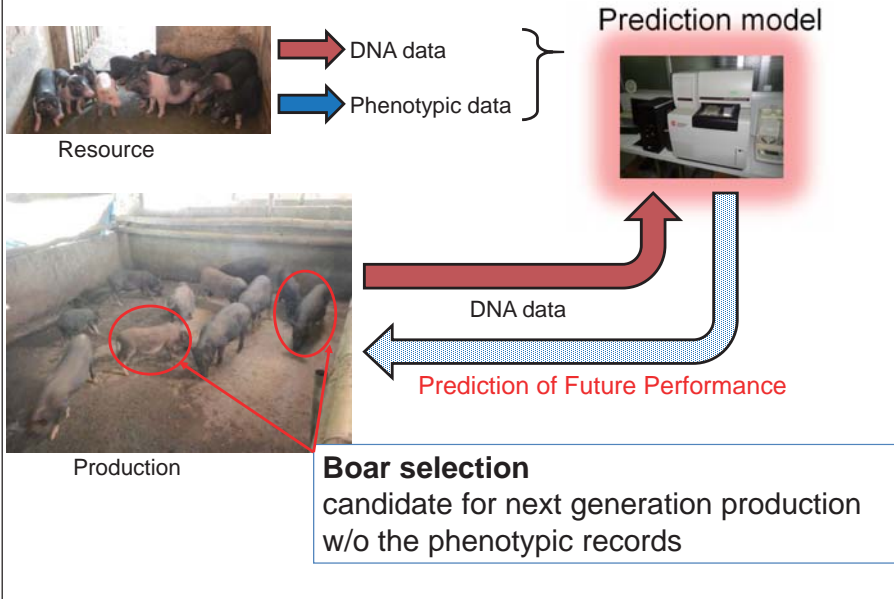


Genetic improvement

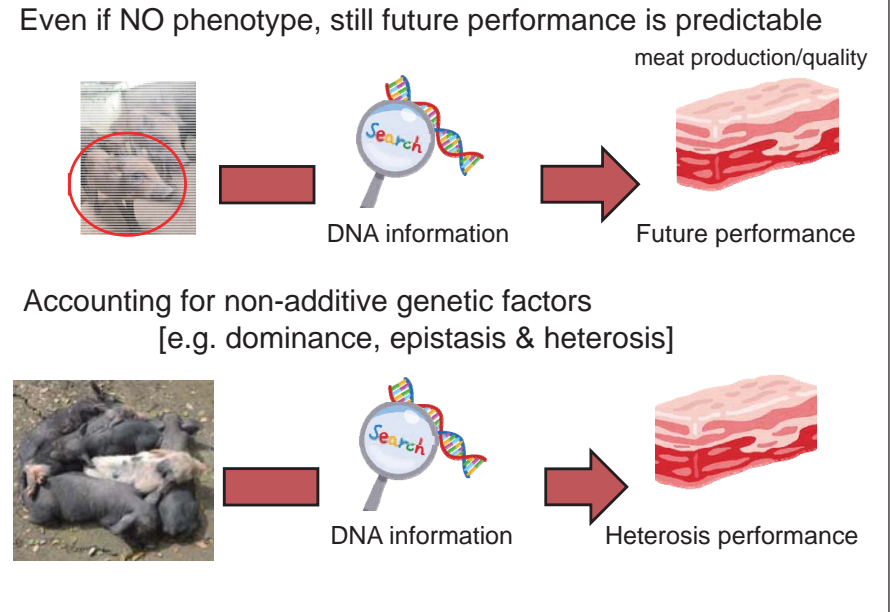
Without phenotypic data

Boar Selection

# Genomic selection in pig production



# Merit of genomic selection



A-27

# Acknowledgement

- Tohoku University  
Professor Dr. Keiichi Suzuki
  - National Livestock Breeding Center  
Dr. Shuji Sato
  - JATAFF Institute  
Dr. Takeya Morozumi
  - ZEN-NOH Livestock CO. LTD.  
Dr. Kensuke Hirose
  - ZEN-NOH National Federation of Agricultural Co-Operative Association  
Dr. Kazuo Fukawa
  - Shizuoka prefecture  
Dr. Kei Terada
  - Gifu Prefecture  
Dr. Go Yoshioka
  - Chiba Prefecture  
Dr. Chiaki Matsumoto
  - Tokushima Prefecture  
Dr. Masahiro Nii
- CIMCO corporation, Pacific Ocean Breeding Co. Ltd, Frieden, Toyohashi-shiryō

**Thank you**