

Agricultural genetic resources in rural development

Brussels, 8th December 2014



Research on farm animal genetic resources in Poland



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National Research Institute of Animal Production

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- Own projects and research



Polish diversity



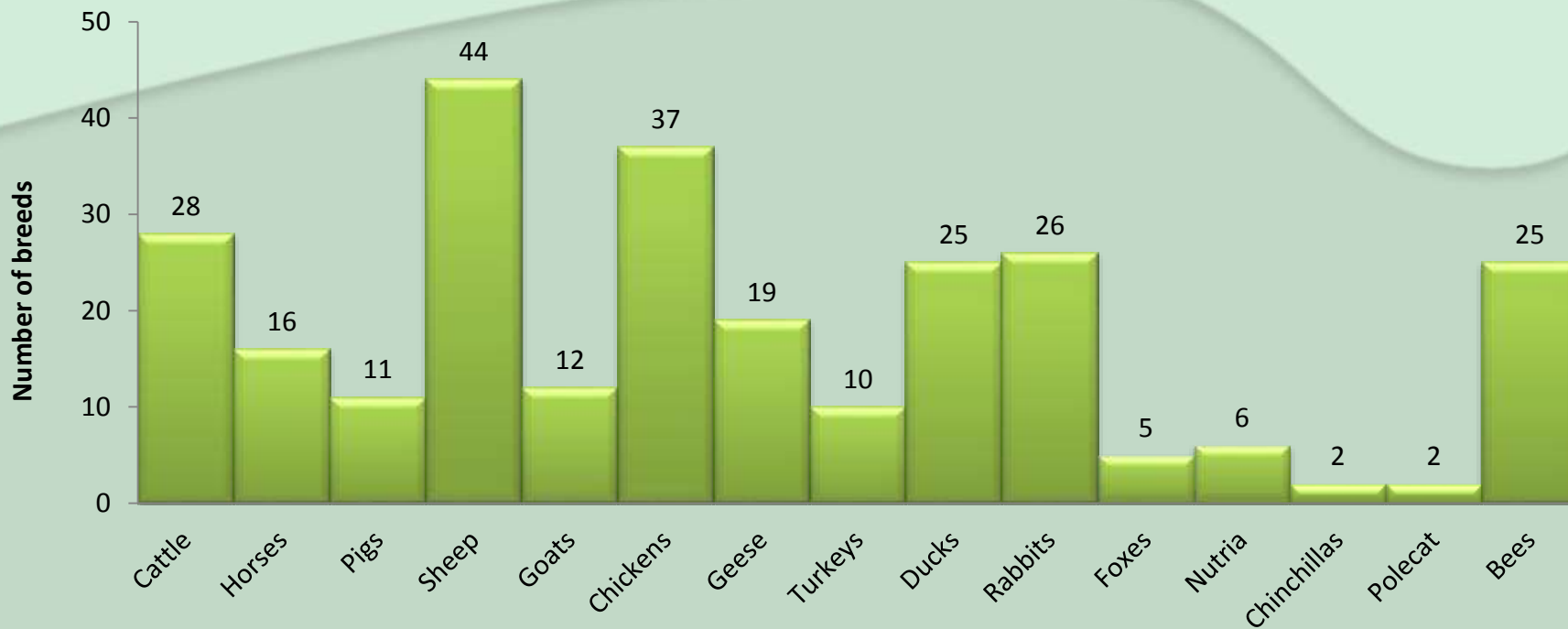
Key facts: Polish diversity

- Land utilisation:
 - Agricultural land 47,9 %
 - Forests 30,0 %
 - Others lands 22,1 %
- 91.3% of lowland areas up to 300 m above sea level
- Protected areas cover 32% of total area of the country,
- Arable areas under organic agriculture only 0,2%.

Key facts: Polish diversity

- Dispersed agricultural structure (1,5 mln farms in 2012)
- Poland: important agricultural producer and exporter
- Conventional methods of farming – mixed semi-intensive production system
- No significant negative impact of agriculture on environment
- Rapid expansion of high-input systems: poultry & dairy
- Extensive systems: difficult environmental conditions & small farms

Breed structure in livestock species



The number of breeds of farm animals in Poland in 2013 (EFABIS)

In 2012: 6 602 000 LU of key species :

Cattle: 5 776 800 heads

Pigs: 11 581 300 heads

Sheep: 266 800 heads

Horses: 222 200 heads



Research institutions involved in research on AnGR and rural development

- Institutes of the Polish Academy of Sciences
- Institutes of the Ministry of Agriculture and Rural Development
- Agricultural/ Life Sciences Universities & colleges



National Research Institute of Animal Production

- Established in year 1950 by the Ministry of Agriculture
- One of the largest Polish national research and development institutes
- Since 23 November 2006 got the status of the State Research Institute
- Designated by Ministry of Agriculture and Rural Development to perform various livestock breeding related responsibilities
- Operate on the basis of MYPOW and research grants



National Strategy for Sustainable Use and Conservation of Farm Animal Genetic Resources

To fulfil obligations resulting from:

- The Convention on Biological Diversity (CBD)
- Global Plan of Action for Animal Genetic Resources adopted by the FAO
- Strategy for Sustainable Development of Agriculture and Fisheries for the years 2012-2020 of the Ministry of Agriculture and Rural Development
 - Objective 3. Food security
 - Objective 4. Increase the productivity and competitiveness of the agri-food sector
 - Objective 5. Environmental protection and adaptation to climate change in rural areas

This Strategy sets out a model of agriculture based on family farms.



Research objectives of the Institute

The **strategic objectives** of the research is modification of animal production methods, incorporating advanced, molecular technologies, conservation of biodiversity, ecology, animal welfare and the farming community as a source of raw materials and products safe for health.

- I. Use of advanced molecular technologies in the genetic improvement of production and functional traits livestock
- II. Opportunities to shape the quality of raw materials and animal products to fulfil consumers' expectations
- III. The use of biotechnology in farming, pharmacy and biomedicine
- IV. Animal Biodiversity conservation methods *in situ* and *ex situ* under sustainable agriculture
- V. Environmental protection and welfare as part of shaping the modern livestock production

The structure of the Institute

The Institute includes the following:

- Seven research departments
- The Main Laboratory in Aleksandrowice
- The Laboratory of Separate Genomics Unit,
- The Laboratory of Animal Cytogenetic and Molecular Genetics Department
- The National Feed Laboratory in Lublin
- The Horse Genetic Markers Laboratory
- The National Bank of Biological Materials
- Nine experimental stations

The scientific staff : 82 scientific researchers
and 41 engineering and technical workers



Nine experimental stations all over Poland



Experimental Stations are of a crucial importance to the Institute.

- play an important role in performance recording (four progeny testing stations)
- provide excellent conditions to carry on research

National Bank of Biological Materials opened on 22 October 2014

- Biological material: semen, embryos and egg cells
- Species coverage: cattle, sheep, pigs & horses





The most important areas of research and development



Use of molecular technologies in genetic improvement

Separate Genomics Unit

- **Next Generation sequencing**

- whole genome sequencing (de novo / resequencing)
- targeted resequencing (exome & amplicon sequencing)
- RNA sequencing (mRNA, small RNA)
- Chip-Seq – DNA-protein interactions

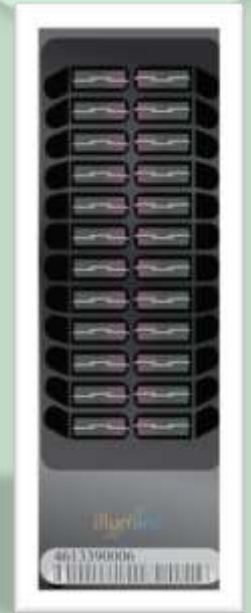
HiScanSQ (Illumina):

- **SNP microarrays**

- genome-wide SNP panels (cattle, pigs, sheep, dogs, mice)
- genome-wide association studies (GWAS)
- identification of copy-number variation (CNV)

- **Expression microarrays**

- transcriptome analysis of human and mice

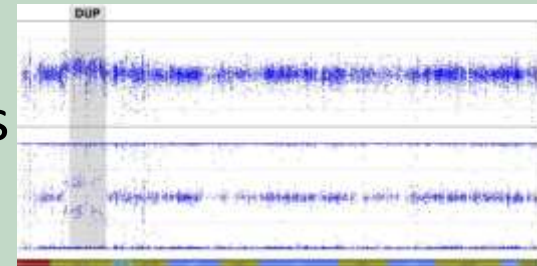


The Laboratory of Genomics

Current projects:



1. SNPs genotyping for genomic selection in cattle
2. Genetic characteristics of Polish Red cattle using high density SNP microarrays
3. Genome re-sequencing of two Polish Red bulls
4. CNV identification in Polish cattle breeds
5. Analysis of methylation status of different genes and genomic regions
6. Study of polymorphism and expression of genes determining meat quality in farm animals
7. Analysis of imprinted genes responsible for economically important traits in farm animals



Use of biotechnology in farming methods

Department of Biotechnology of Animal Reproduction



Calf born after insemination with sexed sperm



Cloned goat



Rabbit obtained as a result of somatic cloning (2003)



Transgenic boar obtained in xenotransplantation project (2003)

The use of biotechnology in farming methods, pharmacy and biomedicine

Department of Animal Nutrition and Feed Science

Mitigating the processes of aging and neurodegenerative changes in human by nutrition using animal models

- Background: A ketogenic diet improves brain function in animals with neurodegenerative diseases.
- The aim of the study is to better understand the protective mechanisms of diet on the nervous system.
- An animal model - the Vietnamese pig
- The study will allow to observe the impact of the diet on brain metabolism.
- The last phase would focus on the development and examination of special purpose feed additive inhibiting neurodegenerative processes.

Animal biodiversity conservation and environmental protection as a part of modern livestock production

Department of Animal Genetic Resources Conservation

The National Research Institute of Animal Production:

- National Focal Point for Animal Genetic Resources
- Coordinates conservation activities in the country
- Maintains conservation herds of native breeds on Experimental Stations

MULTI-YEAR PROGRAMME OF WORK:

Conservation and sustainable management of national farm animal genetic resources



Animal Genetic Resources Conservation Department

Number of herds of animals included in genetic resources conservation programmes
(data of November 2014)

Species	Number of breeds/ strains / lines	Number of herds	Number of females
Horses	7	1 321	5 728
Cattle	4	808	7 304
Sheep	13	748	52 328
Goats	1	2	29
Pigs	3	72	1 644
Layer hens	19	20	17 179
Geese	14	15	5 035
Ducks	10	10	3 992
Rabbits	1	10	350
Fur animals (foxes, chinchillas, polecats, nutrias)	12	28	903
Total	84	3 035	94 492
Local lines of bees	5	-	3000 families
TOTAL	89	-	-

Cattle



Polish Red cattle



Whitebacked cattle



Polish Black and White cattle



Polish Red and White cattle

Horses



Polish Konik



Hucul



Malopolski horse



Wielkopolski horse



Silesian horse



Sokolski horse



Sztumski horse

Pigs



Zlotniki White pig



Zlotniki Spotted pig



Pulawy pig

Sheep



Podhale Zackel



Wrzosowka sheep



Swiniarka sheep



Wilekopolska sheep



Zelazna sheep

Sheep



Coloured Merino



Coloured Mountain sheep



Urhusk sheep



Pomerianian sheep



Old type Polish Merino



Polish Corriedale



Kamieniec sheep



Olkusz sheep

Chicken 10 strains



Geese 14 strains



Ducks 10 strains



Fur animals
12 populations



Nutria



Beige chinchilla



Popielno White rabbit



Polecat
(*mustella putorius*)



Pastel fox



White-necked fox

Bees (5 lines)



Carp
6 lines



Trout
2 lines





Sustainable use



- Protection of traditional production systems of high quality products
- Preservation of unique landscapes
- Preservation of cultural values of native breeds and regional identity

Polish mountain sheep of color variety



The project "black sheep" - restoration of Polish mountain sheep of color variety in Landscape Park of Poprad River. The project is part of the „ The Poprad River Highlanders - Identity of Three Culture" implemented in the framework of the dissemination of culture through the actions of the Ministry of Culture and National Heritage



New projects: some examples

- Further development and application of breeding value evaluation methods
- Genomic selection for application in farm animal breeding to improve performance and functional traits
- Identification of markers determining content of animal products and their organoleptic quality
- Fine tuning of methods for analysis of fodder content, digestibility and value nutrition
- Enhancement of dietetic value of animal origin products
- Development of methods and technologies to enhance reproductive potential in farm animal species
- Evaluation of different production system in the context of animal welfare
- Impact of animal production on environment

From Science to Practice: some examples

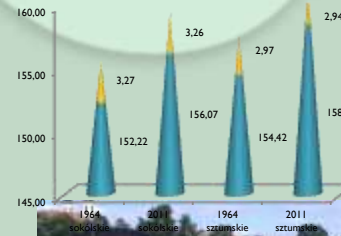


- Evaluation of breeding value of dairy cattle, pigs, sheep
- Extension and consultation on all matters related to animal breeding and housing conditions
- Organization of National Animal Exhibition in Poznan
- Organization of conferences, courses and training in the field of animal production and conservation of animal genetic resources
- Reintroduction Landes geese in France and Leine sheep in Germany
- Rehabilitation through contact with animals - Solidarity Plus. Activities related to biodiversity conservation to support rehabilitation, reintegration and restoration of values

Own projects

- Horse genetic resources conservation programmes (2)

- Estimation of genetic distance between local breeds
- Analysis meet quality of local breeds
- Genetic determination of chronic progressive lymphedema (CPL)
- Evaluation of working predisposition of local breeds
- Monitoring and selection of cold-blooded horse breeds



- Bee genetic resources conservation programmes (5)

- Identification of the occurrence of Central-European bees (*Apis mellifera mellifera*)
- Monitoring and selection of bee populations



Summary

1. Safe food production as a most important objective of livestock production
2. Utilisation of animal models in human medicine application of genetically modified animals for xenotransplantation and production of biopharmaceuticals will increase in importance
3. Fulfilling public expectations regarding animal breeding to support of sustainable agriculture requires substantial investments in development of interdisciplinary teams research and enhancement of knowledge
4. Poland, and in particular, the National Institute of Animal Production has got modern facilities and a strong research capacity that is not fully used due to limited access to funding for research

Thank you for your attention

