GENE-SWItCH

TRANSFORMING PRECISION BREEDING WITH NOVEL TECHNOLOGIES

THE *GENE-SWITCH* PROJECT

Using innovative technologies, the GENE-SWItCH project has embarked on a cutting-edge journey to advance precision breeding in monogastric animals. In this article, we explore the remarkable contributions of the project, focusing on our efforts to address critical issues in the realm of genomics, environmental impact, and predicting animal performance.

THE ISSUE

Precision breeding, while holding immense potential, faces several challenges. These include limited access to functional genomic information, the environmental impact on the genetic makeup, and the ability to accurately predict animal performance for complex traits, particularly those most relevant to the agroecological transition and Green Deal objectives.

The GENE-SWItCH project recognised these challenges and committed to finding solutions that could transform the field of precision breeding in pigs and poultry.

GENE-SWitCH
CONTRIBUTION TO SOLUTIONS

1 **Genomic Information Availability:** The project embarked on enhancing genomic information availability. By recognising the importance of accessible reference data on genome functionality, we contributed to using the world-wide recognised European genomics platform, *Ensembl* *(https://www.ensembl.org/)*. This effort has paved the way for researchers in public institutes and private companies to use an impressive amount of well-annotated and easily accessible genomic data. The *GENE-SWitCH* project's high-quality genomics data across a range of tissues and developmental time points significantly enhances the pig and chicken reference annotations. This promises heightened awareness of genotype-environment interactions, benefitting researchers in public institutes and private companies, the general public, and farmers to develop a more sustainable European livestock sector.

2 **Predicting Animal Performance:** *GENE-SWitCH* introduced cutting-edge tools that harness biological data to predict relevant phenotypes.
We recognised the challenge of foreseeing animal traits solely based on genomic information. To meet this challenge, we have added the layer of functional genomic data to the genetic one to predict which animals will best suit tomorrow's breeding systems.
These innovative tools pave the way for breeding more robust and adaptable monogastric species. Once widely adopted, these tools could benefit the farming sector by enhancing agricultural sustainability and productivity.

3 **Environmental Impact:** *GENE-SWitCH* explored the complex interplay between the environment and the genome. Our research explored how changing environments, specifically diet, can influence the genetic makeup of the progeny. The findings revealed subtle yet significant epigenetic effects of maternal diets on offspring in pigs, opening doors to further studies and precision breeding investigations (*see Article on Healthy Diets*).

APPLICATION AND POTENTIAL IMPACT

The impact of these solutions extends far beyond the research labs. Enhanced genomic information availability fosters collaboration, empowers farmers with valuable insights, and can lead to more informed breeding decisions to implement sustainable livestock farming. Improving tools for predicting animal performance signifies a paradigm shift in breeding practices, potentially increasing food production efficiency while minimising resource usage, thus aligning with global efforts to reduce environmental harm. It will also help to manage genetic diversity and adapt animals to climate change's impacts. Understanding the environmental impact on the genome can lead in the future to complementary measures to genomic selection.

GENE-SWitCH CONCLUSIONS AND NEXT STEPS

In summary, **GENE-SWitCH** project's collective efforts and strong stakeholder outreach activities have advanced science and paved the way to transform the animal breeding sector, thus contributing to global sustainability goals and the well-being of both farmers and consumers. The project's dedication to innovation underscores its mission to create a more resilient, efficient, and environmentally conscious poultry and pig production sector.
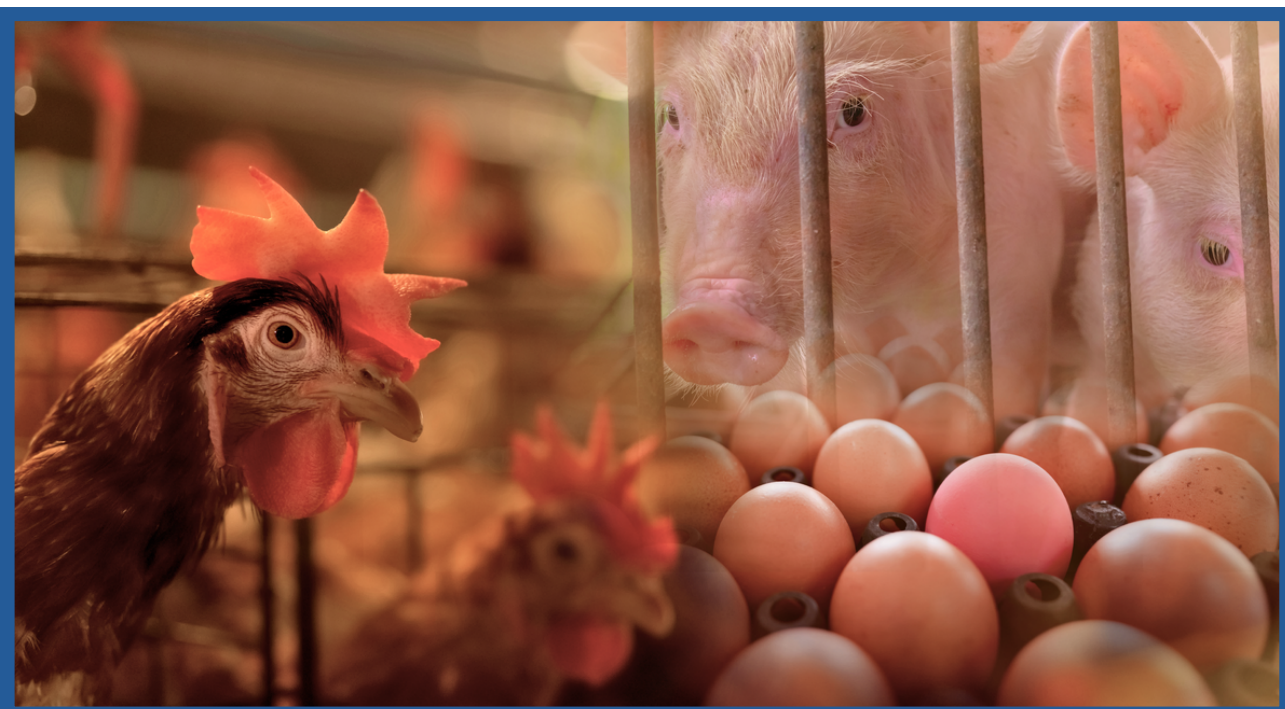
GENE-SWitCH
CONCLUSIONS AND NEXT STEPS

Building upon the achievements of the GENE-SWitCH project, the following areas should be prioritized for funding research to further advance precision breeding with novel technologies:

1

EXPANDING GENOMIC INFORMATION AVAILABILITY:

- Expand and refine genomic databases for pigs and poultry, including comprehensive annotations, functional information, and links to phenotypic data.
- Continue to support projects and research that aim to enhance the accessibility and quality of genomic information. This could include funding for database maintenance, expansion, and initiatives to promote data sharing among researchers and businesses.
- Develop user-friendly interfaces and data visualization tools to make genomic information accessible to a broader range of researchers, breeders, and feed producers.

2

ENHANCING ANIMAL PERFORMANCE PREDICTION:

- Integrate functional genomics, transcriptomics, and other omics data to improve the accuracy of animal performance predictions for complex traits.
- Develop machine learning and artificial intelligence algorithms to model the complex interactions between genetics, environment, and management practices.

3

EXTEND AND EXPLORE THE APPLICATION OF PRECISION GENOME EDITING TECHNOLOGY:

- Continue to develop the technology and regulatory framework to expand the utilisation of genome editing for precision breeding.

4

DEEPENING ENVIRONMENTAL IMPACT UNDERSTANDING:

- Conduct in-depth studies on the epigenetic effects of environmental factors, such as diet, stress, and climate, on farmed animals' genetic makeup and performance.
- Further, develop predictive models to assess the long-term impact of environmental changes on livestock genetics and identify strategies for mitigating negative effects.

5

FOSTERING COLLABORATION AND KNOWLEDGE TRANSFER:

- Encourage comparative studies that draw insights from genetics and breeding practices in different animal species to identify common principles and innovative solutions.
- Support collaborative research networks and knowledge exchange platforms to facilitate sharing of data, tools, and expertise among researchers, breeders, and farmers.
- Develop educational programs and training workshops to enhance the understanding and application of precision breeding technologies among stakeholders.
- Encourage international collaboration in research, as it allows for shared expertise, resources, and data.

By prioritizing these research areas, the development and deployment of precision breeding technologies will be accelerated, contributing to a more sustainable, productive, and resilient European livestock sector.

GENE-SWitCH

**GENOMIC REVOLUTION:
TRANSFORMING PRECISION BREEDING
WITH NOVEL TECHNOLOGIES**

**Join us for a more sustainable and resilient
pig and poultry production in Europe!**