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1. Breeding goal scenarios
 2. To quantify EU policy options
 3. On pig reproductive traits

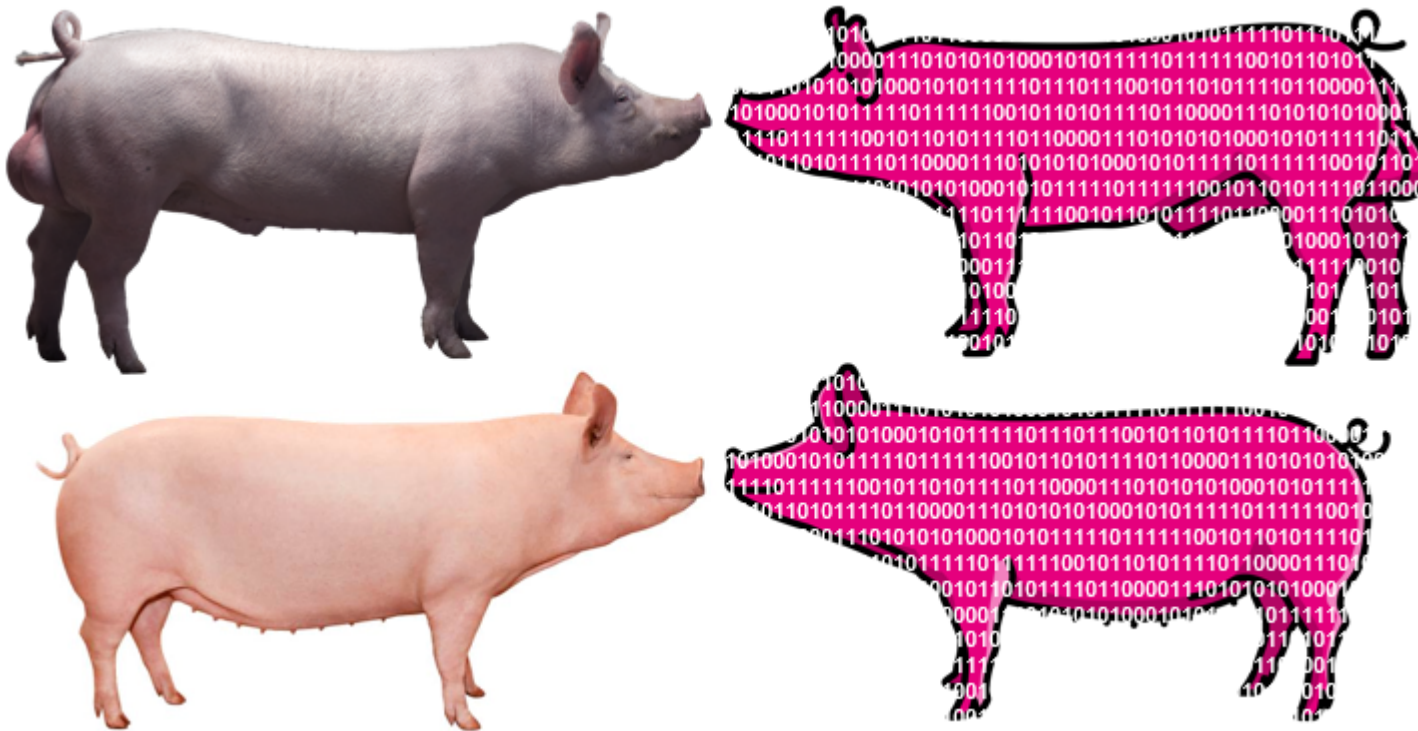
2024-09-03 – EAAP, Italy

E.H.A.T. Hanenberg, L. Vargovic, T. Pook, E.F. Knol

(1) Breeding goal scenarios

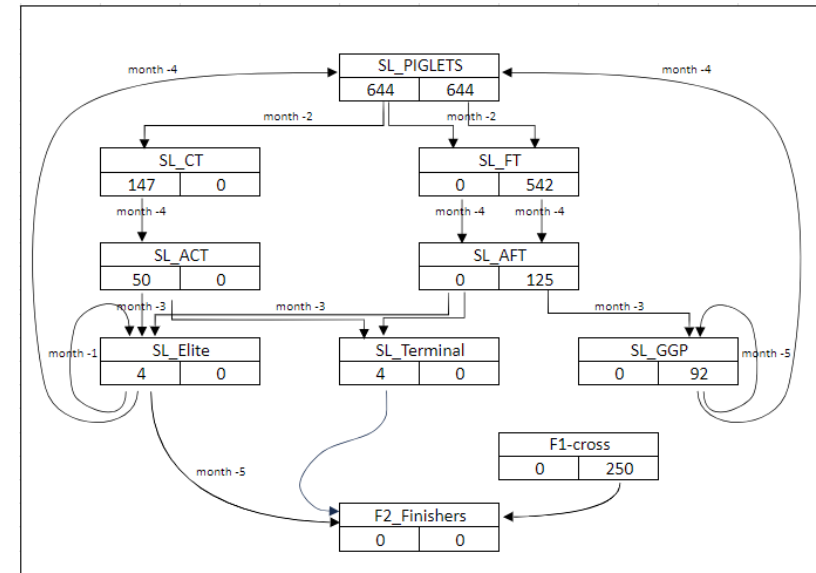
MoBPS - Creating a digital twin

Used to simulate a series of scenarios



Breeding structure

- Pure dam line and F1
- Monthly basis
- Steps:
 - Generate animals / matings
 - Phenotyping and genotyping
 - BVE
 - Selection and animal flow
- Traits:
 - Variance components Topigs Norsvin genetic parameters (align with literature)



Traits in a simulation

Reproduction:	Mothering ability:
Survival:	Finishing:

Traits in a simulation

Reproduction:

- **TNB** (Total born piglets)
- **STB** (Stillborn piglets)
- *Derived trait:*
 - **NBA** (born alive piglets)
 - **NWP** (number weaned piglets)

Mothering ability:

Survival:

Finishing:

Traits in a simulation

Reproduction: • TNB (Total born piglets) • STB (Stillborn piglets) • <i>Derived trait:</i> • NBA (<i>born alive piglets</i>) • NWP (<i>number weaned piglets</i>)	Mothering ability: • LMO (Litter mortality) • LBW (Litter birthweight) • LVR (Litter birthweight variation) • NTE (Number of teats)
Survival:	Finishing:

Traits in a simulation

Reproduction: • TNB (Total born piglets) • STB (Stillborn piglets) • <i>Derived trait:</i> • NBA (born alive piglets) • NWP (number weaned piglets)	Mothering ability: • LMO (Litter mortality) • LBW (Litter birthweight) • LVR (Litter birthweight variation) • NTE (Number of teats)
Survival: • RFM (Rear to Finish mortality) • STF (Stiff front and hind leg movement) • IWI (Interval wean to 1st insemination) • SHS (Shoulder score at weaning) • BCS (Body condition score at weaning) • LGY (Longevity)	Finishing:

Traits in a simulation

Reproduction: • TNB (Total born piglets) • STB (Stillborn piglets) • <i>Derived trait:</i> • NBA (born alive piglets) • NWP (number weaned piglets)	Mothering ability: • LMO (Litter mortality) • LBW (Litter birthweight) • LVR (Litter birthweight variation) • NTE (Number of teats)
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(2) To quantify EU policy options

Background

- To remain sustainable and competitive, pig breeders have developed balanced breeding programs; keeping focus on production efficiency alongside better AHW, environmental impact reduction, etc.
- Welfare of pigs on farms
 - EU Commission - comprehensive evaluation of the welfare legislation (Farm to Fork Strategy)
 - EFSA requested by the EU Commission to investigate welfare of pigs, including prolific sows and their piglets



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Welfare of pigs on farm

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ORIGINAL RESEARCH article

Front. Anim. Sci., 20 July 2023

Sec. Animal Breeding and Genetics

Volume 4 - 2023 | <https://doi.org/10.3389/fanim.2023.1218175>

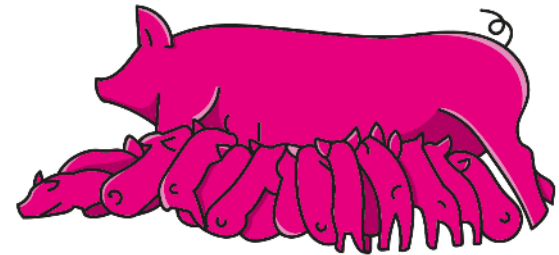
Genetic and phenotypic time trends of litter size, piglet mortality, and birth weight in pigs

Pieter W. Knap^{1*} Egbert F. Knol² A. Christian Sørensen³ Abe E. Huisman⁴ Dianne van der Spek²
Louisa J. Zak² Ana Granados Chapatte⁵ Craig R. G. Lewis⁶



Strategies for surplus piglets - EFSA

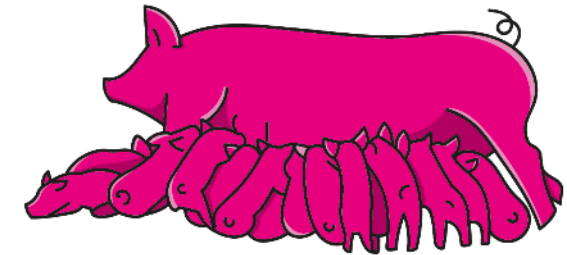
- Proposed **corrective** strategies for surplus piglets
- Proposed **preventive** strategies for surplus piglets



Proposed **corrective** strategies for surplus piglets

Farm Management optimization

- Split suckling, cross-fostering, early creep feed
- Artificial milk in home pens
- Artificial piglet rearing systems
- Use of a nurse sow



Proposed **preventive** strategies for surplus piglets

Genetic selection

- Adapting the herd's **average litter size** to the physical capabilities of the sow
- The average # NBA within a breed/line $\leq$ # average # **functional teats**
- Increased **within-litter birth weight** uniformity
- Increased **perinatal** survival
- Selection **against intrauterine growth retardation** at the maternal level to increase survival within 24 h post-partum
- Increased **survival of born alive** piglets
- Increased sow **longevity**

(3) On pig reproductive traits

Simulations - scenarios

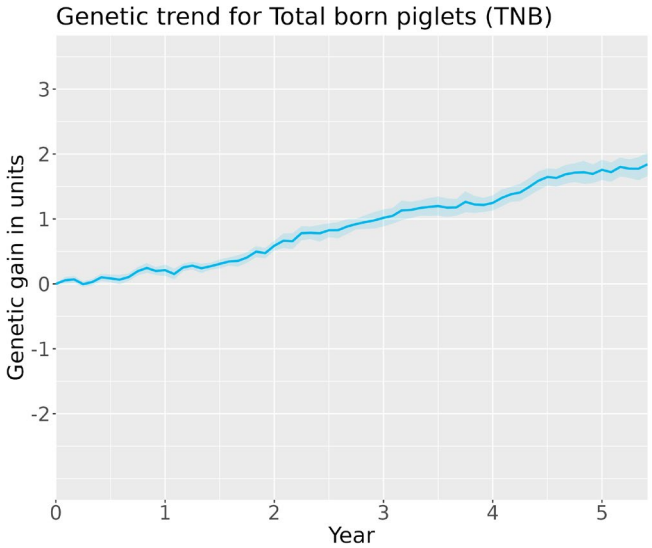
Scenario	Description
BASE	Base MEVs
TNB_025	Reduced MEV for TNB
EU	No MEV for TNB, include subjective MEV for NTE and LVR
LMO_STB_0	No MEV for LMO and STB

Description	Trait	BASE	TNB_025	EU	LMO_STB_0
Total born piglets	TNB	0.50	0.25		0.50
Stillborn piglets	STB	0.50	0.50	0.50	
Litter mortality	LMO	0.50	0.50	0.50	
Litter birth weight variation	LVR			2.00	
Number of teats	NTE			0.50	

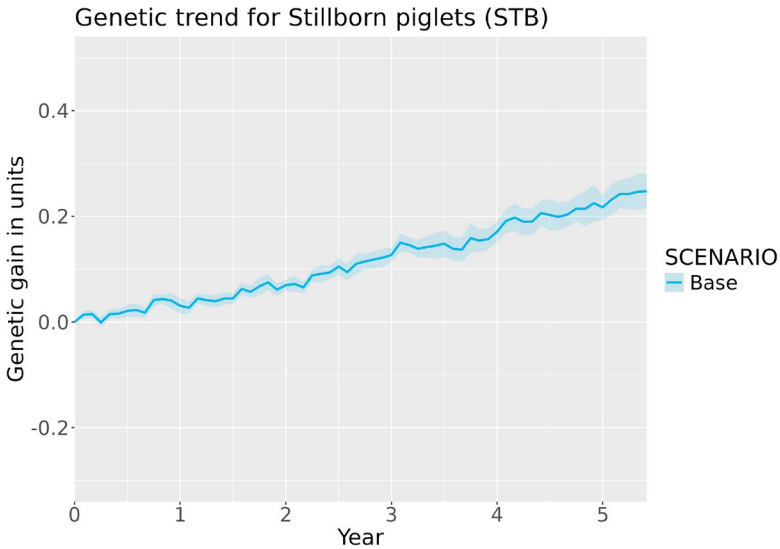
Summary main results

Scenario	% Relative response	ΔG (Euro/year)	ΔF (%/year)	r_{IH}
BASE	100	1.02 ± 0.05	0.57 ± 0.04	0.61
TNB_025	91	0.93 ± 0.03	0.54 ± 0.04	0.61
LMO_STB_0	97	0.99 ± 0.04	0.74 ± 0.08	0.60
EU	58	0.59 ± 0.05	0.64 ± 0.08	0.60

Genetic trend BASE

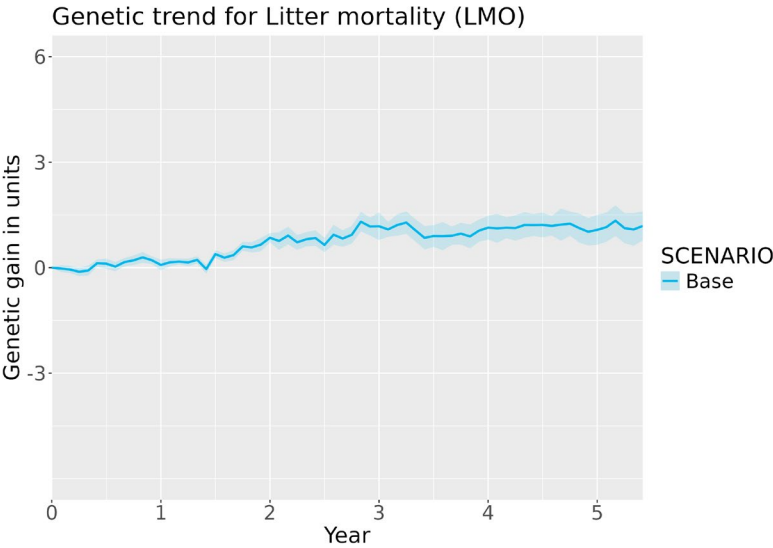


← Total born piglets

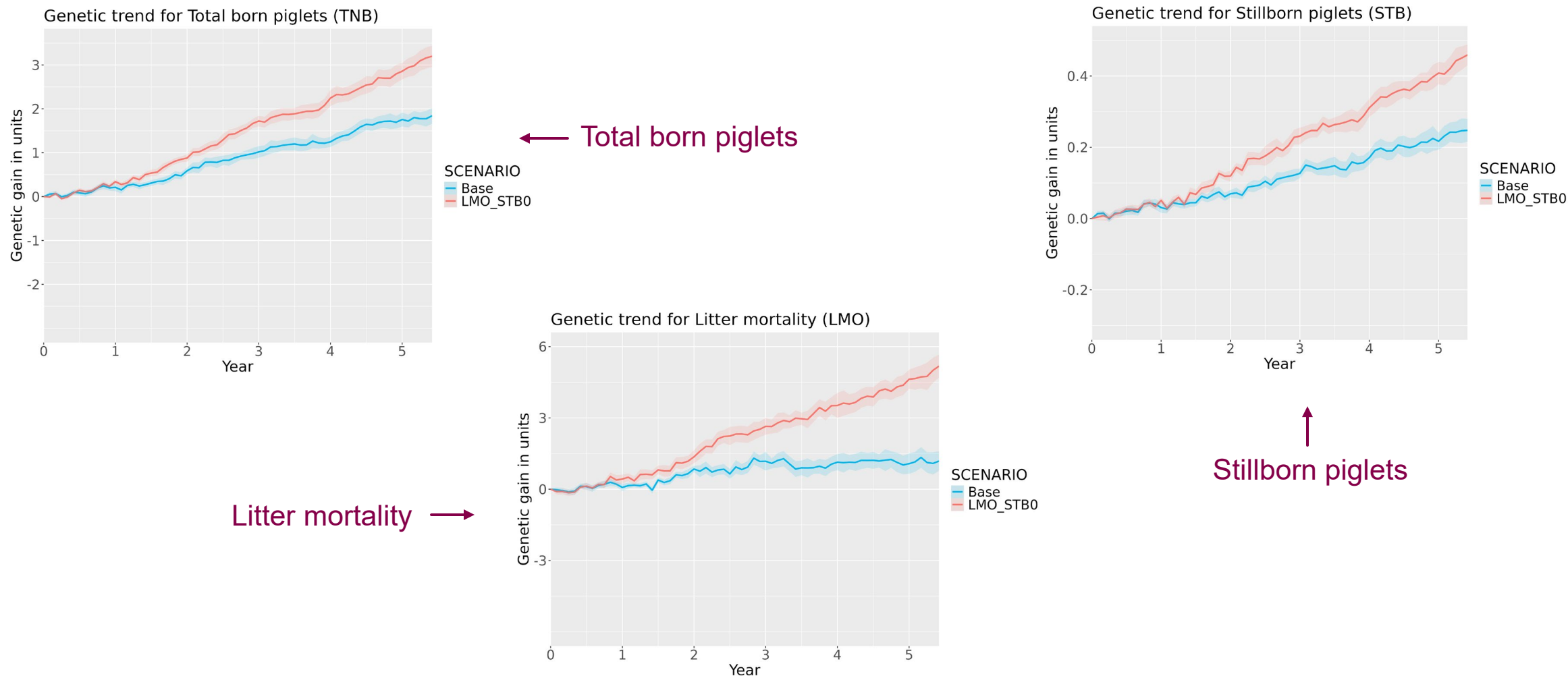


↑ Stillborn piglets

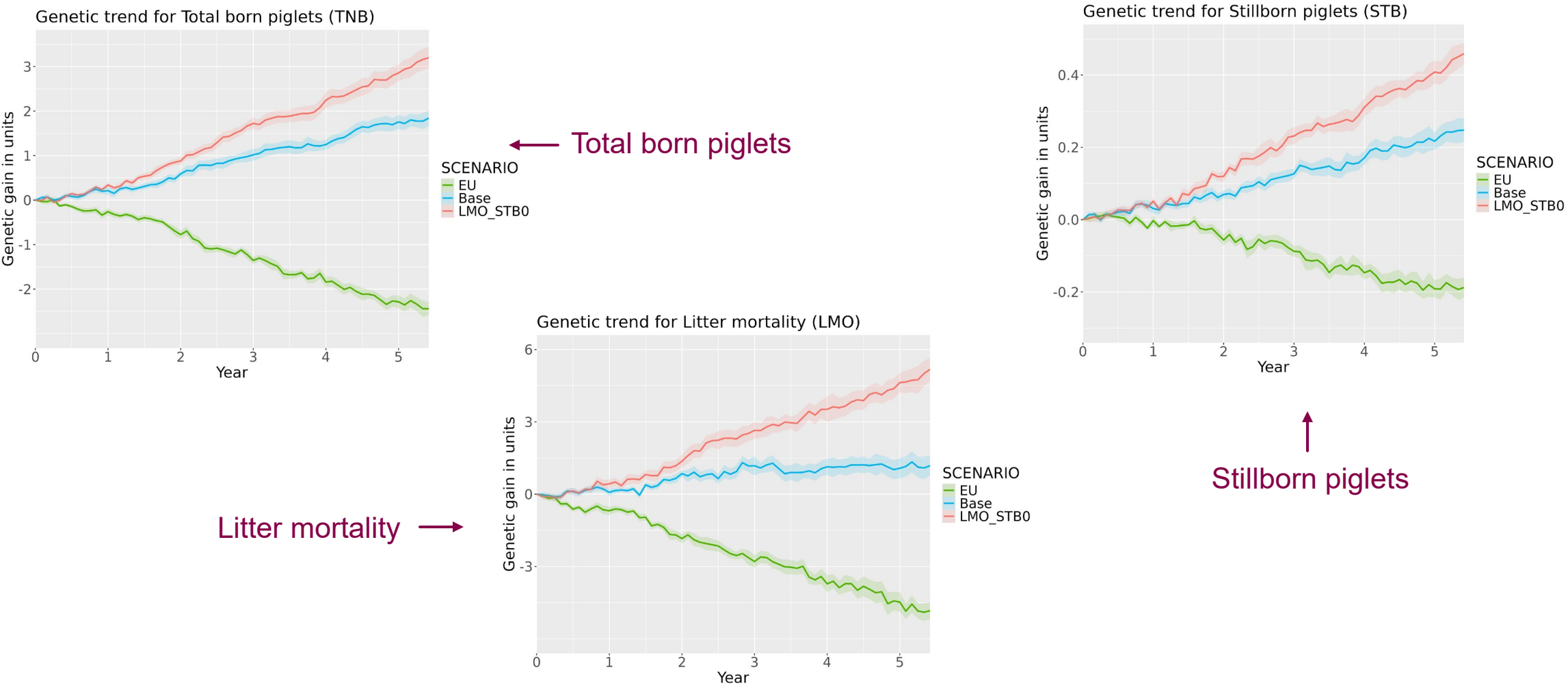
Litter mortality →



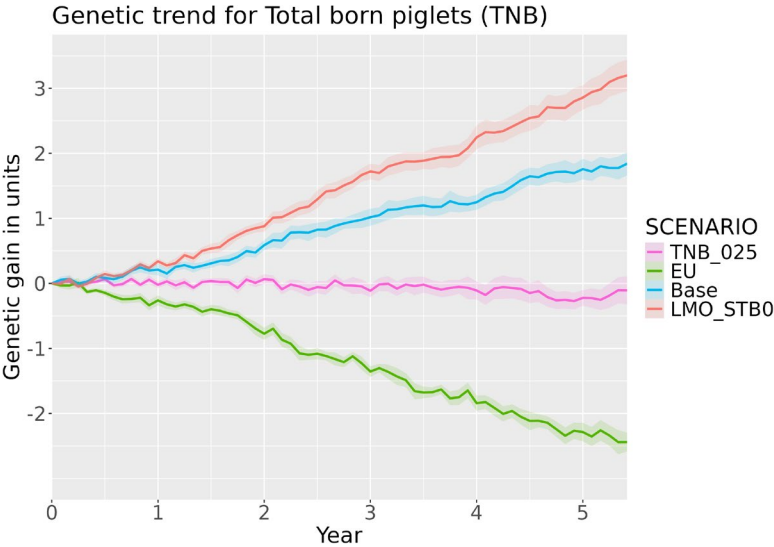
Genetic trend BASE and LMO_STB0



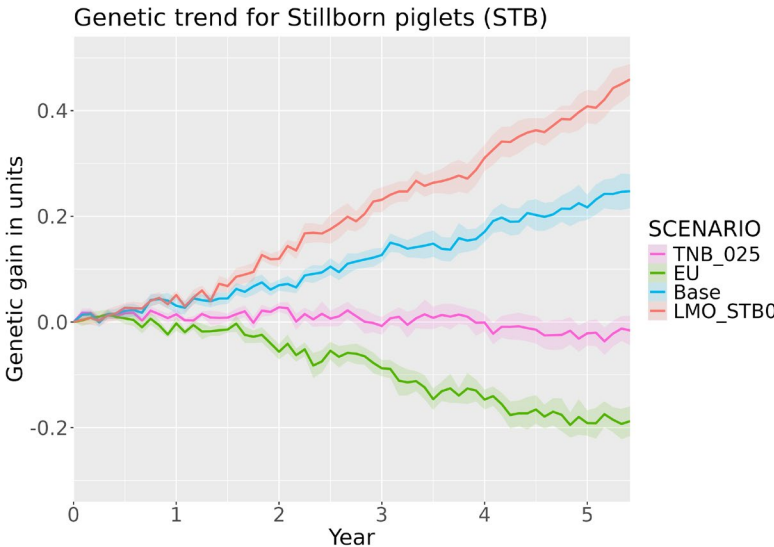
Genetic trend BASE, LMO_STB0 and EU



Genetic trend ALL SCENARIOS

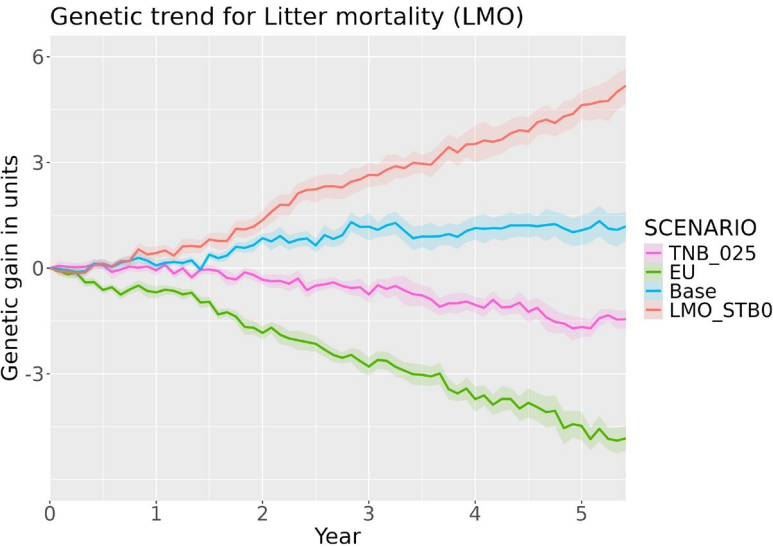


← Total born piglets

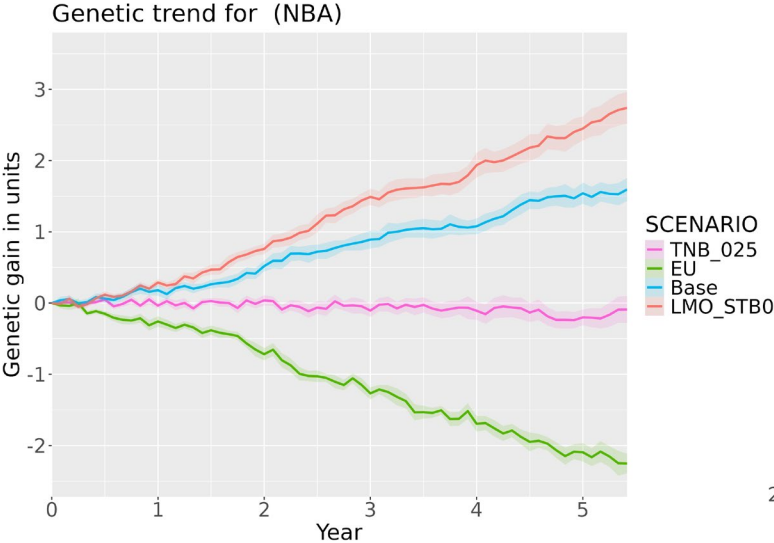


↑ Stillborn piglets

Litter mortality →

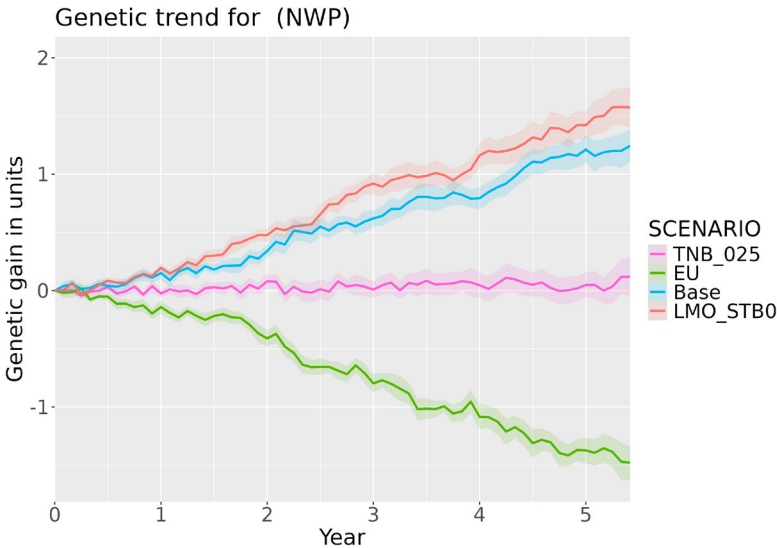
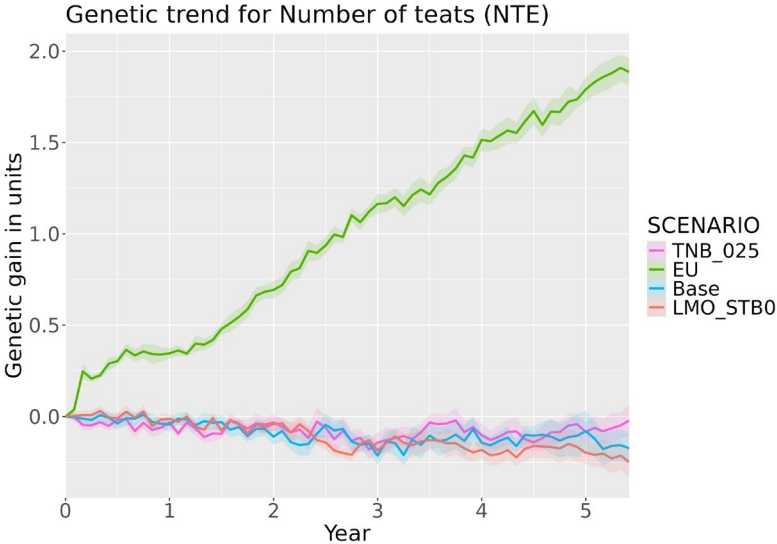


Genetic trend ALL SCENARIOS



← Born alive piglets

Number of teats



↑
Number weaned piglets

Take home messages

- **Digital twin** of breeding programs
 - Qualify direction of changes
 - MoBPS – scientifically sound, maintained by universities, can be used across species
 - Simulation of alternatives
- **Optimization** of breeding programs
 - Selection for survival: stillborn, litter mortality, rear to finish mortality, teat number, etc.
 - Balance: welfare, survival, reproduction, production

Acknowledgements

