Abstract M68

# Genetic parameters for length of productive life and lifetime production traits of purebred Landrace and Yorkshire sows in Northern Thailand

**Udomsak Noppibool[*], Skorn Koonawootrittriron[*], Mauricio A. Elzo[†] and Thanathip Suwanasopee[*]**

*Department of Animal Science, Kasetsart University, Bangkok 10900, Thailand

†Department of Animal Sciences, University of Florida, Gainesville, FL 32611, USA

## SUMMARY

The objective of this research was to estimate genetic parameters and trends for length of productive life (**LPL**), lifetime piglets born alive (**LBA**), lifetime piglets weaned (**LPW**), lifetime piglets' birth weight (**LBW**), lifetime piglets' weaning weight (**LWW**) in a commercial swine farm in Northern Thailand. Phenotypic records came from 1,983 Landrace (**L**) and 745 Yorkshire sows (**Y**) collected from July 1989 to August 2013. Variance and covariance components, heritabilities and correlations were estimated using a multiple-trait AIREML procedure. The 5-trait mixed animal model contained the fixed effects of first farrowing year-season, breed group (**L** and **Y**) and age at first farrowing. Random effects were sow and residual. Medium heritabilities were estimated for all five traits (**LPL** = 0.16 ± 0.04; **LBA** = 0.18 ± 0.04; **LPW** = 0.22 ± 0.04, **LBW** 0.18 ± 0.04 and **LWW** = 0.22 ± 0.04). Genetic correlations among these traits were positive and favorable (greater than 0.91; P < 0.05). Genetic correlation estimates were 0.94 ± 0.02 for **LPL-LBA**, 0.98 ± 0.03 for **LPL-LPW**, 0.92 ± 0.03 for **LPL-LBW**, 0.93 ± 0.02 for **LPL-LWW**, 0.96 ± 0.01 for **LBA-LPW**, 0.96 ± 0.01 for **LBA-LBW**, 0.93 ± 0.02 for **LBA-LWW**, 0.93 ± 0.02 for **LPW-LBW**, 0.97 ± 0.01 for **LPW-LWW** and 0.94 ± 0.02 for **LBW-LWW**. Dam genetic trends were positive, small and significant only for **LBA** (0.18 ± 0.05 piglets/yr; P = 0.0024), **LPW** (0.12 ± 0.05 piglets/yr; P = 0.0153), **LBW** (0.35 ± 0.09 kg/yr; P = 0.0009), and **LWW** (1.36 ± 0.40 kg/yr; P = 0.0024). Genetic trends for sows and sires were mostly small, negative and not-significant for any trait. ***Thus, the selection program in this commercial herd was ineffective to improve LPL in sows, sires, and dams, and lifetime production traits in sows and sires. This program was only effective to improve lifetime productive traits in dams.***

## INTRODUCTION

Length of productive life (**LPL**) and lifetime production traits (**LBA**, **LPW**, **LBW** and **LWW**) are important for the efficiency of commercial piglet production systems. Highly productive sows will be preferred and kept for as long as possible in the production system. Sows that have long **LPL** would be more productive and profitable than sows with short **LPL**. These sows are preferred by producers. Thus, a genetic improvement program for **LPL** and lifetime production traits in Thailand is needed. Such program requires accurate genetic parameter estimates. Parameter estimates found in the literature for these traits vary depending on the breed composition and environmental conditions of swine populations. Most Thai swine producers use open-house systems that expose breeding sows to more variation in environmental conditions than sows kept in climate-controlled barns. Thus, an appropriate selection strategy for Thailand would require estimation of variance components and genetic parameters under open-house conditions. ***Thus, the objectives of this study were to estimate genetic parameters and trends for LPL and lifetime production traits in a swine population raised in an open-house system in Thailand.***






## MATERIALS AND METHODS

**Data and Animals.** The current research was performed using a field dataset from a commercial swine farm in Northern Thailand. The original dataset included 3,541 sows. After the editing process, 2,728 sows with complete lifetime records (1,983 Landrace and 745 Yorkshire) in the breeding herd that had their first farrowing between July 1989 and August 2013 were included in the study. The phenotypic records of sows consisted of sow identities, sow breed, sire breed, dam breed, parity number, sow birth date, farrowing date, number of piglets born alive, number of piglets weaned, weight at birth and weight at weaning for each parity. Only sows that farrowed continuously, had at least one lifetime production trait, and had completed their lifetime production (known date of first farrowing and date of last weaning) were included in the study. Sows that were still alive, had missing records, or had their first farrowing at less than 300 or more than 500 d of age were excluded from the analysis.

**Climate, Nutrition, and Management.** Swine were from a farm located in the province of Chiang Mai (latitude 18° 47′ 43″ North and longitude 98° 59′ 55″ East; elevation = 310 m above sea level). The average temperature in this area over the last thirteen years was 27°C (17°C to 34.5°C), the average rainfall was 1,218 mm (880 mm to 1,457 mm), and the average humidity was 73.2% (37% to 99%). Seasons were classified into 3 groups: winter (November to February), summer (March to June), and rainy (July to October). All gilts and sows were kept in an open-house system. Gilts and sows that had their first litter in the same year-season received similar feeding and management. Gilts and non-lactating sows received 2.5 kg/d of feed with 16% crude protein and 3,200 to 3,500 kcal/kg (two feeding times; 7.00 a.m. and 13.00 p.m.), whereas nursing sows received 5 to 6 kg/d of feed with 17 to 18% crude protein and 4,060 kcal/kg (four feeding times; 7.00 a.m., 10.00 a.m., 13.00 p.m. and 15.00 p.m.).

Mating was performed by artificial insemination. Estrus was detected by visual appraisal (reddening and swelling of the vulva) and by boar exposure twice a day (morning and afternoon). Replacement gilts were inseminated in their third observed estrus (8 to 9 mo of age and body weight of at least 140 kg), and sows were serviced on the second observed estrus (twice; firstly 12 hr after detecting estrus and then 12 hours later. Gilts and sows were kept in individual stalls in open-house buildings with dripping, fogging and fans placed in the farrowing unit approximately 7 d before farrowing. Piglets were weaned when they reached 5 to 7 kg of body weight or 26 to 30 d of age.

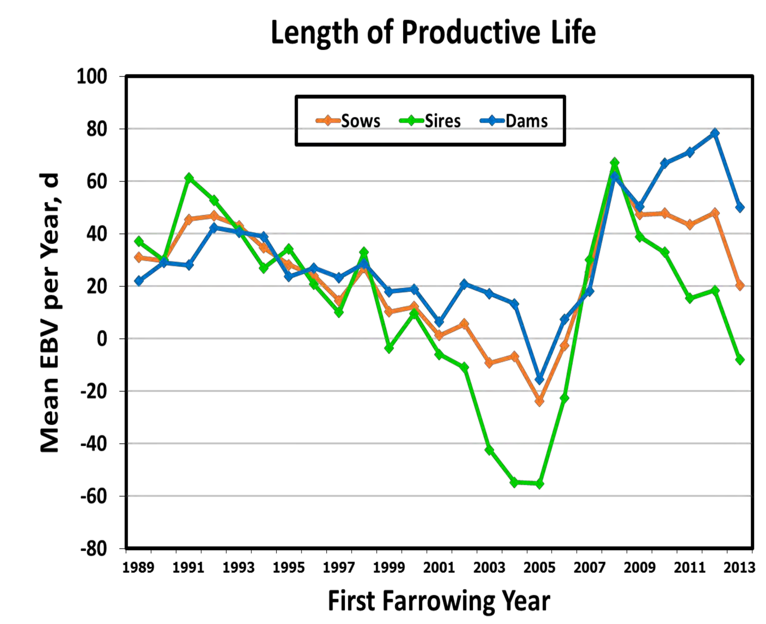
**Traits.** Length of productive life (**LPL**) was defined as the number of days between age of sow at first farrowing and age of sow at weaning of her last farrowing. Lifetime piglets born alive (**LBA**), lifetime piglets weaned (**LPW**), lifetime piglets' birth weight (**LBW**) and lifetime piglets' weaning weight (**LWW**) were calculated as the sum of the number of piglets born alive, piglets' birth weight, number of piglets weaned, and piglets' weaning weight from first to last weaning.

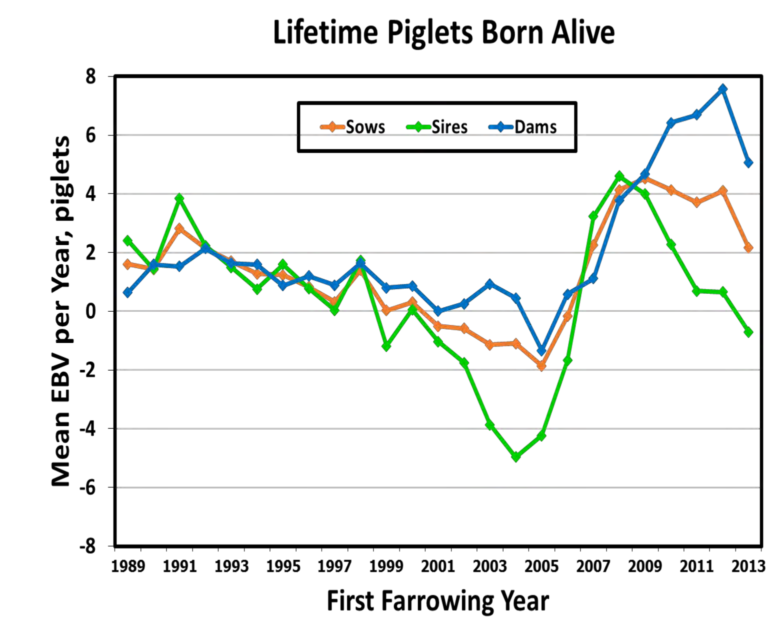
**Statistical Analysis.** A five-trait analysis was carried out to estimate variance and covariance components, heritabilities, genetic correlations and phenotypic correlations using an Average Information REML algorithm. The 5-trait mixed animal model contained the fixed effects of first farrowing year-season and breed group (**L** and **Y**) as subclass fixed effects, and age at first farrowing as a fixed covariate. Random effects were sow and residual. The pedigree file contained 2,728 sows, 575 sires, and 1,245 dams. Weighted means of additive genetic values (EBV) for sows, sires, and dams were computed for each first farrowing year (FFY) for all traits. Weighted yearly means of sow, sire, and dam EBV were plotted against FFY to illustrate genetic trends.

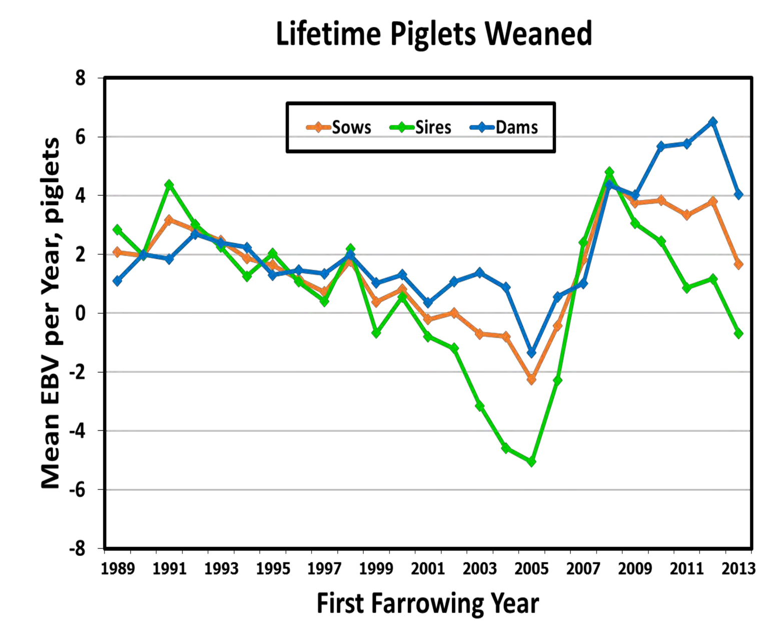
**Table 1. Heritability, phenotypic (below diagonal) and genetic correlation (above diagonal) estimates between length of productive life and lifetime production traits of swine population**

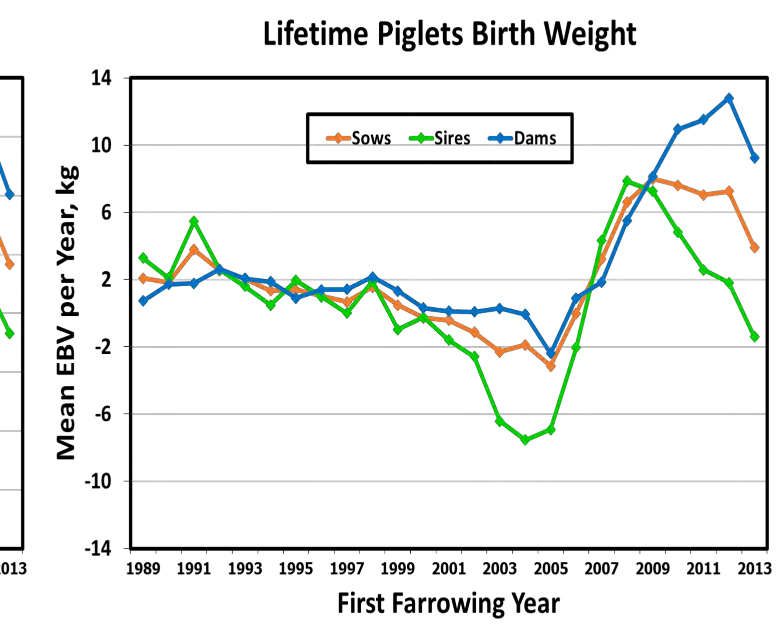
| Traits[a] | LPL | LBA | LPW | LBW | LWW |
|---|---|---|---|---|---|
| LPL | 0.16 ± 0.04 | 0.94 ± 0.02 | 0.98 ± 0.03 | 0.92 ± 0.03 | 0.93 ± 0.02 |
| LBA | 0.91 ± 0.01 | 0.18 ± 0.04 | 0.96 ± 0.01 | 0.96 ± 0.01 | 0.93 ± 0.02 |
| LPW | 0.93 ± 0.01 | 0.93 ± 0.01 | 0.22 ± 0.04 | 0.93 ± 0.02 | 0.97 ± 0.01 |
| LBW | 0.90 ± 0.01 | 0.97 ± 0.01 | 0.92 ± 0.01 | 0.18 ± 0.04 | 0.94 ± 0.02 |
| LWW | 0.91 ± 0.01 | 0.90 ± 0.01 | 0.97 ± 0.01 | 0.92 ± 0.01 | 0.22 ± 0.04 |

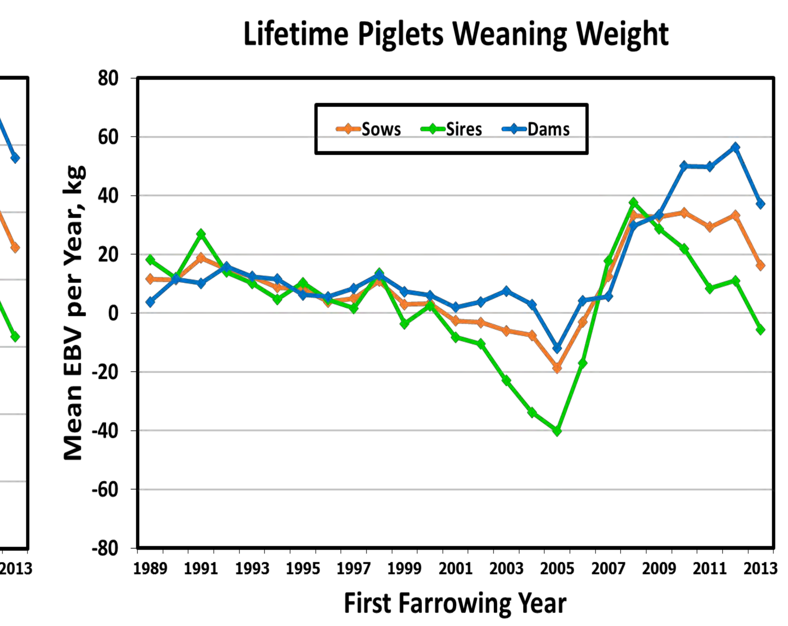
[a] LPL = length of productive life; LBA = lifetime piglets born alive; LPW = lifetime piglets weaned; LBW = lifetime piglets' birth weight and LWW = lifetime piglets' weaning weight




## RESULTS AND DISCUSSION

The variance components for **LPL**, **LBA**, **LPW**, **LBW** and **LWW** in this commercial population were 20,252.90 ± 4,765.39 $d^2$, 124.42 ± 26.81 $piglets^2$, 120.15 ± 23.11 $piglets^2$, 309.36 ± 65.68 $kg^2$ and 7,013.37 ± 1,306.03 $kg^2$ for additive genetic, 103,135.00 ± 4,876.36 $d^2$, 549.81 ± 26.64 $piglets^2$, 425.15 ± 21.90 $piglets^2$, 1,401.94 ± 66.25 $kg^2$ and 24,659.70 ± 1,245.44 $kg^2$ for environmental and 123,400.00 ± 3,483.00 $d^2$, 674.20 ± 19.10 $piglets^2$, 545.30 ± 15.61 $piglets^2$, 1,711.00 ± 48.28 $kg^2$ and 31,670.00 ± 903.80 $kg^2$ for phenotypic, respectively. Heritability estimates were medium for all traits (from 0.16 for **LPL** to 0.22 for **LPW** and **LWW**; **Table 1**). Heritability estimates found in this study fell into the range of earlier estimates on purebred populations (Serenius and Stalder, 2004; Serenius et al., 2008), and they were higher than those reported by Keonouchanh (2002) for a Thai commercial swine farm. The levels of genetic variation found in this commercial herd indicated that these traits would respond to genetic selection.

Genetic and phenotypic correlations among these traits were high and positive (**Table 1**). Lifetime production traits had high genetic correlations with **LPL** (from 0.92 ± 0.03 for **LPL-LBW** to 0.98 ± 0.03 for **LPL-LPW**). These correlations indicated that sows with higher **LBA**, higher **LPW**, heavier **LBW** and heavier **LWW** tended to remain longer in the breeding herd. These favorable correlations were in agreement with the results of Sobczynska et al. (2013) in a Polish swine population. Thus, it would be possible to improve **LPL** not only by direct selection on **LPL**, but also indirectly by selecting animals for one or more lifetime production traits. Heritabilities and genetic correlations among **LPL** and lifetime production traits suggested that computing preliminary EBV for gilts and boars using records from relatives would be a good tool to preselect young animals before sending them to the breeding unit. Preselecting young animals for these traits would keep selection pressure on these traits in a consistent manner.

All estimated sow and sire genetic trends for **LPL**, **LBA**, **LPW**, **LBW** and **LWW** from 1989 to 2013 were small and non-significant for all traits. Contrarily, genetic trends for dam were small, positive, and significant for **LBA** (0.18 ± 0.05 piglets/yr; P = 0.0024), **LPW** (0.12 ± 0.05 piglets/yr; P = 0.0153), **LBW** (0.35 ± 0.09 kg/yr; P = 0.0009) and **LWW** (1.36 ± 0.40 kg/yr; P = 0.0024), but not for **LPL** (1.10 ± 0.58 d/yr; P = 0.0703). The EBV yearly means for all traits tended to decrease from 1989 to 2005 for sows, sires, and dams. After 2005, the pattern of EBV yearly means differed in sows, sires, and dams. Sow and sire EBV yearly means greatly increased for **LPL** and lifetime production traits between 2005 and 2008, then they decreased until 2013. Conversely, dam EBV yearly means steadily increased from 2005 to 2012, then they dropped in 2013 to levels similar to those of 2009. These yearly EBV means indicated that sires and dams of increasingly better EBV for litter size and weight at birth and weaning were chosen after 2005, and that selection pressure drastically decreased in 2008 for sires and 2012 for dams, resulting in a steep decreasing trend in mean sow EBV for **LPL** and lifetime production traits.

## FINAL REMARKS

→ Medium heritabilities for **LPL**, **LBA**, **LPW**, **LBW** and **LWW** indicated that improvement by selection would continue to be effective in this herd

→ Positive genetic correlations between **LPL** with **LBA**, **LPW**, **LBW** and **LWW** suggested that preliminary EBV for gilts and boars using records from relatives could be used to preselect young animals to improve **LPL**, **LBA**, **LPW**, **LBW** and **LWW**

→ Yearly sire EBV means for all traits were lower than dam EBV means for all but 2 years, suggesting selection objectives different from dams

→ Yearly dam EBV means for all traits increased until 2012, then decreased suggesting a decrease in selection pressure for litter size and weight

## LITERATURE CITED

Keonouchanh, S. 2002. MS Thesis. Chulalongkorn University, Thailand. 80 p.

Serenius, T. and K.J. Stalder. 2004. J. Anim. Sci. 82: 3111-3117.

Serenius, T. and K.J. Stalder and R.L. Fernando. 2008. J. Anim. Sci. 86: 3324-3329.

Sobczynska, M., T. Blicharski and M. Tyra. 2013. J. Anim. Breed. Genet. DOI:10.1111/jbg.12024.