Incorporating Risk in Economic Values for Pigs in Smallholder Production Systems in Kenya

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ABSTRACT: This study derived economic values for production traits (dressing percentage, DP, %; live weight for growers, LWg, kg; live weight for sows, LWs, kg) and functional traits (feed intake for growers, FEEDg, feed intake for sow, FEEDs, preweaning survival rate, PrSR, %; postweaning survival, PoSR, %; sow survival rate, SoSR, %, total number of piglets born, TNB and farrowing interval, FI, days) in different smallholder pig production systems in Kenya. In addition to the traditional bio-economic profit model, a risk-rated model was used to derive risk-rated economic values. This model accounted for imperfect knowledge concerning risk attitudes of farmers and variance of input and output prices. Positive economic values obtained for traits DP, LWg, LWs, PoSR, PrSR, SoSR and TNB indicate that targeting them in improvement would positively impact profitability in pig breeding programmes. Accounting for risks in the economic values did not yield errors in a single economic value greater than ±50% in all production systems and basis of evaluation, meaning there would be small effects on the magnitude and direction of genetic change and relative efficiency of a selection index. Therefore, both traditional and risk-rated models can be satisfactorily used to predict profitability and develop selection index criteria in pig breeding programmes.

Keywords: Breeding objective; economic values; pigs; production systems; smallholder

Introduction

Although the breeding goal for pigs production is to produce the demanded pork meat at the right quantity and quality with minimum costs (Houška et al. (2004)), the application of objective breeding methods for smallholder production in Kenya is rare. Estimation of economic values (EVs) of the traits for the Kenyan pig population has not been attempted. Estimates of EVs from simple profit models (traditional) are prone to overestimation since such models assume perfect knowledge of all relevant parameters and that economic circumstances are constant (Kulak et al. (2003); Okeno et al. (2012)). As a result, an incorrect selection criterion may be applied, leading to suboptimal direction of selection. To account for this, risk-rated models are applied which account for farmers' preferences, imperfect knowledge concerning risk attitude of farmers and dynamic economic circumstances. The objective of this study was to estimate traditional and risk-rated EVs for production and functional traits in the breeding objective for pigs reared in different smallholder production systems in Kenya. The EVs estimated are important in assessing the influence of genetic improvement in a breeding programme.

Materials and Methods

Economic values for breeding objective traits were estimated for smallholder pig production in Kenya using a bio-economic model developed by Mbuthia et al. (2013). The model was used to simulate both the economic and biological variables to derive the unit price and cost variables and other production and management variables. In order to account for imperfect knowledge concerning risk attitudes of farmers and economic dynamics of input and output variables, the model employed risk-rated profit model functions (Kulak et al. (2003); Okeno et al. (2012)). The smallholder production systems evaluated were described as semi-intensive and extensive based on the management regimes. This study evaluated a farrow to finish operation but with a proportion of the piglets being removed at weaning.

The risk-rated EVs per unit change in the trait of interest were derived from the equation:

$$\mathrm{EVr}_{\mathrm{fixed-herd}} = \frac{\delta \mathrm{P_r}}{\delta \mathrm{t}}$$

where δP_r is the marginal change in risk-rated profits after 1% change in the trait of interest and δt is the marginal change in the trait after the 1% increase.
The risk-rated P_r, was obtained from the equation of Kulak et al. (2003).

$$P_r = E(P_t) - 0.5\lambda\sigma^2(P_t)$$

where P_r is the risk-rated profit, $E(P_t)$ expected profit, λ the Arrow-Pratt coefficient of absolute risk aversion, and $\sigma^2(P_t)$ the variance of profit. The Arrow-Pratt coefficient measures the intensity of an individual's aversion to risk (Kulak et al. (2003)). The results presented here were evaluated using a λ value of 0.02.

The variance of meat price and cost of feeds were computed from the approximate monthly price averages for 2012, where animal feed retailers and butchers were consulted. The variance in feed cost (σ^2_{pf}) was 0.84 KSh^2/kg^2 while the variance meat price (σ^2_{pm}) was 300 KSh^2/kg^2. The covariance between price of meat (pm) and price of feed (pf), $\sigma_{pm\,pf}$ was 13.04.

Table 1. Economic values (in KSh) per unit increase in genetic merit for traits per sow per year (1US£=KSh. 86)

	Production system			
	Semi-intensive		Extensive	
Traits	EVt	EVr	EVt	EVr
Dressing percentage, DP (%)	2356.67	2049.36	295.70	257.14
Feed intake for growers FEEDg (Kcal ME/day)	-158.45	-137.79	-13.97	-12.14
Feed intake for sow FEEDs (Kcal ME/day)	-12.67	-11.01	-2.82	-2.45
Farrowing interval, FI (days)	-519.17	-451.47	-24.32	-21.15
Live weight of growers, LWg (kg)	2251.61	1958.00	642.22	558.47
Live weight of sow LWs (kg)	11.65	10.13	16.14	14.04
Postweaning survival rate PoSR, (%)	1001.11	870.57	62.06	53.97
Preweaning survival rate, PrSR (%)	1089.83	947.72	94.06	81.79
Sow survival rate, SoSR (%)	69.63	60.55	17.83	15.50
Total number born, TNB	8946.27	7779.68	934.13	812032

EVt = economic values estimated from traditional bio-economic model, EVr = economic values estimated from risk-rated bio-economic model

Results and Discussion

Economic values for survival traits, PrSR, PoSR and SoSR were positive for all bases of evaluation and production systems (Table 1). As expected, the EVs for feed intake traits were negative. This is because an increase in genetic merit of these traits does not affect revenue but results in increased feed costs only (Kosgey et al. (2004); Bett et al. (2007)).

The economic value for live weight was higher for the growers than for the sow in all systems. This is because an improvement in this trait affects several animals per sow per year in the category. The growers are the major contributors to revenue and market prices are based on live weight. The EVs for the reproductive trait FI was negative, indicating that management should be aimed at decreasing the trait to positively influence the overall profit. The negative EV for FI is a result of reduced number of offspring per productive lifetime by increasing the number of unproductive days. This would result in reduced revenues from the sale of slaughter pigs.

Among the traits evaluated, TNB had the highest EV. The benefit of increasing the TNB is higher financial returns from the sale of more pigs. An increase in the TNB was accompanied by an increase in the total number of piglets weaned and ultimately an increase in the number of slaughter pigs per sow per year. By increasing TNB, the overall sow costs were expected to increase due to increased feed requirement, the grower costs were also expected to increase (feed and husbandry costs). However, revenues from grower pigs would also increase because of more slaughter pigs per sow per year. Except for number born alive/litter, which yielded a positive EV, most reproductive traits, e.g. preweaning mortality, interval weaning to oestrus, and gilt age at first oestrus, reported negative EVs (Skorupski et al. (1995)).

In this study, accounting for risks in the EVs did not yield errors larger than ±50% for any trait in all the production systems and basis of evaluation. These changes have relatively little effect on the real genetic gain of a selection index. This indicates that both traditional and risk-rated models can be satisfactorily used to predict profitability and develop selection index criteria applicable in smallholder pig breeding programmes.

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