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Economics of sow culling

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The literature contains several reports regarding the economics of sow culling that provide a range of recommendations with respect to optimal removal parity (Kroes and Van Male, 1979; Dijkhuizen et al., 1986; Faust et al., 1993a, 1993b; Dhuyvetter, 2000; Rodrigues-Zas et al., 2006; Dhuyvetter et al., 2007). Often, these analyses focus on the herd level. Production expectations typically reflect the average performance of the average animal of a given age. And although these models may be useful for describing how culling practices would potentially impact productivity and profitability, they often ignore interactions and are of limited value with respect to individual animal culling decisions (Dhuyvetter et al., 2007).

In reality, the vast majority of culling decisions are made at the level of the individual animal within the context of contemporary herd constraints. That is, culling criteria frequently differ within herds across time according to factors such as gilt availability and herd performance.

From an economic perspective, sow removals fall into one of two categories (Fetrow *et al*, 2004). Biologic, or involuntary, removals occur when sows need to be removed for reasons of death, poor health or welfare. Economic, or voluntary, removals occur when sows are removed for reasons attributed to poor productivity. The merits of minimizing involuntary culls are readily apparent. However, the determination of when to voluntarily remove a sow is not so "black and white."

In 1979, Dagorn and Aumaitre reported that litter size at birth and weaning and pigs weaned per sow per year all increased with increased parity at weaning. In 1986, Friendship *et al* reported a negative correlation between sow removal rate and litter size among the 30 farms. That same investigation found no associations between culling rate and litters per sow per year and culling rate and pigs weaned per sow per year. However, cause-and-effect aspects of these relationships were not pursued, i.e., the lower litters and pigs weaned per sow per year led to higher culling rates or higher culling rates led to lower litters and pigs weaned per sow per year. In Lucia *et al* (2000) reported that financial performance was optimized among sow herds with higher proportions of high-parity females. Similarly, Koketsu (2007) reported a null relationship between sow longevity and pigs weaned per mated female per year in a set of 110 Japanese herds. And in 1992, Jalvingh *et al* (1992) reported that culling strategy changed the herd financials but not herd productivity.

First, our ability to predict an individual sow's subsequent performance is limited because of substantial within-sow variability (Dewey *et al*, 1995; Roehe and Kennedy, 1995). In addition to an individual sow effect, a number of other variables can influence the sow's future fertility (conceiving and carrying a litter to term) and fecundity (litter size). These include items such as mating frequency (Xue *et al*, 1998a; Xue *et al*, 1998b), insemination timing (Rozeboom *et al*, 1997), plane of nutrition during follicular development (Foxcroft *et al*, 2007), and season of the year (Koketsu and Dial, 1997; Southwood and Kennedy, 1991).

Second, our definition of a productively successful removal and replacement action may conflict with an economically successful removal and replacement action. Furthermore, the economic considerations for removal and replacement also differ according to production system. Unlike the sow unit feeding a nursery and finisher flow, the sow unit that produces pigs for sale at weaning may not need to consider the lifetime value of weaned offspring.

Herd-level economics

Changes to voluntary culling practices have the potential to reduce replacement rates and thereby alter herd parity distribution. And fewer piglets derived from parity 1 litters have implications for improvements to nursery and finisher survivability and growth rates (Smith *et al*, 2007; Larriestra *et al*, 2006; de Grau *et al*, 2005; Larriestra *et al*, 2005b; Mahan, 1993).

Dijkhuizen *et al* (1986) developed the PorkCHOP model which generated a farm-level economic index to serve as a guide for culling decisions. The dairy industry has developed models for voluntary culling to optimize the value of the cow slot/space (de Vries, 2006a,b; Eicker, 2007; Eicker *et al*, 2007). In these models, the net present value (NPV) of the cow slot with the current cow is compared to the NPV of the slot with a "universal heifer" (replacement with average lifetime and average productivity).

Borrowing from the dairy the industry, there is potential for a herd to estimate the NPV of its "universal gilt." However, an estimate for the individual sow NPV requires model refinement.

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