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Herd-level analysis of sow longevity

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Introduction

The decision to replace or to retain a sow in the herd is driven by the need to maintain a productive herd while controlling costs and addressing the welfare of the sow. The extent of sow retention in any herd is dependent on the level of culling and the mortality rate. Increasing rates of sow mortality in US farms (Deen and Xue, 1999; Koketsu, 2000) in the recent years has become a cause of concern for both producers and researchers alike. Mortality has both economic as well as welfare implications. Although the causes of sow mortality (Schultz et al., 2001) and the association of mortality risk with management factors have been studied (Straw, 1984; Christensen et al., 1995; Abiven et al., 1998), there are only few studies (Abiven et al., 1998., Deen and Xue, 1999) focusing on the association between productivity and mortality risk. It is essential to understand the association between mortality risk and production variables to arrive at management decisions that will ensure a balance between possible economic gain by maintaining and increasing production targets on the one side and the economic loss and welfare implications associated with sow death on the other side.

The associations between sow retention and sow productivity are, however, contrary. A high removal rate is reported to be associated with low productivity due to the increase in proportion of younger animals with smaller litter sizes and higher infertility rates (Bilkei and Bolcskei, 1995; D'Allaire and Drolet, 1999), whereas low culling rate may result in the death of animals that are retained for too long, causing economic loss. However, Stein et al. (1990) reported that higher replacement rates and shorter average sow life can result in increased pigs born live and weaned per litter because of the introduction of genetically superior females with higher average prolificacy. The factors associated with herd-level and sow-level productivity may not be same. It is essential to observe whether the associations reported between sow retention and sow productivity at sow level hold good at herd level as well in order to have meaningful understanding of these associations.

This requires data analysis across herds to take into account the variation in removal rates due to differences in management, nutrition, and environment. A dataset with many farms from different geographical regions reflecting the possible differences among the variables is available through the PigCHAMP datashare program. In this database the calculations of productivity are the same across the farms, due to the common software.

The objective of this study was to analyze the association between production parameters with factors affecting sow longevity at the herd level using data from the datashare program.

Materials and methods

Data were collected by PigCHAMP Inc (Ames, IA) through its datashare program. Annual average values for production variables related to breeding, farrowing, weaning, and the population were collected from each farm. Herds from Brazil, Canada, and the US were included. Farms that provided updates of their data on or after September 2001 were considered for analysis. The resulting dataset comprised 106 farms from Brazil, 95 farms from Canada, and 364 farms from the US. Data pertaining to a one-year period from the respective date of data updating was used for analysis.

The means of culling and mortality rates along with production and management indicators (average female inventory, average parity, farrowing rate, farrowing interval, average pigs born alive/litter, average stillborn pigs, average mummies per litter, average lactation length, average non-productive sow days and litters per female per year) for the farms in the three countries were compared using ANOVA. Separate, stepwise linear regression (forward P entry 0.05 and P exit 0.1) models were fitted for mortality and culling rates with the parameters such as average female inventory, average parity, farrowing rate, average pigs born alive/litter, average stillborn, average mummies, and average lactation length. Country was included as a categorical variable. For all analyses $P < 0.05$ was considered significant.

Results

The mean production variables in different countries are presented in **Table 1**.

There was no significant difference between countries with respect to average female inventory and culling rate. However, the mortality rate in the US was significantly higher than that of Brazil and Canada. There was no significant difference between Canada and Brazil in the case of mortality rate, average parity, and average pigs born alive/litter. US herds had significantly lower average parity and average pigs born alive/litter than the other two countries.

Canada and the US had no significant difference with respect to farrowing interval and average mummies, whereas Brazil had significantly lower farrowing interval and significantly higher mummies/litter. There was significant difference among the countries in the case of farrowing rate, lactation length, average non-productive days, average stillborn/litter, and litters/female/year. US had significantly lower farrowing rate, lactation length, and litters/female/year and higher average NPD, and average stillborn/litter. Canada had significantly higher lactation length than the other countries. Brazil had significantly higher farrowing rate, and litters/female/year and lower average NPD, and stillborn.

The stepwise regression models for mortality and culling rates are presented in **Table 2**.

Regression analysis showed that mortality rate was positively and significantly associated with average female inventory and average stillborn per litter, whereas it had

Table 1: Management and production variables in Brazil, Canada, and the US (Mean ± SD).[A]

	Brazil	Canada	US
Average female inventory	1156.33±870.764[NS]	1046.01±1193.339[NS]	1115.1±1073.85[NS]
Average parity	2.75±0.608[a]	2.79±0.774[a]	2.55±0.788[b]
Culling rate	42.65±12.333[NS]	39.48±13.012[NS]	41.6±17.506[NS]
Mortality rate	5.45±2.809[a]	6.49±3.288[a]	7.8±4.794[b]
Ave non-productive sow days	52.02±15.424[a]	60.39±18.526[b]	76.78±31.038[c]
Farrowing interval	142.77±2.286[a]	146.97±6.443[b]	148.46±8.918[b]
Farrowing rate	83.57±4.364[a]	80.22±7.217[b]	72.98±9.089[c]
Average pigs born alive/litter	10.74±0.501[a]	10.69±0.544[a]	10.12±0.606[b]
Average stillborn pigs	0.55±0.193[a]	0.83±0.287[b]	0.9±0.274[c]
Average mummies per litter	0.27±0.141[a]	0.21±0.105[b]	0.23±0.147[b]
Litters / female / year	2.33±0.107[a]	2.26±0.134[b]	2.18±0.232[c]
Average lactation length	19.86±1.455[a]	20.62±2.738[b]	18.21±2.619[c]

[A]Values with different superscripts in the same row indicate significant difference (P < 0.05).

Table 2: Stepwise regression models for mortality and culling rates.

	Outcome	
Explanatory variables	**Mortality rate**	**Culling rate**
Constant	6.32648	39.65697
Average female inventory	0.00112	-0.00125
Average lactation length	NI[A]	NI
Average mummies per litter	NI	NI
Average parity	NI	-6.57535
Average stillborn	2.83453	NI
Average pigs born alive / litter	NI	NI
Culling rate	NI	-
Mortality rate	-	NI
Farrowing rate	-0.04321	0.27082
Brazil	NI	NI
Canada	NI	NI
US	0.8327	NI
R^2	0.14	0.10

[A]NI = not included in the model.

Production

significant negative association with farrowing rate. US herds showed a positive association with mortality rate. Culling rate was positively and significantly associated with farrowing rate. Culling rate had significant negative association with average parity and average female inventory. Geographical region had no significant association with culling rate.

Discussion

A positive association between average female inventory and mortality risk has been previously reported (Christensen, et al., 1995; Abiven et al., 1998; Koketsu, 2000). The greater number of sows per person to work with and the resultant lack of individual attention have been suggested as possible reasons for this association (Koketsu, 2000). The increased frequency of purchase of gilts adding to disease risk may also be a factor increasing mortality rate. However, Sanz et al., (2002) reported that sow mortality was higher in smaller farms than in larger ones. The positive association between average stillborn and mortality rates has been reported previously in US herds. Deen and Xue (1999) noticed that sows with more stillbirths are more likely to die subsequent to the stillbirths. No biological reason for the association of mortality risk with herd size or stillborn has been reported in the previous studies. The negative association noted between mortality rate and farrowing rate suggests that older parity sows are dying out more. The positive association of mortality rate with US is substantiated by the significantly higher mortality rate in US herds (see **Table 1**).

The culling rate showed a negative significant association with average female inventory. A higher female inventory means greater number of sows per person to work with and the resultant lack of individual attention. This may lead to inefficient management and poor productive and reproductive performances leading to higher culling rates. The positive association of culling rate with farrowing rate is likely. This suggests that sows are culled mainly for productive and reproductive reasons. However, during this process the sows that are less likely to survive for health or other reasons are retained, eventually ending up in high mortality rate. This applies mainly to higher parity sows. More farrowings per year means a higher annual probability of being culled as a sow has a constant probability of being culled during each farrow-to-farrow interval (D'Allaire and Drolet, 1999).

Culling rate was negatively associated with average parity, indicating that older sows are getting culled more. The negative association between culling rate and average parity has previously been reported by Stein et al., (1990). A culling rate of approximately 40% co-exists with a high mortality rate, suggesting that the culling policy is not judicious enough to selectively cull those sows that are less likely to survive for various reasons.

Conclusion

Results indicate that only few production and management indicators had association with mortality and culling rates. Mortality rate had association with average female inventory, average stillborn, and farrowing rate whereas culling rate had association with average female inventory, average parity, and farrowing rate. However, this does not mean that producers need not be concerned about higher mortality rates in their herds, as in the case of US farms, because of the economic and welfare implications of increased sow deaths. The important point evident from these analyses is the need to have a carefully planned culling strategy to reduce sow deaths without lowering productivity. The common management intervention to improve productivity is to reduce culling rate, and the outcome would be a higher retention of older parity females. Any early-replacement decision should be based on the cost of sow flow disruptions, quality of the progeny, and the possibility for genetic change by bringing gilts into the herd (Deen and Matzat, 2003).

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