Odor Management in Swine Finishing Operations: Cost Effectiveness*

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The purpose of this paper is to investigate the cost effectiveness of the odor control strategies identified to be important in reducing odor emissions from swine finishing buildings by Miller et al. (2003). Cost effectiveness analysis in this paper evaluates the marginal reduction in odor emission rates relative to the increase in production costs per market hog sold due to the application of an odor management option. Miller et al. (2003) examined the effects of different practices and building characteristics controlled by management on odor emitted from pig finishing buildings. Results showed that greater pig space, air treatment, shallower manure depths, and the use of deep pits reduced odor emission rates of swine finishing buildings. Specifically, the odor emission rate measured at a deep pit building, assuming other factors were held constant, was 0.17 log OU/h lower than that at a shallow pit building; an increase of one m² in pig floor space decreases the odor emission rate by 0.25 log OU/h; one additional meter (3.3 ft.) of manure depth increases the odor emission rate by 0.26 log OU/h; and improving observed air dustiness (another study variable) by one decreases odor emission rate by 0.07 log OU/h.

Cost Effectiveness of Increasing Floor Area Per Pig. The cost of using floor space for odor management arises from the decrease in the number of hogs marketed and hence the returns to production. Assuming that the odor management strategy is to increase floor space per pig by 10% for a typical 1,020-head finishing barn with pig density of 0.74 m²/pig, the total cost due to reduced production is $5,607/yr, or $2.22 per marketed hog.

Cost Effectiveness of Improving Air Quality. Air quality was measured as subjective impressions of air dustiness on a scale of 1 (very clean) to 10 (very dusty). Totally, five air treatment technologies were examined: manual oil sprinkling, automatic oil sprinkling, wet scrubbing, diffusion-coagulation-separation (DCS) dedusting, and evaporative misting. According to the existing literature and our own estimations, the costs (per marketed hog) of applying these technologies are $0.87 for manual oil sprinkling, $0.51 for automatic oil sprinkling, $0.54 for wet scrubbing, $0.66 for DCS dedusting, and $0.30 for evaporative misting, respectively. Based on their dust removal efficiencies, the effects of these technologies on odor emission reduction were estimated as 0.42 log OU/h for oil sprinkling, 0.28 log OU/h for wet scrubbing, 0.49 log OU/h for DCS dedusting, and 0.21 log OU/h for evaporative misting.

Cost Effectiveness of Reducing Manure Depth in Shallow Pit Systems. The strategy of reducing manure depth is limited to shallow pit systems because for deep pit systems, manure is removed once or twice a year and timing is often influenced by weather and other variables. For shallow pit systems, reducing manure depth is simply a matter of scheduling. Since cost effectiveness is based on comparisons, the efficiencies and costs of two alternative manure depth reducing strategies were compared. The two alternatives considered were flushing the pit weekly versus biweekly and their costs were estimated as $0.12 and $0.06/marketed hog, respectively. Based on manure generation data in the ASAE Standard, manure depth in the pit will increase by about 0.05 m every week. Therefore, the efficiency of weekly flushing compared with biweekly flushing is 0.26*0.05 = 0.01 log OU/h. The annualized cost difference between the two strategies is $0.12 - $0.06 = $0.06 per pig marketed.

Cost Effectiveness of Deep vs. Shallow Pit Systems. When the contribution of manure depth to odor is accounted for, deep pit systems were shown to have a lower odor emission rate than shallow pit systems. However, the odor advantage of deep pit over shallow pit systems can be reversed if manure depth in a deep pit system is 0.65 m greater than in a comparable shallow pit system. Assuming that a typical shallow pit is recharged with 0.3 m recycled lagoon effluent, the manure depth in the deep pit that may cause it to have higher odor than a shallow pit is 0.95 m. The cost of a deep pit system is $0.63/marketed hog higher than that of a shallow pit system when facility, manure removal, and land application costs are all taken into account. Keeping manure depth less than 0.95 m in a deep pit may not entail additional costs as long as the manure removal costs are based solely on manure volume, but it requires that manure be removed from the pit three times a year. The average manure depth over the year in the pit in this case is 0.48 m. The odor reduction efficiency of a deep pit building compared with a shallow pit building flushed once a week then is 0.13 log OU/h. Hence, the cost effectiveness of a deep pit system relative to a shallow pit system with lagoon can be obtained as 0.21 log OU/h per dollar per marketed hog. This of course assumes no influence from weather or crop cycles that would prohibit land application of manure. It is unlikely that this is technically feasible in much of the Midwest. However, removing manure twice a year still gives deep pit systems an advantage in reduced odor emissions from buildings on average because the average manure depth in the pit in this case is 0.72 m.

SUMMARY

The rank of most cost-effective (those to use first) to least cost-effective (those to use last) for these alternative strategies is: automatic oil sprinkling > DCS dedusting > evaporative misting > wet scrubbing > manual oil sprinkling > deep pit building removing manure three times a year > draining shallow pit weekly > deep pit building removing manure twice a year > 10% increase in square meters per pig. The symbol "greater than" means "is preferred to."

REFERENCE