Reducing Water Consumption in Swine Barns: Alternatives for Animal Drinking and Barn Cleaning

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SUMMARY

Evaluation of selected water conservation measures involving drinkers and different cleaning procedures revealed that 60% reduction in water wastage was achieved with a drinking trough (with side panel and constant water level) to nipple drinkers. The use of conventional nozzle for pressure washing led to reduced time and water consumption during cleaning. Cost analysis of the different measures showed reduction in water wastage achieved by a drinking trough translated to about $4.76/pig savings or 29% reduction in total costs associated with water use when compared to a nipple drinker.

"Using Alternative Water Management Practices could Translate to Savings of $4.76/pig"

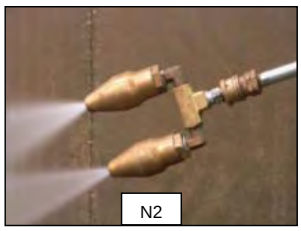
INTRODUCTION

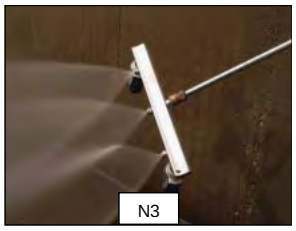
More efficient water use in swine operations is essential both for economic and environmental considerations. Previous work demonstrated that there are various opportunities to improve water use in swine operations (PSC Annual Report 2010, pp. 24-25). Evaluation of conservation measures identified in the literature review and producer survey using an assessment criteria that considered effectiveness in reducing water use impact on manure production, and effect on pig performance and other operational aspects (i.e., air quality). Barn cleaning and animal drinking were identified as the areas in the barn where highest water savings can be potentially achieved, therefore these were further evaluated in commercial swine facilities.

METHODOLOGY

The overall approach of this study was to evaluate the effectiveness of selected water conservation measures pertaining to animal drinking and cleaning in reducing overall water use and to assess their economic impact in swine barn operations. Two different experiments were performed. The first experiment involved installing three different types of drinkers in a grow-finish room at PSCI barn facility. The drinkers used included 1) nipple drinker (Control), 2) nipple drinker with side panel, and 3) a trough with side panel and constant water level (Figure 1). Performance of these drinkers in terms of water disappearance (use), water wastage, water contamination level as well as effect on ADG and ADFI were assessed throughout one growth cycle. The second experiment involved

Figure 1. Three types of animal drinkers used: nipple (D1), nipple with side panel (D2) and a trough with side panel and constant water level (D3).





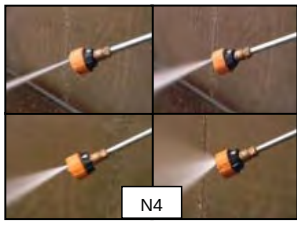


Figure 2. Four different types of pressure-washing nozzles used: conventional nozzle (N1), Y-nozzle (N2), water broom (N3), and 4-in-1 nozzle (N4).

two different cleaning strategies in grow-finish rooms with either partially or fully slatted concrete flooring. The cleaning strategies included 1) water sprinkling (soaking) prior to high pressure washing and 2) use of different high pressure washing nozzles: conventional nozzle, Y-nozzle, water broom and 4-in-1 nozzle (Figure 2). The amount of water consumed, time spent during high-pressure washing, as well as the surface cleanliness were evaluated. A cost analysis of the use of different types of drinkers and cleaning strategies in swine operations was carried out after completion of the actual in-barn experiments.

RESULTS

A. Animal drinking

Figure 3 shows the performance of the test drinkers in terms of water disappearance (water use), water intake, and water wastage. Results showed that 60% less water wastage was achieved when a trough with side panel and constant water level (1.27 L/day-pig) was used compared to the nipple drinker alone (3.77 L/day-pig) and the nipple with side panel (3.57 L/day-pig) (Figure 3). This observation led to lower total water disappearance (consumed + wastage) in trough with side panel and constant water level compared to nipple drinkers. Even with the substantial decrease in water disappearance, the net water intake of the pigs from the trough with side panel and constant water level (after subtracting the water wastage) was still within the recommended water intake requirements for grower-finisher pigs (4.5 – 10 L/day-pig).

Water in the trough had significantly higher microbial ATP (adenosine triphosphate) levels (indicating contamination with organic material) than the water drawn from nipple drinkers. However, this did not affect pig performance since the use of the trough with side panel and constant water level had no significant effect ($p>0.05$) on average daily gain and average daily feed intake of pigs. Further investigation is needed to find out the type of microorganisms present in the water in the trough and its potential effects on the pigs apart from ADG and ADFI.

B. Cleaning

As expected, water sprinkling (or soaking) in fully and partially slatted concrete flooring resulted to significantly higher ($p<0.05$) water consumption mainly due to the additional water used during the sprinkling phase. However, significantly more time ($p<0.05$) was needed when washing a partially slatted concrete flooring without sprinkling than with sprinkling. As shown in Figure 4, the use of the conventional nozzle led to the lowest water volume consumed and time spent in washing rooms with partially and fully slatted concrete flooring among all test nozzles. Also, the use of the conventional nozzle and the Y-nozzle achieved the highest significant reduction ($p<0.05$) in microbial ATPs on concrete and plastic surfaces (measured before and after washing), respectively.

C. Economic analysis

The economic analysis were based on the assumption that the treatment was applied to a 168-head grow-finish room with a floor area of 157.3 m^2 (14.3 m x 11 m) for one complete growth cycle of

Table 1. Operational information and associated cost of using the different types of drinkers in a swine production room.

Operational information and associated cost	Nipple	Nipple with Side Panel	Trough with side panel and constant water level
Cost of required materials & equipment, $	546.0	826.0	1,185.0
Installation cost, $	104.0	156.0	156.0
Capital and installation cost (per pig basis), $/pig	0.26	0.39	0.53
Number of hours per cycle for drinker maintenance, hr	6	6	8
Labour cost for installation and maintenance (per pig basis), $/pig	0.93	0.93	1.24
Total water use (consumed + wastage) (per pig basis), L/day-pig	8.175	8.025	6.7
Total water consumption per year, gal/yr	397,281.2	389,991.7	325,600.5
Cost of water used (per pig basis), $/pig	6.30	6.19	5.16
Volume of additional water to the pit (due to wastage) (per pig basis), L/day-pig	3.77	3.57	1.27
Total manure produced (in storage tank) per year, gal/yr	262,804	253,084	141,311
Cost of handling the manure produced (per pig basis), $/pig	9.11	8.77	4.90
Total cost per pig, $/pig	**16.59**	**16.27**	**11.83**

All costs in CAD$
Wage rate = $13/hr; Cost of water = $8.01/1000 gal; Cost of manure handling = $0.0175/gal

about 16 weeks. Table 1 shows the summary of the operational information and associated costs of installing each type of drinker (nipple, nipple with side panel or trough with side panel and constant water level) in the grow-finish room. Costs were calculated for each drinker type and included the cost of water of $8.01 per 1000 gallon for this particular barn as well as the costs associated with capital and installation, maintenance and operation, and manure slurry handling. The total cost of the use of the trough with side panel and constant water level was around $11.83/pig, which translated to about 29% reduction in cost when compared to the use of nipple drinkers. For cleaning, the total cost per pig for pre-soaking with water sprinkling and pressure washing a fully slatted flooring was about $0.54/pig, which is $0.01/pig higher than without sprinkling. However, for partially slatted flooring, the use of water sprinkling prior to washing was about $0.09/pig less than without sprinkling. Similarly, the use of the conventional nozzle for high-pressure washing resulted to a total cost of about $0.78/pig (fully slatted) and $0.80/pig (partially slatted), almost half of the other test nozzles.

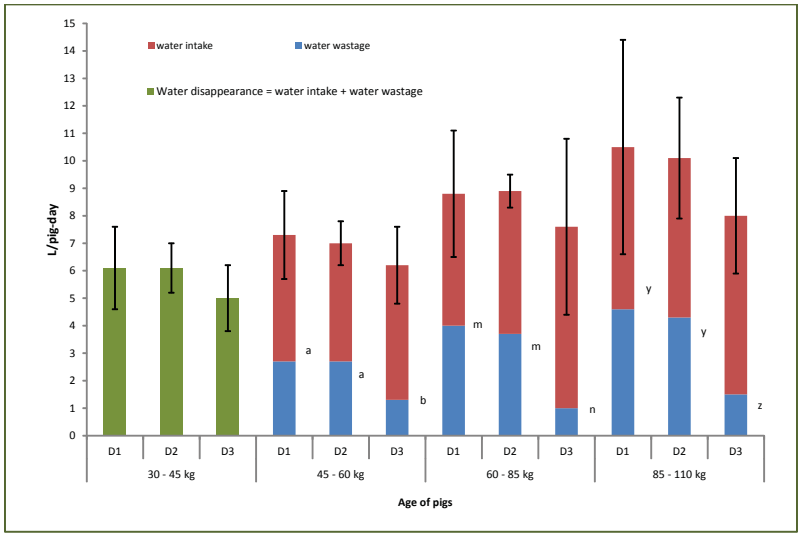


Figure 3. . Effect of different types of drinkers on water disappearance and wastage, n=4. Means (water wastage) with the same letters are not significantly different (p>0.05) from each other. D1 – Nipple; D2 – Nipple with side panel; D3 – Trough with side panel and constant water level.

Based on the results of the producer survey on barn water use (PSC Annual Report 2010, pp. 24-25), the most common practices associated with water use in the participating barns were the use of nipple drinker, pre-soaking the room prior to cleaning, and high-pressure washing using the conventional nozzle. The total cost associated with these current production practices is about $17.13/pig for fully slatted flooring and $17.31/pig for partially slatted flooring (using the above assumptions for water and slurry handling costs). In comparison, using a trough with side panel and constant water level for animal drinking, pressure washing using conventional nozzle, and pre-soaking only in rooms with partially slatted flooring (not in fully slatted flooring), the total cost would be about $12.36/pig (fully slatted) and $12.55/pig (partially slatted). Using these alternative practices then could translate to savings of about $4.77 per pig or 28% reduction in costs associated with water use compared to the current conventional production practices in most barns.

CONCLUSIONS

The barn evaluation of selected water conservation measures indicated that relative to conventional nipple drinkers, the use of a drinking trough with side panel and constant water level saved significant amount of water mainly due to reduced water wastage without adversely affecting pig performance.

High pressure washing in fully slatted flooring can be done without prior water sprinkling (soaking). Compared to current conventional practices, the combination of using a drinking trough with side panel and constant water level for animal drinking, pre-soaking, and high-pressure washing with conventional nozzle for cleaning had the greatest potential for cost savings of up to $4.77 per pig arising from reduced overall water use and accumulated manure slurry.

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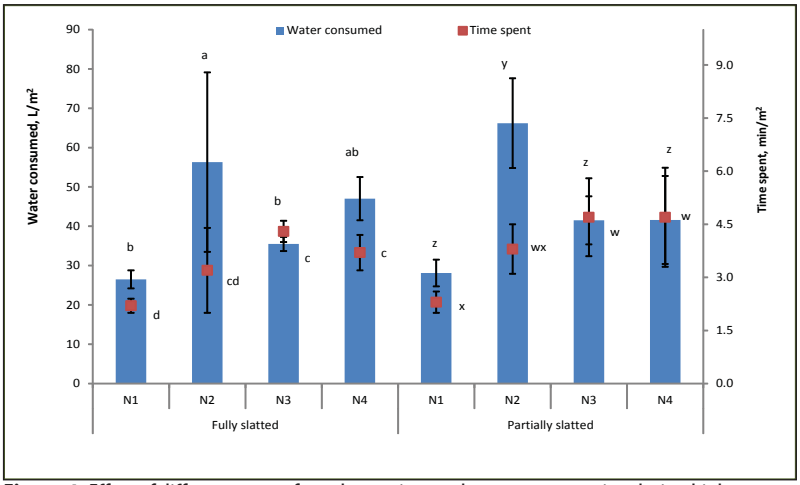

Figure 4. Effect of different types of nozzles on time and water consumption during high-pressure washing, n=5. Means with the same letters within the same type of flooring are not significantly different (p>0.05) from each other. N1 – Conventional nozzle; N2 – Y-nozzle; N3 – Water broom; N4 – 4-in-1 nozzle.