

Water Usage and Manure Production Rates in Today's Pig Industry

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■ Introduction

An accurate account of water use is important in today's expanding hog industry. As well as dictating the requirements of wells or reservoirs serving the barn, the volume of water used will influence the size of the manure storage system and the costs for manure disposal. Numerous current standards quantify water requirements for hogs in different stages of production and for different types of production units. Many of these standards have remained unchanged for twenty or more years, and may not offer an accurate account of water use on modern farms.

Furthermore, little information is available on the partitioning of total water use into its various components within an operation. Most published water requirement figures deal with water used for animal drinking only and fail to account for usages for washing, cooling, and other functions within a fully operational, modern production unit. This serves to invalidate existing figures and leads to unnecessary speculation about actual total water use, particularly for publicly scrutinized large operations. As well, this lack of information hampers efforts to focus and prioritize water conservation practices.

Published manure production rates similarly require updating. Although the industry keeps pace with increasing rates of manure production by expanding manure storage structures, these rates are often not reflected in published codes or guidelines, which are based on outdated survey data. There is little effort made to identify the reason and necessity for these increased rates and possible measures for their mitigation.

■ Findings

This study was initiated to quantify and update values used by the swine industry and regulatory authorities for water consumption and manure production for swine operations using modern management practices. A second objective was to apportion total water usage and total manure production into components according to stage of production and function.

Nine farrow-to-finish swine operations of similar design and management practices, but representing a cross section of herd sizes were selected and monitored for approximately 18 months. The following conclusions were drawn from the data collected:

- Total water use for all production phases and functions averaged 89.5 L/sow/day.
- 80% of total water use was for animal drinking, with the remainder used for animal cooling (10 – 15%), washing (5 – 10%), and domestic use (1%) (**Table 1**).
- Total water uses for different types of operations were in general agreement with published guidelines with the exception of nursery and grow/finish units (**Table 2**).
- Daily drinking and cooling water usage showed a wide variability between operations, particularly in the grow/finish stage (**Table 3 and 4**).
- Total daily drinking water usage rates water requirements were similar to published standards for gestating sows, but were significantly higher for farrowing sows, nursery, and grow/finish pigs (**Table 5**).
- Daily manure production rates in each production stage were very similar to daily drinking water usage rates, but were significantly less than total water usage rates.
- Daily manure production rates showed a wide variability between operations in all stages of production (**Table 6**).
- Average daily manure production rates in the herds surveyed were at least twice as high as those reported in the Netherlands and the US (**Table 7**).
- Average daily manure production rates in the farrowing and nursery phases were generally higher than those stated in published guidelines or codes, and lower than most guidelines for the gestation and grow/finish phases (**Table 8**).
- Opportunities exist to reduce total water usage by up to 50% in Manitoba swine operations. Most of this reduction could be achieved in the grow/finish and gestation production stages by altering management practices and focusing on water-saving drinking equipment (**Table 9**).

Table 1: Average daily water disappearance by function in farrow-finish operations

Function	Number of Herds	Total Observations	Average (per sow, L)	Range (per sow, L)
Drinking	5	5	72.3	62.5 – 82.4
Washing	5	5	3.1	1.5 – 4.3
Cooling, grow/finish ¹	4	7	22.4	8.1 – 37.1
Cooling, farrowing ¹	2	3	0.3	0.3 – 0.3
Domestic ²	4	4	1.0	0.4 – 1.5
All Functions			89.5 ³	71.1 – 110.0

¹Expressed as the average per total inventoried female in the herd.

²Includes all water for human usage and sow washing.

³ Average for those herds with data for all functions

Table 2: Values for total daily water requirements¹ by type of operation and comparison to other published values

Operation Type	Current Study	Alberta Agriculture ⁴
Farrow to Finish, L/sow/day	89.5	91.0
² Farrow to 50 lbs, L/sow/day	31.6	30.0
² Farrow to wean, L/sow/day	21.1	25.0
² Nursery, L/pig/day	3.8	2.0
² Grow/Finish, L/pig/day	11.7 (7.9) ³	7.0

¹ Total of water required for drinking, cooling, washing and domestic use.

² Derived from individual production stage data in farrow-finish operations.

³ Requirement without sprinklers for cooling.

⁴ Farm Water Supply Requirements, AAFRD, 2000

Table 3: Average daily cooling water disappearance by stage of production in farrow-finish operations.

Production Stage	# Herds	Total Obs ¹	Average (L/day)		Range (L/day)	
			Per Sow ²	Per Pig	Per Sow ²	Per Pig
Breeding/ Gestation	0	0	-	-	-	-
Farrowing	2	3	0.3	-	0.3	-
Nursery	0	0	-	-	-	-
Grower/ Finisher	4	7	-	3.4	-	1.2 – 5.7

¹ Observations² Expressed as the average per total inventoried females in the herd.**Table 4: Average daily drinking water disappearance by stage of production in farrow-finish operations.**

Production Stage	# Herds	Total Obs ¹	Average (L/day)		Range (L/day)	
			Per Sow ²	Per Pig	Per Sow ²	Per Pig
Breeding/ Gestation	7	10	15.7	-	11.2 – 21.2	-
Farrowing	7	13	37.4	-	27.3 – 49.5	-
Nursery	7	12	-	3.4	-	1.4 – 4.9
Grower/ Finisher	6	12	-	7.7	-	4.7 – 13.9

¹ Observations² Expressed as the average per total inventoried females in the herd.

Table 5: Comparison of drinking water disappearance values to other published values.

Production Stage	Source			
	Current Study	Prairie Swine Centre ¹	North Carolina ²	The Netherlands ³
Breeding/ Gestation, L/sow/day	15.7	15.0	26.0	10.0
Farrowing, L/sow/day	37.4	20.0	32.0	-
Nursery, L/pig/day	3.4	3.0	3.0	1.4
Grow/Finish, L/pig/day	7.7	7.0	17.0	4.6

¹ Pork Production Reference Guide, Prairie Swine Centre, 2000.

² Water Intake of Pigs, Swine News, North Carolina Extension Service, 1999.

³ The Dutch Water Consumption, DGH Engineering, 1999.

Table 6: Average daily manure production rates by stage of production in farrow-finish operations.

Production Stage	# Herds	Total Obs ¹	Average (L/day)		Range (L/day)	
			Per Sow	Per Pig	Per Sow	Per Pig
Breeding/ Gestation	3	4	15.0	-	12.2 – 20.7	-
Farrowing	4	8	30.1	-	23.5 – 41.1	-
Nursery	4	7	-	3.4	-	2.3 – 4.5
Grower/ Finisher	2	3	-	7.9	-	7.1 – 9.1

¹ Observations

Table 7: Comparison of daily manure production values to other published values.

Production Stage	Source			
	Current Study	Prairie Swine Centre ¹	USA ²	The Netherlands ³
Breeding/ Gestation, L/sow/day	15.0	15.9	3.4	9.1
Farrowing, L/sow/day	30.1	21.8	10.2	13.9
Nursery, L/pig/day	3.4	1.6	1.1	1.7
Grow/Finish, L/pig/day	7.9	8.5	4.5	3.1

¹ Pork Production Reference Guide, Prairie Swine Centre, 2000.

² Manure Characteristics, Midwest Plan Service, 2000.

³ The Dutch Water Consumption, DGH Engineering, 1999.

Table 8: Comparison of daily manure production values to provincial and private guidelines.

Production Stage	Current Study	MB ¹	SK ²	PEI ³	DGH ⁴
Gestation, L/sow/day	15.0	7.6	15.9	15.9	22.7
Farrowing, L/sow/day	30.1	14.2	21.8	21.8	
Nursery, L/pig/day	3.4	1.1	1.6	2.4	3.1
Grow/Finish, L/pig/day	7.9	5.4	8.5	9.3	8.5

¹ Farm Practices Guidelines for Hog Producers in Manitoba, Manitoba Agriculture, 1998.

² Manual for: Developing a Manure and Dead Animal Management Plan, Saskatchewan Agriculture and Food, 1997.

³ Guidelines for Manure Management for Prince Edward Island, Prince Edward Island Department of Agriculture and Forestry, 1999.

⁴ DGH Engineering Ltd., unpublished data, 2001.

Table 9: Areas for potential reduction of total water usage.

Function	Water Usage ¹ , L/sow/day		
	Current	Requirement	Difference
Spray cooling of grow/finish pigs	22.4	1.2	21.2
Drinking water usage by grow/finish pigs	50.1	37.4	12.7
Drinking water usage by gestating sows	12.6	5.6	7.0
Drinking water usage by farrowing sows	7.5	3.0	4.5
Drinking water usage by nursery pigs	8.5	5.5	3.0

¹ Figures are expressed on a total inventoried sow basis, extrapolated from typical animal inventories by production stage, in a farrow-to-finish operation.

■ Discussion

Total water usage in five Manitoba farrow-to-finish operations averaged 89.5 L/sow/day, with a range of 71.1 L to 110.0 L, or approximately 44% of the average. On average, 80% of this total was used for watering of animals, with the next highest use being for cooling of growing/finishing pigs. Washing accounted for 5 to 10% of total usage, followed by domestic use and cooling of farrowing sows.

The highest per head usage was observed in the farrowing phase, followed in descending order by gestation, grow/finish, and nursery phases. When animal inventories in each of these production stages were considered, the grow/finish stage accounted for the highest percentage of total herd usage (64%), followed by gestation (16%), nursery (11%), and farrowing (9 %). The water usage figures recorded in this study for the sow herd were generally in agreement with other published values. However, values for the nursery and grow/finish herds were significantly higher than those reported in other publications.

Daily manure production rates were recorded in four herds. Similar to total water usage, the highest per head production was in the farrowing phase, followed in descending order by gestation, grow/finish, and nursery phases. Taking animal inventories into account, the grow/finish stage accounted for 66% of the total herd manure production, followed by gestation (15%), nursery

(11%), and farrowing (8%). Average daily manure production rates in each phase were generally higher than those stated in published provincial guidelines, but similar to those used by industry planners.

A comparison of the water usage values to manure production values collected by this study show close agreement between drinking water usage and total manure production levels. A general assumption within the industry has been that manure production equals water consumption. This study would suggest that total water consumption is higher than total manure production, and that drinking water consumption is a close approximation of total manure production.

■ Conclusion

This study identified a number of areas where significant water wastage, and hence excess manure production, was occurring. These mainly focused on management practices for cooling and watering of the grow/finish and gestating sow herd. Based on these observations, a cumulative reduction of 50% of current usage was identified as potentially achievable. It is recommended that Western Canadian research organizations investigate each of these areas in further detail to develop and demonstrate effective practices to achieve the potential savings identified. Further field monitoring of grow/finish production units for both water consumption and manure production is also recommended to obtain a larger sample size on which to base conclusions. The grow/finish phase of production appears to offer the greatest potential for significant and immediate savings in both water consumption and manure production within the industry.

There is a need for a targeted research and extension effort to adopt altered management practices and equipment choices. Such an effort could realize immediate and substantial water usage and manure production savings.

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