Livestock and Water Use

A part of the LRIC White Paper Series

August 2021

Written by:

Mike McMorris and Chloe Neudorf
Livestock Research Innovation Corporation

Contributing editor:

Dr. Andrew VanderZaag

Agriculture and Agri-Food Canada

Livestock and Water Use:

Water is one of the most valuable resources, making up about 71% of the Earth's surface and 45-60% of the human body. Fresh water scarcity, an intimidating reality, is on the horizon. Expected population growth and the increased demand for food and climate change influence the supply of available water. Particularly for hot, arid parts of the world, water scarcity is a problem of today. Fortunately for Canadians, Canada holds one of the largest renewable supplies of freshwater in the world. Creating the human food supply requires a great deal of natural resources. The Food and Agriculture Organization of the United Nations (FAO) estimates that approximately 70% of all water withdrawn from renewable freshwater resources is used for irrigation, livestock and aquaculture (Thornton et al., 2009). Agriculture is already a very large user of resources, land and water. This is only expected to increase due to expected population growth, yet competition for resources is expected to leave 64% of the world in water-stressful conditions by 2025 (Rosegrant et al, 2002).

Water Metrics:

Metrics of water use are displayed in a variety of ways. Water use assessments, lifecycle assessments and water footprints are all ways of expressing the amount of water used. Large numbers without context make it easy to exaggerate the impact livestock has on the environment. The water cycle can be a complex system for some to understand. With the input of drinking water, livestock create outputs (urine, milk, manure, water vapour, eggs and meat). Considering the quantity of water the livestock industry utilizes and the impact it has on freshwater systems, agricultural water resource management is an important consideration for the industry. Nutrient leaching in which water carries manure or fertilizer into freshwater systems is another concern. The consequences of poor water management, primarily through well location and management, were seen all too well in Walkerton, Ontario with the E.Coli outbreak. The FAO's Livestock Environmental Assessment and Performance Partnership (LEAP) initiative provides guidance to the livestock industry and consumers to improve the industry's environmental sustainability through scientific methods, metrics and data. It is a very important global initiative to ensure that the 2030 Sustainable Development Goal's are met and stand in accordance with the Paris Agreement.

A life cycle assessment (LCA) uses methodology to track the water footprint of a product including both direct and indirect use of water. This is the common assessment for measuring the environmental impact of agricultural products. The results of an LCA should only be compared to other LCA's of a product and likewise for other forms of assessments. For agricultural products, LCA's account for both water consumption and water degradation. There are a variety of ways to measure water footprints, dependent on the scope. LCA's depict a quantity over a life cycle, water footprints are similar, however focus on a number of factors including, type of production system, scale of farm and species of livestock. Comparing a number of assessments, the range of estimates for water used to produce 1kg of beef (3 – 540 litres) is very large (Doreau et al., 2012). Using a water footprint assessment, results range from 10,000 to 200,000 litres of water (Doreau et al., 2012). Agriculture accounts for 92% of the freshwater footprint of humans, about one third is attributed to animal products (Gerbens-Leens et al., 2011). Fresh water includes rain water and blue and grey water footprints as grazing animals require a great amount of rain, and manure is a large grey water contributer. Primarilty in Western Provinces and Internationally, intensive systems are often irrigated and use more water in comparison to grazing systems. It is recommended to report the use of rainwater separately from the use of ground or surface water to better capture meaningful water use by grazing animals. Meaningful assessment requires clarity of context and comparison when measuring water use in agricultural productions.

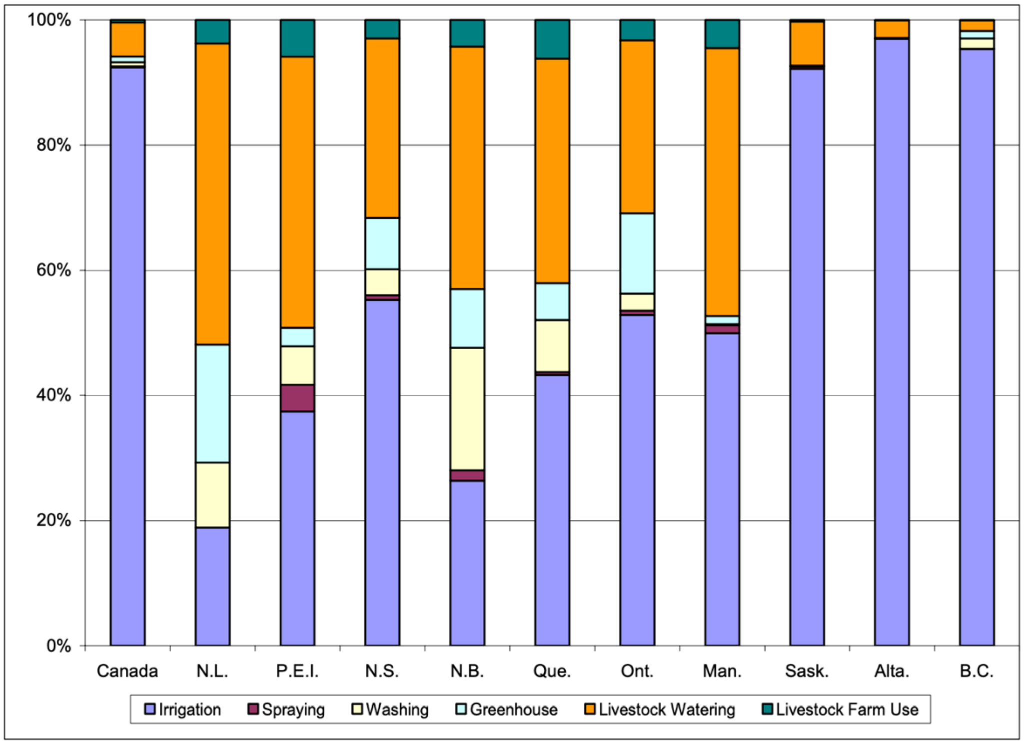
Impact Depends on Context:

The impact of water use depends on local water stress, which varies with place and time. Likewise, livestock production systems are widely diverse and vary depending on the animal and the geographical area of the farm. Therefore, generalizations about water consumption should be avoided because they do not help people make informed choices. For example, a life cycle assessment of lamb cuts from Australia found that the production and consumption of meat did not impose a heavy burden on freshwater resource availability (Ridoutt et al., 2012). The same study suggested that livestock and livestock products have substantial variability related to geographical differences in the water footprint between systems. Livestock farms that are more sustainable when it comes to water input, have similar water footprints to some seeds, grains and cereals. Many livestock graze on land that is otherwise not suitable for growing crops. Grazing primarily uses rain water, 97% of beef's water footprint in a grazing system is rainwater, also known as green water (Gerbens-Leens et al., 2011). Improvement of environmental performance requires an informed understanding of the types of water uses involved, and the impacts.

Why it matters to the Ontario livestock industry:

Livestock production in Ontario is a large consumer of water, accounting for roughly 30% of the agricultural water use in Ontario (Beaulieu et al., 2001). These estimates include water for drinking and cleaning processes in-barn. Water used to create livestock feed was not included. Although Canada is abundant in freshwater, the cost of water is low compared to water-scarce countries. There is a cost to using such a large quantity of water, whether the water needs to be softened, treated, stored or moved.

Distribution of total agricultural water use, Canada and provinces, 2001



Source: (Beaulieu et al., 2001)

What can livestock farmers do?

There are a number of water saving practices for livestock farmers to consider. Small changes matter and can make a big difference down the line. If Canadian dairy farms alone were to reduce their water footprint by 1%, about 500 million litres of water would be conserved (Canadian Dairy Information Centre (CDIC)). Livestock farmers should understand how water footprints are calculated to see where they can make improvements. Knowing the ways that water can flow in and out of the farm and how to better manage resources is important for livestock farmers. Water used for livestock includes drinking, cleaning and cooling (FAO, 2018). Maintaining equipment and ensuring cleaning protocols are followed can reduce the water used in the cleaning process.

Direct water savings

- Optimize cleaning processes to minimize water inputs
  - Example: in a swine finishing barn, the use of intermittent pre-wash vs a continuous soak observed half the water use without affecting wash time (Muhlbauer et al., 2010).
- Prevent leaks
  - Example: 25% of drinkers in a 1,000 head swine finishing facility leak at 1 drip per second. This accumulates to over 43,000 gallons of water added to manure storage; at a cost of $526 to apply that water to land as manure each year (Muhlbauer et al., 2010).
  - Example: 60% water savings by converting from fixed nipple waterers to troughs in swine (Predicala and Alvarado, 2013)
- Recycle water when possible
  - Example: re-use plate-cooler water; LRIC produced some YouTube videos on this with the Dairy Farmers of Canada.
  - Example: Use rainwater collected from barn roofs. This could supply up to 25% of water needs in a swine operation in parts of USA (Muhlbauer et al., 2010)
  - Keep animals cool in the summer to increase productivity per unit of water consumed
- Optimize herd productivity

Indirect water savings

- Optimize productivity of pasture land
- Optimize crop production (maximize productivity of rainwater) while minimizing fertilizer use
- Conserve energy as this reduces water use in the energy sector
- Consider the water used in production of purchased feeds
- Continue increasing feed conversion efficiency

Water Quality

- Ensure that water returns to the environment without nutrient or pathogen contaminants. For example, follow best practices for:
    - Manure management and for fertilizing crops
    - Managing cleaning water (e.g. milkhouse washwater)
    - Avoiding nutrient transport to surface waters (applies to cropland, pastures/paddocks, bunker silos, yards)

Other:

- Increase diversity within the farm, including livestock and crop varieties, to help with weather and drought resistance (Batima et al., 2005)
- Incorporate agroforesty by including trees alongside crops and pastures to help maintain balance and improve quality of air, soil, water, biodiversity, pest and disease resistance, and nutrient cycling (Rojas-Downing et al., 2017)
- Make use of mixed crop-livestock systems which can improve efficiency of resource use, yielding more products per land, water, and resources (Herrero et al., 2012; Steinfeld et al., 2006; Rojas-Downing et al., 2017)
- Optimize feed use with proper ration composition
- Improve land management to better suit rainfall to improve soil health and crop production (Batima et al., 2005; Rojas-Downing et al., 2017)
- Use breeding strategies and regenerative agriculture practices to improve water efficiency, retention and management on farm.

Research Gaps

- Identify livestock genetics and production practices that require less water.
- Capture of detailed farm level data regarding climate, agricultural practices and utilization of feed.
- Water consumption studies for a number of Ontario farm types / geography.
- Benchmarking current practices in Ontario.

Innovation Gaps

- Development and scaling of water conservation technologies that are economical for the livestock systems and farm sizes in Ontario

- Optimizing robotic cleaning systems to use less water in cleanup practices in the barn.
- More water efficient means of processing, for example; dairy processing in Ireland (Yan & Holden, 2019).

For more information

1. Andrew VanderZaag, Agriculture and Agri-Food Canada, Ottawa, ON | andrew.vanderzaag@agr.gc.ca

Additional resources

- LRIC videos for the Dairy Farmers of Canada
- Livestock Environmental Assessment and Performance Partnership (LEAPP) Food and Agriculture Organization of the United Nations (FAO)
- Water Requirements of Livestock – Ontario Ministry of Agriculture, Food and Rural Affairs
- Agricultural Water Use in Canada – Statistics Canada

References

1. Thornton, P. K., Van de Steeg, J., Notenbaert, A., & Herrer, M. (2009). The impacts of climate change on livestock and livestock systems in developing countries: A review of what we know and what we need to know. *Agricultural Systems*, 101. 113-127. 10.1016/j.agsy.2009.05.002.
2. Rosegrant, M., Cai, X., Cline, S., & Nakagawa, N. (2002). The role of rainfed Agriculture in the future of global food production. *Environment and Production Technology Division, International Food Policy Research Institute*
3. Ridoutt, B. G., Sanguansri, P., Freer, M., & Harper, G. S. (2012). Water footprint of livestock: Comparison of six geographically defined beef production systems. *The International Journal of Life Cycle Assessment* 17, 165-175, Retrieved from https://link.springer.com/article/10.1007/s11367-011-0346-y
4. Gerbens-Leenes, P. W., Mekonnen, M. M., & Hoekstra, A. Y. (2013). The water footprint of poultry, pork and beef: A comparative study in different countries and production systems. *Water Resources and Industry*, 1-2, 25-36, Retrieved from https://www.sciencedirect.com/science/article/pii/S2212371713000024?via%3Dihub
5. Beaulieu, M. S., Fric, C., & Soulard, F. (2001). Agriculture and Rural Working Paper Series: Estimation of water use in Canadian agriculture in 2001. *Statistics Canada*, Retrieved from https://www150.statcan.gc.ca/n1/en/pub/21-601-m/21-601-m2007087-eng.pdf?st=erdN1D_v
6. Doreau, M., Corson, M.S., Wiedemann, S.G. (2012). Water use by livestock: A global perspective for a regional issue?, *Animal Frontiers*, (2) 2, 9–16, Retrieved from https://doi.org/10.2527/af.2012-0036
7. Canadian Dairy Information Centre (CDIC), *Government of Canada*. Retrieved from https://agriculture.canada.ca/en/canadas-agriculture-sectors/animal-industry/canadian-dairy-information-centre
8. FAO. (2018). Water use of livestock production systems and supply chains – Guidelines for assessment (Draft for public review). *Livestock Environmental Assessment and Performance (LEAP) Partnership. FAO*, Rome, Italy.
9. Muhlbauer, R. V., Moody, L. B., Burns, R. T., Harmon, J., & Stalder, K. (2010). Water consumption and conservation techniques currently available for swine production – NPB #09-128*, Department of Animal Science, Iowa State University*.
10. Pridicala, B. Z., & Alverado, A. C. (2013). Benchmarking water use and developing strategies for water conservation in swine production operations. *The Canadian Society for Bioengineering, Retrieved from https://library.csbe-scgab.ca/docs/meetings/2013/CSBE13084.pdf*
11. Batima, P., Natsagdorj, L., Gobluudev, P., & Erdenetsetseg, B. (2005). Observed climate change in Mongolia*. AIACC Working Paper*. 12
12. Rojas-Downing, M. M., Nejadhashemi, A., Woznicki, S.A., & Harrigan, T. (2017). Climate change and livestock: Impacts, adaption, and mitigation, *Climate Risk Management*,
13. Herrero, M., Thornton, P.K., Notenbaert, A., Msangi, S., Wood, S., Kruska, R., Dixon, J., Bossio, D., Van de steeg, J., Freeman, H. A., Li, X., Parthasarathy, P. R. (2012). Drivers of chang in crop-livestock systems and their potential impacts on agro-ecosystems services and human wellbeing to 2030: A study commissioned by the CGIAR systemwide livestock programme, *International Livestock Research Institute, Nairobi, Kenya.*

14. Steinfeld H., Gerber P., Wassenaar T., Castel V., Rosales M.& de Haan C. (2006). *Livestock's long shadow: Environmental issues and options. Rome, Italy: FAO*, Retrieved from *https://books.google.ca/books?hl=en&lr=&id=1B9LQQkm_qMC&oi=fnd&pg=PR16&ots=LPW1iSaHuJ&sig=g_4FGpLQdLGr0lsAzAZOeSZpt98&redir_esc=y#v=onepage&q&f=false*
15. Yan, M. J. & Holden, N. M. (2019). Water use efficiency of Irish dairy processing. *Journal of Dairy Science*, Retrieved from https://www.journalofdairyscience.org/article/S0022-0302(19)30649-6/fulltext