

Human versus Animals - Comparison of Waste Properties

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There has been some debate about the size of livestock barns currently being built and their comparison to residential areas, in terms of waste production. The following table is based on the information from design manuals for human waste treatment and animal manure production. It is an attempt to compare production on an equal footing, and includes waste generated, as well as other parameters typically of concern due to potential environmental impacts.

It may not be entirely fair to compare the waste produced by humans and livestock in this manner, since the systems of storage, treatment, and utilization or disposal are so different. This information is intended as a guide, to help put the issue into perspective. Sources of background data and assumptions used to compile the following information are found at the end of this report.

Daily Production of Waste Constituents for Dairy Cattle, Beef Cattle, Laying Hens, Broiler Chickens, Feeder Pigs, and Humans

(all calculations were rounded to two significant figures)

n/a: information not available

	Units	Dairy Cow	Beef Feeder	Feeder Pig	Laying Hen	Broiler Chicken	Human
typical weights	kg	590	295	52	1.6	0.7	63
Volume of manure/wastewater (including dilution liquid)	L	68.7	21.3	5.8	0.2	0.07	227
Total Solids	g	7100	2500	570	26	15	160
BOD ₅ *	g	940	470	160	5.3	n/a	50
Total Nitrogen	g	260	100	27	1.3	0.77	9.1
Total Phosphorus	g	55	27	9.4	0.48	0.21	1.8
Total coliform bacteria	number	6.5x10 ¹²	1.8x10 ¹¹	2.3x10 ¹⁰	1.8x10 ⁹	n/a	2.3x10 ¹¹

* BOD₅ refers to the 5-day Biochemical Oxygen Demand which is a measure of the organic matter in the waste

Another way of expressing this - on average, for a given period of time:

- 1,000 humans produce as much **total solids** as:
 - 20 dairy cows
 - 60 beef feeder cattle
 - 280 feeder pigs
 - 6 200 laying hensor 11 000 broiler chickens
- 1,000 humans produce as much **BOD₅** as:
 - 50 dairy cows
 - 100 beef feeder cattle
 - 310 feeder pigsor 9 400 laying hens
- 1,000 humans produce as much **Total Nitrogen** as:
 - 40 dairy cows
 - 90 beef feeder cattle
 - 340 feeder pigs
 - 7 000 laying hensor 12 000 broiler chickens
- 1,000 humans produce as much **Total Phosphorus** as:
 - 30 dairy cows
 - 70 beef feeder cattle
 - 190 feeder pigs
 - 3 800 laying hensor 8 600 broiler chickens
- 1,000 humans produce as much **Total coliform bacteria** as:
 - 30 dairy cows
 - 1 300 beef feeder cattle
 - 10 000 feeder pigsor 130 000 laying hens
- 1,000 humans produce as much **total waste (including dilution liquid)** as:
 - 3 300 dairy cows
 - 11 000 beef feeder cattle
 - 39 000 feeder pigs
 - 1 100 000 laying hensor 3 200 000 broiler chickens

Background - Sources of data, and assumptions made

1. Metcalf & Eddy Inc. Wastewater Engineering - Treatment, Disposal and Reuse, Third Edition. Revised by: Tchobanoglous, G. and Burton, F.L., published by: McGraw-Hill Inc

from Table 2-9: Typical wastewater flow rates per person from residential sources

high-rise apartment	50 gal / day (US gal)	189 L / day
low-rise apartment	65 gal / day	246 L / day
typical home	70 gal / day	265 L / day
Assume	60 gal / day	227 L / day

from Table 3-16: Typical composition of untreated wastewater

Assume “medium” concentration (as opposed to “weak” or “strong”)

Total solids	720 mg / L	
BOD ₅	220 mg / L	
Total Nitrogen	40 mg / L	
Total Phosphorus	8 mg / L	
Total coliform bacteria	10 ⁷ - 10 ⁸ / 100 mL	(Assume 10⁸)

2. Ontario Ministry of Agriculture and Food, Rural Affairs (OMAFRA). MSTOR2000 - Manure Storage Sizing Program. version: August 9, 2000.

Dairy Cattle - mature cows default weight is 590 kg
assume: 100 % floor space utilization
total manure per cow: 68.7 L / day estimated dry matter: 9.1 %

Beef Cattle - feeders default weight is 295 kg
assume a continuous housing system (i.e. 100% floor space utilization)
total manure per animal: 21.3 L / day estimated dry matter: 9.0 %

Pigs - feeder pigs default weight is 52 kg
assume “all in, all out” housing (i.e. 85 % utilization of floor space)
total manure per pig: 5.8 L / day estimated dry matter: 5 %
(if wet/dry feeders were used: 4.6 L / day of total diluted manure / animal
if continuous housing were used: 6.9 L / day of total diluted manure / animal)

Chickens - laying hens default weight is 1.6 kg
assuming 100% of utilization of floor space
total manure per chicken: 0.2 L / day estimated dry matter: 10%

Chickens - broilers default weight is 0.7 kg
assume “all in, all out” (i.e. 80% utilization of floor space)
total manure per chicken: 0.07 L / day estimated dry matter: 60%

3. ASAE. 1998. Manure Production and Characteristics. Data sheet ASAE D384.1 DEC98, in ASAE Standards 1999. American Society of Agricultural Engineers, St Jacobs, MI - page 663

From Table 1: Fresh manure production and characteristics per 1 000 kg live animal mass per day

	Dairy Cattle	Beef Cattle	Swine	Layers	Broilers
Total Solids (kg)	12	8.5	11	16	22
BOD ₅ (kg)	1.6	1.6	3.1	3.3	n/a
Total N (kg)	0.45	0.34	0.52	0.84	1.1
Total P (kg)	0.094	0.092	0.18	0.30	0.30
Total coliform bacteria (# colonies)	1100 x 10 ¹⁰	6.3 x 10 ¹⁰	45 x 10 ¹⁰	110 x 10 ¹⁰	n/a

n/a: information not available

4. Handbook of tables for Applied Engineering Science, Second Edition. Editors: Bolz, Ray E. and Tuve George L., published in 1973 by Chemical Rubber Co. in Cleveland Ohio

from table 7-57, pg 702: Body Size of Young Adults

median approximate weight for males 155 lb

median approximate weight for females 122 lb

Assume average weight for humans is 138.5 lb = 63 kg

(rounded to two significant figures)