

## Production, economic viability, and risks associated with switching dairy cows from Drylots to Compost Bedded Pack systems

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*Table S1 – Descriptive data from dairy cattle farms that switched or did not switch from Drylots to compost bedded pack systems*

Items	Compost Bedded Pack			Drylots		
	1 <sup>1</sup>	2	3	1	2	3
Area used for livestock, ha	89.37	85.30	83.94	76.12	75.19	74.77
Annual milk production, L/yr	772 056.50	980 692.50	1 219 847.17	553 539.21	591 374.83	676 218.67
Daily Milk Production, L/d	2115.22	2686.83	3342.05	1516.54	1620.21	1852.65
Milk production per area, L/ha	15 609.22	38 688.65	53 063.08	8213.26	8809.77	9715.78
Milk production per day of calving interval, L/d	14.78	15.65	16.44	12.94	14.19	14.13
Milk production per labor, L/FTE <sup>2</sup>	418.55	482.68	501.68	484.46	510.73	549.89
Milk production per lactating cow, L/cow	20.83	24.68	26.18	17.64	17.70	17.96
Milk production per total # of cows, L/cow	17.21	18.35	19.20	14.63	15.09	15.27
Milk fat, %	3.69	3.67	3.66	3.84	3.87	4.04
Milk protein, %	3.33	3.25	3.26	3.25	3.27	3.30
Milk total solids, %	11.72	11.58	12.38	12.26	12.26	12.06
Somatic cell count, 100,000 cells/mL	2.54	2.56	2.47	2.59	2.62	2.61
Herd Size, # (cows and young stock)	211.07	241.42	305.37	202.23	204.62	224.36
Full time equivalent labor, #	5.20	5.52	6.16	3.18	3.15	3.28
Lactating cows, #	98.78	116.11	134.42	85.92	91.45	101.52
Lactating cows per area, cows/ha	2.12	4.83	5.97	1.27	1.37	1.48
Lactating cows/herd size, %	47.00	47.43	44.13	43.77	46.44	47.20
Lactating cows/full time equivalent, cows/#	20.26	21.83	21.19	27.35	28.86	30.41
Total cows, #	123.42	142.62	168.17	103.48	107.08	119.15

Lactating cows/total cows, %	82.50	82.47	77.86	83.93	85.30	85.03
Assets with land value, \$	924 639.74	937 995.42	948 633.21	841 815.50	804 454.12	778 704.27
Assets without land value, \$	470 375.05	533 643.72	575 620.70	330 964.83	337 073.60	350 283.54
Milk price, \$/kg	0.42	0.44	0.46	0.41	0.41	0.49
Annual revenue from milk production, \$/yr	339 187.04	419 097.40	550 507.49	229 825.00	248 132.66	337 055.96
Annual revenue from milk production/annual revenue, %	94.88	92.74	88.82	90.92	94.01	96.74
Annual revenue, \$/yr	361 208.40	449 517.39	612 315.03	257 192.97	266 448.01	346 876.60
Expenditures with concentrate, \$/yr	142 582.90	170 133.08	217 766.24	80 231.53	93 858.23	102 781.13
Expenditures with concentrate/annual revenue, %	35.83	36.36	32.44	31.25	35.30	29.91
Expenditures with concentrate/liter of milk produced	0.16	0.17	0.17	0.14	0.16	0.15
Expenditures with concentrate/accrual operating costs, %	46.04	46.56	47.47	43.62	45.13	41.76
Expenditures with labor (FTE), \$/yr	33 777.89	38 503.41	46 616.36	15 468.18	16 226.12	18 831.43
Expenditures with labor (FTE)/annual revenue, %	8.52	7.91	7.49	5.79	6.14	5.59
Expenditures with labor (FTE)/liter of milk produced, \$/L	0.05	0.05	0.05	0.05	0.05	0.05
Expenditures with labor (FTE)/ accrual operating costs, %	15.04	13.88	14.13	16.12	14.27	13.33
Expenditures with medicines, \$/yr	14 541.68	15 120.15	20 501.84	9303.46	9894.18	11 543.62
Expenditures with medicines/annual revenue, %	3.57	3.65	3.23	3.58	3.60	3.20
Expenditures with medicines/liter of milk produced, \$/L	0.01	0.01	0.01	0.01	0.01	0.01
Expenditures with medicines/ accrual operating costs, %	3.13	2.98	2.79	3.29	3.14	2.69
Expenditures with roughage, \$/yr	31 218.97	36 152.85	52 452.62	37 776.87	40 159.53	43 637.65
Expenditures with roughage/annual revenue, %	10.82	8.66	10.09	14.87	14.90	13.19
Expenditures with roughage/liter of milk produced, \$/L	0.05	0.04	0.05	0.07	0.07	0.07
Expenditures with roughage/ accrual operating costs, %	13.87	11.25	13.52	20.88	19.19	18.39
Total operating costs, \$/yr	290 616.78	361 769.53	479 106.33	190 331.28	210 328.83	244 311.27
Milk total operating costs, \$/L	0.32	0.34	0.33	0.29	0.31	0.32
Total operating costs/milk price, %	77.08	77.30	73.17	70.47	75.03	66.53
Accrual operating costs, \$/yr	313 731.95	387 144.59	506 912.47	215 303.07	234 137.32	268 360.92
Milk total operating costs, \$/L	0.35	0.37	0.36	0.33	0.35	0.36

Accrual operating costs from milk production, \$/yr	293 436.46	360 597.13	456 693.66	192 543.98	218 071.23	260 745.82
Accrual operating costs/milk price, %	85.42	84.68	79.62	80.92	84.80	74.67
Gross margin, \$/yr	70 591.62	119 755.14	159 432.37	66 861.69	56 119.18	94 327.00
Gross margin per liter of milk produced, \$/L	0.09	0.12	0.13	0.12	0.09	0.14
Gross margin/area, \$/ha	789.92	1403.98	1899.44	878.38	746.35	1261.49
Gross margin/lactating cow, \$/cow	714.65	1031.38	1186.09	778.22	613.65	929.19
Net margin, \$/yr	47 476.44	92 030.51	128 955.49	418 89.90	32 310.69	78 515.68
Net margin per liter of milk produced, \$/L	0.06	0.09	0.11	0.08	0.05	0.12
Net margin/area, \$/ha	531.26	1078.95	1536.34	550.32	429.71	1050.04
Net margin/lactating cow, \$/cow	480.64	792.60	959.36	487.56	353.31	773.43
Operating profit, %	13.13	12.78	17.62	15.01	10.96	20.21
Return on assets, %	12.49	13.42	23.06	11.82	9.16	22.53
Assets turnover rate, %	48.77	77.85	98.56	38.69	40.15	44.20
Risk, %	47.42	39.78	33.00	36.65	50.74	56.37
Expected Net Margin per liter of milk produced, \$/L	0.00	0.01	0.02	0.02	-0.01	-0.02
Expected Net Margin, \$/yr	-14 689.28	3096.71	10 340.36	4783.94	-3631.90	-14 461.77

<sup>1</sup>Farms that switched from Drylots to a compost bedded pack system were on Drylots in the first year; <sup>2</sup>Full time equivalent labor.

*Table S2 – Equations used to calculate technical, economic and risk indexes of dairy cattle farms that switched or did not switch from Drylots to compost bedded pack systems*

Index	Equation
<i>Technical indexes</i>	
Milk production per area (MP <sub>A</sub> ), L/ha	$\frac{\text{annual milk production}}{\text{area}}$
Milk production per day (MP <sub>D</sub> ), L/d	$\frac{\text{annual milk production}}{365}$
Milk production per calving interval (MP <sub>CI</sub> ), L/d	$\frac{\text{milk production per lactation}}{\text{calving interval}}$
Milk production per full time equivalent labor (MP <sub>FTE</sub> ), L/FTE	$\frac{\text{daily milk production}}{\text{full time equivalent labor}}$
Milk production per cow (MP <sub>LC</sub> ), L/d	$\frac{\text{daily milk production}}{\text{average number of lactating cows}}$
Average herd size (HS)	sum of all animals in the herd, such as cows, heifers, bulls, and service animals
Proportion of lactation cows (LC <sub>HS</sub> ), %	$\frac{\text{average number of lactating cows}}{\text{herd size}} \times 100$
<i>Economic Indexes</i>	
Concentrate expenses in AOC <sup>1</sup> (CE <sub>AOC</sub> ), %	$\frac{\text{concentrate expenses}}{\text{accrual operating costs}} \times 100$
Concentrate expenses per liter (CE <sub>L</sub> ), \$/L	$\frac{\text{concentrate expenses}}{\text{annual milk production}}$
Proportion of concentrate expenses in AR <sup>2</sup> (CE <sub>AR</sub> ), %	$\frac{\text{concentrate expenses}}{\text{annual revenue}} \times 100$
Roughage expenses in AOC (RE <sub>AOC</sub> ), %	$\frac{\text{roughage expenses}}{\text{accrual operating costs}} \times 100$
Roughage expenses per liter (RE <sub>L</sub> ), \$/L	$\frac{\text{roughage expenses}}{\text{annual milk production}}$
Proportion of roughage expenses in AR (RE <sub>AR</sub> ), %	$\frac{\text{roughage expenses}}{\text{annual revenue}} \times 100$
Total accrual costs per liter (AOC <sub>L</sub> ), \$/L	$\text{AOC} \times \frac{\text{total milk income}}{\text{annual revenue}}$
Assets per liter (A <sub>L</sub> ), \$/L	$\frac{\text{annual milk production}}{\text{assets}}$
Operating profit (OP), %	$\frac{\text{Net Margin (NM)}}{\text{annual revenue}} \times 100$
Labor expenses in AOC (LE <sub>AOC</sub> ), %	$\frac{\text{labor expenses}}{\text{accrual operating Costs}} \times 100$
Labor expenses per liter (LE <sub>L</sub> ), %	$\frac{\text{labor expenses}}{\text{annual milk production}} \times 100$
Proportion of labor expenses in AR (LE <sub>AR</sub> ), %	$\frac{\text{labor expenses}}{\text{annual revenue}} \times 100$
Medicine expenses in AOC (MED <sub>AOC</sub> ), %	$\frac{\text{medicine expenses}}{\text{accrual operating costs}} \times 100$
Medicine expenses per liter (MED <sub>L</sub> ), \$/L	$\frac{\text{medicine expenses}}{\text{annual milk production}}$
Total accrual costs per liter (AOC <sub>L</sub> ), \$/L	$\text{accrual operating costs} \times \frac{\text{annual milk sales}}{\text{annual revenue}}$
Net margin per liter (NML), \$/L	$\text{milk price} - \text{AOC}_L$

Profit per cow per year, \$/cow/year	$\frac{\text{profit}}{\text{average number of cows in the herd}}$
Assets turnover rate (ATR), %	$\frac{\text{annual revenues}}{\text{assets}} \times 100$
Return on assets (ROA), %	$\frac{\text{profit}}{\text{assets}} \times 100$

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*Risk indexes*

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Total Risk, %	likelihood of a negative NM using the actual costs and most likely milk prices to estimate annual farm revenue
Expected net margin (ENM), \$/year	NM obtained using the expected milk price using a historical series of prices (Monte Carlo analysis)
Expected NM per liter of milk (ENM <sub>L</sub> ), \$/L	$\frac{\text{expected net margin}}{\text{annual milk production}}$
Expected NM per cow (ENM <sub>C</sub> ), \$/cow	$\frac{\text{expected net margin}}{\text{total number of cows}}$

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<sup>1</sup>AOC = Accrual operational costs; <sup>2</sup>AR = Annual revenue



*Figure S1 – Overview of dairy cows in Drylot systems in Brazil*



*Figure S2 – Overview dairy cows in compost bedded pack barn systems in Brazil*