

Technification in dairy farms may reconcile habitat conservation in a Brazilian savanna region

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Supplementary A – Tables

Table S1. Characterization of the 25 dairy farms in the COFA-LTER long-term project. Numbers from 1 to 25 correspond to the dairy farm boundaries in Fig. B1 Appendix B. IIC is the Integral Index of Connectivity (for 100, 300, 500 and 1000 m dispersal distances, and mean value). Nd, not declared (farmer did not respond to the question). Size class corresponds to the fiscal module for the study region (1 module = 1 ha). A, family farm (< 30 ha); B, small farms; C, medium; D, large.

Farm	Farm area (ha)	Size class	Natural vegetation (ha)	% Natural vegetation	IIC 100	IIC 300	IIC 500	IIC 1000	IIC Mean	Legal reserve area (ha)	% Legal reserve	Daily milk production (l)
1	143.472	C	66.793	46.555	0.214	0.214	0.214	0.214	0.214	35.400	0.20	250.0
2	49.917	B	7.603	15.231	0.023	0.023	0.023	0.023	0.023	12.900	0.20	1425.0
3	31.433	B	3.669	11.672	0.015	0.015	0.015	0.015	0.015	1.200	0.20	200.0
4	9.838	A	1.809	18.384	0.026	0.026	0.026	0.026	0.026	1.920	0.20	220.0
5	73.781	B	23.053	31.245	0.097	0.097	0.097	0.097	0.097	1.960	0.20	115.0
6	237.038	C	96.282	40.619	0.160	0.162	0.162	0.162	0.161	49.000	0.80	300.0
7	70.570	B	3.823	5.417	0.002	0.002	0.002	0.002	0.002	nd	nd	90.0
8	68.440	B	12.853	18.780	0.027	0.029	0.029	0.029	0.029	14.000	0.19	1000.0
9	16.756	A	3.831	22.863	0.018	0.034	0.035	0.035	0.031	3.360	0.20	35.0

10	32.812	B	6.816	20.773	0.037	0.037	0.037	0.037	0.037	7.200	0.18	940.0
11	218.188	C	28.924	13.257	0.015	0.016	0.016	0.016	0.016	43.200	0.20	600.0
12	15.958	A	3.934	24.654	0.065	0.065	0.065	0.065	0.065	3.360	0.20	300.0
13	48.718	B	15.172	31.143	0.075	0.076	0.076	0.076	0.076	7.680	0.20	480.0
14	26.321	A	4.630	17.589	0.026	0.029	0.029	0.029	0.028	4.800	0.20	40.0
15	33.075	B	8.283	25.043	0.034	0.040	0.040	0.040	0.039	6.720	0.20	100.0
16	61.928	B	24.746	39.959	0.108	0.112	0.112	0.112	0.111	12.000	0.20	8.0
17	38.263	B	5.267	13.765	0.014	0.014	0.015	0.015	0.014	7.680	0.20	40.0
18	5.264	A	2.145	40.758	0.129	0.129	0.129	0.129	0.129	7.680	0.20	400.0
19	102.481	B	27.103	26.446	0.065	0.065	0.065	0.065	0.065	22.800	0.20	3200.0
20	391.035	C	108.084	27.640	0.053	0.057	0.057	0.058	0.056	96.000	0.40	150.0
21	7.103	A	2.799	39.401	0.155	0.155	0.155	0.155	0.155	1.500	0.20	16.0
22	10.814	A	3.885	35.924	0.116	0.116	0.116	0.116	0.116	2.000	0.20	30.0
23	710.943	D	231.450	32.555	0.083	0.084	0.084	0.084	0.084	133.000	0.33	1200.0
24	34.377	B	3.078	8.954	0.009	0.011	0.011	0.011	0.011	6.800	0.20	700.0
25	23.982	A	2.982	12.435	0.015	0.015	0.015	0.015	0.015	3.800	0.20	20.0
Mean	98.500		27.960	24.842	0.063	0.065	0.065	0.065	0.065	20.248		474.4
Minimum	5.264		1.809	5.417	0.002	0.002	0.002	0.002	0.002	1.200		8.0
Maximum	710.943		231.450	46.555	0.214	0.214	0.214	0.214	0.214	133.000		3200.0
SD	155.775		51.185	11.448	0.057	0.056	0.056	0.056	0.056	32.308		695.2
Median	38.263		6.816	24.654	0.037	0.040	0.040	0.040	0.039	7.440		220.0

Table S2. Outcomes of the variables related to the level of technification and overall milking management characteristics in dairy farms in COFA-LTER landscape. For details of each variable possible outcome (1 to 5) see Table 1 in the main text. Variables with total < 25 have missing data (the farmer did not respond).

Variable	Number of outcomes					Total
	1	2	3	4	5	
Primary forage diet	10	1	12	2	-	25
Fertilizer pasture management	17	7	-	-	-	24
Time of supplementary feed	8	16	-	-	-	24
Pasture restoration	15	9	-	-	-	24
Criterion to supplement	0	6	11	8	-	25
Add vitamins to supplement	14	11	-	-	-	25
Milking method	6	11	7	-	-	24
Milking frequency	9	15	1	-	-	25
Farm infrastructure for milking	10	8	5	2	0	25

Milk cooling tank	1	18	6	-	-	25
Milk quality-based payment	16	9	-	-	-	25
Cleaning of udder before milking	5	6	14	-	-	25
CMT test	2	2	8	11	1	24
Breeding program for productivity	10	15	-	-	-	25
Selective breeding method	16	9	-	-	-	25
Pregnancy diagnosis	5	14	6	-	-	25
Cattle breed composition	10	0	5	10	-	25
Management separating pregnant cows	9	16	-	-	-	25

Table S3. Collinearity among variables related to the level of technification in dairy farms in COFA-LTER landscape. CMT is the California Mastitis Test. Gvif is the generalized variance-inflation factor. In bold, values of Gvif > 5.0, variables were excluded for the next step of Gvif analysis.

Group/Variable	Gvif	df	Gvif ^{^(1/(2*df))}
Feed management Step 1			
primary forage diet	8.974	3	1.442
fertilizer pasture management	3.142	2	1.331
time of supplementary feed	2.959	2	1.312
criterium to supplement	3.184	2	1.336
add vitamins to supplement	2.600	1	1.612
Feed management Step 2 (excluding primary forage diet)			
fertilizer pasture management	2.041	2	1.195
time of supplementary feed	1.479	2	1.103
criterium to supplement	1.866	2	1.169
add vitamins to supplement	1.767	1	1.329
Milking management Step 1			
milking method	5.093	3	1.312
milking frequency	3.310	2	1.349
farm infrastructure for milking	3.956	3	1.258
Milking management Step 2 (excluding milking method)			

milking frequency	2.243	2	1.224
farm infrastructure for milking	2.243	3	1.144
Sanitary control			
cleaning of udder before milking	2.053	2	1.197
CMT	2.053	5	1.075
Genetics and breeding			
Breeding program for productivity improvement	2.553	1	1.598
selective breeding method	2.757	1	1.661
pregnancy diagnosis	2.264	2	1.227

Table S4. Models of technification to explain variation in percentage of natural vegetation among dairy farms, analyzed per group of explanatory variables. RSS, residual sum of square; AIC, Akaike Information Criterion; SE, standard error. * significant ($p < 0.05$).

Group/Variable	df	Sum of Square	RSS	AIC	p
Feed management					
null model			2955.1	135.31	
fertilizer pasture management	2	6.226	2961.3	131.36	0.974
time of supplementary feed	2	33.211	2988.3	131.59	0.869
criterium to supplement	2	133.271	3088.4	132.41	0.576
add vitamins to supplement	1	0.003	2955.1	133.31	0.996
Milking management					
null model			2716.2	129.20	
milking frequency	2	54.55	2770.7	125.70	0.779
farm infrastructure for milking	3	425.22	3141.4	126.84	0.304
Sanitary control					
null model			2364.3	129.73	
cleaning of udder before milking	2	168.73	2533.0	127.46	0.423
CMT	5	480.62	2844.9	124.36	0.463
Genetics and breeding					
null model			2293.2	122.97	
breeding program for productivity improvement	1	504.32	2797.5	125.94	0.026*

selective breeding method	1	430.89	2724.0	125.28	0.038*
pregnancy diagnosis	2	314.89	2608.1	122.19	0.200
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Daily milk production					
	Estimate	SE	t	p	
intercept	25.365	2.844	8.919	6.32e-09	
daily milk production	-0.001	0.003	-0.321	0.751	
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Table S5. Models of technification to explain variation in mean IIC among dairy farms, analyzed per group of explanatory variables. RSS, residual sum of square; AIC, Akaike Information Criterion; SE, standar error. ** marginally significant ($p < 0.10$).

Group/Variable	df	Sum of Square	RSS	AIC	p
Feed management					
null model			0.072347	-130.13	
fertilizer pasture management	2	2.5e-05	0.072373	-134.12	0.996
time of supplementary feed	2	1.7e-05	0.072521	-134.07	0.971
criterium to supplement	2	1.2e-05	0.073566	-133.71	0.812
add vitamins to supplement	1	8.9e-04	0.073242	-131.82	0.579
Milking management					
null model			0.061	-138.37	
milking frequency	2	0.002	0.063	-141.50	0.646
farm infrastructure for milking	3	0.015	0.076	-138.79	0.134
Sanitary control					
null model			0.059	-135.30	
cleaning of udder before milking	2	0.004	0.063	-137.53	0.412
CMT	5	0.012	0.071	-140.51	0.442
Genetics and breeding					
null model			0.059	-141.12	
breeding program for productivity improvement	1	0.006	0.065	-140.90	0.136

selective breeding method	1	0.008	0.068	-139.85	0.071**
pregnancy diagnosis	2	0.009	0.068	-141.75	0.185
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Daily milk production					
	Estimate	SE	t	p	
intercept	0.0683	0.014	4.923	5.65e-05	
daily milk production	-7.881e-06	1.673e-05	-0.471	0.642	
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Final model					
Selective breeding method	1	0.003	0.075	-141.33	0.303
Daily milk production	1	0.003	0.076	-141.35	0.309
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Table S6. Association between selective breeding method and the variables related to the level of technification and overall milking management characteristics in dairy farms in COFA-LTER landscape. For details of each variable see Table 1. * significant ($p < 0.05$).

Variable	Kendall's Tau-b	p
Primary forage diet	0.583	0.001*
Fertilizer pasture management	-0.259	0.898
Time of supplementary feed	-0.426	0.985
Pasture restoration	-0.183	0.814
Criterion to supplement	-0.381	0.978
Add vitamins to supplement	-0.329	0.950
Milking method	0.669	<0.001*
Milking frequency	0.582	0.002*

Farm infrastructure for milking	-0.663	0.999
Milk cooling tank	-0.326	0.951
Milk quality-based payment	-0.389	0.974
Cleaning of udder before milking	0.418	0.014*
CMT test	-0.153	0.797
Breeding program for productivity	-0.748	0.999
Pregnancy diagnosis	-0.639	0.999
Cattle breed composition	-0.530	0.997
Management separating pregnant cows	-0.653	0.999

Table S7. Collinearity among variables related to dairy farm environment features in the COFA-LTER. Vif is the variance-inflation factor. In bold, values of Vif > 5.0, variables that were excluded for the next step of Vif analysis.

Variable	Vif
Step 1	
Slope	1.263
Percentage of riparian forest	1.991
Percentage of agriculture	7.945
Percentage of pasture	7.252
Step 2 (excluding percentage of agriculture)	
Slope	1.262
Percentage of riparian forest	1.071
Percentage of pasture	1.192

Table S8. Models of environment features to explain variation in percentage of natural vegetation among dairy farms. RSS, residual sum of square; AIC, Akaike Information Criterion. ** significant ($p < 0.05$). * marginally significant ($p < 0.10$).

Model	df	Sum of Square	RSS	AIC	p
Slope	1	51.03	1167.3	108.09	0.290
Percentage of riparian forest	1	1444.50	2560.8	127.73	5.8212e-06**
Percentage of pasture	1	112.41	1228.7	109.37	0.121
Size of rural property	3	369.49	1485.8	110.12	0.067*
Final model					
Percentage of riparian forest	1	1420.24	2652.5	124.61	1.198e-05**
Size of rural property	3	483.08	1715.3	109.71	0.041**

Table S9. Models of environment features to explain variation in IIC among dairy farms. RSS, residual sum of square; AIC, Akaike Information Criterion. * significant ($p < 0.05$).

Model	df	Sum of Square	RSS	AIC	p
Slope	1	0.0018	0.0278	-158.02	0.189
Percentage of riparian forest	1	0.0328	0.0587	-139.34	6.287e-06*
Percentage of pasture	1	0.0026	0.0286	-157.31	0.119
Size of rural property	3	0.0121	0.0380	-154.20	0.023*
Final model					
Percentage of riparian forest	1	0.0314	0.0603	-142.66	1.851e-05*
Size of rural property	3	0.0139	0.0429	-155.16	0.019*

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Supplementary B – Figure



Fig. S1 Spatial distribution of the 25 dairy farms in the COFA-LTER landscape showing the farm boundaries. Numbers from 1 to 25 correspond to the dairy farm boundaries. Green corresponds to natural vegetation land cover (habitat) and white to anthropic land cover (matrix).

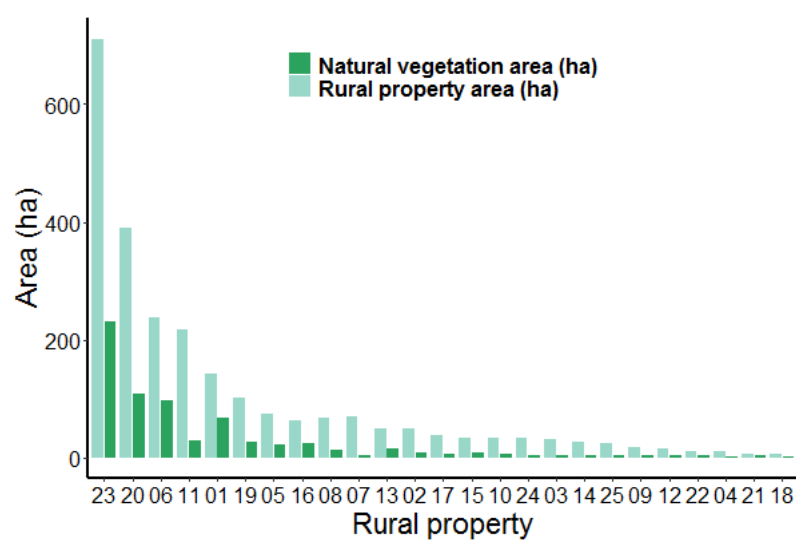


Fig. S2 Distribution of dairy farm size and natural vegetation in the COFA-LTER landscape.

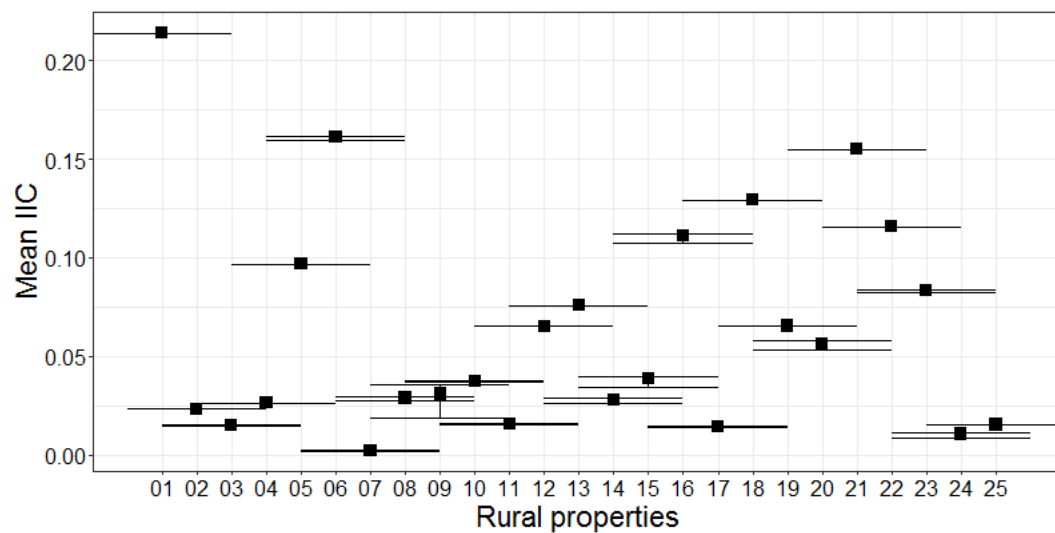


Figure S3 Integral Index of Connectivity (IIC) in the 25 dairy farms in the COFA-LTER landscape. The square and central bar show the mean IIC calculated for the three distances: 300 m, 500 m and 1000 m each farm. The low bar represents the minimum value and the above bar shows the maximum value of IIC among the three distances.