Sustainable livestock intensification and well-being in rural Brazil

Jacqueline Tereza da Silva*[1], Dominic Moran[1], Luis Gustavo Barioni[2], Rafael de Oliveira Silva[1]

[1] Global Academy of Agriculture and Food Systems, University of Edinburgh, UK

[2] Brazilian Agricultural Research Corporation (EMBRAPA), Brazil

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Corresponding author
Jacqueline Tereza da Silva
Global Academy of Agriculture and Food Systems
The Royal (Dick) School of Veterinary Studies and The Roslin Institute
Easter Bush Campus, Midlothian, EH25 9RG
E-mail: jacqueline.silva@ed.ac.uk

Abstract

Since the early 2000s, sustainable livestock intensification (SI) practices have slowly displaced unsustainable beef production in Brazil. Numerous studies have investigated the environmental and economic effects of SI, but the implications for social well-being and rural development are under-explored. This study investigates how a tendency towards livestock SI affects rural well-being in Brazil. We used propensity score matching (PSM) to estimate the effects of SI trends on a rural development index (RDI), poverty rates and other common development metrics of Brazilian microregions. We analysed historical data (10 years) on pasture area and herd size. Based on linear regressions, we assume microregions with a positive slope in herd size and a negative slope in pasture areas are following a SI trend. We found a negative correlation between the contribution of beef production to GDP and RDI across all regions (-0.201, p-value < 0.001). However, using PSM we found the average effect of the SI trend is positive, with a magnitude of ~4 points in the RDI (95% CI 0.02; 7.74). The results suggest that beef production value does not drive rural development, but microregions following an intensification trend have better rural development than non-intensified regions.

Keywords: Livestock; Sustainable intensification; Rural Development; Social well-being

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1. Introduction

Livestock is the focus of much of current global debate about food system transformation. Meat production provides employment and income to many people worldwide and can provide ecosystem services in grazing areas (1), while meat consumption in specific circumstances can reduce nutritional deficiencies (2). However, ruminant production is the single biggest contributor to environmental degradation (3). Furthermore, excessive meat consumption is among the major drivers of poor health outcomes (4). Rising demand for livestock products associated and unsustainable production practices mean that for some, the external costs of livestock production and consumption exceed the benefits. Hence the growing polemic around transformational pathways.

Sustainable intensification (SI) is a broad concept embracing a range of methods and strategies to minimize the external costs related to food production. Essentially, any type of production technology aiming to prevent land expansion and reduce environmental impacts while increasing yields can be accommodated under the term (5). SI strategies for livestock include integrated crop-livestock systems (6), life-cycle optimized on-pasture supplementation or feedlot diets (7), accompanying deforestation control (8), government incentives or taxes to promote intensive production (9), improved pasture restoration and management (8), animal management (stocking rate, mating and slaughter age) (10), and genetic selection (11).

Nevertheless, SI rhetoric has been criticised for its narrow production-side focus, overlooking the multiple dimensions and complexities of food systems (12, 13). Most research has explored how SI affects the economic and environmental dimensions of beef systems. The relationship between SI and social well-being has been overlooked due to the lack of agreement about its definition and appropriate metrics to reflect well-being at different scales.

Brazilian livestock production has been the focus of much discussion given its role in global food systems. Brazil is the world's largest beef exporter, and domestic production occurs in all municipalities. Meat is an essential part of Brazilian food culture and traditions and the country is among the largest consumers of beef. Since the introduction of mechanisms to tackle climate change in the early 2000s, SI practices have slowly displaced unsustainable beef production (14). Numerous studies have investigated the environmental and economic effects of SI in Brazil (8, 9, 15, 16). However, the social implications of SI are under-explored. This study addresses this gap by evaluating the effects of a 10-year SI trend on rural development and social well-being. The paper is structured as follows. Section 2 provides background on the

Brazilian livestock sector and its role promoting rural development. Section 3 describes data sources and methods. Section 4 summarises results. Section 5 compares the findings with the literature and discusses the limitations of the study. Section 6 concludes.

2. Background

A quarter of Brazil's Gross Domestic Product (GDP) derives from agriculture and livestock (17); the latter contributing around 6% to GDP. Around 15% of the Brazilian population live in rural areas; half are rural producers (18), with the beef sector employing 4.5 million people (19) or 5% of the labour force (20). However, the sector is implicated in deforestation, climate change and loss of biodiversity, social inequalities, power imbalances, and poor health (9, 21, 22). While its role in rural development is arguably significant, less is known about the consequences of any emerging transformative trend towards forms of SI.

Rural development is multidimensional, encompassing the improvement of the quality of life and social well-being of rural livelihoods (23). Livestock can contribute by employment, poverty alleviation and in general by helping to level up inequalities (23).

Context-specific Rural Development Indexes (RDI) summarise the multiple dimensions of rural development into a single metric (24-32). The RDI for Brazilian microregions highlights that rural development follow a similar pattern to other metrics of development. For example, the North region has higher rates of poverty and inequality compared to the South. Similarly, northern microregions have lower RDI lower than the national average, while RDIs for southern microregions are higher than the average (32).

The contribution and social impacts of beef systems are unevenly distributed and sector transformation will likely impact differently across social groups (33). Accordingly, a social impact assessment of SI should be part of the transformational agenda.

3. Methods

We applied propensity score matching (PSM) to investigate the effects of SI trends in the rural development of Brazilian microregions. Propensity score is the estimated probability of receiving a treatment conditional on observed characteristics (34). Observations with similar

propensity scores (probabilities) are grouped, resulting in a similar distribution of measured baseline covariates between treated and untreated. The application of propensity score allows for causal inference about a treatment-outcome relationship in observational studies because it control for selection bias by removing systematic differences between treatment and control units. Microregions are contiguous municipalities with similar characteristics (socio-economic, agricultural, industrial, and trade). Brazilian municipalities are grouped into 558 microregions.

GDP and population data for each municipality were taken from the Brazilian Institute of Geography and Statistics (IBGE) (35), and aggregated to the microregion level. Beef production value-added (to GDP) was estimated by taking the production value of large animals from the Agricultural Census 2006 (18). Historical data on pasture area and quality and herd size were taken from the Atlas of Brazilian Pastures (36) and Municipal Livestock Survey (37), respectively. Information on the proportion of beef exports was extracted from a study on beef origin and supply chains (38).

The RDI for Brazilian Microregions was developed by Stege (2011) applying principal component analysis to 27 indicators, representing different dimensions (social, demographic, institutional policy, economic, and environmental) (32). Most of the data used cover the year 2008, and a few represent the years 2006 or 2007. The RDI varies from 0 to 100; higher numbers measuring better development.

Levels of beef production vary across all microregions. For comparative ease microregions with similar levels of production were grouped by contribution to microregional GDP (< 5%, 5-10%, 10-20%, > 20%). We calculated Spearman correlation coefficients between beef production value and RDI for all microregions, and for those with different levels of beef contribution to GDP.

To determine the SI trend we investigated the trajectories of pasture area and herd size in the microregions over ten years (1996-2006). For each microregion, we ran two linear regression models considering pasture area (hectares) or herd size (number of animals) as dependent variables, and years as independents. Treated microregions were those with a positive slope in herd size and a neutral or negative slope in pasture areas. All other microregions were considered as controls. The slopes can be found in **Supplementary Information**. We performed sensitivity analysis testing different criteria to determine whether a microregion is under sustainable intensification (treatment).

We used a linear logit function to calculate a propensity score to match microregions with and without SI trends (treatment and control, respectively). Population, GDP per capita, herd size, % of non-degraded pasture area, and % of exported production were model covariates. Because the covariates have a great variability between microregions (reflecting how diverse the microregions are), they were categorised to allow for a better covariate balance between treatment and control groups. For example, beef herd size ranges from under two hundred to more than 3 million heads, which were then grouped into < 10K, 10K - 50k, 50k - 100K, 100K - 500K, > 500K.

Treated and control microregions were matched using the nearest neighbour approach with replacement, calliper 0.1, and exact matching for Region (South, Southeast, Midwest, Northeast, North), and the level of beef contribution to GDP. Treatment/control measures covered 1996-2006, while the outcome measures covered 2008-2010, allowing for a coherent temporal sequence between exposure and outcome.

Because we matched treatment and controls with replacement, that is, each control could be matched to more than one treatment, the average effect of treatment on treated was estimated using weighted linear regression. All analyses were performed using R version 4.2.0 (39), and the package Matchit (40).

4. Results

542 microregions were included in the analysis. Microregions with missing data on herd size (n=8) and stocking rate higher than 30 animals per hectare (n=8) were excluded. Table 1 summarises microregional characteristics. Beef production contributes in excess of 10% of the GDP in a minority of the microregions (n=66, 12%). These high-producing microregions have populations below 200,000 people, 78% have a GDP per capita higher than R$5000, and most have a herd size greater than 150,000 animals. Half of the high-producing microregions have a greater than 25% degraded pastures; most do not follow an intensification trend and export at least 15% of the production.

Table 2 presents the Spearman correlation coefficients between beef production metrics and the RDI. Beef production value, stocking rate and exports have a positive but low correlation with rural development across all regions. This correlation is stronger in microregions where beef is not a major economic activity (< 5% of GDP). The data revealed a negative correlation

between the share of beef production to GDP and RDI. We also observed an inverse relationship between pasture area and RDI.

Table 1. Microregional socio-economic characteristics.

Characteristic	Share (%) of beef production to GDP in 2006				
	< 5%	**5 - 10%**	**10 - 20%**	**> 20%**	**All**
N	379	97	42	24	542
Population, n (%)					
100K people	70 (18%)	32 (33%)	19 (45%)	12 (50%)	133 (25%)
100K - 200K people	154 (41%)	42 (43%)	22 (52%)	12 (50%)	230 (42%)
250K - 500K people	94 (25%)	21 (22%)	1 (2%)	0 (%)	116 (21%)
> 500K people	61 (16%)	2 (2%)	0 (%)	0 (%)	63 (12%)
Per capita GDP (Brazilian Reais), n (%)					
2.5K R$	21 (6%)	5 (5%)	2 (5%)	0 (%)	28 (5%)
2.5 - 5K R$	113 (30%)	32 (33%)	11 (26%)	3 (13%)	159 (29%)
5K - 7.5 R$	35 (9%)	23 (24%)	9 (21%)	11 (46%)	78 (14%)
> 7.5 R$	210 (55%)	37 (38%)	20 (48%)	10 (42%)	277 (51%)
Herd size, n (%)					
50K heads	226 (60%)	27 (28%)	8 (19%)	0 (%)	261 (48%)
50K - 100K heads	76 (20%)	10 (10%)	0 (%)	0 (%)	86 (16%)
150K - 250K heads	44 (12%)	26 (27%)	4 (10%)	2 (8%)	76 (14%)
> 250K heads	33 (9%)	34 (35%)	30 (71%)	22 (92%)	119 (22%)
% Non-degraded pasture, n (%)					
<= 25%	97 (26%)	38 (39%)	17 (40%)	12 (50%)	164 (30%)
> 25%	282 (74%)	59 (61%)	25 (60%)	12 (50%)	378 (70%)
% of production exported, n (%)					
<= 15%	310 (82%)	70 (72%)	22 (52%)	9 (38%)	411 (76%)
> 15%	69 (18%)	27 (28%)	20 (48%)	15 (63%)	131 (24%)
10y sustainable intensification trend					
Yes	96 (25%)	23 (24%)	12 (29%)	1 (4%)	132 (24%)
No	283 (75%)	74 (76%)	30 (71%)	23 (96%)	410 (76%)

Before the PSM, there were 132 treated and 410 control microregions (Table 1) with mean RDI 47.7 and 43.2, respectively. After applying the PSM, we retained 116 treated and 66 controls, and the mean RDI was 48.1 for treated and 46.3 for controls (Table 3). The average effect of treatment on treated (ATT) is positive. The effect ranges from 3.85 (95% CI -0.19; 7.90) to 3.88% (95% CI 0.02; 7.74) for univariate and multivariate and weighted linear regression, respectively. This means that if a microregion has a 10-year trend intensification trend from 1996 to 2006, the 2010 RDI will likely be ~4 points higher than the non-intensified regions. Note we arbitrary used a 4 year-delay correlation analysis to infer potential causal relationships between SI and RDI.

Table 2. Correlation between beef production metrics and the RDI.

Beef production metric	Microregions by share (%) of beef production to GDP				
	< 5%	**5 - 10%**	**10 - 20%**	**> 20%**	**All**
N	379	97	42	24	542
Production value	**0.319**	0.535	-0.016	0.095	**0.147**
Production value per capita	**0.198**	**0.343**	0.132	0.346	-0.009
Share of beef to GDP	-0.064	-0.003	-0.235	-0.018	**-0.201**
Herd size	**0.155**	**0.284**	**-0.298**	-0.014	-0.003
Pasture Area	-0.007	**0.212**	**-0.330**	0.009	**-0.131**
Stocking Rate	**0.208**	**0.224**	-0.002	-0.147	**0.091**
Non-degraded pasture	-0.025	-0.008	-0.217	-0.385	-0.054
Exports share	**0.256**	**0.227**	-0.011	0.377	**0.119**

RDI = Rural Development Index. The values presented are Spearman correlation coefficients. Bold indicates p-values < 0.05. Beef production metrics are from 2006, while RDI is from 2008.

The PSM analysis PSM suggests that the 10-y SI trend also has an effect on human development and poverty rates (Table 3). Intensified microregions have Human Development Index (HDI) 0.012 (95% CI 0.004; 0.0206) higher than non-intensified microregions. In contrast, poverty rates are lower in microregions under an intensification trend compared with non-intensified microregions; the percentage of the population vulnerable to poverty, poor or extremely poor is 3.4 (95% CI -6.34; -0.37), 2.2 (95% CI -4.13; -0.32) and 1.3 (95% CI -2.46; -0.16) points lower, respectively.

Table 3. Estimated effects of a 10-year sustainable intensification trend on rural social well-being.

Metric of social well-being	10-year SI trend[1]		Univariate[2]		Multivariate[3]	
	Yes (n=116)	No (n=67)	Effect	95% CI	Effect	95% CI
Rural Development Index, 0-100	48.06	46.33	3.85	-0.19; 7.90	3.88	0.02; 7.74
Human Development Index, 0-1	0.692	0.667	0.015	-0.001; 0.031	0.012	0.004; 0.0206
Gini Index, 0-1	0.483	0.490	0.005	-0.009; 0.018	0.005	-0.006; 0.015
Vulnerability to poverty, %	33.7	41.3	-4.11	-9.66; 1.44	-3.35	-6.34; -0.37
Poverty, %	14.8	20.5	-2.65	-6.87; 1.58	-2.23	-4.13; -0.32
Extreme poverty, %	6.05	9.58	-1.48	-4.094; 1.13	-1.31	-2.46; -0.16

[1] SI = sustainable intensification. SI trend = yes if the microregion has a negative linear trend in pasture area and a positive linear trend in herd size, otherwise SI trend = no.
[2] Univariate model = linear regression with the rural development as the dependent variable and the 10-year sustainable intensification trend as the independent variable.
[3] Multivariate model = same as the univariate model, adding the covariates GDP per capita, herd size, region, population, non-degraded pasture and exports.
CI = confidence interval.

Sensitivity analysis tested different criteria for the inclusion of microregions in the treatment group. Table 4 shows that the number of microregions retained in the analysis after the PSM does not differ significantly, except when stocking rate higher than 1.2 animals/hectare is the criteria for the allocation of a microregion in the treatment group. The magnitude of the effect of SI on RDI is much higher when treated microregions are those with stocking rate > 1.2 animal/hectare. The magnitude of the effect was always positive, no matter the criteria

adopted. In addition, the effect sizes using different thresholds always fell within the 95% confidence interval obtained from the main analysis.

Table 4. Sensitivity analysis of the effects of SI on RDI considering different thresholds for the binary SI variable.

Threshold for SI	SI (treatment)		Univariate[1]		Multivariate[2]	
	Yes	No	Effect	95% CI	Effect	95% CI
6-year intensification trend	179	76	1.37	-1.37; 4.11	2.44	-1.39; 6.27
SR > 0.70 animal/hectare	110	54	2.62	-1.45; 6.69	3.05	-0.72; 6.83
SR > 1.2 animal/hectare	55	42	5.79	0.44; 11.14	6.23	1.58; 10.88
Region-specific	123	61	3.33	-0.69; 7.36	2.89	-0.75; 6.53
Biome-specific	116	56	4.57	0.63; 8.50	4.48	0.80; 8.16
Region-Biome-specific	135	71	3.07	-0.50; 6.63	2.95	-0.314; 6.22

SI = Sustainable intensification. RDI = Rural Development Index. SR = Stocking rate. CI = confidence interval. Region, Biome, and Region-Biome-specific: we took the mean stocking rate for a particular area, and considered SI = yes if the stocking rate was above the mean, otherwise SI = no.

[1] Univariate model = linear regression with the rural development as the dependent variable and the 10-year sustainable intensification trend as the independent variable.

[2] Multivariate model = same as the univariate model, adding the covariates GDP per capita, herd size, region, population, non-degraded pasture and exports.

5. Discussion

On average, a 10-year SI trend increases the RDI by 4 points, and HDI by 0.012. An intensification trend decreases poverty rates by 1-3 percentage points.

The data revealed a negative relationship between the share of beef production value to GDP and rural development. We also observed that the higher the share of beef in GDP, the lower the correlation between production value and RDI, suggesting that positive changes in RDI are at some point driven by other sectors of the economy and public policies. Beef production value might be distributed along the supply chain, accruing beyond the microregion with little effect on the RDI. Another explanation is the predominance of extensive production systems characterised by poorly managed and low productivity pastures, with little and otherwise unskilled labour and poor working conditions. It may also be the case that other sectors of the economy (manufacturing, financial services), and the public sector, have a greater impact on RDI than livestock. It is noteworthy that the RDI reflects more than economic growth in terms of added-value, but factors such as access to education, number of employees in the rural property, registration to vote in municipal and general elections, and quality of air are considered in the RDI for Brazilian microregions.

When beef production is intensified, which requires more inputs, technology, farm infrastructure and skilled labour, rural development and social well-being are improved. The analysis shows evidence of improvements in rural development and in poverty rates. A 4-point increase in the RDI and 1-3 percentage point increase in poverty rates for a region with an intensification trend is relevant.

The relationship between RDI and greenhouse gas (GHG) emissions from agriculture and livestock in Brazil has been investigated (29). This relationship is highly dependent on spatial distribution and has different patterns. States that produce more beef (Mato Grosso, Mato Grosso do Sul, Rio Grande do Sul) have high GHG emissions and high RDI, while São Paulo, Santa Catarina and Paraná present low emissions and high RDI. Direct comparison with our results are difficult to draw due to the different methodologies and the unit of analysis (microregion versus state).

Higher rates of intensification are generally observed in more developed regions, begging the question of the direction of this relationship: is SI really causing rural development? Or are developed microregions more likely to adopt modern and more sustainable production practices? One study has shown that cattle breeds with improved performance, often associated with sustainable intensification, are more prevalent in areas with higher HDI (41). A possible explanation is that prosperous regions with better education levels and life expectancy are more adaptive to changes and the adoption of innovative technologies.

We attempted to determine causality between SI of livestock and social well-being by the application of PSM, which aims to reduce the confounding in the estimation of the effects of Y on X. This is achieved by balancing observed covariates between treated and control units. Our propensity score model considered proxies of development (population and GDP per capita). Consequently, we ensured that our treated and control microregions had the same level of development, minimizing the effects of this confounding in our causal inference.

The study is limited by data availability. Data on beef production were updated in 2018 when the last Agricultural Census was released. However, all the indicators of social well-being are from 2008-2010 and have not been updated recently. Because information on social metrics dates from 2008-2010, we choose to use the previous Agricultural Census (2006) to ensure a temporal sequence between our exposure (beef production) and outcome (social metrics). A forthcoming Population Census for 2022 will include data on social metrics, allowing this study to be updated.

Another limitation refers to the spatial distribution of the variables, and the likelihood that neighbouring areas have similar characteristics. For instance, microregions in the North region have lower levels of rural development. Our analysis attempted to deal with this issue by exact matching treated and control microregions within the same Region and with the same level of beef contribution to the local economy. But more sophisticated analytical techniques are available to deal with this issue. Further developments of the current work could incorporate spatial regression analysis into the estimation of the propensity score. A spatial propensity score matching has been applied to estimate the social effects of cane sugar in Brazil (42), and this could be adapted to the livestock context.

Finally, the definition of treatment and control groups may have affected the results. SI is a complex concept with a broad scope making it difficult to determine whether a region is intensified. In our analysis, we explored the relationship between pasture area and herd size to determine microregional intensification trajectories as indicators of pasture and animal management. For example, regions with lower pasture size and bigger herd size are likely to be implementing SI practices such as integrated crop-livestock systems, on-pasture supplementation, deforestation control, and pasture restoration. To minimize this issue, we tested different definitions of SI (treatment) considering static and temporal metrics.

The 10-year intensification trend reflects the progress towards increased sustainability within the microregion, instead of comparing it to a generic standard. In this sense, our results explain how moving away from extensive to intensive livestock production affects social well-being in Brazil. Because we have used region-specific data, we believe our findings cannot be generalized to other areas. However, the PSM methodology can be replicated in other settings.

6. Conclusion

To our knowledge, this is the first study reporting how SI of beef production affects rural development and social well-being .There is a consensus around the idea that beef systems needs to undergo a transformation to mitigate environmental impacts and to adapt to climate change. Evaluation of transformation scenarios and policies needs to include a social dimension.

Our results demonstrate that beef production value does not drive rural well-being, but microregions following an intensification trend have better rural development and lower

poverty rates than non-intensified regions. This means that moving away from extensive and unsustainable beef production practices through SI will deliver better environmental and social outcomes.

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Supplementary information

* Angular coefficients from linear regression with either pasture area or herd size as the dependent variable and year (1996-2006) as the independent variable.

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
50001	Baixo Pantanal	Mato Grosso do Sul	Centro-Oeste	31.91	No	23385.9	66663.173
50002	Aquidauana	Mato Grosso do Sul	Centro-Oeste	30.56	No	8584.233	50310.545
50003	Alto Taquari	Mato Grosso do Sul	Centro-Oeste	47.38	No	51828.09	75691.627
50004	Campo Grande	Mato Grosso do Sul	Centro-Oeste	28.27	Yes	-3663.688	44730.591
50005	Cassilândia	Mato Grosso do Sul	Centro-Oeste	91.24	Yes	-600.5913	12985.391
50006	Paranaíba	Mato Grosso do Sul	Centro-Oeste	38.13	Yes	-1881.605	13396.427
50007	Três Lagoas	Mato Grosso do Sul	Centro-Oeste	49.04	No	23647.14	91942.227
50008	Nova Andradina	Mato Grosso do Sul	Centro-Oeste	41.14	No	1654.178	19882.518
50009	Bodoquena	Mato Grosso do Sul	Centro-Oeste	36.28	No	15217.74	57088.745
50010	Dourados	Mato Grosso do Sul	Centro-Oeste	61.03	No	-42851.25	-13763.89
50011	Iguatemi	Mato Grosso do Sul	Centro-Oeste	35.06	Yes	-18142.47	4678.0182
51001	Aripuanã	Mato Grosso	Centro-Oeste	32.54	No	146103.5	169441.08
51002	Alta Floresta	Mato Grosso	Centro-Oeste	20.73	No	78528.92	152362.95
51003	Colíder	Mato Grosso	Centro-Oeste	24.24	No	63705.88	150090.15
51004	Parecis	Mato Grosso	Centro-Oeste	86.7	No	13785.34	13021.391
51005	Arinos	Mato Grosso	Centro-Oeste	37.47	No	76850.86	87538.273
51006	Alto Teles Pires	Mato Grosso	Centro-Oeste	88.57	No	29174.75	-382.5182
51007	Sinop	Mato Grosso	Centro-Oeste	53.14	No	40028.96	29486.618
51008	Paranatinga	Mato Grosso	Centro-Oeste	39.2	No	57125.53	45426.818
51009	Norte Araguaia	Mato Grosso	Centro-Oeste	33.59	No	126524.9	154462.29

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
51010	Canarana	Mato Grosso	Centro-Oeste	72.77	No	54014.18	60720.164
51011	Médio Araguaia	Mato Grosso	Centro-Oeste	7.27	No	17123.05	39915.582
51012	Alto Guaporé	Mato Grosso	Centro-Oeste	31.43	No	51259.04	117071.66
51013	Tangará da Serra	Mato Grosso	Centro-Oeste	39.07	No	4585.167	18110.927
51014	Jauru	Mato Grosso	Centro-Oeste	39.92	No	14001.26	81330.727
51015	Alto Paraguai	Mato Grosso	Centro-Oeste	37.32	No	5199.346	8719.2455
51016	Rosário Oeste	Mato Grosso	Centro-Oeste	29.46	No	9214.315	14256.182
51017	Cuiabá	Mato Grosso	Centro-Oeste	34.77	No	26121.7	31385.155
51018	Alto Pantanal	Mato Grosso	Centro-Oeste	34.98	No	29481.61	78990.918
51019	Primavera do Leste	Mato Grosso	Centro-Oeste	91.37	No	-7482.972	-7128.373
51020	Tesouro	Mato Grosso	Centro-Oeste	53.61	No	12771.98	20530
51021	Rondonópolis	Mato Grosso	Centro-Oeste	62.27	No	399.364	1208.5091
51022	Alto Araguaia	Mato Grosso	Centro-Oeste	66.53	No	-1872.477	-980.9818
52001	São Miguel do Araguaia	Goiás	Centro-Oeste	24.36	No	32010.3	68808.291
52002	Rio Vermelho	Goiás	Centro-Oeste	30.4	No	12177.54	43872.509
52003	Aragarças	Goiás	Centro-Oeste	37.41	No	4470.106	23891.818
52004	Porangatu	Goiás	Centro-Oeste	39.78	No	28582.41	68299.727
52005	Chapada dos Veadeiros	Goiás	Centro-Oeste	41.43	No	6845.819	15785.155
52006	Ceres	Goiás	Centro-Oeste	48.36	No	4350.752	11828.182
52007	Anápolis	Goiás	Centro-Oeste	40.85	Yes	-3310.352	22409.036
52008	Iporá	Goiás	Centro-Oeste	25.2	No	3106.431	15098.564
52009	Anicuns	Goiás	Centro-Oeste	43.1	Yes	-2513.488	10945.664
52010	Goiânia	Goiás	Centro-Oeste	37.77	Yes	-3328.07	13440.627
52011	Vão do Paranã	Goiás	Centro-Oeste	41.38	No	7013.671	39784.964
52012	Entorno de Brasília	Goiás	Centro-Oeste	46.46	No	8123.403	28801.791
52013	Sudoeste de Goiás	Goiás	Centro-Oeste	73.92	Yes	-25491.57	13223.709
52014	Vale do Rio dos Bois	Goiás	Centro-Oeste	50.77	No	-10809.17	-9087.864

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
52015	Meia Ponte	Goiás	Centro-Oeste	50.34	No	-8054.271	-5037.564
52016	Pires do Rio	Goiás	Centro-Oeste	30.34	Yes	-1635.038	12804.455
52017	Catalão	Goiás	Centro-Oeste	52.77	Yes	-3948.679	20460.627
52018	Quirinópolis	Goiás	Centro-Oeste	31.87	Yes	-2208.03	13812.518
53001	Brasília	Distrito Federal	Centro-Oeste	54.3	No	1327.198	-1320.645
21001	Litoral Ocidental Maranhense	Maranhão	Nordeste	45.12	No	714.425	1513.4182
21003	Rosário	Maranhão	Nordeste	36.06	No	2889.159	1249.5455
21004	Lençóis Maranhenses	Maranhão	Nordeste	30.42	No	445.8801	571.97273
21005	Baixada Maranhense	Maranhão	Nordeste	55.62	No	24363.38	7625.5636
21006	Itapecuru Mirim	Maranhão	Nordeste	35.71	No	6063.276	2610.1091
21007	Gurupi	Maranhão	Nordeste	36.04	No	43958.3	8466.0545
21008	Pindaré	Maranhão	Nordeste	49.35	No	62731.21	73083.764
21009	Imperatriz	Maranhão	Nordeste	43.99	No	47443.87	101208.01
21010	Médio Mearim	Maranhão	Nordeste	45.2	No	17893.33	16796.136
21011	Alto Mearim e Grajaú	Maranhão	Nordeste	44.87	No	30161.86	31429.045
21012	Presidente Dutra	Maranhão	Nordeste	40.98	No	8116.624	9456.6
21013	Baixo Parnaíba Maranhense	Maranhão	Nordeste	45.34	No	269.5833	673.04545
21014	Chapadinha	Maranhão	Nordeste	37.6	No	583.6827	611.11818
21015	Codó	Maranhão	Nordeste	35.46	No	8757.335	5062.0091
21016	Coelho Neto	Maranhão	Nordeste	36.48	No	240.0694	437.86364
21017	Caxias	Maranhão	Nordeste	41.76	No	4696.185	5120.4727
21018	Chapadas do Alto Itapecuru	Maranhão	Nordeste	43.05	No	2000.112	6274.4545
21019	Porto Franco	Maranhão	Nordeste	37.72	No	13226.31	20952.436
21020	Gerais de Balsas	Maranhão	Nordeste	50.89	No	2933.198	3693.6091
21021	Chapadas das Mangabeiras	Maranhão	Nordeste	43.19	No	1387.459	5764.8909
22001	Baixo Parnaíba Piauiense	Piauí	Nordeste	45.67	No	2124.965	1184.7909
22002	Litoral Piauiense	Piauí	Nordeste	42.52	No	1940.143	1236.7182

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
22003	Teresina	Piauí	Nordeste	43.42	No	4186.156	522.46364
22004	Campo Maior	Piauí	Nordeste	40.93	No	8996.799	1290.4727
22005	Médio Parnaíba Piauiense	Piauí	Nordeste	42.51	No	195.5407	280.40909
22006	Valença do Piauí	Piauí	Nordeste	43.16	No	1833.712	1018.3636
22008	Bertolínia	Piauí	Nordeste	43.29	Yes	-112.9328	424.12727
22009	Floriano	Piauí	Nordeste	29.13	No	111.9058	1126.7636
22010	Alto Médio Gurguéia	Piauí	Nordeste	44.73	Yes	-280.0632	1713.5545
22011	São Raimundo Nonato	Piauí	Nordeste	43.14	No	-662.4054	-1333.4
22012	Chapadas do Extremo Sul Piauiense	Piauí	Nordeste	20.25	No	1220.883	1658.8545
22013	Picos	Piauí	Nordeste	48.82	No	916.6206	685.30909
22014	Pio IX	Piauí	Nordeste	41.39	Yes	-446.8756	266.69091
22015	Alto Médio Canindé	Piauí	Nordeste	44.12	No	17948.13	1323.3909
23001	Litoral de Camocim e Acaraú	Ceará	Nordeste	40.25	No	4594.057	-1475.809
23002	Ibiapaba	Ceará	Nordeste	48.84	No	2395.622	-447.2182
23003	Coreaú	Ceará	Nordeste	40.36	No	1935.64	254.32727
23005	Sobral	Ceará	Nordeste	41.62	No	7634.499	543.18182
23006	Ipu	Ceará	Nordeste	40.27	No	1831.965	-427.8909
23007	Santa Quitéria	Ceará	Nordeste	35.07	No	3807.587	-2273.109
23008	Itapipoca	Ceará	Nordeste	43.79	No	2605.808	-362.8455
23009	Baixo Curu	Ceará	Nordeste	42.16	No	185.4073	187.4
23010	Uruburetama	Ceará	Nordeste	52.11	No	127.3225	-284.7091
23011	Médio Curu	Ceará	Nordeste	46.15	No	452.3077	25.654545
23012	Canindé	Ceará	Nordeste	41.06	No	1491.254	-253.0091
23013	Baturité	Ceará	Nordeste	54	No	189.4857	144.78182
23014	Chorozinho	Ceará	Nordeste	45.12	No	16.57755	195.60909
23015	Cascavel	Ceará	Nordeste	45.02	No	22.036	226.47273
23016	Fortaleza	Ceará	Nordeste	43.02	No	132.2671	1050.5091

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
23017	Pacajus	Ceará	Nordeste	30.27	No	48.60045	-219.4545
23018	Sertão de Cratéus	Ceará	Nordeste	44.64	No	13049.39	-4039.182
23019	Sertão de Quixeramobim	Ceará	Nordeste	44.86	No	7213.246	4920.5091
23020	Sertão de Inhamuns	Ceará	Nordeste	29.81	No	10132.16	-3284.109
23021	Sertão de Senador Pompeu	Ceará	Nordeste	47.62	No	7515.545	2583.8545
23022	Litoral de Aracati	Ceará	Nordeste	41.17	No	-363.3355	-104.9818
23023	Baixo Jaguaribe	Ceará	Nordeste	43.25	No	1335.9	294.76364
23024	Médio Jaguaribe	Ceará	Nordeste	31.6	No	11933.97	-1435.009
23025	Serra do Pereiro	Ceará	Nordeste	26.82	No	1265.7	247.42727
23026	Iguatu	Ceará	Nordeste	53.46	No	7379.102	2243.5182
23027	Várzea Alegre	Ceará	Nordeste	39	No	2809.145	-143.3636
23028	Lavras da Mangabeira	Ceará	Nordeste	34.01	No	849.3645	396.10909
23029	Chapada do Araripe	Ceará	Nordeste	33.44	No	5058.042	-952.2091
23030	Caririaçu	Ceará	Nordeste	35.95	No	693.0721	-7.272727
23031	Barro	Ceará	Nordeste	45.13	No	1485.073	601.38182
23032	Cariri	Ceará	Nordeste	44.47	No	2406.029	876.75455
23033	Brejo Santo	Ceará	Nordeste	38.56	No	1887.9	646.85455
24001	Mossoró	Rio Grande do Norte	Nordeste	50.45	No	313.9396	833.24545
24002	Chapada do Apodi	Rio Grande do Norte	Nordeste	28.3	No	-440.652	-627.3727
24003	Médio Oeste	Rio Grande do Norte	Nordeste	34.78	No	546.0724	-2336.3
24004	Vale do Açu	Rio Grande do Norte	Nordeste	37.55	No	1714.679	0.5818182
24005	Serra de São Miguel	Rio Grande do Norte	Nordeste	40.24	No	1031.758	510.24545
24006	Pau dos Ferros	Rio Grande do Norte	Nordeste	32.55	No	2343.766	1104.6636
24007	Umarizal	Rio Grande do Norte	Nordeste	26.08	Yes	-75.55982	186.31818
24008	Macau	Rio Grande do Norte	Nordeste	41.79	No	353.0741	167.27273
24009	Angicos	Rio Grande do Norte	Nordeste	30.08	No	2565.156	-881.4273
24010	Serra de Santana	Rio Grande do Norte	Nordeste	35.56	No	410.9781	1116.3364

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
24011	Seridó Ocidental	Rio Grande do Norte	Nordeste	33.44	Yes	-270.4755	234.25455
24012	Seridó Oriental	Rio Grande do Norte	Nordeste	26.41	No	1163.334	1305
24013	Baixa Verde	Rio Grande do Norte	Nordeste	45.47	No	1927.597	172.99091
24014	Borborema Potiguar	Rio Grande do Norte	Nordeste	37.02	No	77.80091	2431.3909
24015	Agreste Potiguar	Rio Grande do Norte	Nordeste	49.03	No	4503.657	4916.2182
24016	Litoral Nordeste	Rio Grande do Norte	Nordeste	47.92	No	497.2065	780.73636
24017	Macaíba	Rio Grande do Norte	Nordeste	46.21	No	339.2265	1573.0091
24018	Natal	Rio Grande do Norte	Nordeste	42.16	Yes	-75.21536	706.55455
24019	Litoral Sul	Rio Grande do Norte	Nordeste	50.44	No	1136.266	140.64545
25001	Catolé do Rocha	Paraíba	Nordeste	42.3	No	26.50191	-1541.518
25002	Cajazeiras	Paraíba	Nordeste	39.04	No	1240.42	-1962.573
25003	Sousa	Paraíba	Nordeste	43.29	No	-934.01	-2187.318
25004	Patos	Paraíba	Nordeste	45.32	No	-380.0123	-740.9909
25005	Piancó	Paraíba	Nordeste	43.12	No	-304.4977	-314.6818
25006	Itaporanga	Paraíba	Nordeste	40.63	No	155.7929	869.07273
25007	Serra do Teixeira	Paraíba	Nordeste	47.79	No	-1165.859	-459
25008	Seridó Ocidental Paraibano	Paraíba	Nordeste	37.35	No	57.22855	-175.9545
25009	Seridó Oriental Paraibano	Paraíba	Nordeste	39.2	No	-1278.147	-132.9909
25010	Cariri Ocidental	Paraíba	Nordeste	31.78	No	-2054.217	-2333.473
25011	Cariri Oriental	Paraíba	Nordeste	27.16	No	260.1905	-903.2545
25012	Curimataú Ocidental	Paraíba	Nordeste	42.77	No	-627.3565	-1973.9
25013	Curimataú Oriental	Paraíba	Nordeste	38.79	No	317.4014	101.50909
25014	Esperança	Paraíba	Nordeste	43.12	Yes	-191.6761	90.790909
25015	Brejo Paraibano	Paraíba	Nordeste	49.1	No	306.4847	253.16364
25016	Guarabira	Paraíba	Nordeste	45.84	No	1115.878	-115.2727
25017	Campina Grande	Paraíba	Nordeste	50.43	No	1604.165	-679.1091
25018	Itabaiana	Paraíba	Nordeste	43.56	No	2859.065	-3071.209

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
25019	Umbuzeiro	Paraíba	Nordeste	40.59	No	485.0931	-1310.991
25020	Litoral Norte	Paraíba	Nordeste	39.1	No	3157.975	1600.1364
25021	Sapé	Paraíba	Nordeste	45.66	No	2806.252	-885.6909
25022	João Pessoa	Paraíba	Nordeste	36.6	No	1131.114	433.07273
25023	Litoral Sul	Paraíba	Nordeste	46.27	No	1467.24	-180.3091
26001	Araripina	Pernambuco	Nordeste	33.05	No	9957.467	3581.8364
26002	Salgueiro	Pernambuco	Nordeste	41.74	No	3584.889	1832.5545
26003	Pajeú	Pernambuco	Nordeste	48.23	Yes	-2045.503	3120.3091
26004	Sertão do Moxotó	Pernambuco	Nordeste	39.97	No	1537.289	-1317.464
26005	Petrolina	Pernambuco	Nordeste	59.36	No	3829.201	1636.5273
26006	Itaparica	Pernambuco	Nordeste	39.45	No	-847.2867	-1958.4
26007	Vale do Ipanema	Pernambuco	Nordeste	32.7	No	388.5084	2337.2818
26008	Vale do Ipojuca	Pernambuco	Nordeste	40.45	Yes	-2037.487	10520.591
26009	Alto Capibaribe	Pernambuco	Nordeste	35.75	No	646.4347	320.7
26010	Médio Capibaribe	Pernambuco	Nordeste	52.06	No	-1496.846	-1495.173
26011	Garanhuns	Pernambuco	Nordeste	51.97	No	-1962.047	-50.79091
26012	Brejo Pernambucano	Pernambuco	Nordeste	40.24	No	905.3462	553.00909
26013	Mata Setentrional Pernambucana	Pernambuco	Nordeste	54.12	No	1047.24	2372.5455
26014	Vitória de Santo Antão	Pernambuco	Nordeste	39.54	No	709.4547	6.3636364
26015	Mata Meridional Pernambucana	Pernambuco	Nordeste	53.16	No	5191.87	5945.9818
26016	Itamaracá	Pernambuco	Nordeste	54.9	No	95.36882	256.36364
26017	Recife	Pernambuco	Nordeste	41.61	No	162.4571	314.39091
26018	Suape	Pernambuco	Nordeste	52.29	No	521.4054	457.78182
27001	Serrana do Sertão Alagoano	Alagoas	Nordeste	40.23	No	-280.484	-16.02727
27002	Alagoana do Sertão do São Francisco	Alagoas	Nordeste	47.08	No	637.5094	83.818182
27003	Santana do Ipanema	Alagoas	Nordeste	40.23	No	-899.5209	-1139.818
27004	Batalha	Alagoas	Nordeste	43.35	No	-589.3515	-2202.127

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
27005	Palmeira dos Índios	Alagoas	Nordeste	48.38	Yes	-607.4719	1622.8273
27006	Arapiraca	Alagoas	Nordeste	61.55	No	117.2303	-190.7
27007	Traipu	Alagoas	Nordeste	26.4	No	350.2824	-672.3091
27008	Serrana dos Quilombos	Alagoas	Nordeste	40.24	No	1684.286	3045.7273
27009	Mata Alagoana	Alagoas	Nordeste	51.11	No	5600.705	6585.6091
27010	Litoral Norte Alagoano	Alagoas	Nordeste	37.35	No	1154.841	736.65455
27011	Maceió	Alagoas	Nordeste	69.06	Yes	-479.308	1819.4909
27012	São Miguel dos Campos	Alagoas	Nordeste	65.29	No	60.78282	144.26364
27013	Penedo	Alagoas	Nordeste	41.08	Yes	-283.4768	238.36364
28001	Sergipana do Sertão do São Francisco	Sergipe	Nordeste	35.27	No	3342.51	-4072.909
28002	Carira	Sergipe	Nordeste	40.39	No	742.6218	-943.4727
28003	Nossa Senhora das Dores	Sergipe	Nordeste	46.32	Yes	-29.14445	2273.6364
28004	Agreste de Itabaiana	Sergipe	Nordeste	56.49	No	-816.5705	-395.8727
28005	Tobias Barreto	Sergipe	Nordeste	37.12	Yes	-894.2746	1531.4
28006	Agreste de Lagarto	Sergipe	Nordeste	37.96	Yes	-321.5454	2539.1364
28007	Propriá	Sergipe	Nordeste	51.58	Yes	-484.6313	877.8
28008	Cotinguiba	Sergipe	Nordeste	46.31	Yes	-696.3006	661.9
28009	Japaratuba	Sergipe	Nordeste	54.95	Yes	-881.9685	1951.7909
28010	Baixo Cotinguiba	Sergipe	Nordeste	48.3	Yes	-1028.169	1137.2727
28011	Aracaju	Sergipe	Nordeste	39.16	No	85.20482	310.95455
28012	Boquim	Sergipe	Nordeste	47.71	No	2807.006	398.15455
28013	Estância	Sergipe	Nordeste	43.7	No	2557.166	834.43636
29001	Barreiras	Bahia	Nordeste	77	No	3793.003	2714.0455
29002	Cotegipe	Bahia	Nordeste	40.33	No	7392.519	7550.6273
29003	Santa Maria da Vitória	Bahia	Nordeste	49.84	No	936.8109	11634.718
29004	Juazeiro	Bahia	Nordeste	46.12	No	-2463.444	-6036.864
29005	Paulo Afonso	Bahia	Nordeste	45.49	No	-125.0314	-342.5545

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
29006	Barra	Bahia	Nordeste	41.32	No	1992.608	5013.4545
29007	Bom Jesus da Lapa	Bahia	Nordeste	44.66	No	6160.567	3965
29008	Senhor do Bonfim	Bahia	Nordeste	32.18	No	5511.368	830.7
29009	Irecê	Bahia	Nordeste	56.1	No	231.0705	2948.8364
29010	Jacobina	Bahia	Nordeste	46.18	No	7003.091	14900.209
29011	Itaberaba	Bahia	Nordeste	40.63	No	13584.15	-2012.055
29012	Feira de Santana	Bahia	Nordeste	49.95	No	6545.131	10980.218
29013	Jeremoabo	Bahia	Nordeste	38.45	No	175.7285	-11474.5
29014	Euclides da Cunha	Bahia	Nordeste	44.75	No	8761.249	7930.6818
29015	Ribeira do Pombal	Bahia	Nordeste	49.78	No	978.8062	8340.2455
29016	Serrinha	Bahia	Nordeste	45.32	No	8232.393	4751.4909
29017	Alagoinhas	Bahia	Nordeste	44.66	No	-62.87564	-2898.409
29018	Entre Rios	Bahia	Nordeste	43.02	No	2752.575	-2745.455
29019	Catu	Bahia	Nordeste	34.29	No	432.745	-11863.14
29020	Santo Antônio de Jesus	Bahia	Nordeste	54.41	No	6224.488	-710.9091
29021	Salvador	Bahia	Nordeste	47.14	No	-512.2225	-557.4455
29022	Boquira	Bahia	Nordeste	41.68	No	836.727	-3394.455
29023	Seabra	Bahia	Nordeste	49.65	No	-4478.776	-3535.682
29024	Jequié	Bahia	Nordeste	47.23	No	7956.667	-2287.709
29025	Livramento do Brumado	Bahia	Nordeste	44.67	No	-701.6486	-246.8455
29026	Guanambi	Bahia	Nordeste	55.1	No	15121.43	9697.5727
29027	Brumado	Bahia	Nordeste	32.46	No	2086.47	-3962.136
29028	Vitória da Conquista	Bahia	Nordeste	48.35	No	5109.514	11279.1
29029	Itapetinga	Bahia	Nordeste	42.19	No	-1699.248	-13157.34
29030	Valença	Bahia	Nordeste	42.96	No	1193.091	-3775.3
29031	Ilhéus-Itabuna	Bahia	Nordeste	53.69	No	7095.154	18861.264
29032	Porto Seguro	Bahia	Nordeste	44.93	Yes	-11628.76	64256.082

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
11001	Porto Velho	Rondônia	Norte	29.61	No	96337.78	166904.97
11002	Guajará-Mirim	Rondônia	Norte	27.45	No	32847.06	57568.627
11003	Ariquemes	Rondônia	Norte	33.03	No	56118.9	133942.15
11004	Ji-Paraná	Rondônia	Norte	31.96	No	34680.38	173498.54
11005	Alvorada D'Oeste	Rondônia	Norte	32.84	No	26305.27	66800.827
11006	Cacoal	Rondônia	Norte	40.94	No	37298.68	127658.24
11007	Vilhena	Rondônia	Norte	41.38	No	41138.15	75554.982
11008	Colorado do Oeste	Rondônia	Norte	35.86	No	13560.98	41588.627
12001	Cruzeiro do Sul	Acre	Norte	26.21	No	3971.624	5202.0636
12002	Tarauacá	Acre	Norte	23.93	No	5546.568	9929.6273
12003	Sena Madureira	Acre	Norte	11.93	No	5653.226	15421.645
12004	Rio Branco	Acre	Norte	26.34	No	37044.5	118975.88
12005	Brasiléia	Acre	Norte	28.26	No	10161.91	31762.164
13001	Rio Negro	Amazonas	Norte	23.63	No	519.1566	89.636364
13002	Japurá	Amazonas	Norte	20.04	No	121.0575	5.3363636
13003	Alto Solimões	Amazonas	Norte	26.86	No	323.7269	429.00909
13004	Juruá	Amazonas	Norte	22.89	No	2722.554	1901.4091
13005	Tefé	Amazonas	Norte	28.05	No	605.3225	137.68182
13006	Coari	Amazonas	Norte	29.41	Yes	-176.3388	470.38182
13007	Manaus	Amazonas	Norte	29.36	No	6453.257	5950.7727
13008	Rio Preto da Eva	Amazonas	Norte	31.61	No	925.579	441.64545
13009	Itacoatiara	Amazonas	Norte	25.76	No	2473.861	3787.8636
13010	Parintins	Amazonas	Norte	30.57	No	5861.434	6431.3
13011	Boca do Acre	Amazonas	Norte	23.02	No	6603.64	24283.518
13012	Purus	Amazonas	Norte	25.53	No	20767.33	544.76364
13013	Madeira	Amazonas	Norte	34.24	No	8929.555	9495.2
14001	Boa Vista	Roraima	Norte	34.95	No	5318.937	36.636364

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
14002	Nordeste de Roraima	Roraima	Norte	26.06	No	9829.873	2494.7818
14003	Caracaraí	Roraima	Norte	25.25	No	15307.5	3422.2727
14004	Sudeste de Roraima	Roraima	Norte	20.27	No	14892.33	3050.3636
15001	Óbidos	Pará	Norte	22.97	No	4824.759	15944.536
15002	Santarém	Pará	Norte	40.62	No	19864.31	38395.109
15003	Almeirim	Pará	Norte	12.81	No	3097.819	3047.5
15004	Portel	Pará	Norte	25.21	No	1601.918	-2491.3
15008	Castanhal	Pará	Norte	32.52	No	3429.673	4234.1091
15009	Salgado	Pará	Norte	45.19	No	5161.269	1378.5455
15010	Bragantina	Pará	Norte	46.71	No	16945.19	7163.4545
15011	Cametá	Pará	Norte	43.78	Yes	-4334.504	2296.2818
15012	Tomé-Açu	Pará	Norte	28.35	No	17308.06	22144.227
15013	Guamá	Pará	Norte	45.87	No	43959.53	49211.236
15014	Itaituba	Pará	Norte	30.37	No	49947.54	69257.009
15015	Altamira	Pará	Norte	32.41	No	93222.22	146469.82
15016	Tucuruí	Pará	Norte	31.79	No	62425.86	107619.7
15017	Paragominas	Pará	Norte	45.18	No	55037.4	118154.95
15018	São Félix do Xingu	Pará	Norte	3.05	No	152070.7	273969.77
15019	Parauapebas	Pará	Norte	18.87	No	36036.03	122638.98
15020	Marabá	Pará	Norte	23.82	No	46533.16	88804.764
15021	Redenção	Pará	Norte	11.15	No	46507.25	56842.618
15022	Conceição do Araguaia	Pará	Norte	24.41	No	80437.79	110138.41
16004	Mazagão	Amapá	Norte	30.78	Yes	-2285.965	289
17001	Bico do Papagaio	Tocantins	Norte	43.58	No	17490.94	36157.273
17002	Araguaína	Tocantins	Norte	29.26	No	26970.13	84035.027
17003	Miracema do Tocantins	Tocantins	Norte	35.85	No	37820.46	57862.091
17004	Rio Formoso	Tocantins	Norte	32.17	No	30810.44	45645.645

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
17005	Gurupi	Tocantins	Norte	26.91	No	22075.06	39097.882
17006	Porto Nacional	Tocantins	Norte	38.12	No	6944.86	13322
17007	Jalapão	Tocantins	Norte	35.41	No	8070.308	17129.818
17008	Dianópolis	Tocantins	Norte	16.11	No	13318.1	25041.618
31001	Unaí	Minas Gerais	Sudeste	46.63	No	2765.356	4758.1091
31002	Paracatu	Minas Gerais	Sudeste	55.46	No	2036.265	23096.773
31003	Januária	Minas Gerais	Sudeste	40.57	No	8085.456	23045.973
31004	Janaúba	Minas Gerais	Sudeste	43.8	No	4584.51	6420.9545
31005	Salinas	Minas Gerais	Sudeste	43.69	No	4783.871	-1950.427
31006	Pirapora	Minas Gerais	Sudeste	41.15	No	12007.45	15689.582
31007	Montes Claros	Minas Gerais	Sudeste	41.42	No	17424.52	23055.255
31008	Grão Mogol	Minas Gerais	Sudeste	47.18	Yes	-1574.16	114.9
31009	Bocaiúva	Minas Gerais	Sudeste	36.73	No	5681.718	3959.1091
31010	Diamantina	Minas Gerais	Sudeste	34.68	No	740.8105	-425.0636
31011	Capelinha	Minas Gerais	Sudeste	40.4	No	2452.63	-3251
31012	Araçuaí	Minas Gerais	Sudeste	34.21	No	-4764.025	-1590.445
31013	Pedra Azul	Minas Gerais	Sudeste	39.41	Yes	-2426.296	452.60909
31014	Almenara	Minas Gerais	Sudeste	43.89	Yes	-510.4589	14157.918
31015	Teófilo Otoni	Minas Gerais	Sudeste	38.37	No	2500.406	10839.173
31016	Nanuque	Minas Gerais	Sudeste	33.15	No	780.1471	16182.282
31017	Ituiutaba	Minas Gerais	Sudeste	42.8	Yes	-7448.589	4319.3909
31018	Uberlândia	Minas Gerais	Sudeste	57.79	Yes	-17468.98	9399.7
31019	Patrocínio	Minas Gerais	Sudeste	65.35	No	-16470.94	-512.4364
31020	Patos de Minas	Minas Gerais	Sudeste	49.46	Yes	-4976.943	5568.4545
31021	Frutal	Minas Gerais	Sudeste	57.42	Yes	-13205.81	18549.245
31022	Uberaba	Minas Gerais	Sudeste	43.87	Yes	-15550.37	1799.2364
31023	Araxá	Minas Gerais	Sudeste	51.38	Yes	-15898.56	6385.6636

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
31024	Três Marias	Minas Gerais	Sudeste	26.27	No	2471.92	-2943.709
31025	Curvelo	Minas Gerais	Sudeste	39.68	Yes	-836.2445	7735.1909
31026	Bom Despacho	Minas Gerais	Sudeste	47.99	No	2311.52	2982.0455
31027	Sete Lagoas	Minas Gerais	Sudeste	41.74	No	-765.8735	-641.5091
31028	Conceição do Mato Dentro	Minas Gerais	Sudeste	28.95	No	2382.159	1782.9091
31029	Pará de Minas	Minas Gerais	Sudeste	24.1	No	222.76	3046.8091
31030	Belo Horizonte	Minas Gerais	Sudeste	49.49	Yes	-2644.429	243.74545
31031	Itabira	Minas Gerais	Sudeste	37.09	No	2537.397	2082.7091
31032	Itaguara	Minas Gerais	Sudeste	33.98	No	-2027.472	-528.8455
31033	Ouro Preto	Minas Gerais	Sudeste	41.21	No	252.9927	1038.8909
31034	Conselheiro Lafaiete	Minas Gerais	Sudeste	44.53	No	-1505.753	-691.7636
31035	Guanhães	Minas Gerais	Sudeste	41.39	No	2123.894	2161.2091
31036	Peçanha	Minas Gerais	Sudeste	38.13	No	-442.3257	-759.4455
31037	Governador Valadares	Minas Gerais	Sudeste	38.43	Yes	-1126.744	7977.8364
31038	Mantena	Minas Gerais	Sudeste	42.16	No	1135.376	-264.2545
31039	Ipatinga	Minas Gerais	Sudeste	34.83	No	2618.519	1833.6909
31040	Caratinga	Minas Gerais	Sudeste	52.24	No	3842.751	1092.4
31041	Aimorés	Minas Gerais	Sudeste	33.04	Yes	-628.2842	364.21818
31042	Piuí	Minas Gerais	Sudeste	51.29	No	-1204.329	-2330.573
31043	Divinópolis	Minas Gerais	Sudeste	43.45	No	-63.48591	-1116.409
31044	Formiga	Minas Gerais	Sudeste	36.88	No	-667.0726	-2722.918
31045	Campo Belo	Minas Gerais	Sudeste	49.31	No	-371.1427	-375.8636
31046	Oliveira	Minas Gerais	Sudeste	51.31	Yes	-4069.764	67.136364
31047	Passos	Minas Gerais	Sudeste	57.23	No	-6195.003	-1785.382
31048	São Sebastião do Paraíso	Minas Gerais	Sudeste	56.95	No	-7872.61	-3338.827
31049	Alfenas	Minas Gerais	Sudeste	41.11	No	-5126.905	-3571.4
31050	Varginha	Minas Gerais	Sudeste	62.62	No	-7509.338	-1240.364

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
31051	Poços de Caldas	Minas Gerais	Sudeste	49.95	No	-3257.707	-15.69091
31052	Pouso Alegre	Minas Gerais	Sudeste	48.04	Yes	-313.2496	5936.4455
31053	Santa Rita do Sapucaí	Minas Gerais	Sudeste	48.6	Yes	-1582.052	2975
31054	São Lourenço	Minas Gerais	Sudeste	49.53	Yes	-1496.495	2683.8636
31055	Andrelândia	Minas Gerais	Sudeste	43.38	No	-3343.821	-1784.8
31056	Itajubá	Minas Gerais	Sudeste	43.91	No	194.0123	3200.0727
31057	Lavras	Minas Gerais	Sudeste	43.23	No	-2352.321	-1140.436
31058	São João Del Rei	Minas Gerais	Sudeste	42.7	No	-5375.267	-3458.855
31059	Barbacena	Minas Gerais	Sudeste	51.05	No	900.3506	-2988.109
31060	Ponte Nova	Minas Gerais	Sudeste	39.19	No	3285.582	-353.9636
31061	Manhuaçu	Minas Gerais	Sudeste	59.06	No	1102.646	-4049.536
31062	Viçosa	Minas Gerais	Sudeste	44.16	No	2796.682	-5572.527
31063	Muriaé	Minas Gerais	Sudeste	48.14	No	3212.006	-1346.255
31064	Ubá	Minas Gerais	Sudeste	37.71	No	1595.705	-3255.6
31065	Juiz de Fora	Minas Gerais	Sudeste	36.14	No	6202.597	-1769.473
31066	Cataguases	Minas Gerais	Sudeste	43.85	No	2314.243	507.45455
32001	Barra de São Francisco	Espírito Santo	Sudeste	34.14	Yes	-2117.602	8844.7636
32002	Nova Venécia	Espírito Santo	Sudeste	41.87	Yes	-2618.832	3003.2364
32003	Colatina	Espírito Santo	Sudeste	50.33	No	940.1695	2207.7909
32004	Montanha	Espírito Santo	Sudeste	47.55	Yes	-296.7241	6929.8818
32005	São Mateus	Espírito Santo	Sudeste	55.84	No	-2040.897	-171.8545
32006	Linhares	Espírito Santo	Sudeste	56.95	No	-2318.758	-2624.882
32007	Afonso Cláudio	Espírito Santo	Sudeste	48.65	No	609.2787	-1883.973
32008	Santa Teresa	Espírito Santo	Sudeste	40.93	No	1086.292	-797.2455
32009	Vitória	Espírito Santo	Sudeste	20.39	Yes	-82.47782	2156.2
32010	Guarapari	Espírito Santo	Sudeste	37.78	No	808.104	-1282.736
32011	Alegre	Espírito Santo	Sudeste	40.01	No	4.738182	-2589.455

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
32012	Cachoeiro de Itapemirim	Espírito Santo	Sudeste	47.63	Yes	-335.1835	188.36364
32013	Itapemirim	Espírito Santo	Sudeste	42.77	No	56.24445	86.727273
33001	Itaperuna	Rio de Janeiro	Sudeste	43.98	Yes	-1140.721	4062.0909
33002	Santo Antônio de Pádua	Rio de Janeiro	Sudeste	44.82	No	45.39482	5507.5818
33003	Campos dos Goytacazes	Rio de Janeiro	Sudeste	45.26	Yes	-335.3977	2824.4818
33004	Macaé	Rio de Janeiro	Sudeste	32.75	No	1092.078	5722.5455
33005	Três Rios	Rio de Janeiro	Sudeste	41.43	No	232.9185	333.24545
33006	Cantagalo-Cordeiro	Rio de Janeiro	Sudeste	40.6	No	100.8395	916.31818
33007	Nova Friburgo	Rio de Janeiro	Sudeste	46.17	No	689.9134	181.96364
33008	Santa Maria Madalena	Rio de Janeiro	Sudeste	45.17	No	-625.5617	-539.5455
33009	Bacia de São João	Rio de Janeiro	Sudeste	39.12	No	299.3725	717.36364
33010	Lagos	Rio de Janeiro	Sudeste	40.8	Yes	-72.15764	2440.9727
33011	Vale do Paraíba Fluminense	Rio de Janeiro	Sudeste	41.21	No	173.158	2017.2909
33012	Barra do Piraí	Rio de Janeiro	Sudeste	37.21	No	409.511	2298.9273
33013	Baía da Ilha Grande	Rio de Janeiro	Sudeste	37.79	No	21.24964	341.67273
33014	Vassouras	Rio de Janeiro	Sudeste	46.57	No	166.9701	1271.5545
33015	Serrana	Rio de Janeiro	Sudeste	52.99	Yes	-34.67891	591.88182
33016	Macacu-Caceribu	Rio de Janeiro	Sudeste	26.03	No	168.7031	1165.6
33017	Itaguaí	Rio de Janeiro	Sudeste	46.78	No	468.764	123.75455
33018	Rio de Janeiro	Rio de Janeiro	Sudeste	40.61	No	-132.6439	-1432.618
35001	Jales	São Paulo	Sudeste	53.11	Yes	-2752.744	5122.1455
35002	Fernandópolis	São Paulo	Sudeste	34.9	Yes	-1615.888	4713.4455
35003	Votuporanga	São Paulo	Sudeste	21.03	No	-3879.46	-2598.055
35004	São José do Rio Preto	São Paulo	Sudeste	40.8	No	-14145.23	-8006.327
35005	Catanduva	São Paulo	Sudeste	53.85	Yes	-1326.968	166.79091
35006	Auriflama	São Paulo	Sudeste	34.64	Yes	-2692.579	3587.8273
35007	Nhandeara	São Paulo	Sudeste	29.15	No	-4983.755	-1544.864

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
35008	Novo Horizonte	São Paulo	Sudeste	30.61	No	-4763.063	-5495.027
35009	Barretos	São Paulo	Sudeste	61.27	No	-4882.035	-1581.782
35010	São Joaquim da Barra	São Paulo	Sudeste	63.58	No	-1276.201	-1674.855
35011	Ituverava	São Paulo	Sudeste	64.87	No	-2038.528	-385.9727
35012	Franca	São Paulo	Sudeste	50.27	No	-6324.929	-199.1182
35013	Jaboticabal	São Paulo	Sudeste	85.94	No	-1175.844	-1551.064
35014	Ribeirão Preto	São Paulo	Sudeste	86.25	Yes	-2210.248	132.93636
35015	Batatais	São Paulo	Sudeste	66.53	No	-2708.798	-1466.8
35016	Andradina	São Paulo	Sudeste	55.99	No	-10564.3	-1793.173
35017	Araçatuba	São Paulo	Sudeste	40.9	No	-11747.09	-101.8455
35018	Birigui	São Paulo	Sudeste	54.58	No	-11615.2	-721.0182
35019	Lins	São Paulo	Sudeste	49.61	Yes	-5143.071	8225.6455
35020	Bauru	São Paulo	Sudeste	80.2	Yes	-4941.548	8428.4273
35021	Jaú	São Paulo	Sudeste	75.39	No	-3056.396	-467.6545
35022	Avaré	São Paulo	Sudeste	53.3	Yes	-7621.252	4621.0545
35023	Botucatu	São Paulo	Sudeste	62.88	Yes	-3329.106	3513.5818
35024	Araraquara	São Paulo	Sudeste	61.18	No	-3974.685	-3582.091
35025	São Carlos	São Paulo	Sudeste	45.07	Yes	-3186.601	680.79091
35026	Rio Claro	São Paulo	Sudeste	32.53	Yes	-2922.334	465.06364
35027	Limeira	São Paulo	Sudeste	55.38	Yes	-478.6621	372.14545
35028	Piracicaba	São Paulo	Sudeste	59.3	Yes	-1679.771	3205.1182
35029	Pirassununga	São Paulo	Sudeste	50.69	No	-1112.151	-1917.991
35030	São João da Boa Vista	São Paulo	Sudeste	58.42	No	-5346.22	-713.6455
35032	Campinas	São Paulo	Sudeste	52.55	Yes	-1687.15	885.08182
35033	Amparo	São Paulo	Sudeste	39.33	Yes	-733.6641	1639.5909
35034	Dracena	São Paulo	Sudeste	25.15	Yes	-2502.578	1930.5364
35035	Adamantina	São Paulo	Sudeste	39.79	No	-6095.999	-217.3909

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
35036	Presidente Prudente	São Paulo	Sudeste	49.67	Yes	-12592.15	20958.7
35037	Tupã	São Paulo	Sudeste	40.02	Yes	-2045.277	1754.9545
35038	Marília	São Paulo	Sudeste	51.13	Yes	-700.0293	12184.8
35039	Assis	São Paulo	Sudeste	63.44	No	-7903.98	-5854.5
35040	Ourinhos	São Paulo	Sudeste	45.31	Yes	-5503.154	350.24545
35041	Itapeva	São Paulo	Sudeste	52.03	Yes	-7128.736	4715.0455
35042	Itapetininga	São Paulo	Sudeste	50.59	Yes	-3886.024	904.68182
35043	Tatuí	São Paulo	Sudeste	50.33	Yes	-1591.157	50.736364
35044	Capão Bonito	São Paulo	Sudeste	46.36	No	-304.4535	-251.2273
35045	Piedade	São Paulo	Sudeste	49.08	Yes	-1342.171	1435.9273
35046	Sorocaba	São Paulo	Sudeste	100	Yes	-1838.762	2996.2091
35047	Jundiaí	São Paulo	Sudeste	32.18	Yes	-565.5012	191.70909
35048	Bragança Paulista	São Paulo	Sudeste	47.77	Yes	-1687.147	675.8
35049	Campos do Jordão	São Paulo	Sudeste	40.08	Yes	-43.40818	135.79091
35050	São José dos Campos	São Paulo	Sudeste	37.34	Yes	-1147.064	4090.9909
35051	Guaratinguetá	São Paulo	Sudeste	46.36	Yes	-1321.113	1107.5818
35052	Bananal	São Paulo	Sudeste	38.31	Yes	-619.9066	494.56364
35053	Paraibuna/Paraitinga	São Paulo	Sudeste	30.39	Yes	-382.9866	4426.9636
35054	Caraguatatuba	São Paulo	Sudeste	36.31	Yes	-102.1699	300.82727
35055	Registro	São Paulo	Sudeste	52.67	No	1096.293	4774.5636
35057	Osasco	São Paulo	Sudeste	54.44	Yes	-43.10691	13.8
35059	Guarulhos	São Paulo	Sudeste	42.84	Yes	-55.89709	469.42727
35062	Mogi das Cruzes	São Paulo	Sudeste	41.56	No	169.8128	125.2
41001	Paranavaí	Paraná	Sul	59.23	No	-11209.71	-681.3909
41002	Umuarama	Paraná	Sul	52.46	No	-9345.316	-15500.23
41003	Cianorte	Paraná	Sul	48.23	No	-7908.994	-11661.06
41004	Goioerê	Paraná	Sul	58.51	No	-794.7337	-301.1636

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
41005	Campo Mourão	Paraná	Sul	52.63	No	-5577.053	-603.6273
41006	Astorga	Paraná	Sul	34.42	No	-9365.272	-15241.67
41007	Porecatu	Paraná	Sul	54.88	No	-1742.716	-3801.682
41008	Floraí	Paraná	Sul	37.9	No	-603.2558	-2717.309
41009	Maringá	Paraná	Sul	61.95	No	-1047.77	-1701.745
41010	Apucarana	Paraná	Sul	58.77	No	-2403.254	-1235.336
41011	Londrina	Paraná	Sul	57.8	No	-2834.702	-5865.627
41012	Faxinal	Paraná	Sul	59.08	Yes	-2601.836	2582.7818
41013	Ivaiporã	Paraná	Sul	47.99	Yes	-3602.579	5984.4455
41014	Assaí	Paraná	Sul	49.88	Yes	-1676.27	1041.9909
41015	Cornélio Procópio	Paraná	Sul	54.32	No	-3332.915	-1119.464
41016	Jacarezinho	Paraná	Sul	49.9	Yes	-747.3105	3166.1182
41017	Ibaiti	Paraná	Sul	45.96	Yes	-2512.041	5875.8273
41018	Wenceslau Braz	Paraná	Sul	45.04	Yes	-1328.879	7544.7818
41019	Telêmaco Borba	Paraná	Sul	56.47	Yes	-8987.934	5358.9545
41020	Jaguariaíva	Paraná	Sul	50.77	Yes	-6078.61	217.58182
41021	Ponta Grossa	Paraná	Sul	50.97	Yes	-2208.646	1195.3182
41022	Toledo	Paraná	Sul	64.87	No	-2905.427	-6231.5
41023	Cascavel	Paraná	Sul	50.29	Yes	-2512.474	6940.1455
41024	Foz do Iguaçu	Paraná	Sul	62.2	No	-1587.441	-2788.491
41025	Capanema	Paraná	Sul	49.01	No	911.2042	6033.8727
41026	Francisco Beltrão	Paraná	Sul	52.33	No	1019.579	16835.727
41027	Pato Branco	Paraná	Sul	56.06	Yes	-792.9665	2098.0455
41028	Pitanga	Paraná	Sul	41.69	Yes	-1074.838	9287.4455
41029	Guarapuava	Paraná	Sul	57.88	Yes	-1053.718	22766.464
41030	Palmas	Paraná	Sul	53.49	Yes	-2313.345	1200.5091
41031	Prudentópolis	Paraná	Sul	46.77	Yes	-560.2852	1390.4364

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
41032	Irati	Paraná	Sul	52.63	No	615.9638	684.49091
41033	União da Vitória	Paraná	Sul	54.84	Yes	-427.1389	204.85455
41034	São Mateus do Sul	Paraná	Sul	55.17	No	653.699	1300.7545
41035	Cerro Azul	Paraná	Sul	44.87	No	843.0835	1092.5727
41036	Lapa	Paraná	Sul	54.83	Yes	-197.4036	417.93636
41037	Curitiba	Paraná	Sul	47.46	No	434.3678	2354.5545
41038	Paranaguá	Paraná	Sul	48.11	No	-46.13518	-82.79091
41039	Rio Negro	Paraná	Sul	48.69	No	-201.1835	-51.73636
42001	São Miguel do Oeste	Santa Catarina	Sul	57.16	No	423.4761	9633.6636
42002	Chapecó	Santa Catarina	Sul	53.8	No	1872.543	7335.0182
42003	Xanxerê	Santa Catarina	Sul	52.55	Yes	-642.4188	2246.4364
42004	Joaçaba	Santa Catarina	Sul	54.19	Yes	-3159.281	2061.0545
42005	Concórdia	Santa Catarina	Sul	49.2	No	187.4344	4705.3727
42006	Canoinhas	Santa Catarina	Sul	53.11	No	1384.82	-1586.991
42007	São Bento do Sul	Santa Catarina	Sul	48.28	No	117.6555	-22.84545
42008	Joinville	Santa Catarina	Sul	48.81	No	98.96782	-67.70909
42009	Curitibanos	Santa Catarina	Sul	53.57	No	-3741.518	-1916.145
42010	Campos de Lages	Santa Catarina	Sul	53.31	Yes	-660.5161	1834.0909
42011	Rio do Sul	Santa Catarina	Sul	50.14	No	3069.585	2495.5
42012	Blumenau	Santa Catarina	Sul	47.61	No	679.9529	336.20909
42013	Itajaí	Santa Catarina	Sul	47.91	No	468.1373	2056.7545
42014	Ituporanga	Santa Catarina	Sul	48.9	No	417.7199	-495
42015	Tijucas	Santa Catarina	Sul	52.03	No	380.0395	1476.4364
42016	Florianópolis	Santa Catarina	Sul	33.28	No	239.1126	2109.5
42017	Tabuleiro	Santa Catarina	Sul	49.58	No	182.3562	-737.2091
42018	Tubarão	Santa Catarina	Sul	45.28	Yes	-179.1488	4664.8182
42019	Criciúma	Santa Catarina	Sul	56.86	Yes	-350.5981	1142.8545

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
42020	Araranguá	Santa Catarina	Sul	53.16	No	-423.5948	-2409.636
43001	Santa Rosa	Rio Grande do Sul	Sul	56.73	Yes	-51.44545	824.57273
43002	Três Passos	Rio Grande do Sul	Sul	55.95	Yes	-27.44573	22.336364
43003	Frederico Westphalen	Rio Grande do Sul	Sul	64.06	No	426.0322	3100.7818
43004	Erechim	Rio Grande do Sul	Sul	58.51	No	520.1259	943.32727
43005	Sananduva	Rio Grande do Sul	Sul	50.38	No	-977.4255	-1619.609
43006	Cerro Largo	Rio Grande do Sul	Sul	60.34	No	153.6749	2197.7273
43007	Santo Ângelo	Rio Grande do Sul	Sul	58.99	No	38.58664	4216.9818
43008	Ijuí	Rio Grande do Sul	Sul	63.59	No	-119.6935	-3600.245
43009	Carazinho	Rio Grande do Sul	Sul	69.14	No	-86.38618	-2517.445
43010	Passo Fundo	Rio Grande do Sul	Sul	57.25	No	-1653.489	-2938.364
43011	Cruz Alta	Rio Grande do Sul	Sul	60.47	No	-262.0798	-12922.09
43012	Não-Me-Toque	Rio Grande do Sul	Sul	55.28	No	42.62182	-1142.445
43013	Soledade	Rio Grande do Sul	Sul	52.58	No	-1826.172	-2960.864
43014	Guaporé	Rio Grande do Sul	Sul	60.83	Yes	-1783.374	688.8
43015	Vacaria	Rio Grande do Sul	Sul	54.06	No	-1269.126	-11700.09
43016	Caxias do Sul	Rio Grande do Sul	Sul	60.38	No	-598.6103	-624.4545
43017	Santiago	Rio Grande do Sul	Sul	56.74	No	8.133455	-12249.71
43018	Santa Maria	Rio Grande do Sul	Sul	47.59	No	47.52791	522.60909
43019	Restinga Seca	Rio Grande do Sul	Sul	58.94	No	-383.7376	-2361.209
43020	Santa Cruz do Sul	Rio Grande do Sul	Sul	69.16	No	-360.6927	-285.7
43021	Lajeado-Estrela	Rio Grande do Sul	Sul	62.38	Yes	-2.370091	1082.7273
43022	Cachoeira do Sul	Rio Grande do Sul	Sul	55.19	No	-140.3029	-3094.609
43023	Montenegro	Rio Grande do Sul	Sul	49.12	Yes	-124.2278	269.50909
43024	Gramado-Canela	Rio Grande do Sul	Sul	48.72	Yes	-110.5798	334.87273
43025	São Jerônimo	Rio Grande do Sul	Sul	54.97	Yes	-33.06727	5803.6182
43026	Porto Alegre	Rio Grande do Sul	Sul	51.07	Yes	-19.88073	1998.5818

Microregion Code	Microregion Name	State	Region	RDI	Treatment	Pasture Area* (hectares)	Herd size* (animals)
43027	Osório	Rio Grande do Sul	Sul	49.05	Yes	-28.873	7510.9818
43028	Camaquã	Rio Grande do Sul	Sul	58.75	No	0	-17.09091
43029	Campanha Ocidental	Rio Grande do Sul	Sul	63.41	Yes	-16.43018	35109.327
43030	Campanha Central	Rio Grande do Sul	Sul	37.91	Yes	0	25463.491
43031	Campanha Meridional	Rio Grande do Sul	Sul	46.94	Yes	0	27949.664
43032	Serras de Sudeste	Rio Grande do Sul	Sul	46.57	Yes	0	17714.255
43033	Pelotas	Rio Grande do Sul	Sul	57.91	Yes	0	7471.2182
43034	Jaguarão	Rio Grande do Sul	Sul	58.49	No	0	-3034.764
43035	Litoral Lagunar	Rio Grande do Sul	Sul	49.68	Yes	0	10612.291