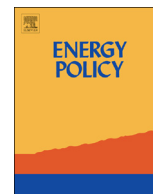




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Reduction of emissions from Brazilian cattle raising and the generation of energy: Intensification and confinement potentials



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HIGHLIGHTS

- We identify one main source of anthropic GHG in Brazil after forest conversion (deforestation), the beef cattle raising.
- Four scenarios to mitigate emissions from cattle raising (agriculture sector) are modeled.
- We calculate potential removals of carbon from the atmosphere through natural regeneration of biomes for each scenario.
- The results suggest that picketing and rotation has the greatest potential, with a carbon reduction of 1.8 Mt CO₂eq/yr.
- Biodigestion of manure allows the generation of biogas and biofertilizers, increasing carbon reduction potentials.

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ABSTRACT

The identification of the main sources of anthropic greenhouse gas emissions (GHG) associated with the mitigation and removal of these emissions has become an important instrument in the attenuation of the climatic changes predicted by the IPCC. The largest emission source in Brazil is forest conversion. This land use change has always had a strong relationship with the expansion of agriculture, an activity of great importance in the country, which has the largest commercial cattle herd in the planet. Following the considerable reduction in emissions from deforestation, agriculture has been since 2010 the most important source (MCTI (Ministério da Ciência, Tecnologia e Inovação), 2013. Brasília: Ministério da Ciência, Tecnologia e Inovação, Brasil). Seeking to discover the possibilities of altering the emissions profile in the agricultural sector, four scenarios were developed related to how this is dealt with in the beef cattle sector, calculating the potential removal of carbon from the atmosphere through natural regeneration of biomes. The results suggest that picketing and rotation scenario has the greatest potential, with a carbon reduction of 17.7 Gt CO₂eq, while the shared raising with grain legumes scenario has the lowest calculated reduction potential of 7.1 Gt CO₂eq was calculated. The animal confinement scenario had an intermediary reduction potential of 8.3 Gt CO₂eq. The mosaic of methods scenario, in which it is attempted to simulate the parallel adoption of the measures proposed in all other scenarios, had a reduction potential of 13.1 Gt CO₂eq. In the scenarios where animal confinement occurs, the treatment of waste with biodigestion allows the generation of biogas and biofertilizers, contributing to an increase in the potential carbon reduction.

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1. Introduction

According to FAO (Food and Agriculture Organization) (2011), Brazil is the second largest meat exporter (cattle, pork, and poultry) in the world, being responsible for more than 16% of world exports of cattle meat, behind only the US (FAO (Food and Agriculture Organization), 2011). Steinfeld et al. (2006) show that between 1995 and 2005, Brazilian exports of bovine meat tripled.

The country currently possesses the largest commercial cattle herd in the world (second largest in absolute size, Fig. 1), with 205 million head of cattle (FAO (Food and Agriculture Organization), 2011). According to IBGE (Instituto Brasileiro de Geografia e Estatística) (2009) data, between 1970 and 2006 this grew by approximately 3.3% per year, from approximately 78.5 million cattle in 1970 to 171.6 million in 2006.

In this period the Northern region of the country had the highest increase in the number of animals, followed by the Mid-West region, as shown in Table 1. The Mid West is the region which had in 2006 the highest absolute number of animals, with 33.5% of the country's cattle (IBGE (Instituto Brasileiro de Geografia e Estatística), 2009).

Pasture areas are almost exclusively occupied by cattle and total 196 million hectares (FAO (Food and Agriculture Organization), 2011). In 1970 pasture areas amounted to around 154 million ha, with a stocking rate of approximately 0.5 head/ha. In 2006 there were around 158.8 million ha, or 1.08 head/ha. In this period the Northern region had the greatest increase in pasture, followed by the Northeast (Table 2). The region with the

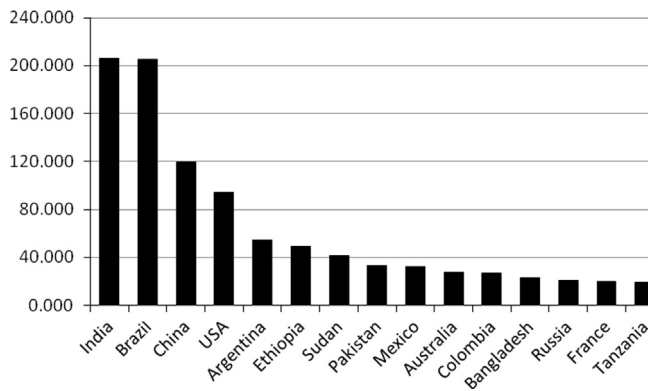


Fig. 1. Countries with the largest cattle herds in 2009, in 1000s of heads. Source: Prepared by the authors, based on FAO (Food and Agriculture Organization) (2011).

Table 1

Size of bovine herds by region and total in the country, between 1970 and 2006, and the corresponding variation in this period. Source: Prepared by the authors based on IBGE (Instituto Brasileiro de Geografia e Estatística) (2009).

Region	Cattle herd (1000 head)						Variation 1970–2006 (%)
	1970	1975	1980	1985	1995	2006	
North	1,706	2,130	3,989	8,966	17,277	31,336	1736.64
Northeast	13,806	18,041	21,506	22,391	22,842	25,326	83.44
Southeast	26,845	35,237	34,835	35,742	35,954	34,060	26.88
South	18,953	21,516	24,495	24,827	26,220	23,365	23.28
Mid-West	17,252	24,750	33,261	36,116	50,766	57,527	233.45
Brazil	78,562	101,674	118,086	128,042	153,058	171,614	118.44

Table 2

Total area occupied by pasture, per region and total in country, between 1970 and 2006, and the corresponding variation in the period. Source: Prepared by the authors based on IBGE (Instituto Brasileiro de Geografia e Estatística) (2009).

Region	Area occupied by pasture (1000 ha)						Variation 1970–2006 (%)
	1970	1975	1980	1985	1995	2006	
North	4,428	5,281	7,722	20,876	24,387	26,524	498.99%
Northeast	27,875	30,624	34,159	35,148	32,076	30,540	9.56
Southeast	44,739	47,277	43,639	42,487	37,777	27,561	–38.40
South	21,613	21,160	21,313	21,432	20,697	15,611	–27.77
Mid-West	55,483	61,310	67,666	59,244	62,764	58,518	5.47
Brazil	154,139	165,652	174,500	179,188	177,700	158,754	2.99

largest pasture area is the Mid-West, with 36.9% of total pasture in the country in 2006. This region was also the one with the greatest increase in the pasture stocking rate in the period in question, followed by the Northern Region (Table 3) (IBGE (Instituto Brasileiro de Geografia e Estatística), 2009).

Like any other human activity, livestock raising causes more or less significant impacts on the environment, almost always contributing to the degradation of natural systems, depending on the form of livestock raising used and the production processes. In the Brazilian case the negative impacts are strengthened because the use of extensive livestock raising on pasture is predominant. Among the most relevant impacts resulting from livestock raising are water consumption and pollution, the loss of biodiversity, and the contribution to the intensification of global climatic changes (Steinfeld et al., 2006). It is an essentially 'hydro-intensive' activity, both in relation to the consumption of water by the animal through the watering of individual animals, and the processing of derivative products and the production of feed. Furthermore, the pollution of bodies of water derived from the destination of the waste created at all stages of this productive process is significant. Extensive livestock raising in pasture also alters the water cycle, since it alters the natural landscape, and consequently the dynamic of the flows of water.

Table 3

Pasture Stocking Rate, per region and total in country, between 1970 and 2006, and the corresponding variation in the period.

Source: Prepared by the authors based on IBGE (Instituto Brasileiro de Geografia e Estatística) (2009).

Region	Herd density (head/ha)		Variation 1970–2006 (%)
	1970	2006	
North	0.39	1.18	206.62
Northeast	0.50	0.83	67.44
Southeast	0.60	1.24	105.95
South	0.88	1.50	70.68
Mid-West	0.31	0.98	216.16
Brazil	0.51	1.08	112.09

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