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Inverting the carbon footprint in Brazilian agriculture: an estimate of the effects of the ABC plan

Invertendo a pegada de carbono na agricultura brasileira: estimativa do efeito do Plano ABC

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ABSTRACT

The Sectoral Plan of Mitigation and Adaptation to Climate Change, drafted in order to consolidate an Economy of Low Carbon Emission in Agriculture (ABC Plan), integrates the commitments made by Brazil to mitigate its emissions of greenhouse gases (GHG). The objective of this study is to estimate GHG emissions produced by the agriculture and livestock sector considering the adoption of three low carbon emission technologies (LCT) – pasture recovery, integrated crop-livestock systems (ICLS), and integrated crop-livestock-forest systems (ICLFS). The GHG emissions were estimated considering the growth projections of the production of soybean, corn, rice, beans, cotton, wheat, sugarcane and pastures from 2012 to 2023. Two scenarios were considered: I - without the adoption of LCT; II - with adoption of LCT, as proposed by the ABC Plan. In scenario I, the cumulative emissions estimated were 670.47 million tCO_2eq, with only about 22.67 million tCO_2eq from agricultural activities. In the scenario II, the stock of carbon in the soil was higher than carbon emissions and amounted to 1.10 billion tCO_2eq, with a recovery of 75% of degraded pasture areas and implementation of ICLS and ICLFS in 25% of the area of degraded pastures. It was estimated that 52 million cattle would be added to the Brazilian production system with the adoption of the LCT. We concluded that the technologies proposed by the ABC Plan can mitigate climate change, and the Brazilian agricultural sector can reduce its carbon footprint and become the main sector in mitigating emissions.
Keywords: climate change, mitigation, soil carbon.

RESUMO

O Plano Setorial de Mitigação e Adaptação às Mudanças Climáticas para consolidar uma Economia de Baixa Emissão de Carbono na Agricultura (Plano ABC) integra os compromissos assumidos pelo Brasil para mitigar suas emissões de gases de efeito estufa (GEE). O objetivo deste estudo foi estimar as emissões de GEE do setor agropecuário considerando a adoção de três tecnologias de baixa emissão de carbono (LCT) - recuperação de pastagens, integração lavoura-pecuária (ICLS) e integração lavoura-pecuária-floresta (ICLFS). As emissões de GEE foram estimadas considerando as projeções de crescimento da produção de soja, milho, arroz, feijão, algodão, trigo, cana-de-açúcar e pastagens de 2012 a 2023. Dois cenários foram considerados: I - sem a adoção de LCT; II - com adoção de LCT, propostas pelo Plano ABC. No cenário I, as emissões acumuladas estimadas foram de 670,47 milhões tCO_2eq, com apenas cerca de 22,67 milhões tCO_2eq de atividades agrícolas. No cenário II, o estoque de carbono no solo foi superior às emissões de carbono e foi de

1,10 bilhão tCO_2eq, com recuperação de 75% das áreas de pastagens degradadas e implantação de ICLS e ICLFS em 25% da área de pastagens degradadas. Estima-se que 52 milhões de cabeças de gado seriam acrescentadas ao sistema de produção brasileiro com a adoção das LCT. Conclui-se que as tecnologias propostas pelo Plano ABC podem mitigar as mudanças climáticas e o setor agrícola brasileiro pode reduzir sua pegada de carbono e se tornar o principal setor na mitigação de emissões.
Palavras-chave: mudanças climáticas, mitigação, carbono do solo.

INTRODUCTION

Changes in the Earth´s climate may become one of the greatest environmental challenges ever faced by humanity. The consequences of possible increases in temperature and changes in rainfall patterns are concerning, and may cause systemic and irreversible damage to individuals and nations (Intergovernmental Panel on Climate Change, 2007). To face these problems, it is necessary to find political, economic and technological solutions that enable the reduction of greenhouse gas (GHG) emissions and the economic growth with respect to the environment (Intergovernmental Panel on Climate Change, 2014).

Agribusiness is a very important sector in the Brazilian economy, since it represents 25% of the gross domestic product. Since 2008, Brazil is one of the largest exporters of agricultural products in the world. It ranks first in sugar, chicken meat, coffee, orange juice, tobacco and alcohol; second in beef, soybean and corn; and is the fourth exporter of pork. Grain production accounted for 186,610 million tons in 2015/2016 distributed into 58,336 million hectares; livestock farming occupies 25% of the total area of Brazil (Companhia Nacional de Abastecimento, 2017). Pastures correspond to 172 million hectares, of which an estimated 50% is in the process of degradation and 25% would be moderately degraded (Dias-Filho, 2014). Much of this cattle breeding is still extensive due to the great area with pastures in Brazil. Reducing the productivity and quality of forage and soil carbon stocks and the low level of animal productivity may result in more GHG emissions per unit of product in that system.

Given the sector’s relevance to the Brazilian economy, the transition from the current model of agricultural production to a low-carbon model is urgent. The Low Carbon Agriculture Plan (ABC Plan) is a policy of the Brazilian federal government launched in 2010 comprising actions aiming to reduce GHG emissions in agriculture (Brasil, 2012). The scope of the Plan is to finance low-GHG emissions technologies.

The agricultural sector is the second largest emitter of GHG in Brazil, according to the Third National Inventory of GHG Emissions (Brasil, 2016). There was an increase between 2005 and 2010 from 415,754 million to 472,734 million tons of CO_2eq. With the growing world demand for food increasingly pressing for agricultural expansion, these emissions tend to increase even more. On the other hand, the sector, due to its characteristics and its sensitivity to the climate, is also one of the most vulnerable sectors to climate change (Yohannes, 2016). Food production is an absolute priority for society, and mitigating climate change has the strategic interest of promoting food security.

Pasture recovery is considered a reference to estimate the reduction of GHG emissions in the agricultural sector. It is a set of techniques applied to improve pasture productivity. Such techniques provide the system with a greater carbon stock compared to a degraded pasture because the emission of CO_2 by the soil to the atmosphere occurs mainly by the decomposition of organic waste and the respiration of organisms from degraded areas (Carvalho et al., 2010). The balance between inputs of C through plant residues and losses of C, primarily through decomposition, is directly related to soil C levels (Paustian et al., 2000). Increasing cropping intensification and plant production efficiency may contribute to reduced CO_2 emissions by agricultural soils. Therefore, Brazilian agribusiness, besides providing food, raw materials and energy, balancing trade and generating jobs for the country, could contribute to the reduction of GHG emissions. It is necessary to strengthen low-carbon agriculture in Brazil and make the provision of resources to finance this transition feasible.

In this context, it is essential to know and assess the potential contribution of Brazilian agriculture to climate change mitigation. In addition to the ABC Plan, this study can contribute to evaluate the potential of agriculture to reach the Brazilian goal of the COP 21, i.e., the Nationally Determined Contributions (NDC). The objective of this study is to estimate GHG emissions by the agriculture and livestock sector considering the adoption of three low carbon emission technologies (LCT) – pasture recovery, integrated crop-livestock systems (ICLS) and the integrated crop-livestock-forest systems (ICLFS) – to mitigate climate change from 2012 to 2023.

MATERIALS AND METHODS

The estimates of the balance of GHG emissions in agriculture were based on MMA (Brasil, 2015). The sources of emissions were agriculture emissions of methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2). The N sources, transformed in (N_2O), were grazing animals, crop residues, manure management systems (excluding pastures), atmospheric deposition of volatilized N (indirect emissions), and burning of sugarcane and cotton residues in the Northeast region of Brazil. The sources of CH_4 were rice cultivation, enteric fermentation of cattle, manure management, and burning of sugarcane residues in the Northeast. The application of urea to the soil was considered a source of N, transformed in N_2O, and the sources of CO_2 were the practices and systems of soil management used for conventional agriculture.

For the projections of crop production growth from 2012 to 2023, we considered data from the Ministry of Agriculture, Livestock and Food Supply - MAPA (Brasil, 2013) for soybean, corn, rice, beans, cotton, wheat, sugarcane and pastures.

In this work, we considered the GHG emission balance of the agriculture and livestock sector, that is, all the emissions and all CO_2eq sinks resulting from the production system, unlike the Brazilian Emissions Inventory methodology (Brasil, 2015), which only considers the emissions of the activity in a disaggregated way. For example, for livestock activity, the Inventory considers the emissions per animal (N_2O and CH_4 only) and does not consider the possible carbon stored in the soil in low carbon productive systems (Brasil, 2015).

The ABC Plan aims to reach, above all, those rural landowners and agricultural regions with a low technology adoption and/or degraded areas. Therefore, we assumed that the advance of the technologies of the ABC Plan, mainly pasture recovery, ICLS and ICLFS, will take place in these degraded regions as pointed by Assad et al. (2015).

GHG Estimates without Adoption of LCT - Scenario I

Additionally, for the calculation of the emissions, we considered that the expansion of the conventional agriculture projected until 2023 shall take place in degraded pasture areas, with a carrying capacity lower than or equal to 0.70 AU/ha, according to Dias-Filho (2014) and Assad et al. (2015). The IBGE's municipal base (Instituto Brasileiro de Geografia e Estatística, 2006) was used to determine municipalities presenting this average. Thus, we considered the agricultural areas of the selected crops only of the municipalities with degraded pastures. For livestock emissions estimates, we considered a constant number of cattle and low carrying capacity until 2023 in the municipalities with degraded pastures. Emissions were calculated using the Global Warming Potential (GWP) metrics (Manning et al., 2009), which considers the influence of gases on changes in the Earth´s energy balance measured for hundred-year periods.

GHG Estimates with Adoption of LCT - Scenario II

To evaluate the GHG balance up to 2023 with the adoption of LCT in areas of agricultural expansion according to MAPA (Brasil, 2013), the following technologies were considered: pasture recovery, crop-livestock integration (ICLS), integrated crop-livestock-forest system (ICLFS). In order to compare GHG emissions from agriculture with (scenario 2) and without the adoption of LCT (scenario 1), we analyzed only part of the Brazilian territory, excluding the Amazon biome. For estimates of mitigation through pasture recovery and the implementation of ICLS and ICLFS, we assumed that:

i) 75% of degraded pasture areas would be recovered; in the remaining 25%, other integrated systems such as the ICLS and the ICLFS would be implemented;

ii) crop expansion, considered until 2023, will take place on 25% of the degraded pasture areas through integrated production systems such as the ICLS and ICLFS. The crops considered were soybean, corn, rice, beans, wheat and pastures. These crops may make up the ICLS and ICLFS systems and are far more representative when compared to the total cultivated area in Brazil;

iii) for estimates of emissions related to the change of land use, a soil carbon rate of 1 tC/ha/year was considered for the conversion of degraded pastures into productive pastures; and

iv) for estimates of emissions related to the conversion of degraded pasture into ICLS and ICLFS, a soil carbon rate of 1.5 tC/ha/year was considered.

RESULTS AND DISCUSSION

GHG Estimates without the Adoption of LCT

By analyzing the agriculture growth projections, it is evident that, for all crops analyzed, the tendency was to increase production between 2012/13 and 2022/23 (Table 1). According to MAPA projections (Brasil, 2013), the crops with the highest growth rates are cotton, sugarcane, soybean and corn, followed by wheat, beans and rice.

IBGE's municipal base pointed that 1,285 municipalities had less than or exactly 0.7 AU/ha (Instituto Brasileiro de Geografia e Estatística, 2006). The extent of degraded pasture is 52.32 million hectares in Brazil as a whole, and there were 39,791,956 cattle, about 20% of the total Brazilian cattle herd. The main regions for pasture recovery or advancement of low-carbon agriculture are the Midwest (Mato Grosso do Sul, Mato Grosso and Goiás), which concentrates 34.7% of the national herd and 23% of the total degraded pasture; the Southeast (mainly the Minas Gerais state), which concentrates 18% of the national herd and 36% of the total degraded pasture; and the Northeast (mainly the Bahia state), with the largest areas of degraded pasture (Table 2).

According to MAPA projections (Brasil, 2013), the estimated cumulative emissions for Brazilian agriculture (livestock and agricultural activities) in the selected municipalities and in the studied period (11 years, from 2012/2013 to 2022/2023) were 670.47 million tCO_2eq, with only about 22.67 million tCO_2eq from agricultural activities (Table 3).

Notably, the number of cattle was the main source of GHG emissions in the projected scenario for the selected municipalities considering low carbon emissions technologies (Table 3), corroborating the data of the Brazilian Inventory of Emissions (Brasil, 2015). In addition,

Table 1. Growth projection for Brazilian agriculture from the crop year 2012/2013 to 2022/2023 according to MAPA (Brasil, 2013).

Crop	2012/2013	2022/2023	Variation	Annual Rate
	thousand tons		%	
Beans	2.86	3.26	14.20	1.42
Corn	78.00	93.62	20.00	2.00
Cotton	1.35	2.53	87.60	8.76
Rice	12.37	13.75	11.10	1.11
Soybean	81.51	99.25	21.80	2.18
Sugarcane	589.13	833.17	41.40	4.14
Wheat	5.94	6.98	17.60	1.76

Table 2. Degraded pasture areas and number of cattle in the Brazilian regions.

Region	Degraded Pasture		Head of cattle	
	............ha............	%	number	%
MW	12,145,461	23.21	59,609,744	34.69
N	4,752,572	9.08	35,563,948	20.69
NE	15,994,218	30.57	21,670,483	12.61
S	401,830	0.77	23,564,736	13.71
SE	19,030,244	36.37	31,449,257	18.30
Brazil	52,324,325	100.00	171,858,168	100.00

the annual emissions estimated, considering only cattle herd and the seven analyzed crops, in municipalities with degraded pastures (1,285 municipalities), represented about 13% of the total emissions of all activities of the agriculture sector listed in the National Emissions Inventory (Brasil, 2015). However, emissions from crop management varied substantially. Due to a larger planted area, corn was the main source of GEE emissions among the crops analyzed. Following this, there is sugar cane and rice (Table 3).

Soybean, due to biological nitrogen fixation (BNF), contributed very little to GHG emissions (2.79 tCO_2eq). The success of soybean in Brazil is due to BNF, which is capable of providing the necessary nitrogen even for high-yielding varieties. This technology is adopted in most areas with soybean crops in Brazil (Hungria and Vargas, 2005; Zilli et al., 2010), occupying about 111.6 million tons in the 2016/2017 harvest (Companhia Nacional de Abastecimento, 2017) producing about 100 million tons of grains with BNF (Empresa Brasileira de Pesquisa Agropecuária, 2015). Its use results for annual savings are estimated in around US$ 3.4 billion in nitrogen fertilizers.

The use of N fertilizers is the main cause of Brazilian GHG emissions from crops. Synthetic fertilizers contribute with 38% of N_2O[1] emissions (Brasil, 2015). Therefore, it is necessary to consider the potential for reducing agriculture emissions by reducing the use of synthetic fertilizers, especially N fertilizers. In addition, rice crops in Brazil emitted 464.2 Gg of methane in 2010 (Brasil, 2015), as a great part of its production is conducted in wetlands.

Moreover, the areas of corn, compared to the other crops in the selected municipalities in this study, are significantly greater, totaling 3.3 million hectares and a production of 17 million tons in 2012/2013. This leads to a high demand for nitrogen fertilizer and, thus, to higher GHG emissions. Wheat, the crop with the smallest area in the selected municipalities, presented the lowest GHG emissions between 2012/2013 and 2022/2023.

GHG Estimates with the Adoption of LCT

Considering the premises assumed here and agriculture growth projections made by MAPA (Brasil, 2013), it would be possible to avoid the emission of 670 million tons of CO_2eq and further store 1.10 billion tons of CO_2eq in the soil (about 100.2 million tons per year), according to the GWP calculation metric as adopted by the IPCC for this type of analysis (Table 4), using the technology to pasture recovery applied to 75% of the degraded pasture land area and the implementation of the ICLS and ICLFS in the remaining 25%.

The simulation made here is conservative, as it does not consider other technologies of the ABC Plan, such as biological nitrogen fixation in crops in addition to those of soybean, and encompasses only 1,285 Brazilian municipalities with degraded pasture lands (which have 0.7 animal units per hectare), considering bovine herds and only seven agricultural crops. Even so, in the breakdown per region, the Southeast, for example, could avoid the emission of 214 million tCO2eq (Table 3) and store around 434 million tCO2eq (Table 4) in the soil using pasture regeneration. The states that would emit GHG the most in a scenario without the expansion of ABC technologies are those that neutralize emissions the most according to the mitigation scenario.

It is important to highlight that the South region presented the lowest degraded pasture area (Table 2). Therefore, the expansion of rice, one of the main crops planted in this region, in around 11% between 2012/13 and 2022/23 (Table 1) using LCT will occur in a smaller area compared to the other regions of Brazil. For the other regions, the negative sign (Table 4) represents carbon sequestration in the soil with the expansion of LCT in degraded pasture areas.

Thus, the potential for mitigation of agriculture GHG emissions of 1.8 billion tCO2eq (avoided emissions plus CO2eq stocks in soil) in eleven years through pasture recovery, ICLS and ICLFS (Figure 1) applied to 52 million ha of pastures with a low carrying capacity (< 0.7 AU/ha) is much higher than the goals stipulated by the ABC Plan and the NDC, indicating that Brazilian agriculture is fully capable of being transformed from a strong GHG emitter into an efficient GHG mitigating agent.

In terms of agriculture, the ABC Plan sets the goal of reducing 166 million tCO2eq by 2020 (Brasil, 2012), and the Brazilian NDC sets the emission reduction target of CO2eq at 37% and 43%, below 2005 levels in 2025 and 2030, respectively (Brasil, 2015). The agriculture

[1] N_2O warming potential is 298 times greater than CO_2.

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Table 3. Cumulative emissions (2012/2013 to 2022/2023), in thousands of tCO_2eq, and percentage of total emissions using MAPA projections and GWP metrics for each geopolitical region of Brazil and for the country, according to selected municipalities in Brazil, in the scenario of no adoption of low carbon emissions technologies listed in the ABC Plan.

Region	MW		N		NE		S		SE		Total	
	CO_2eq	%	CO_2eq	%	CO_2eq	%	tCO_2eq	%	tCO_2eq	%	tCO_2eq	%
Beans	208.16	0.1	64.79	0.1	437.44	0.4	35.49	0.3	330.86	0.2	1,076.73	0.2
Corn	5,412.95	2.6	351.01	0.3	988.06	0.9	445.52	3.2	2,157.39	1.0	9,354.94	1.4
Cotton	424.38	0.2	0%	0.0	257.12	0.2	0	0.0	19.14	0.0	700.63	0.1
Rice	151.9	0.1	191.97	0.2	75.56	0.1	2,175.29	15.8	37.41	0.0	2,632.13	0.4
Soybean	2.14	0.0	0.11	0.0	0.29	0.0	0.06	0.0	0.19	0.0	2.79	0.0
Sugarcane	1,054.04	0.5	53.8	0.0	5,482.02	4.8	164.83	1.2	2,062.3	1.0	8,816.99	1.3
Wheat	4.97	0.0	0	0.0	0	0.0	49.13	0.4	35.09	0.0	89.19	0.0
Total Crops	7,258.53	3.4	661.67	0.6	7,240.49	6.4	2,870.33	20.9	4,642.38	2.2	22,673.39	3.4
Cattle	204,653.93	96.6	116,718.93	99.4	105,858.23	93.6	10,869.50	79.1	209,691.73	97.8	647,792.32	96.6
Crop + Cattle	211,912.46		117,380.61		113,098.72		13,739.83		214,334.1		670,465.71	

Table 4. Balance of agriculture cumulative GHG emissions (2012/2013 to 2022/2023), in thousands of tCO_2eq, for the selected municipalities in Brazil with the adoption of low-carbon technologies in areas of degraded pasture (being 75% with recovery and 25% with ICLS/ICLFS) using the GWP metrics and projections made by MAPA (Brasil, 2013).

Region	MW		N		NE		S		SE		Total	
	CO_2eq	%	CO_2eq	%	CO_2eq	%	tCO_2eq	%	tCO_2eq	%	tCO_2eq	%
Beans	-8,445.1	-3.1	-84,17.2	-8.7	-95,059.04	-32.2	-361.02	-6.9	-73,961.49	-17.0	-186,243.86	-16.9
Corn	-50,745.81	-18.7	-24,482.65	-25.4	-64,325.02	-21.8	-2,064.3	-39.7	-168,084.58	-38.7	-309,702.36	-28.1
Rice	-3,220.88	-1.2	-6,978.8	-7.2	-4,657.53	-1.6	1,778	34.2	-2,458.07	-0.6	-15,537.27	-1.4
Soybean	-105,635.42	-38.9	-16,790.37	-17.4	-4,968.11	-1.7	-1,232.4	-23.7	-33,287.69	-7.7	-161,913.99	-14.7
Wheat	-18.29	0.0	0.0	0.0	0.0	0.0	-291.32	-5.6	-832.31	-0.2	-1,141.92	-0.1
Rec.	-156,845.23	-57.7	-52,278.47	-54.1	-154,233.86	-52.3	-1,799.81	-34.6	-261,043.55	-60.1	-626,200.92	-56.8
Int.	-114,821.91	-42.3	-44,265.37	-45.9	-140,616.49	-47.7	-3,400.03	-65.4	-173,125.86	-39.9	-476,229.66	-43.2
Rec. + Int.	-271,667.13		-96,543.84		-294,850.34		-5,199.84		-434,169.42		-1,102,430.58	

Rec. = Recovery of 75% of degraded pasture areas; Int. = ICLS/ICLFS in 25% of degraded pastures; Total = Rec. + Int.

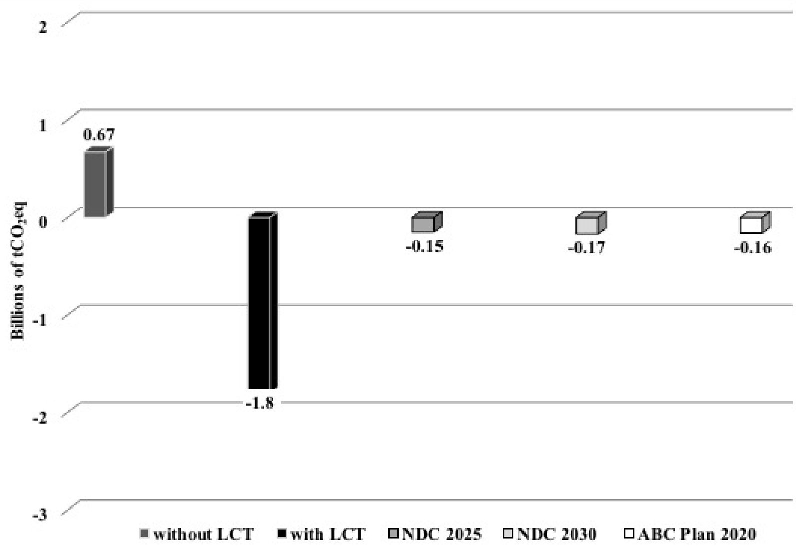

Figure 1. Agricultural CO_2eq emissions estimated from 2012/13 to 2022/23 for different scenarios: without (without ABC Plan) and with the adoption of low-carbon technologies (with ABC Plan), Nationally Determined Contribution for 2025 (NDC 2025) and for 2030 (NDC 2030), and emission reduction goals of the ABC Plan until 2020. NDC = Intended Nationally Determined Contribution; NDC 2025 = emission reduction target of CO_2eq in 2025 by 37% below 2005 levels; NDC 2030 = emission reduction target of CO_2eq in 2030 by 43% below 2005 levels. ABC Plan 2020 = emission reduction target of CO_2eq in 2020.

emission in 2005 was 392.5 million de tCO2eq (Sistema de Registro Nacional de Emissões, 2018).

Moreover, it is possible to estimate the number of cattle that would be added to the Brazilian production system in those 52 million hectares of degraded pastures or pastures in the process of degradation. Through recovery of 75% of the degraded pasture area, there would be an additional of 0.70 to 1.5 animal unit by hectare (AU/ha) in 39 million ha, totaling an additional 29.3 million cattle. In addition, most importantly, emissions would be neutralized with the advantage of storing more carbon in the system and without the opening of new areas, the so-called land-sparing effect (De Lima, 2017).

If 25% of the degraded pasture area were used for integrated systems such as ICLS and ICLFS, which have a greater productivity than the forage systems in monoculture (Balbino et al., 2011; Vilela et al., 2011), the capacity rate could rise. It would rise from 0.70 AU/ha to 2.5 AU/ha in 13 million ha (25% of degraded pasture areas), and this would allow an increase of 22.8 million cattle with neutralized emissions, and an increase in the soil carbon stock.

Strassburg et al. (2014), using various models and climatic datasets for producing the first estimate of the carrying capacity of Brazil's 115 million hectares of cultivated pasture lands, found that the current productivity of Brazilian cultivated pasture lands is 32–34% of its potential, and that increasing productivity to 49–52% of the potential would suffice to meet demands for meat, crops, wood products and biofuels until at least 2040, without further conversion of natural ecosystems. As a result, up to 14.3 Gt CO_2eq could be mitigated with the increasing cattle productivity. This mitigation potential stems from a reduction in deforestation (12.5 Gt CO_2) and reduced enteric emissions from the cattle herd due to a smaller herd size and earlier slaughtering (1.8 Gt CO_2). It is important to note that the carbon stored in the soil was not considered. Assad and Martins (2015), considering an interval of ten years and that 45 million hectares of pastures could be recovered and 15 million hectares could be transformed into integrated systems, stated that it is possible to avoid the emission of 143 million tons of CO_2eq. Thus, only recovering pastures and integrated systems, practically the total goal of the ABC Plan is reached.

Increased livestock productivity is achieved by adopting low carbon technologies, such as those recommended by the ABC Plan, with a high potential for storing carbon in the soil. Bogaerts et al. (2017) found 35.8% less emissions (kg CO_2eq/kg carcass) on farms with an intensified production in recovered pastures when compared to farms with degraded or non-intensified pastures. In other words, increasing cattle productivity while stopping the conversion of natural environments would be a major contribution to tackling climate change.

CONCLUSIONS

The potential to mitigate GHG emissions by the Brazilian livestock and agriculture is more than ten-fold the goal set forth by the ABC Plan. From 2012 to 2023, it will be possible to reach 1.8 billion tons of CO_2 equivalent (tCO_2eq) by incorporating the emissions avoided and the carbon stored in the soil through the adoption of three technologies advocated by the ABC Plan (pasture recovery, integrated crop-livestock systems and the integrated crop-livestock-forest systems) in 52 million hectares of degraded pasture lands.

It was possible to estimate the number of cattle that would be added to the Brazilian production system in those 52 million hectares of degraded pastures or pastures in the process of degradation, totaling an additional 29.3 million cattle.

Currently, 80 million hectares of the national territory are cultivated with crops and 172 million with pasture, summing about 30 percent of the total. With the sustainable tropical technology, with competent and competitive rural producers, Brazil is fully apt to take advantage of the huge opportunity that arises with the growing worldwide demand for agribusiness products.

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