

# Terra Boa Program for Pasture Improvement: Potential Impact on Greenhouse Gasses Mitigation through soils in Mato Grosso do Sul (MS) State

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## Introduction

Mato Grosso do Sul State has about 20 million hectares of pastures (SIGA-MS, 2016). From this total, close to four million hectares are natural grasslands in the Pantanal wetlands. The balance, or about 16 million hectares, are sown pastures. The State Secretary of Agriculture (Secretaria de Estado de Produção e Agricultura Familiar - SEPAF) estimated that at least 50% of the total cultivated pasture are degraded or with some degree of degradation. These areas have low productivity and may negatively affect environment.

To face the problem of degraded pastures, SEPAF created the “Terra Boa Program” focused on the improvement of pastures in Mato Grosso do Sul (SEPAF, 2016). The Program aims “to promote, within five years, restoration and maintenance of production capacity for two million hectares of degraded pastures in the state”. The Program addresses seven major actions: (i) improvement of pastures; (ii) conversion of pastures into cropland; (iii) integrated crop- livestock systems; (iv) integrated crop-livestock-forestry systems; (v) integrated livestock- forestry systems; (vi) conversion of pastures into sugarcane farming; and (vii) afforestation.

All the systems proposed by the Terra Boa Program have potential for not only improving cattle husbandry, grain farming, bioenergy and forestry production, but also reducing greenhouse gases emissions from those areas. A pasture when degraded has a low carbon stock in the soil. Additionally, beef production per unit of area is much lower when compared to improved pastures, since cattle takes longer to reach slaughtering weights. This implies in higher total enteric GHG emissions per animal.

The Terra Boa Program is integrated to the State Program on Climate Change (PROCLIMA), which shall implement the State Policy on Climate Change, complying with the State Law 4.555/2014 (Lei 4.555/2014). Mato Grosso do Sul assumed a voluntary reduction in greenhouse gases emissions (GHG) of 20% by 2020 with the year 2005 as baseline.

In this work, we aimed to estimate the potential contribution of the Terra Boa Program to mitigate greenhouse gases emissions in the next five years, considering only the carbon absorption into soils.

## Material and Methods

Estimated Land Use Change (LUC) between 2016 and 2020 was based on Terra Boa Program targets set by the State Secretary of Agriculture (SEPAF) (Table 1), where LUC was allocated into seven groups: improvement of pastures; conversion into cropland; conversion into integrated crop-livestock system (ICL); conversion into integrated crop-livestock-forestry systems (ICLF); conversion into integrated livestock-forestry systems (ILF); conversion into sugarcane; and afforestation.

As for carbon sequestration rates, we adopted estimated values of the ABC Observatory (OBSERVATÓRIO ABC, 2015) for improved pastures ( $1.0 \text{ Mg C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$ ), crops (considered under no-tillage) ( $0.5 \text{ Mg C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$ ), ICL ( $1.5 \text{ Mg C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$ ), ICLF ( $1.5 \text{ Mg C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$ ), and ILF ( $1.0 \text{ Mg C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$ ). Sequestration rates adopted for sugar cane were  $1.62 \text{ Mg C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$  (Carvalho et al, 2010). As for afforestation, we considered the rate of  $1.22 \text{ Mg C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$  (Corazza et al 1999).

Table 1. Estimated land use change in Mato Grosso do Sul State from 2016 to 2020, as anticipated by the Terra Boa Program (SEPAF, 2016) in 1,000 hectares.

Land use	2016	2017	2018	2019	2020	Total
<b>Improved Pastures</b>	120	180	240	300	360	1.120
<b>Grain farming</b>	20	30	40	50	60	200
<b>ICL*</b>	15	22.5	30	37.5	45	150
<b>ICLF**</b>	15	22.5	30	37.5	45	150
<b>ILF***</b>	10	15	20	25	30	100
<b>Sugarcane farming</b>	10	15	20	25	30	100
<b>Afforestation</b>	10	15	20	25	30	100

\* ICL – Integrated Crop-Livestock System; \*\* ICLF – Integrated Crop-Livestock-Forestry System; \*\*\* ILF– Integrated Livestock-Forestry System.

## Results and Conclusions

The expected changes in land use triggered by the Terra Boa Program (Table 1) have the potential to sequester  $2.134 \text{ Mt C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$  (Table 2). This represents about 10% of the estimated GHG emissions related to total local cattle herd in 2014. The System Study Greenhouse Gas Emissions Estimates (SEEG) reported an estimated emission due to enteric fermentation of cattle in Mato Grosso do Sul of  $22 \text{ Mt C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$ , in 2014 (SEEG, 2016). The largest potential was registered to direct improvement of pastures, which represents the most representative LUC expected.

Table 2. Carbon sequestration potential into soils ( $1,000 \text{ t C-CO}_2\text{e ha}^{-1} \text{ yr}^{-1}$ ), as a function of land use change in Mato Grosso do Sul (from 2016 to 2020) as anticipated by the Terra Boa Program (SEPAF, 2016).

Land use	2016	2017	2018	2019	2020	Total
<b>Improved Pastures</b>	120	180	240	300	360	1.120
<b>Grain farming</b>	10	15	20	25	30	100
<b>ICL</b>	22.5	33.75	45	56.25	67.5	225
<b>ICLF</b>	22.5	33.75	45	56.25	67.5	225
<b>ILF</b>	10	15	20	25	30	100
<b>Sugarcane farming</b>	16.2	24.3	32.4	40.5	48.6	162
<b>Afforestation</b>	12.2	18.3	24.4	30.5	36.6	122
<b>Total</b>	213.4	320.4	426.8	533.5	640.2	2.134

\* ICL – Integrated Crop-Livestock System; \*\* ICLF – Integrated Crop-Livestock-Forestry System; \*\*\* ILF– Integrated Livestock-Forestry System.

The GHG mitigation potential of the Program is significant in terms of total emission related to current beef production in Mato Grosso do Sul. The Program has also the potential to increase the land productivity as a whole, reducing emissions per unit of beef produced. We conclude that Terra Boa Program is an important public policy initiative with a high potential to contribute to mitigate GHG emissions in Mato Grosso do Sul, helping the State to reach its voluntary reduction targets towards 2020.

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