Greenhouse Gasses Emissions and land use in Mato Grosso do Sul (MS) State: an exploratory study to the MS Carbon Neutral Initiative

Renato ROSCOE[1], Davi J. BUNGENSTAB[2], Roberto GIOLO de ALMEIDA[2], Leonardo PORTALETE[3]*

[1] Superintendent of Science, Technology & Innovation – State Secretary of Culture, Tourism, Entrepreneurship & Innovation, State Government of Mato Grosso do Sul - Brazil, [2] Embrapa Beef Cattle, 79.106-550, Campo Grande, MS, Brazil, [3] Technical Analyst, APROSOJA-MS/FAMASUL.
E-mail address of presenting author*: rroscoe@sectei.ms.gov.br

Introduction

Climate Change Policy of Mato Grosso do Sul (CCP-MS) was stablished by the State Law 4.555/2014 (Lei 4.555/2014). The state assumed a voluntary reduction in greenhouse gases emissions (GHG) of 20% by 2020 in relation to 2005 emissions. To reach this target, the CCP- MS appointed a number of strategies, including the State Program on Climate Change (PROCLIMA). The program will structure the basis to calculate and monitor the emission inventories of MS, and launch initiatives towards a low carbon emission economy.

The current inventories are based on global and national standards and emission factors that are not completely adapted to particular characteristics of MS. Some emission factors are probably overestimating the net GHG emissions. Complementarily, the final balance of GHG do not consider some important mechanisms that absorbs carbon in conservative land use systems, e.g. no-tillage crop farming, improved sown pastures, zero-burning sugarcane plantations and integrated crop-livestock-forestry (ICLF) systems; as well as soil carbon and aboveground biomass through afforestation and ICLF.

The objective of MS Carbon Neutral Project is to create the methodological basis for a low carbon economy in Mato Grosso do Sul,

developing and adapting technologies for GHG emissions reduction and mitigation in the various sectors of the state economy, supporting the achievement of PROCLIMA´s goals.

The first phase of the project was to understand the dynamics of GHG emissions based on available inventories and its relation to changes in land use and agricultural activities in Mato Grosso do Sul State.

Material and Methods

As for GHG emissions attributed to Mato Grosso do Sul, we considered the estimates of the System Study Greenhouse Gas Emissions Estimates (SEEG), a system developed by the Climate Observatory (http://seeg.eco.br/). The estimates follow the guidelines of the Intergovernmental Panel on Climate Change (IPCC). SEEG obtained the basic data from Brazilian Inventories of Anthropogenic Emissions and Removals of Greenhouse Gases, issued by the Brazilian Ministry of Science, Technology and Innovation (MCTI), and from government reports, institutes, research centers, industry organizations and nongovernmental organizations. We analyzed land use changes in Mato Grosso do Sul based on the results of the SIGA-MS Program (SIGA-MS, 2016). Although data are available until 2016, we analyzed data from 2010 to 2014, since emission data are available only until 2014.

Results and Conclusions

Reported GHG estimates to Mato Grosso do Sul showed significant contribution from agriculture and land use change to the total emissions. From the total GHG in 2014 (55 Mt C- CO_{2e} yr^{-1}), 80% came from agriculture and land use change in this State. Energy was the second larger category, accounting for 16% of the GHG emissions (GGE) and showing the largest absolute (3.7 Mt C-CO_{2e} yr^{-1}) and relative (72%) increases on emissions. The final balance of the agricultural sector (land use change + agriculture) was slightly negative, showing

a net GGE reduction of -0.1 Mt C-CO_{2e} yr^{-1}. We also verified that the major contribution for the observed net reduction was the enteric fermentation of cattle that showed an absolute decrease of -1.4 Mt C-CO_{2e} yr^{-1}.

Table 1. Greenhouse gasses emissions (1,000 t C-CO_{2e} – GWP) in Mato Grosso do Sul (SEEG, 2016).

Sector	2010	2011	2012	2013	2014	Difference
Agriculture Total	35.395	34.559	34.639	34.331	34.532	-863
Rice	164	175	105	96	94	-69
Enteric Fermentation	23.417	22.592	22.532	22.063	22.018	-1.399
Management of Animal Waste	838	875	847	827	844	7
Residue Burning	395	396	429	481	500	105
Agricultural Soils	10.581	10.520	10.727	10.863	11.075	493
Land Use Change Total	9.162	9.698	9.717	9.870	9.916	754
Soil Use Changes	8.081	8.265	8.077	8.258	8.244	163
Limestone Application	748	817	1.307	1.270	1.331	582
Residue Burning	333	616	332	343	342	9
Removal of Protected Areas	-	-	-	-	-	0
Energy	5.131	5.068	6.450	7.762	8.803	3.672
Industry	359	424	404	555	563	204
Residue Total	1.009	1.160	1.217	1.350	1.403	395
Waste Disposal	418	403	400	427	466	48
Waste Incineration	-	-	-	-	-	0
Treatment of Domestic Effluents	167	173	177	186	190	23
Treatment of Industrial Effluents	424	585	641	738	747	323
Total Emissions	51.055	50.909	52.428	53.869	55.217	4.162

When we analyzed the changes in the agricultural sector in the same period (Table 2), we observed significant changes on land use from 2010 to 2014. There were net increases in areas of grain production (20%), planted forests (107%), sugarcane (52%), and native forests (5%). At the same time, a proportional decrease in cattle grazing areas) indicates expansion of grain and sugarcane farming and commercial afforestation (mainly eucalyptus) over pasture areas, without displacing pristine or regenerating native land cover, which, as a

matter of fact, increased 5% in the same period. Decrease in enteric methane emissions from cattle might be strongly related to reductions in the total grazing area. From 2010 to 2014, state's total cattle herd decreased from 22.3 to about 21.0 million head (INFOAGRO, 2015). On the other hand, under the local conditions, land use change through expansion of grain crop farming, sugarcane and afforestation over grazing areas do not lead to increases in GHG emissions. These systems are probably increasing carbon stocks and sequestration in the systems and the net annual emission of 8.2 Mt C-CO_{2e} yr^{-1} should probably be overestimated.

Another important point is that from 2010 to 2014, although pasture area and cattle herd decreased, beef production increased 21% (from 796,000 t to 965,000 t) (INFOAGRO, 2015). We calculated that the emissions per unit of beef yielded decreased from 29.4 to 22.8 kg C- CO_{2e} kg^{-1} of beef. In other words, the same quantity of beef produced in 2014 emitted 22% less greenhouse gases than 2010.

Table 2. Land use change in Mato Grosso do Sul from 2010 to 2014 (SIGA-MS, 2016) in 1,000 hectars.

Land use	2010	2011	2012	2013	2014	Difference 2010 - 2014
Grains	1.840	1.902	2.018	2.069	2.211	370
Sugarcane	593	630	677	827	903	310
Planted Forests	341	373	458	591	706	365
Pastures	21.819	20.832	20.724	20.325	19.935	-1.884
Native Forests	10.581	11.197	11.136	11.144	11.105	525
Others*	537	778	699	756	852	314

* Other agricultural uses, water surfaces, infrastructure and urban areas.

We concluded that GHG emissions from Mato Grosso do Sul are mainly related to the agricultural sector, and especially to cattle enteric fermentation. Patterns of changes on emissions sources are compatible with changes in pasture area and cattle herd, but there are strong evidences that emissions due to land use change are overestimated. MS Carbon Neutral Initiative should focus on improving understanding of carbon balance on local agricultural

systems developing site-specific emission factors that are more suitable for regional environmental conditions as well as for local production system's dynamics and peculiarities.

References

INFOAGRO. Balanço anual do agronegócio sul-mato-grossense 2013/2014. Campo Grande, MS: SENAR/MS; FAMASUL, 2015. 494 p.

SEEG. System Study Greenhouse Gas Emissions Estimates. 2016. Available: <http://seeg.eco.br/>

SIGA-MS. Sistema de Informação Geográfica do Agronegócio de Mato Grosso do Sul. 2016. Available: < http://www.sigaweb.org/ms/sistema>