Organic Agriculture, Climate Mitigation and Human Health: A Tradeoff Analysis for Brazil

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Introduction

Brazil stands out as one of the main exporters of agricultural products in the world and, thereby, consumes large volumes of fertilizers and pesticides [1]. Moreover, Brazilian agriculture is responsible for approximately 16% of the country's GHG emissions, or about 5.5% of total emissions in Brazil [2].

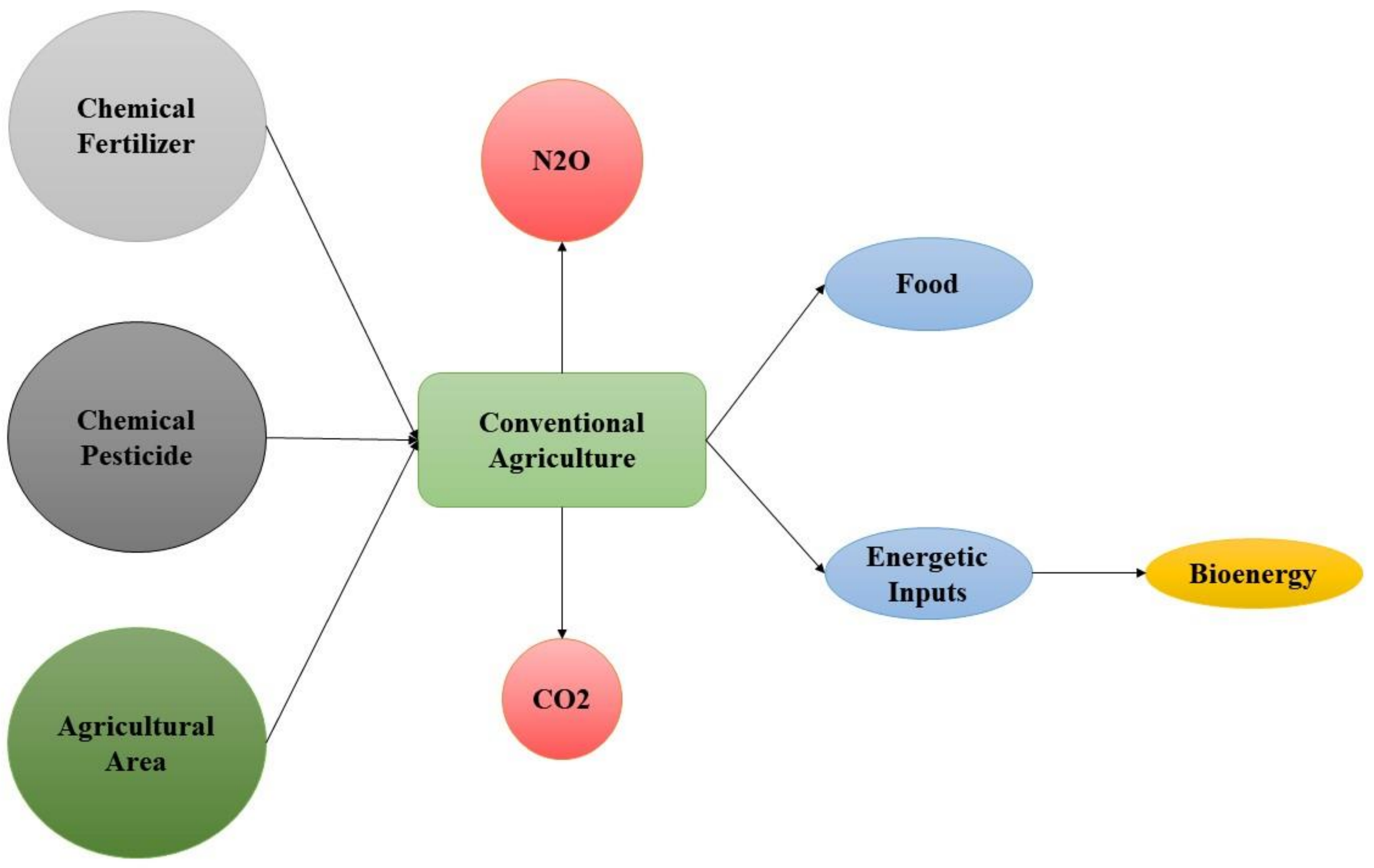

Figure 1: ***Agricultural chain flowchart***

The purpose of this study is to better understand the impacts of more sustainable crop technologies, which have been implemented in a Brazilian IAM, the BLUES model [3].

Methodology

Technology	Detail Level	Technology Description	Represents
Historical Pattern	Regional	Productivity of 2010 and 2015 Irrigation level of 2010 and 2015 Mecanization level of 2010 and 2015 Vol. pesticide and fertilizer of 2010 and 2015 Costs of 2010 and 2015	Conventional Agriculture
Low Productivity	Regional	Minimal feasible productivity in 2010 and 2015 0% of irrigated planted area Low level of mecanization Low level of pesticide and fertilizer Compatible costs with low productivity	Family Agriculture
High Productivity	Regional	Maximal productivity in 2010 and 2015 100% of irrigated planted area High level of mecanization High level of pesticide and fertilizer Compatible costs with the high productivity	Large Landowner
Green	Regional	75% productivity of Historical Pattern Irrigation level equal to Historical Pattern Mecanization level equal to Historical Pattern Without chemical defensive and fertilizer 125% cost of Historical Patter	Organic by Substitution
Green+	Regional	80% produtivity of High Productivity Irrigation level equal to High Productivity Mecanization level equal to High Productivity Without chemical defensive and fertilizer No-tillage system adoption 120% cost of High Productivity	Organic High Productivity

Table 1: **Agricultural cultivation technologies in Brazil**

Five sustainable agriculture technologies were developed for the main Brazilian crops in the BLUES model: bean, coffee, corn, cotton, elephant grass, eucalyptus, rice, pinus, soybean, sugar cane and wheat [3], as shown in Table 1.

These changes were implemented in BLUES, which was run using the Current Policies scenario with no GHG emissions restrictions. The analysis period was 2010 (base year) to 2050.

Results and Discussions

The greater detailing of agricultural production technologies has shown to be of great importance, as it allowed the analysis of the impacts generated by various means of cultivation. Results show that sustainable production methods can generate important positive social-environmental impacts (Figure 2).

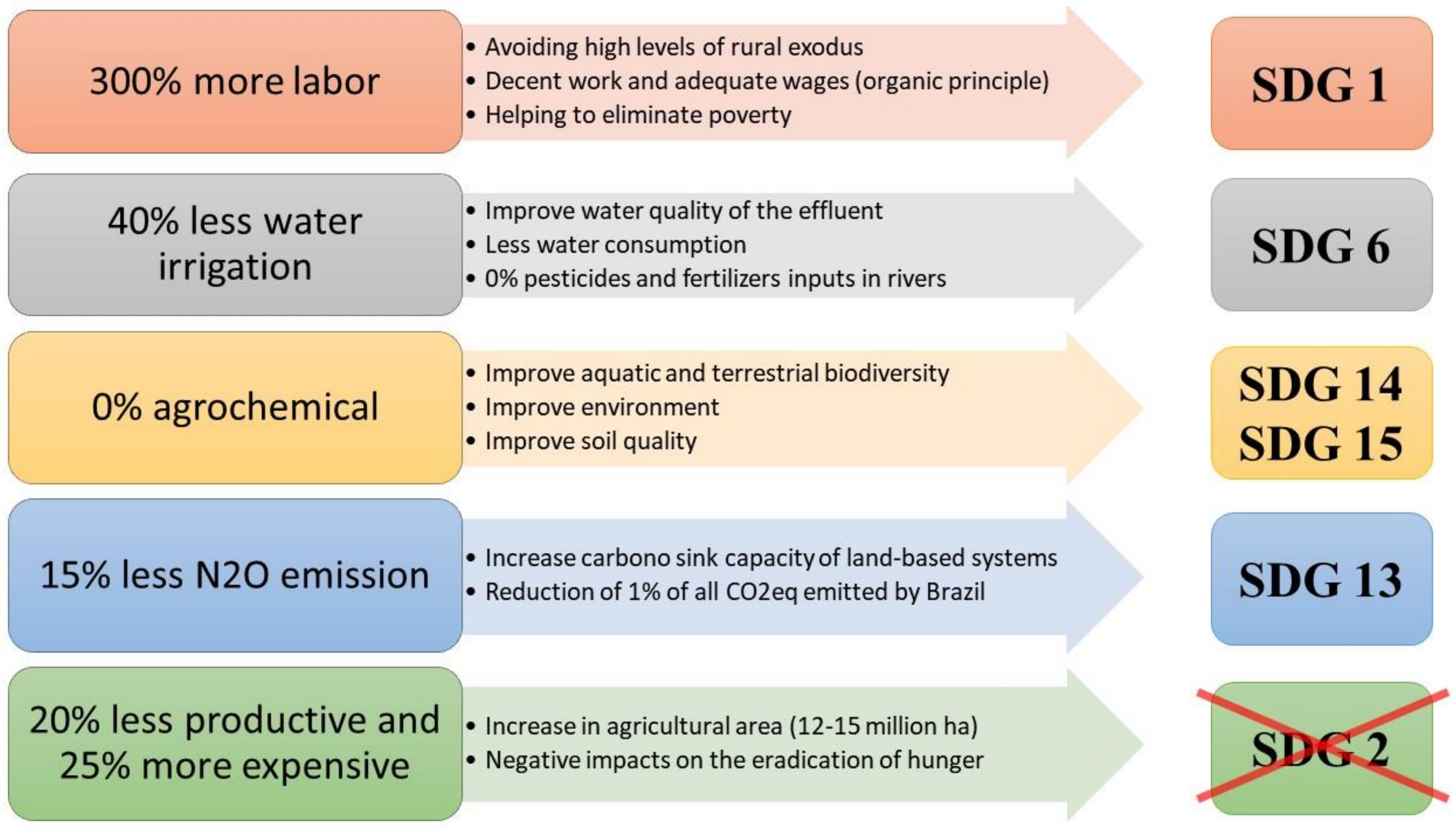

Figure 2: **Impacts of the Green and Green+ technologies**

It is important to emphasize that the Green and Green+ technologies, do not change the amount of nitrogen supplied to crops, only the origin of this fertilizer, which ceases to be chemical and becomes organic (manure).

- Green and Green+ technologies can promote a reduction of approximately 1% of all CO2eq emitted by the country by:
  1. reducing the emissions from manure left on fields or improperly disposed of.
  2. Reducing demand for synthetic fertilizers
- However, it would increase the land requirement to maintain the same level of agricultural production.

Conclusions

Model results show that sustainable farming systems can be highly important and necessary to reduce environmental impacts caused by agriculture, both on the issue of CO2 and non-CO2 gas emissions, and on improving human health and biodiversity. However, the adoption of this type of agriculture in the entire Brazilian territory would increase the total area devoted to agriculture in the country by 120-150 thousand km², if the level of agriculture production is maintained.

Our results show that the development and implementation of new farming technologies in IAMs are of great importance, since they allow for a better understanding of future climate change mitigation and land-use scenarios, and their implications.

Acknowledgments

This work was supported by the National Institute of Science and Technology for Climate Change Phase 2 under CNPq Grant 465501/2014-1, FAPESP Grant 2014/50848-9 and the National Coordination for High Level Education and Training (CAPES) Grant 16/2014.

We thank Greenpeace Brazil for their support under the project "*Global Diet Change: Impacts on Land Use and Water in Brazil*". We also thank the National Council for Scientific and Technological Development (CNPq) for the support of our research activities.

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