Better Representing Land-Use Technologies in a National IAM

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Introduction

Brazil stands out as one of the main exporters of agricultural products worldwide, thereby consuming large volumes of fertilizers and pesticides [1]. As a consequence, the country is also an important emitter of N_2O and of CH_4 from agriculture [2], and is being criticized for the use of several agrochemicals banned in other countries [3].

The purpose of this work is to discuss the impacts of improving the level of detail of land-use technologies, including the quantification of inputs such as fertilizers, pesticides and water in integrated assessment models (IAMs), using the Brazilian BLUES model [4].

Methodology

Technology	Detail Level	Technology Description	Represents
Historical Pattern	Regional	Productivity of 2010 and 2015 Irrigation level of 2010 and 2015 Mechanization level of 2010 and 2015 Vol. pesticide and fetilizer of 2010 and 2015 Costs of 2010 and 2015	Conventional Agriculture
High Productivity	Regional	Maximal productivity in 2010 and 2015 100% of irrigated planted area Mechanization for high productivity Pesticide and fertilizer for high productivity Compatible costs with high productivity	Intensive Systems
Green+	Regional	80% productivity of High Productivity 100% of irrigated planted area Mechanization for high productivity Without chemical pesticide and fertilizer 120% cost of High Productivity Limited by availability of organic fertilizers	High Productivity Organic

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

The entire supply chain is detailed for agricultural production processes, including fertilizers, pesticides and water consumption, meaning that each crop and each process have their own adequate input needs for their proper development.

Also, this work updates the livestock production processes previously defined in the BLUES model. In particular, the food and water needs of the livestock sector are now implemented at a regional level.

Finally, this work introduces restrictions of area, agricultural supplies and water availability for each Brazilian macro-region.

All changes are tested in the BLUES models for three global scenarios: Reference (BAU), 2.0ºC (2D) and 1.5ºC (1D).

Results and Discussions

The modifications introduced in the BLUES model show that, although the model with and without modifications has similar trajectories at the end of the analyzed period, better regional detailing and implementation of new technologies lead to significantly different results.

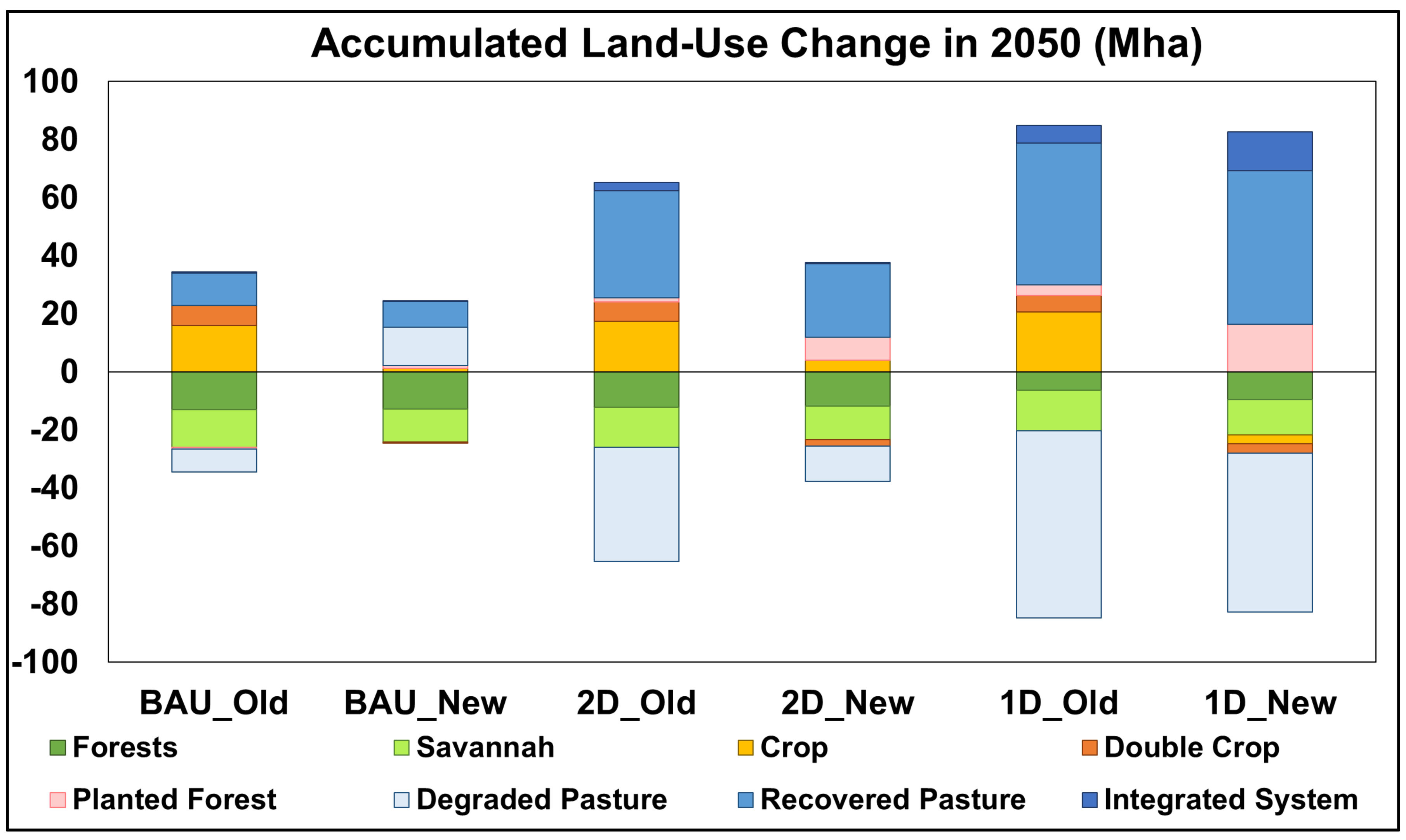

Figure 1: **Accumulated Land-Use Change in 2050**

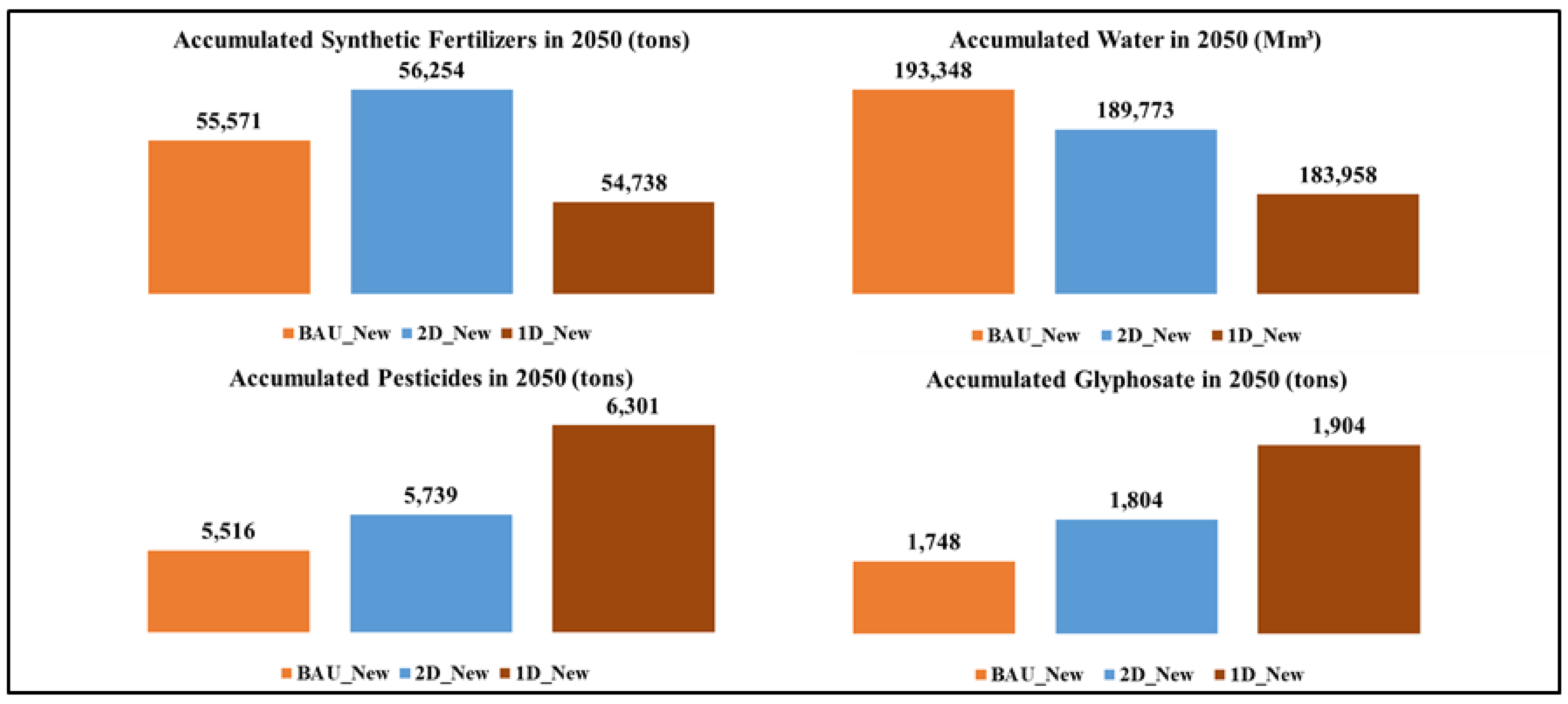

Figure 2: Cumulative **consumption of agricultural inputs in 2050**

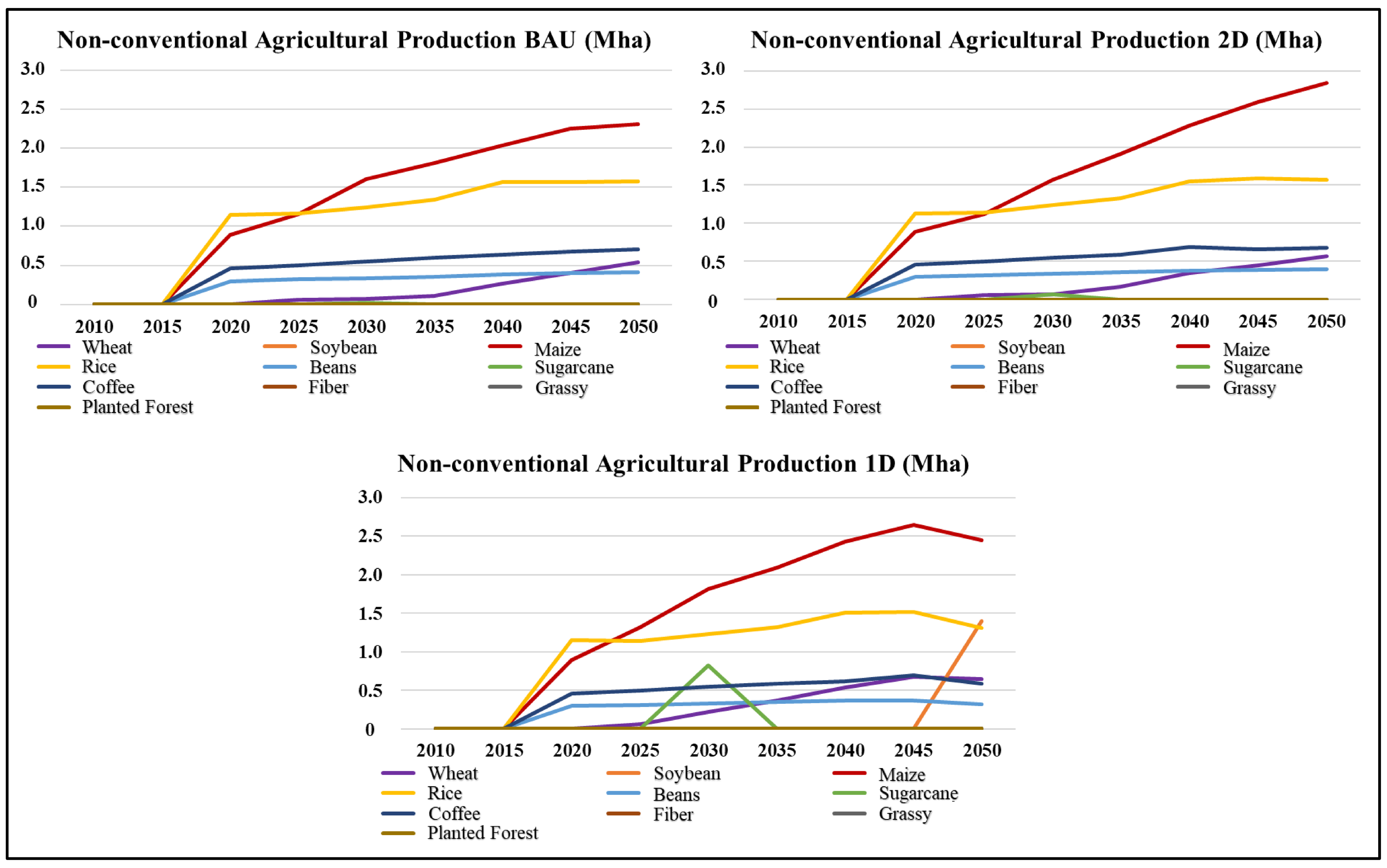

Figure 3: Evolution of **non-conventional agricultural production**

- Increase in productivity explained why scenario 1D resulted in less inputs of synthetic fertilizers and water at the end of the period analyzed. The same cannot be said for pesticides and glyphosate;
- The implementation of new agricultural technologies has made the model more advantageous to intensify agricultural production than to open new agricultural frontiers;
- The modified version of the BLUES model led to lower pressure to expand agricultural frontiers in the northern region of Brazil. Indeed, important crops such as soybean are no longer produced in that region. This deserves attention when it comes to SDGs, since lower pressure in native forests and savannas leads to an increase in local biodiversity.

Conclusions

- The adopted methodology helped to better understand the challenges, obstacles and opportunities of the Brazilian agriculture;
- The new version of the BLUES model quantifies material balances and impacts of chemical inputs and water demand;
- The identified changes in regional production profiles lead to benefits to the water stress and improve national productive distribution;
- Improved SDGs 6 and 15, mainly from North and Northeast regions of Brazil;
- Greater detailing of the model and implementation of high productivity agricultural processes provided lower conversions between land types and less need for the expansion of agricultural belt on the areas of native forest, causing the AFLOU emissions to be smaller than in the previous version.

References

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