Carbon footprint of ProTerra soy in Brazil

ProTerra FOUNDATION

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Introduction

More and more transparency about Environmental, Social and Governance (ESG) aspects of companies and value chains are required for its stakeholders. Good practices such as Life Cycle Management[1] (LCM) have a great potential to reduce risks and increase competitiveness. In the environmental pillar, Climate Change adaptation and mitigation are part of a global agenda guided by Paris Agreement commitments defined by governments.

Life Cycle Assessment[2] (LCA) based methods are widely used to deliver accurate, quantified clear information on environmental, social or economic impacts of products helping in the decision-making process. In Europe, a big initiative took place in 2013, called Product Environmental Footprint[3] (PEF) with the goal to create a “Single Market for Green Products” offering a standard for impact assessment of products and organizations, creating and testing rules recommended set of methods from among the huge number of available options, thus enhancing transparency and fair competition.

In the agriculture and feed production context, LCA is increasingly relevant. In certain countries and markets, it`s mandatory to deliver at least Carbon Footprint (CF - a Climate Change impact category of LCA) data to stakeholders in the value chain.

Over the years the ProTerra standard has carried out many enhancements towards covering these new demands environmental impact of agricultural and feed products being one of them the inclusion of accountable data, starting with Carbon Footprint indicator of soy-derived products.

Before ProTerra implementation of the Carbon Footprint calculator, members have been forced to calculate CF using default data, which, in most cases, creates a disadvantage for them. Now, certified organizations that invest in sustainably produced are able to inform real data, but still face big challenges for producing evidence on land transition pathways in a 20-year period (due to georeferenced systems low resolution, costs or non-existing data) once in land conversion free raw materials are currently tracked from 2008 on.

The goal of this publication is to describe in detail the main aspects that motivated all the choices and assumptions for building the current version of ProTerra’s CF Calculator, showing the calibration results calculated so far and suggestions for the next steps towards the use of the calculator for members of the ProTerra Network and for the continuous improvement of the tool itself.

Methodological overview

In this section, overall methodological approaches are explained. It is divided by topics and will serve as support information for a good understanding of this document. More detailed choices and assumptions related to ProTerra’s calculator development are explained in the next section.

[1]https://www.lifecycleinitiative.org/starting-life-cycle-thinking/life-cycle-approaches/life-cycle-management/
[2]http://www.sciencenetwork.com/lca/unep_guide_to_lca.pdf
[3]https://ec.europa.eu/environment/eussd/smgp/ef_pilots.htm

Carbon Footprint

The Carbon Footprint (CF) is a method consistent with LCA ISO 14040 and 14044 standards, used for assessing life cycle GHG emissions from products. Several guidelines are available for the development of a CF study, being the main ISO 14067:2015[4], WBCSD[5] and BSI PAS 2050: 2011[6], the latter adopted in this project, taking IPPC (2013) guidelines for climate impact assessment of GHG emissions in a 100-year perspective, calculated into CO2 equivalents (CO2e) based on their chemical and physical properties.

In addition to PAS 2050, PEFCR Feed for food producing animals (European Commission, 2018) was the Product Category Rules (PCR) adopted in this project. PCR are documents that provide rules, requirements, and guidelines for developing LCA studies for a specific product category, allowing transparency and comparability between studies.

Land Use Change (LUC)

The growing demand for animal feed leads to an increasing of the growing of crops such as soy, once soy meal is a relevant protein in animal diets. Agricultural production implicates in land use and potential land use change (occupation and transformation). In Brazil, one of the world's leading producers of soybeans, the expansion of soy cultivation over native vegetation has been a hot topic in discussions regarding the sustainability of Brazilian agriculture production.

This expansion in cultivated area can occur through the displacement of other crops on existing farmland or land previously not used in agriculture (pasture/meadow, natural vegetation).

The accounting of LUC and associated emissions is a key consideration for life cycle evaluation of agricultural products. The methods currently used consider emissions related to direct Land Use Change (dLUC), defined as "the change in the purpose for which the land is used by humans" (BSI, 2012).

The impact of land use change is very dependent on the scale of data used, but there is today a more coherent view on 1) that land use change needs to be included and 2) methods for doing so, as several standards even require the inclusion of dLUC.

In this project, BRLUC model, described by Novaes, et al (2017) was used to account for dLUC. The reason for choosing this method is that it brings regionalized data considering the differentiation of land use transition patterns for all Brazilian states and agricultural products, including soybeans. Its temporal coverage ranges from 1999-2018, being aligned then with IPCC default 20-years horizon. Besides, the method composes the main data source for Brazilian LUC datasets in the international LCI database Ecoinvent v3.6.

BRLUC also provides expansion data for crop-specific or shared-responsibility allocation approaches.

[4] ISO 14067:2015 - Greenhouse gases - Product carbon footprint - Quantification and communication requirements and guidance
[5] Product Life Cycle Accounting and Reporting Standard (WBCSD)
[6] BSI PAS 2050: 2011[6] - Specification for the assessment of life-cycle greenhouse gas emissions of goods and services

According to the authors, it is possible to make a parallel between the international guidelines and BRLUC in the following way: 'country known, land use unknown' is equivalent to BRLUC states geographies (an approach like 'state known, land use unknown') and is used to calculate the state-specific LUC emissions.

In ProTerra's calculator the BRLUC state delimitation was applied and recommended as default (called here as "Approach 1") and, in addition to that, it was proposed a more specific possibility for users estimating LUC considering farm information. We called it as "Approach 2" and it can be considered a 'state known, land use known' approach with is a mix of primary data (informed by users) and default data (using BRLUC background data on C stocks). Calibration results were generated considering hypothetical best and worst scenarios (called Approach 2.1 and 2.2). More details about the choices taken and their influence on possible results are presented in the next section.

Allocation

Allocation is a methodological choice that can have considerable impact on the final CF results. It's performed when the same process has more than one output (e.g., soybean meal and soybean oil resulted from soy crushing) and the environmental impact from that process and previous processes need to be shared among these outputs.

ISO 14040 and 14044 provide an allocation[7] decision hierarchy which is preconized by all LCA-based methods and standards. In this hierarchy, the prioritized recommendation is to avoid allocation and when it's not possible (in most cases), physical allocation (like mass and energy) is the first recommendation. Economic allocation is the last option on ISO guidelines but is recommended by PAS 2050 and PEFCR Feed for animal production.

The economic criteria can generate difficulties in defining the main product (the one that actually drives the production) once the value of the coproducts (e.g. soybean oil and soybean meal) can fluctuate over time. So, it's necessary to define a good time series in order to define economic allocation. Instead, mass (or other physical) allocation does not change over time.

Considering allocation, a key influencing factor in LCA and CF results it is strongly recommended to perform a sensitivity analysis over different choices. In this sense, ProTerra's calculator brings Economic as default, according to PEFCR Feed for animal production guidelines, but Mass allocation results can also be used for performing sensitivity provided in case the user wants to perform a sensitivity analysis.

[7] For more information, check: https://link.springer.com/article/10.1007/s11367-014-0812-4

Choices and assumptions

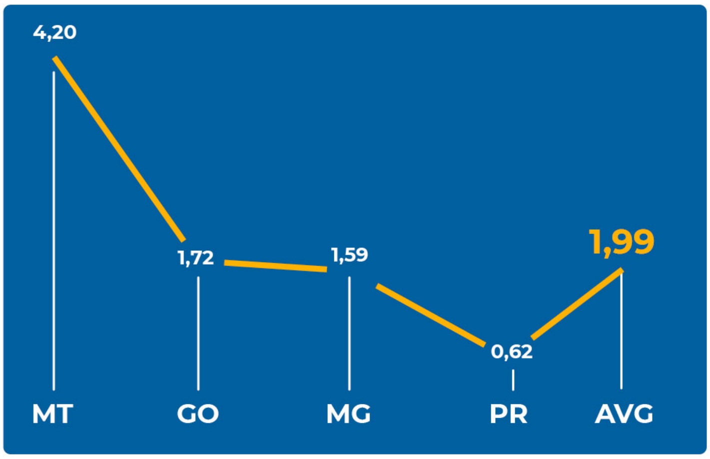
Discussion on the approaches for LUC estimation

Approach 1 results bring the association of BRLUC emissions (originally in tCO2/ha/yr) with calculator user primary data on farm yields, which means that the LUC factor will be the same for all farmers from the same state (e.g.: 12,05 tCO2/ha/yr for Mato Grosso - MT and 3,65 kgCO2/kg soybean for a farmer with a yield of 55 bags/ha and 2,68 kgCO2/kg soybean for a farmer with a yield of 75 bags/ha).

The calculator provides data for soybean cultivated in all 27 Brazilian states but 4 states have been selected for generating a calibration result, according to the locations where ProTerra certified material is grown - Minas Gerais (MG), Mato Grosso (MT), Goiás (GO) and Paraná (PR).

The figure below presents the results of the different approaches analyzed in this project:

State	Carbon Footprint kg CO2eq/kg soybean
MT	4,20
GO	1,72
MG	1,59
PR	0,62
Average	1,99



Allocation criteria

In the agricultural stage, no allocation was applied, even though it is common practice in some Brazilian regions to grow corn as a second crop in the same soybean cultivation area, that is, after the soybean cultivation and harvest period, corn is cultivated and harvested in the same production area. But data required comprise specifically soybean cultivation, even though some inputs, such as soil correctives, bring benefits for both soybean and corn cultivation, the impacts were attributed entirely to soybeans. Furthermore, LUC emissions from the production area were also totally attributed to soybean production, following the guidelines of the BRLUC model.

In the industrial stage (soybean crushing), the calculator automatically generates mass-based allocation ratios (physical allocation) and when filled with market-price of coproducts also provides results based on economic allocation. In the table below the calibration results allocation rations for both criteria are presented.

Product	Mass Allocation	Economic Allocation
Soybean Oil	21%	42%
Soybean Meal	79%	58%

Table 1 – Allocation results of "soybean crushing" process

For economic allocation, the average value of commercialization of products was considered based on the marketing price data from 2010 to 2017, a reasonable time range that contributes to normalising possible fluctuation in the values over the years.

Calibration results

Chart 1 below shows calibration results generated in this project in order to test the usability of ProTerra`s calculator for soybean meal, considering a cradle-to-gate[8] and both mass and economic allocation approaches. It also presents the life cycle activities contribution to overall CF results.

The CF result when considering mass allocation is 36% higher than in the economic allocation. This is why according to table 1 above, the difference between co-products (oil and meal) when considering it economic value are not so big as when considering its physical properties (mass). The last is stable while economic value can fluctuate and needs to be constantly updated.

Cradle-to-gate CF and contribution analysis

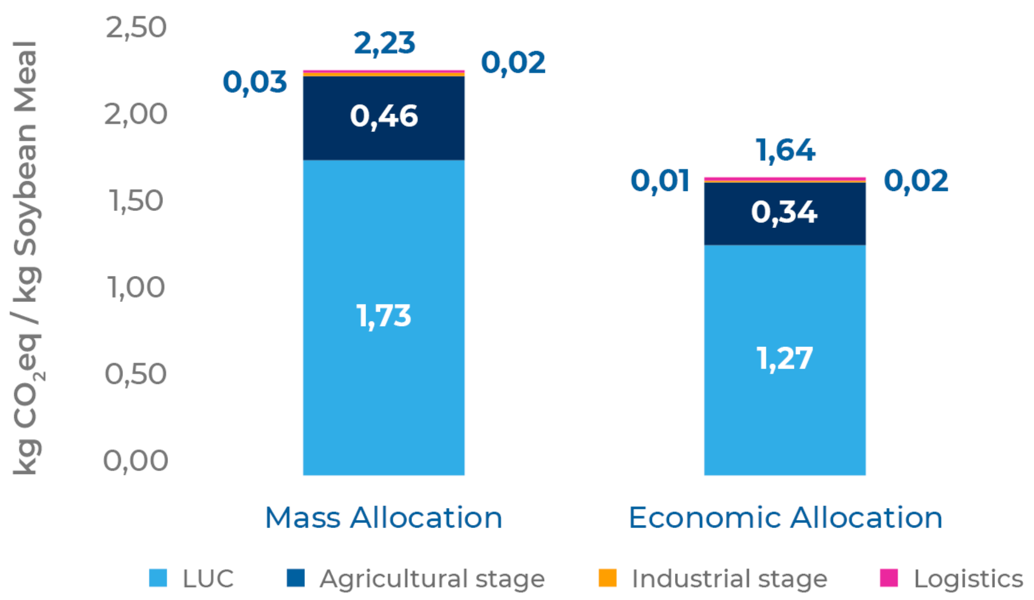


Chart 1

[8]From raw material extraction and processing until the intermediate process finalized in the crushing site; logistics refers to the road transportation of soybean from farm to crushing site.

For both approaches, LUC contributes with 78% of the CF. In this sense, for a deeper dive in LUC emission, results were analyzed for the two main Brazilian producer states with contrasting patterns of land use change: Paraná state (PR), which represents a consolidated crop production area and Mato Grosso (MT), which represents an expansion agriculture frontier area.

Chart 2 evidences the importance of considering regionalized data and the role of origination of soy for CF results. Under a national approach, LUC factors would be reallocated between different regions and contexts of land use patterns, which can influence final results and conclusions.

Chart 3, compares BRLUC results, (published in the Ecoinvent 3.6 database), with the average calibration results of this project (MT,GO,MG and PR states).

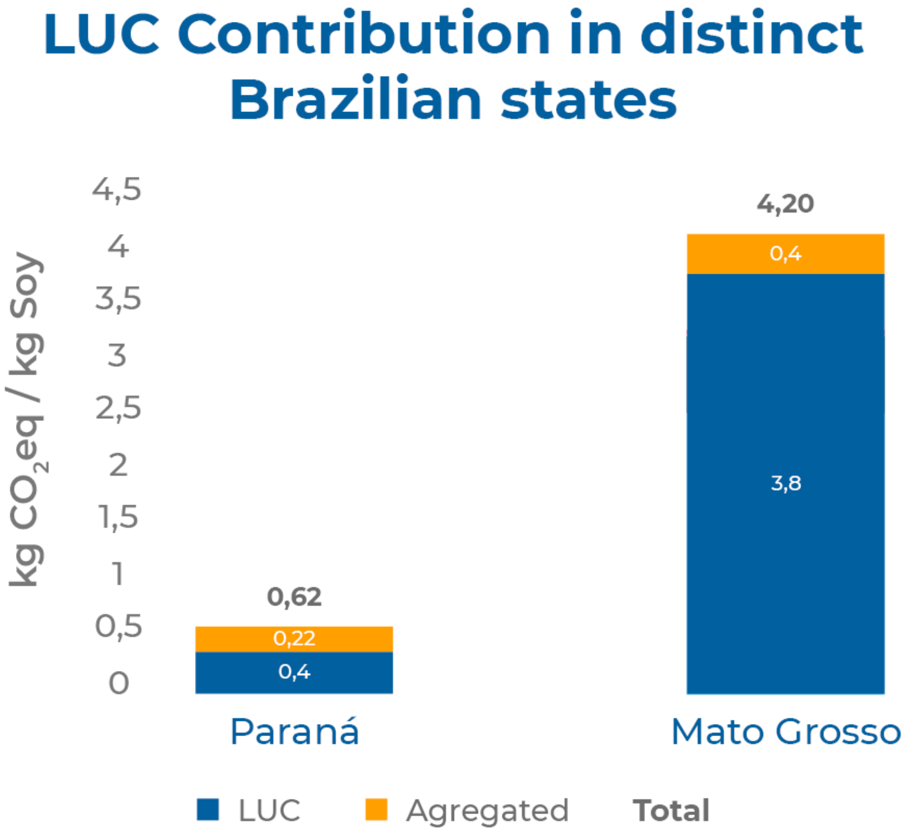


Chart 2

Another comparison performed in this project, was between the CFs of SINTEF (2019) Brazilian SPC and ProTerra`s calibration result (soymeal),considering mass allocation (chart 4).

BR (kg CO2eq/kg soy)

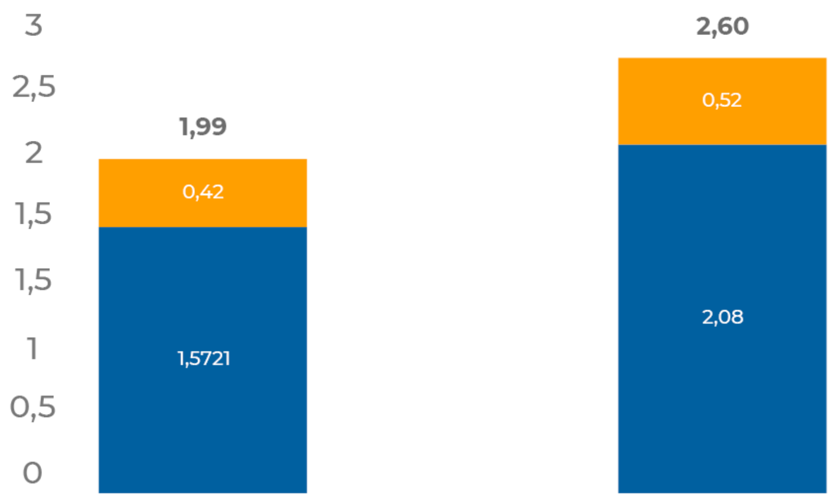


Chart 3

kg CO2eq/kg product

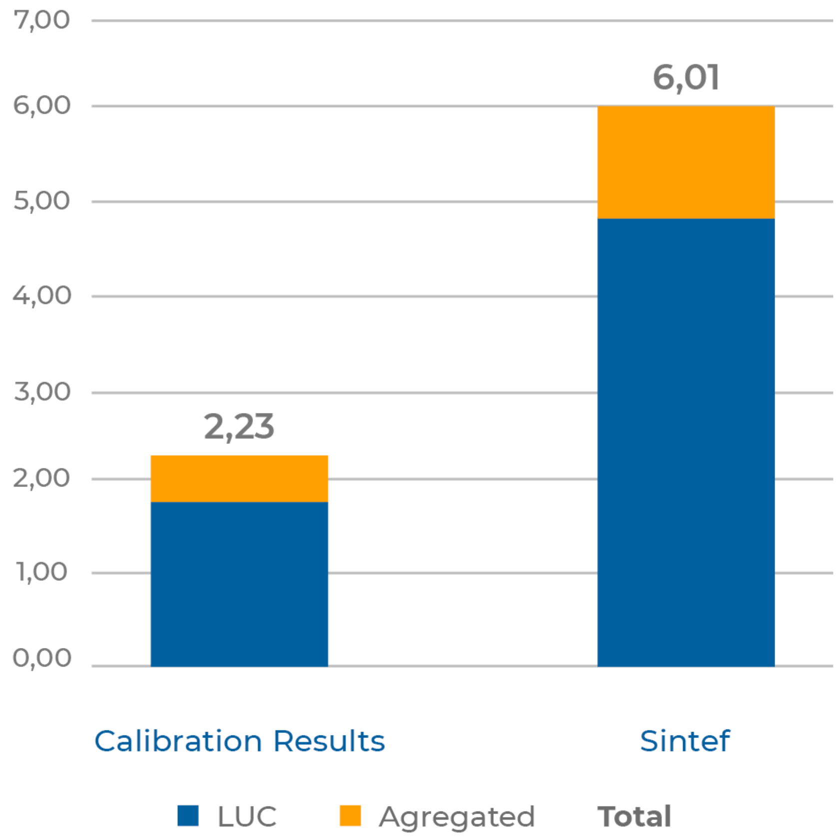


Chart 4

The difference between the alternatives is significant, ProTerra's calibration results are 63% lower than Sintef. However, this comparison has one small limitation because it's between different products from the same production chain: Soymeal (ProTerra's calibration results) and SPC (Sintef) being the latter one step ahead in the value chain. This leads to different mass allocation factors and considering this, another comparison was performed, now applying the same allocation factor for both products (68% - Agrifootprint DB[9], where SPC data was collected in Sintef study) and it has generated a new calibration result, which is presented in the chart below Chart 5.

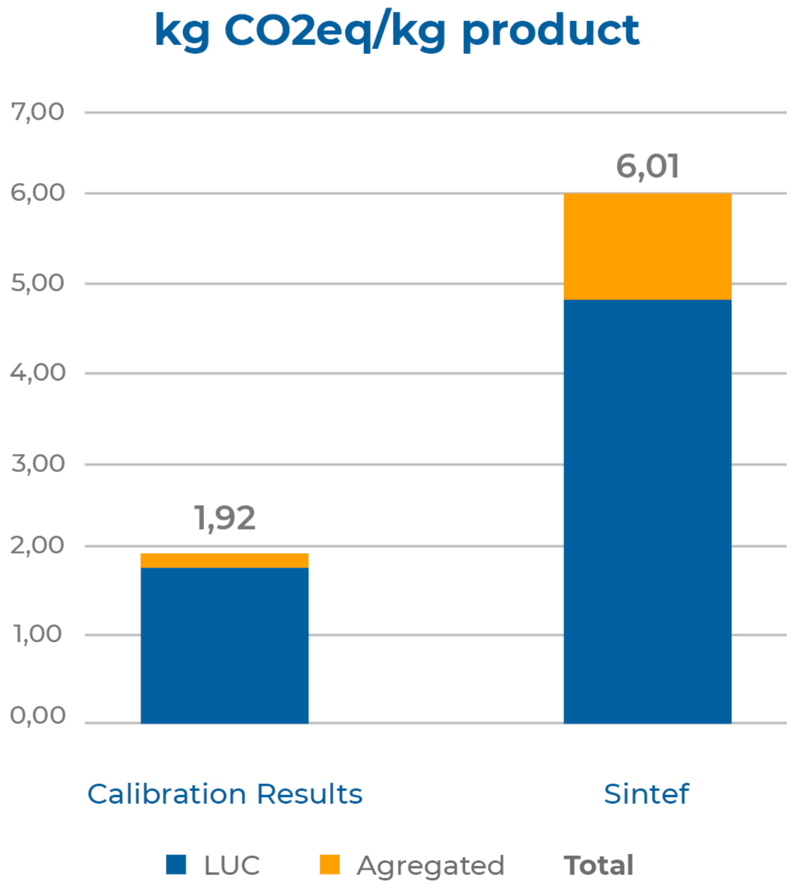


Chart 5

As presented in the chart considering the same allocation factor (68%), ProTerra's calibration results are now significantly, 68% lower than Sintef.

Disclaimer

Every environmental assessment is a result of methodological choices and the quality of the available data. Responsible use and understanding of the results presented in this report are dependent on an understanding of the importance of these aspects and a reference to where they are explained. No producer can therefore say that the results are valid for their specific product and the results presented are more to be seen as a test of the calculator effectiveness against a ProTerra default profile.

[9] https://www.agri-footprint.com/wp-content/uploads/2019/11/Agri-Footprint-5.0-Part-2-Description-of-data-17-7-2019-for-web.pdf Figure 6-5

Next steps and recommendations

This project demonstrates an increased awareness regarding the Carbon Footprint of feed products. After many discussions and analysis of sensitive and important topics (as Land Use Change emissions accountability, data availability, allocation, etc.), a good solution found was to start with the development of a feasible but reliable calculator, in line with requirements and customized and regionalized for Brazilian agriculture context.

It's known that results may vary depending on real sourcing data of a specific crusher. While ProTerra is working on collecting and systematizing data, some small adjustments can be done in the presented Calibration results in order to create an average profile for ProTerra: One first step could be the replacement of yield values (from general to specific averages from ProTerra's members). A second step would be to adjust soy origination geographies according to ProTerra's participation mix.

Based on market demand, we will continue to establish such projects every year, not only in Brazil, but in other geographies as well, such as Europe.