Environmental compliance of coffee, soy, and forest plantations in the state of Minas Gerais, Brazil

Felipe Nunes
Britaldo Soares-Filho
Amanda Oliveira

Débora Assis
Filipe Lisboa
Rodrigo Bellezoni

Traceability has consolidated as a market requirement to eliminate deforestation from agriculture supply chains and, as such, has become pivotal for regulating global trade[1]. Growing pressure for deforestation-free agriculture products has led to agreements by large companies to exclude deforesters from their supply chains (e.g., Soy Moratorium, Cattle Agreements), commitments from China and the United States to ban imports linked to deforestation, regulations with this end in France and the United Kingdom, and more importantly, the European Union Deforestation Regulation (EUDR) approved in May[2] to enforce the import of deforestation-free products.

The EUDR mandates that seven agricultural commodities, namely cattle, cocoa, coffee, palm oil, rubber, soy, and wood be deforestation-free and that their production comply with the "relevant" legislation in the countries of origin. To this end, the regulation requires that companies trace the commodities back to their origin of production, proposing at the same time a benchmarking system based on quantitative and internationally recognized criteria to assign a level of deforestation risk to each sourcing country and its producing regions.

The new regulation – scheduled to come into operation in December 2024 – strongly impacts the state of Minas Gerais, recognized for being the world's largest coffee producer (and exporter), not to mention its vast soy crops and forest plantations. In 2023, the state produced 29 million processed bags of coffee and 8.3 million tons

(Mton) of soybeans, accounting for 53% and 5% of the national output, respectively. Regarding forest plantations, the state yielded 6.3 Mton of charcoal and other products (84% of Brazilian production), and 24.6 million cubic meters of charcoal and other wood products (9% of the national output). In 2023, 12.3 million bags of coffee, 142.1 thousand tons of soybeans (including soy bran and other derivatives), and 404.5 thousand tons of forestry products (cellulose, paper, rubber, wood, and other derivatives) were exported to the EU, totaling business around US$ 2.7 billion (coffee), US$ 81.1 million (soy) and US$ 218.1 million (forest products)[3].

Given this regulatory context, it is essential to evaluate the socio-environmental compliance of agricultural producers in Minas Gerais, especially concerning deforestation and compliance with the Brazilian Forest Code (FC). The FC is the country's primary legislation regulating environmental conservation on private lands[4]. In short, it establishes where native vegetation must be conserved or can be suppressed upon authorization, also regulating the use of natural resources. The law defines two types of conservation areas: i) Areas of Permanent Preservation (APP) along rivers, water bodies and springs and on steep slopes and hilltops, and ii) Legal Reserves (LR), a percentage of the rural property's area where native vegetation must be maintained. This percentage ranges from 80% in the Amazon to 20% in other biomes, such as those occurring in MG, i.e., Cerrado, Atlantic Forest, and Caatinga. For non-compliant properties, the FC also determines the areas that must be restored by

[1]Rajão R., *et al.* (2020) The rotten apples of Brazil's agribusiness. Science, 369 (6501): 246-248.

[2]https://environment.ec.europa.eu/topics/forests/deforestation/regulation-deforestation-free-products_en

[3]Data provided by SEAPA (Secretaria de Estado de Agricultura, Pecuária e Abastecimento de Minas Gerais).

[4]Brazil. Federal law nº 12,727 (October 17, 2012). Available at: <www.planalto.gov.br/ccivil_03/_Ato2011-2014/2012/Lei/L12727.htm>.

landowners, namely LR and APPs, as well as other illegally deforested areas.

There are more than one million private properties in Minas Gerais registered on the Rural Environmental Registry (CAR) - the national web-based database of rural properties. Because the CAR is a self-reported system, there is still a need to verify its information. To do so, it is necessary to develop technological solutions capable of integrating the massive CAR dataset with detailed land-use mapping to automatically analyze the level of environmental compliance for each rural property.

Here we present the results together with the methods of our computer model for calculating the FC balance at the property level for Minas Gerais. For each rural property, the model estimates the areas designated for conservation or restoration of native vegetation (LR and APPs), calculating the deficits (native vegetation that needs to be restored) and surpluses (native vegetation exceeding the FC requirements), including deforestation after 2008 as detected by the "Continuous Monitoring Program of Native Vegetation" under the auspices of the State Forest Institute – IEF-MG and deforestation polygons by the PRODES system of the National Institute for Space Research - INPE. The coffee-producing farms are identified by cross-referencing their georeferenced CAR boundaries[5] with the high-resolution mapping of coffee plantations in Minas Gerais[6]. For mapping soybeans, we used Mapbiomas[7], and for forest plantations the georeferenced plots of the "MG Forests" system, which are previously identified by the CAR code of the registered properties[8].

Our results indicate that 99% of the 118 thousand coffee-producing properties registered on the CAR do not show significant deforestation[9] after 2008, the deadline for granting amnesty to past deforesters (Table 1). In addition, about one-third of the rural properties producing coffee have more native vegetation than required by the FC, totaling 317 thousand hectares of LR surplus (Figure 1), thus adding a key ecosystem service to coffee production. Regarding soy producers, we found no evidence of deforestation after 2008 for the vast majority (88-97%)[10] of farms, of which 28% have LR surpluses. Similarly, 83-93% of properties cultivating forest plantations did not present deforestation after 2008, with emphasis on 68% of properties conserving areas of native vegetation beyond what is required by Brazilian legislation.

In view of the date of December 31, 2020 established in the EUDR for limiting past deforestation, the percentages of properties that could be categorized as deforestation-free reach 99% (coffee), 95% (soybean), and 93% (forest plantations), reinforcing, as a result, the regional classification of low risk for these supply chains in Minas Gerais.

To calculate the FC balance, the model uses as inputs maps of state and municipal boundaries, fiscal modules, vegetation physiognomies, drainage networks, land use, protected areas, and rural properties' boundaries (Figure 2). Initially, the model calculates the total area of each rural property. Then, the model generates APP buffers along rivers, springs, and water bodies according to the FC rules for both conservation and restoration of native vegetation. To calculate the width of the riparian APPs for restoration purposes, a series of hierarchy rules is applied based on the size of the property (defined by the number of fiscal modules as specified for each municipality) and river width.

Table 1 – Number of producing properties, area of crops, surplus of Legal Reserve (RL), deforestation after 2008 - IEF with a threshold of 1 ha and PRODES after 2008 with a threshold of 6.25 ha, and deforestation after 2020 with a threshold of 1 ha for IEF and PRODES.

Products	Proprieties		LR surplus		Post-2008 deforestation		Post-2020 deforestation	
	No. of properties (thousand)	Planted area (Mha)	No. of properties (thousand)	Area (Mha)	No. of properties (thousand) IEF	No. of properties (thousand) PRODES	No. of properties (thousand) IEF	No. of properties (thousand) PRODES
Coffee	118	1.1	39	0.3	0.3	1.0	0.1	1.1
Soy	24	1.8	7	0.6	0.8	2.9	0.2	1.3
Forest Plantation	13	1.3	9	0.9	0.9	2.1	0.1	0.9
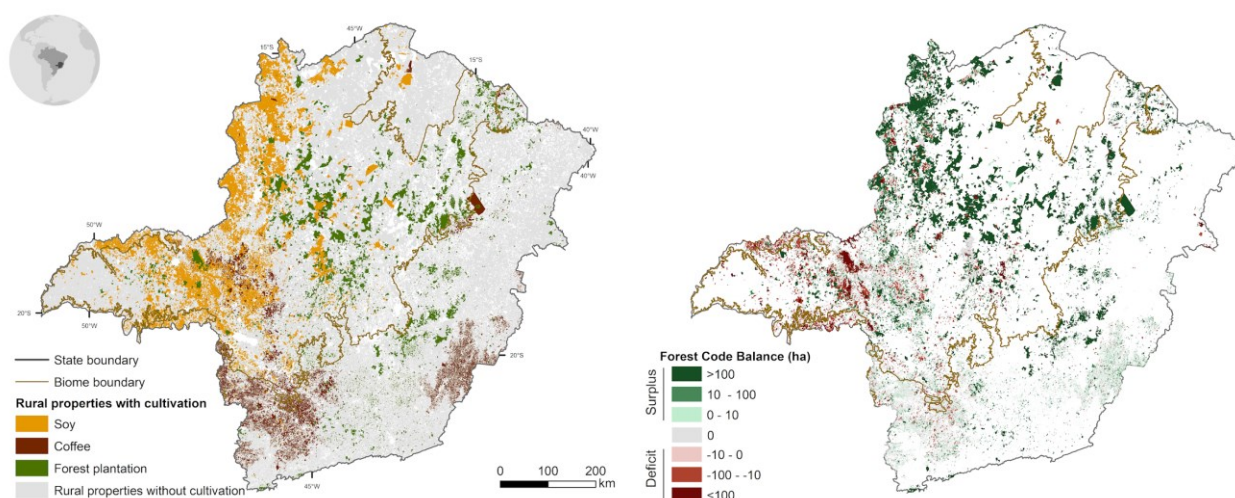
Figure 1 – a) Distribution of the coffee, soy or forest plantation farms in Minas Gerais; b) Environmental surpluses (positive values) and deficits (negative values) of producers according to the Forest Code balance.

Subsequently, the model applies the FC rules to determine the requirement for LR. The legislation considers properties from less than 1 to 4 fiscal modules (FM) as small, those between 4 and 15 FM as medium, and properties larger than 15 FM as large. Of significance for Minas Gerais the FC exempts small landowners (up to 4 FM) from restoring the LR deficit, which represents more than 93% of rural properties in the state. Additionally, the law establishes a maximum percentage of the property for LR restoration, depending on the total width of its riparian APPs. Properties with deficits in APP and LR must either submit plans for the recovery of degraded areas or join the Environmental Regularization Program (PRA) to comply with the legislation.

FC balance estimates and environmental compliance of all rural properties can be accessed on the "SeloVerde-MG"[11] platform, allowing transparent and public traceability of agricultural production per rural property, as well as a possible bonus for producers who conserve areas of native vegetation beyond what is required by the FC.

The results of the automatic diagnosis are presented individually for each rural property and can be compared with high-resolution images freely available on the platform. The system operates in compliance with the Brazilian General Personal Data Protection Law[12]. To access a specific property's data, one needs to simply provide its CAR code. This allows queries by suppliers (direct and indirect) of coffee, soybeans, and planted forests, which can be used both to inform compliance with Brazilian legislation for national markets as well as to support investigation procedures to attest deforestation-free production

[11] https://seloverde.meioambiente.mg.gov.br/

[12] Brazil. Federal law nº 13,709 (August 14, 2018). Available at: <https://www.planalto.gov.br/ccivil_03/_ato2015-2018/2018/lei/l13709.htm>.

– including the so-called "due diligence" needed to comply with the EUDR and UK legislation. Among other requirements, the due diligence demands that companies (operators) collect information, perform a risk assessment and inform the geolocation of the cultivation plots to European authorities, and all of this can easily be obtained using the public SeloVerde-MG platform.

With respect to the EUDR, important issues that directly impact Minas Gerais are still to be defined. For example, this refers as to whether the three-level classification of deforestation risk (low, medium, and high) will be based on a regional or product-specific approach. Products from regions of high-deforestation risk will be subject to a stricter inspection, and the due diligence will involve more steps, which can create obstacles and additional costs for exporting to the EU.

In sum, the results presented here on the environmental compliance of the main supply chains in Minas Gerais, together with the transparency provided by SeloVerde-MG, not only qualify the state agricultural products as a deforestation-free or with neglectable deforestation-risk commodity, but they also contribute to the debate on the criteria for legal compliance, development of traceability tools and risk assessment methods to be implemented in the coming months by both Brazil and its trading partners.
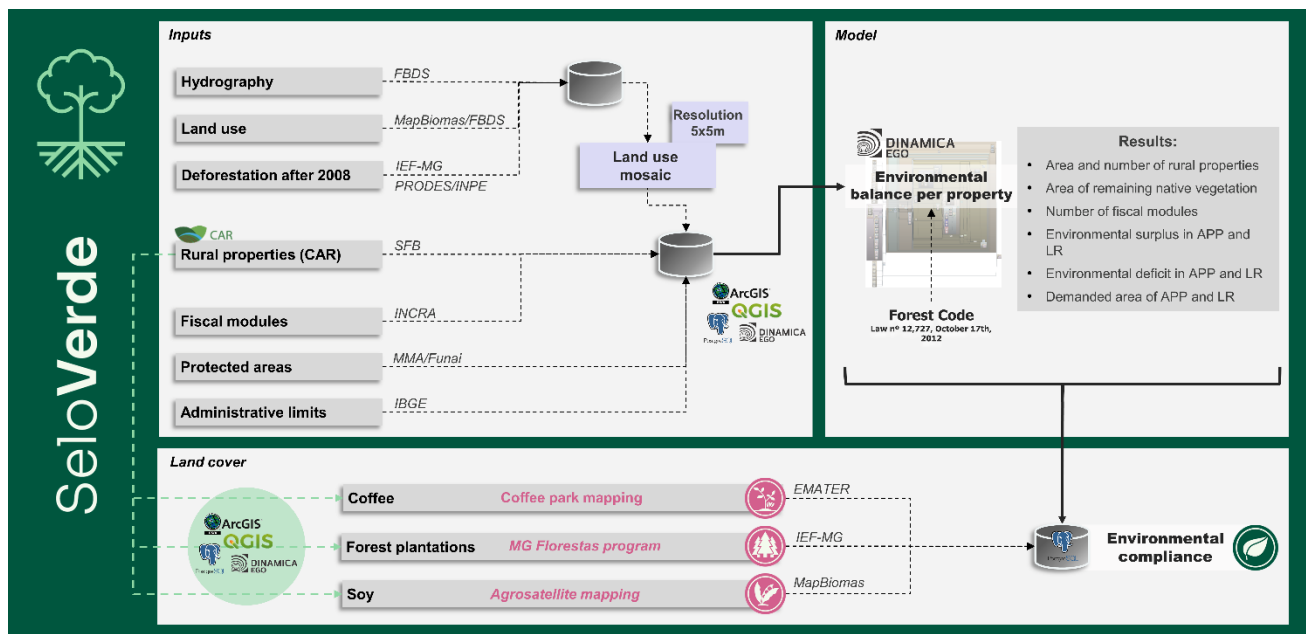
Figure 2 - Diagram with input databases and the Forest Code model results per rural property.

Acknowledgments