TECHNICAL NOTE

SEPTEMBER 2022

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DEFORESTATION INCREASES THE COST OF CLIMATE CHANGE FOR AGRIBUSINESS

Commodity production is responsible for most of the deforestation in the Brazilian Amazon and Cerrado, with impacts on biodiversity, environmental services and populations, as well as the aggravation of global climate change. The effects of human-induced climate change have reduced global agricultural productivity by 21% since 1961, which is equivalent to missing the last seven years of productivity growth. This percentage is much more severe (between 26% and 34%) in warmest regions, such as Africa, Latin America and the Caribbean[1].

This technical note brings a compilation of recent studies that demonstrate that the maintenance of high rates of deforestation in the Amazon and Cerrado also results in a decrease in productivity and profitability for agribusiness in both biomes, which generates an additional cost for the sector, beyond the already expected due to climate change. Local and regional climate effects resulting from deforestation have a comparable (and complementary) magnitude to climate change caused by the global greenhouse effect. The interaction between these two phenomena can imply intense impacts on Brazilian agribusiness[2].

Deforestation in the Amazon, for livestock and grain cultivation, causes changes to the regional climate, which mainly affect temperature and rainfall patterns[3 4]. Currently, almost 20% of the original forest area of the biome have been converted to anthropic uses[5]. This indicates that the duration of the dry season and the high temperature may already be affecting local agriculture[6], harming national production and agribusiness interests[7].

Establishing the causal relationship between climate and productivity from the observed data, however, is still a major challenge, given the limitation of information available in good spatial and temporal resolution on agricultural productivity, in addition to the diversity and complexity of the factors that determine it, such as technological and economic issues. Hence, although changes in temperature and rainfall patterns caused by land use change in the Amazon are increasingly identified in meteorological observations[8 9 10], most existing studies still bring little information based on field observations, but only projections of productivity loss for different land use scenarios and climate change.

A pioneering study, which evaluates the effects of the increase in temperature caused by historical

deforestation on soybean production in the Amazon and Cerrado, estimates that, between 1985 and 2012, deforestation and the consequent increase in temperature caused a 12% reduction in the productivity of soybean cultivation in the Amazon and 6% in the Cerrado, with a decrease of more than 20% in some regions of both biomes, such as soybean and corn production in Matopiba, an agricultural Cerrado region located in the states of Maranhão, Tocantins, Piauí and Bahia[11].

According to the same research, the drop in gross income related to the decrease in the regulation of extreme temperatures after deforestation was, on average, US$158.50 annually for each hectare of soybean produced in the Amazon, using the 2005 dollar value as reference. In the case of Cerrado, monthly increases between 2.2 and 4.0°C were recorded in maximum temperatures and between 2.4 and 2.8°C in minimum temperatures between 1961 and 2019[12].

Projections of future soybean and pasture productivity loss in the Legal Amazon, considering different governance scenarios (which imply different levels of deforestation) and climate change[13], indicate that weak or business-as-usual governance scenarios can lead to productivity losses of 26% for soybean and 32% for pasture by the middle of this century. If producers do not adapt, a 20% increase in the deforested area in the Amazon and Cerrado by 2050 may lead to additional productivity losses between 6% and 10% in Matopiba and 20% in Mato Grosso, the country›s main producing regions, when compared to losses caused by global climate change[14].

Regarding corn grown after soybean harvest (second crop corn), studies indicate that these same rates of deforestation would lead to a drop of up to 8%[15]. If it is necessary to postpone the dates of planting the crops to adapt to a scenario in which the rainy season begins later and lasts shorter, this drop would increase to approximately 30%[16]. In addition, the studies suggest that, with the persistence of deforestation until the middle of the century, the adaptation of planting dates and the adoption of shorter cycle cultivars will not be sufficient to maintain current productivity levels in double crop systems (soybean and corn). Such changes would be linked to the shortening of the rainy season and the impacts resulting from rainfed cropping (without irrigation).

An evaluation of the gross income loss in soybean cultivation in the Amazon in different governance scenarios by 2050 takes into account the empirical relationships established from observed rainfall and deforested area data. Researchers[17] show that a weak governance scenario could lead to the destruction of 56% of the forest area until 2050, which would cause a loss of gross income from soybean cultivation of about R$1 billion annually (about US$200 million). Another study estimates that the economic damage caused by additional deforestation by 2050 may be $1.8 billion (about US$360 million) higher in Mato Grosso when compared to the gross income loss caused by global climate change[18].

But the losses related to deforestation are not restricted to those caused by climate and reduced productivity. A report based on projections of Brazilian companies' risk matrices points to losses of up to R$24 billion (about US$4.8 billion) for not presenting actions against deforestation in their value chains. This value includes reputational damage, consumer flight, difficulties in accessing international markets and changes in ecosystem dynamics. The study also highlights that combating deforestation would be much cheaper: the total cost would be R$3.2 billion (about US$640 million) – about an eighth of the projected loss[19]. Data released by 675 companies that produce or acquire any of the seven main commodities related to deforestation were considered: palm oil, timber products, beef, soybean, rubber, cocoa and coffee.

Furthermore, increasing productivity to only half of its potential would allow meeting the demand for agricultural expansion to increase the production of meat, grains, wood and biofuels by 2040, without deforesting any additional trees[20].

Launched in September 2022, a UN report shows that the largest food and agribusiness companies may have multibillion-dollar losses by the end of the decade due to climate change, causing a downfall for the sector comparable to that suffered by the financial sector in the 2008 crisis. The survey analyzed 40 of the largest companies involved in the food sector, from input manufacturers to retailers, through slaughterhouses and traders, which, together, are worth more than US$2.2 trillion and employ 8 million people. In segments in which Brazil has a large global share, the estimated impact is a 7.2% drop for animal protein companies and 7.4% for agricultural commodities. The study indicates that it is necessary to end deforestation associated with

commodities responsible for the bulk of the negative environmental impact: beef, soy, palm oil, pulp and paper. From such data, over 30 financial institutions signed a commitment to eliminate the financing of these businesses (equivalent to US$8.7 trillion in assets) and disclose their progress in this sense in 2025[21].

In conclusion, Brazilian agribusiness should suffer productivity and revenue losses due to global climate change, which should be aggravated by deforestation and, according to the companies themselves, other related risks. Studies show that combating deforestation and adapting to climate change through the recovery of degraded areas and the adoption of sustainable practices can be more economically advantageous.

TOOL SHOWS GROSS REVENUE LOSS

An interactive and free tool, accessible through the link http://www.biosfera.dea.ufv.br/dchuva/, provides information on the loss of the gross revenue in soybean and beef production due to deforestation and consequent climate change. The platform, called **Deforestation and Rain** is based on a study[22] that evaluates the spatial variation of the climate regulation ecosystem service value for agricultural production in the Amazon from scenarios of progressive deforestation of the forest[23] and simulations with agrometeorological models.

The visualization of the platform data makes it clear that the higher the level of deforestation (ranging from 10% to 40%), the greater the gross revenue loss for soybean, regardless of the date of planting, and for beef production.

Picture 1: Screen of the Deforestation and Rain tool showing the loss of gross soybean revenue for a 40% deforestation scenario in the Amazon

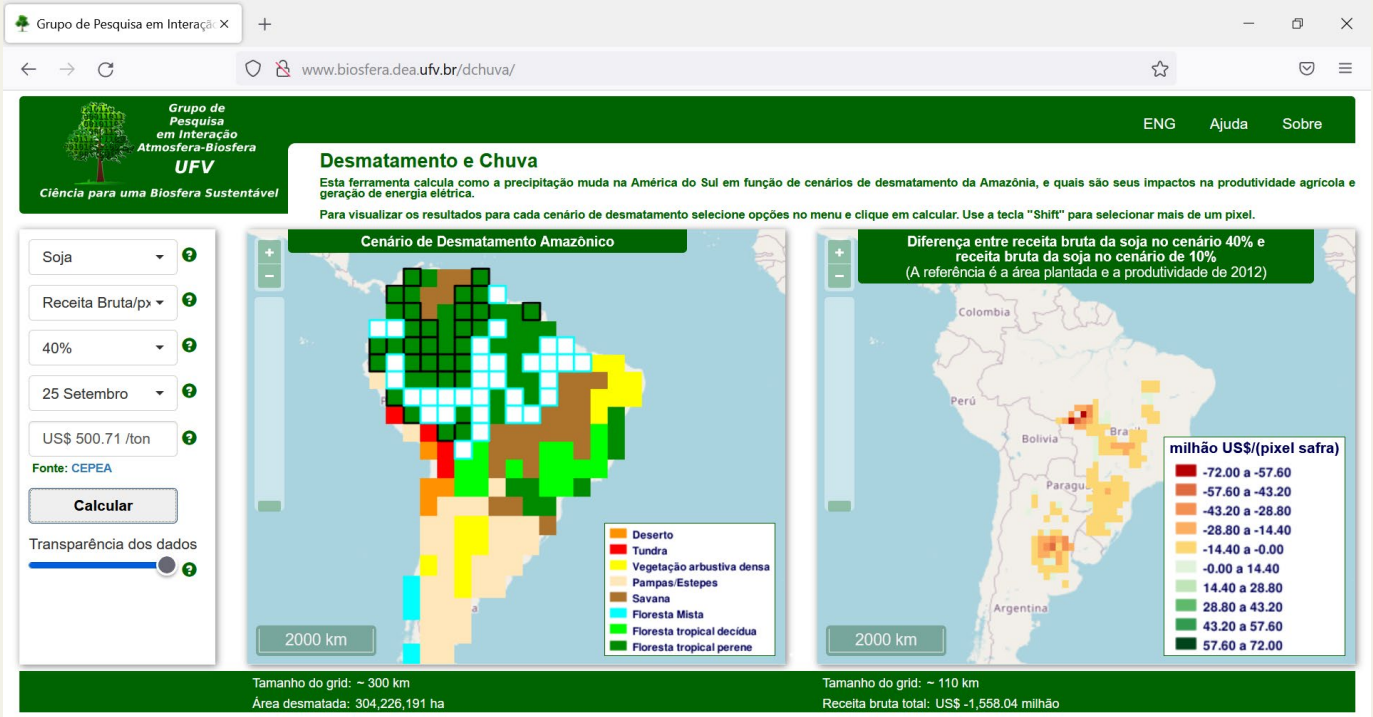

Table 1 summarizes the results obtained by the tool. It indicates the lower limit (LI, calculated for 20% deforestation) and upper limit (LS, calculated for 40% deforestation) of the gross income loss for soybean and beef production due to deforestation in the Amazon, both in absolute values and as a percentage of the agricultural GDP. For the estimate, the average prices in 2021 were considered: US$525.89[24], for the ton of soybean, US$56.81[25], for the arroba of beef, R$5.40 per dollar[26] and R$598,128.21 million[27] for the agricultural GDP.

Table 1: Loss of gross income after deforestation in the Amazon

Agricultural product	Loss of gross income – LI (millions R$)	% of agricultural GDP	Loss of gross income – LS (millions R$)	% of agricultural GDP
Soybean (planting on 09/25)	5,423.65	0.9	8,836.51	1.5
Soybean (planting on 10/15)	2,296.08	0.38	7,417.12	1.24
Soybean (planting on 11/05)	1,739.39	0.29	7,340.76	1.23
Beef	4,313.57	0.72	5,057.96	0.84

The gross income losses described in Table 1 result mainly from the rainfall onset delay and its effects on soybean productivity. The projections do not include the income loss if the rainy season delays enough as to prevent the implementation of a second harvest, or the loss caused by the interaction between the deforestation in the Amazon and that in the Cerrado[28]. The interactions between the deforestation in both biomes and the effects on rainfall and agricultural productivity are presented in the Deforestation, Rain and Agriculture tool[29], although the gross income loss projections are not available. In both cases (impossibility of a second harvest and the effect of deforestation in the Cerrado), the gross income loss would be significantly higher.

ADAPTATION TO MINIMIZE LOSSES

In addition to zeroing deforestation to limit income losses caused by a reduction in the country's agricultural production and productivity, the sector needs to adapt to global climate change through sustainable practices. A WRI Brazil document[30] shows that technologies available in the country, such as genetic improvement of plant cultivars and animal breeds, no-till farming, biological nitrogen fixation, digital sensors for soil and plant evaluation, agricultural climate risk zoning, agroecological zoning, among others, are essential to remain at the top of the agricultural production.

Some of these technologies are already foreseen in the country's public policies, such as the Low Carbon Agriculture Plan (ABC Plan)[31] and the National Policy for the Recovery of Native Vegetation (Planaveg)[32], which are, according to the study, fundamental instruments to enhance adaptation in agribusiness, especially because they guarantee the conservation of biodiversity and protect pollinators; maintain water supply and quality; mitigate climate extremes, such as droughts and heat waves, main drivers of production breaks; reduce the occurrence of natural disasters, especially flooding and soil erosion risks; maintain the balance of biogeochemical cycles; sequester carbon in the soil; provide production and income diversity for the rural producer; and contribute to a greater resilience of productive systems to climate change.

Planaveg is also an instrument that is in line with the United Nations Decade of Ecosystem Restoration, established by the UN and running from 2021 to 2030, with the aim of halting the degradation of ecosystems and restoring them for the benefit of people and nature[33].

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TECHNICAL NOTE

Produced by
WWF-Brazil

Edition
Núcleo de Conteúdos Ambientais – NUCA
(Maura Campanili)

Research
Universidade Federal de Viçosa – UFV
(Prof. Marcos Heil Costa)

Technical supervision, Review and Adaptation
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