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Expanded Reproduction of Devastation: Land Concentration, Agribusiness, and Environmental Impacts in Brazil

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Abstract

The expansion of Brazilian agribusiness, grounded in the intensive use of natural resources, has been a catalytic factor in accelerating climate change. This study examines the interdependence among agrarian issues and ongoing transformations in Brazil, focusing on the impact of three key indicators: wildfires, deforestation, and pesticide use. Anchored in Marx's theory of metabolic rift and the critique of land concentration, the research discusses how the logic of capitalist accumulation subordinates the intensive exploitation of natural resources to the reproduction of capital. Based on a regionalized analysis, the results reveal that the North and Center-West regions of Brazil exhibit the highest levels of environmental degradation, while the use of chemical inputs has reached critical levels in the South and Southeast. Although the Northeast presents lower absolute values, it also registers an accelerated pace of degradation. Furthermore, the operational patterns of agribusiness point to the insufficiency of environmental control policies and to the sector's structural dependence on the intensive exploitation of nature.

Keywords: Agrarian structure; agricultural economy; Agrarian issue; Climate crisis.

Reprodução ampliada da devastação: concentração fundiária, agronegócio e impactos ambientais no Brasil

Resumo

O avanço do agronegócio brasileiro, baseado no uso intenso dos recursos naturais, tem sido fator catalisador na aceleração das mudanças climáticas. O presente estudo examina a interdependência entre questão agrária e as transformações no Brasil, a partir do impacto de três indicadores: queimadas, desmatamento e uso de agrotóxicos. Ancorada na teoria da ruptura metabólica de Marx e na crítica à concentração fundiária, a pesquisa discute como a lógica da acumulação capitalista subordina o uso intensivo dos recursos naturais à

reprodução do capital. A partir de recorte regionalizado, os resultados evidenciam que as Regiões Norte e Centro-Oeste concentram os maiores índices de degradação ambiental, enquanto o uso de insumos químicos atinge níveis críticos também no Sul e Sudeste. O Nordeste, embora apresente valores absolutos menores, também registra ritmo acelerado de degradação. Ademais, os padrões operacionalizados pelo agronegócio indicam insuficiência de políticas de controle ambiental e dependência estrutural do setor em relação à exploração intensiva da natureza.

Palavras-chave: Estrutura fundiária; economia agrícola; questão agrária; crise climática.

Reproducción expandida de la devastación: concentración de tierras, agronegocios e impactos ambientales en el Brasil

Resumen

El crecimiento del agronegocio brasileño, basado en el uso intensivo de recursos naturales, ha sido un catalizador de la aceleración del cambio climático. Este estudio examina la interdependencia entre la cuestión agraria y las transformaciones en Brasil, basándose en el impacto de tres indicadores: incendios, deforestación y uso de pesticidas. Con base en la teoría de Marx sobre la ruptura metabólica y la crítica a la concentración de tierras, la investigación analiza cómo la lógica de la acumulación capitalista subordina el uso intensivo de recursos naturales a la reproducción del capital. A partir de un análisis regionalizado, los resultados muestran que las regiones Norte y Centro-Oeste concentran las mayores tasas de degradación ambiental, mientras que el uso de insumos químicos también alcanza niveles críticos en el Sur y Sudeste. El Nordeste, aunque presenta valores absolutos más bajos, también registra un ritmo acelerado de degradación. Además, las normas implementadas por el agronegocio indican políticas de control ambiental insuficientes y la dependencia estructural del sector de la explotación intensiva de la naturaleza.

Palabras clave: Estructura agraria; economía agrícola; cuestión agraria; crisis climática.

Introduction

Capitalist economic development has significantly contributed to the intensification of climate crises. Consequently, the relationship between humans and nature has come under increasing scrutiny, particularly regarding environmental impacts. In this context, agribusiness is notable for accelerating the exploitation of natural resources in relentless pursuit of economic expansion. The intensive consumption of these resources serves as a strategic mechanism for capital reproduction and accumulation.

In Brazil, a country characterized by peripheral capitalism and an economy historically based on agro-export activities and natural resource exploitation, the climate crisis manifests in particularly severe forms. The capitalist logic associated with globalization positions Brazil in a subordinate role within the international division of labor, increasing pressure on biomes and traditional populations and revealing the limitations of a development model that prioritizes commodity exports over environmental and social

sustainability. Agribusiness has emerged as a central component of the national economy while also intensifying land concentration, a defining feature of Brazilian society.

Therefore, it is essential to examine how the Brazilian agrarian question, particularly land concentration, relates to agricultural expansion and environmental exploitation, as well as the implications for climatic conditions. Accordingly, this study analyzes the relationship between land concentration in Brazil, wildfires, deforestation, agrochemical use, and climate change. Drawing on the Marxist concept of the metabolic rift, the analysis explores how the relationship between human society and nature is shaped by the prevailing mode of production.

The concept of human metabolism with nature, introduced by Karl Marx and further developed by scholars such as Bellamy Foster, is central to understanding the current climate crisis because it emphasizes human labor as the key mediation between society and the natural environment. The nature of this exchange is neither timeless nor neutral; it is historically shaped by specific economic and social structures. Under the capitalist mode of production, this relationship is systematically distorted by the pursuit of profit and capital accumulation, leading to a rupture of natural metabolism, and posing risks to environmental integrity and human survival.

This article is organized into six sections, beginning with this introduction. The next section outlines the methodological procedures employed in the research. The third section discusses the concept of metabolic rift, emphasizing the relationship between humans and nature as mediated by capitalism. The fourth section examines land concentration in Brazil. The subsequent section addresses the climate crisis through the analysis of wildfires, deforestation, and agrochemicals. The concluding section presents the concluding remarks.

Methodological Procedures

This study adopts a qualitative research approach to examine land concentration in Brazil and selected phenomena associated with climate crises. Initially, based on the literature addressing the concept of metabolic rift, a theoretical framework was developed to connect the development of capitalism, the pursuit of economic profit, and their effects on the environment and climate.

Although the research is predominantly qualitative, the study incorporates quantitative data, particularly on wildfires, deforestation, and the use of agrochemicals. Through a regionalized analytical framework, the study describes how these phenomena have manifested across different regions of Brazil. In addition, data on land concentration were collected, revealing an intensification of land inequality when comparing the two most

recent Brazilian Agricultural Censuses, conducted in 2006 and 2017. In this section, the Land Concentration Gini Index (LCGI) was used as an indicator of land distribution inequality.

Data on wildfires and deforestation were obtained from the MapBiomas databases. Regarding agrochemicals, the data were sourced from the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) and the global database of the Food and Agriculture Organization of the United Nations (FAO). This combined dataset both illustrates and complements the observed trends related to land concentration and climate change.

Human–Nature Metabolism under the Capitalist Mode of Production: The Metabolic Rift

The human animal is part of nature and lives from nature, remaining in a constant relationship with the natural environment to sustain life (Marx, 2014). This is because the flow of materials within human production constitutes an essential component of human metabolism (Foster, 2023). This perspective provides the theoretical foundation for understanding the opposition between capital and nature. Through labor in the natural environment, as a planned activity that transforms both nature and human beings themselves, the social being distinguishes itself from other animals and progressively expands its control over natural conditions. “The labor process (…) is purposeful activity aimed at the production of use-values, the appropriation of natural elements for the satisfaction of human needs, the universal condition for the metabolism between human beings and nature, the everlasting natural condition of human life” (Marx, 2014, p. 261).

However, human beings are social beings who organize themselves in diverse ways throughout history, giving rise to historically specific forms of social reproduction and distinct modes of relating to the natural environment. In other words, the human–nature relationship is not uniform across history but rather depends on the prevailing structure of social relations at each historical moment. Even in relatively recent historical periods, social relations of production have assumed markedly different forms, such as ancient slavery (Anderson, 2000), colonial slavery (Gorender, 2016), the Indigenous domestic mode of production (Meillassoux, 1977), feudalism (Anderson, 2000), and capitalism. In each mode of production and reproduction of life, the metabolism between humans and nature operates according to its own specific regulatory logic. Accordingly, human metabolism with nature becomes historically particularized by prevailing social relations. Thus, the human–nature relationship cannot be detached from the historical moment or from the specific way in which contemporary human life is organized—namely, capitalist production.

From this perspective, the study of agribusiness, land concentration, and their environmental and climatic effects does not merely concern the interaction between humans

and nature that has existed since the origin of the species, but rather a form of interaction arising from new and historically specific relations of production. It therefore becomes necessary to understand the dynamics of accumulation under the capitalist mode of production as part of the construction of a historical ecology.

In his analysis of capital and its own laws of motion, Marx (2014) warns of a rupture in the metabolism between humans and nature, progressively produced by market relations. For Marx (2014), metabolism between humans and nature is a natural relationship of mutual dependence, in which human beings, through labor, transform nature to create the means of their own subsistence. Thus, metabolism has a dual dimension: it is not constituted solely as the protection of non-human nature for its own sake, but also as the condition that guarantees the existence of human life itself. “As the creator of use-values, as useful labor, labor is thus a condition of human existence, independent of all forms of society, an eternal natural necessity which mediates the metabolism between human beings and nature, and therefore human life” (Marx, 2014, p. 120).

In Bellamy Foster’s formulation, the concept of metabolism "is used to refer to specific regulatory processes that govern this complex interchange between organisms and their environment” (Foster, 2023, p. 235). According to the author, the concept simultaneously encompasses material exchanges and the regulatory actions humans exercise over nature. In this sense, it allows one to “express human relations with nature as relations that encompass both the ‘conditions imposed by nature’ and the capacity of human beings to affect this process” (Foster, 2023, p. 232). However, it is important to note that this metabolism is historical and social, as far as it is determined by different social relations of production and reproduction of human life. Under the capitalist mode of production, it undergoes ruptures and tensions as a consequence of the functioning of a value-based society.

For Marx (2014), the relationship between wage labor and capital enforces a separation between the inorganic conditions of human existence and the active existence of human beings themselves. The unity of the human animal with the inorganic natural conditions of metabolism is fractured by the opposition between capital and labor, grounded in the private ownership of the means of production (Marx, 2014). The rupture in human–nature metabolism under the capitalist mode of production was already highlighted by Marx and Engels in their analyses of large-scale agriculture, in their critique of the separation between town and country, in their discussions of urban waste, forest conditions, and a range of ecological concerns identified by the authors in their observation of capitalist society (Foster, 2023).

Drawing on the chemical studies of Liebig, Marx (2018) argues that the development of capitalist agriculture destroys the natural fertility of soils while simultaneously exporting that fertility to other territories. The author denounces the capitalist agricultural system as a rupture in the metabolism between humans and nature, such that the reproduction of this interaction itself appears to be under threat. While industry consumes the lives of workers, agricultural industry exhausts the soil, destroying the land's natural productive forces, since "[…] the two go hand in hand, insofar as the industrial system in the countryside also exhausts the workers, while industry and commerce, in turn, supply agriculture with the means for the exhaustion of the soil" (Marx, 2018, p. 873).

In this sense, for Marx (2018), the functioning of the capitalist mode of production—grounded in the private ownership of the means of production, which enforces wage labor and valorizes capital on an ever-expanding scale—is incompatible with rational agriculture. As he argues, "[…] rational agriculture is incompatible with the capitalist system (even though the latter promotes its technical development) and requires either the hand of the small peasant who lives from his own labor or the control of associated producers" (Marx, 2018, p. 151).

Moreover, large-scale agriculture under the capitalist mode of production appears as a driving force behind the separation between town and country, creating a deregulated environment for human life and producing a genuine rupture in the "natural laws of life" (Marx, 2018). The example of the metabolic rift highlighted by Marx and Engels arises from the impossibility of a balanced life within large cities. Both authors are highly critical of the ecological problems of urban centers and of how the conditions imposed on workers "distort" or "disrupt" the metabolism between humans and the land. Marx (2014) understands the formation of cities as a process driven by large-scale industry and by the expulsion of workers from the countryside through industrial activity:

> "With the constantly increasing predominance of the urban population, crowded together in large centers by capitalist production, this production, on the one hand, accumulates the historical driving force of society, while, on the other, it disturbs the metabolism between human beings and the earth, that is, the return to the soil of its constituent elements consumed by human beings in the form of food and clothing—a return which is the everlasting natural condition for the lasting fertility of the soil (…) Every advance in capitalist agriculture is an advance in the art not only of robbing the worker, but also of robbing the soil; for every increase in fertility for a given period is at the same time an advance toward the exhaustion of the lasting sources of that fertility (…) Capitalist production, therefore, develops technology and the combination of the social process of production only by undermining the original sources of all wealth: the soil and the worker" (Marx, 2014, p. 572-574).

Urban concentration imposes precarious living conditions on the working class, particularly regarding housing and the pollution of rivers with human waste. As Marx notes,

“[...] in London, for example, the manure produced by 4.5 million human beings prompts this economy to do nothing better than, at enormous cost, to use it to contaminate the Thames” (Marx, 2018, p. 129). Engels (1885) further denounces the pollution of seas by manure, highlighting the ecological consequences of capitalist production even in maritime environments.

The condition of dependent economies in Latin America can likewise be observed when the separation between town and country is extended to relations between nations, “replicated on a global scale by the fact that some countries are transformed into mere agricultural fields” (Foster, 2023, p. 252) within the international division of labor. The periphery of capitalism is thus transformed into the breadbasket of the world (Marx, 2014), while industrial production becomes concentrated in the countries that spearheaded colonization, enslaved labor, and human trafficking in the colonies. Marx (2018) addresses the loss of soil fertility associated with the productive specialization of countries: “[…] from this rupture arises the squandering of the productive power of the land, which, through trade, is carried far beyond the borders of the country itself (Liebig)” (Marx, 2018, p. 873).

Foster (2023) notes that, according to Marx, private ownership of the means of producing life, at the genesis of the European capitalist system, engendered a process of dissolution of the organic relationship between human labor and the land. In colonized countries based on enslaved labor within colonial relations, as well as in African regions where Black workers were abducted, the separation of humans from the land occurred through the dispossession of Indigenous territories and the trafficking of human beings from the eastern coast of Africa to multiple colonies across the globe. In these territories, significantly larger in spatial terms than the European continent, the separation of workers from the means of producing life, through the enslavement of Black and Indigenous peoples, took place during the initial stages of European primitive accumulation.

To this extent, colonial slavery in Latin America (Gorender, 2016) represented not only the separation of workers from their own means of subsistence, but also a metabolic rift in human–nature relations (Marx, 2018). This interruption of natural metabolism sustained production based on the enslaved labor of Indigenous and African peoples, oriented toward commodity exports, to secure raw materials for European manufacturing and to sustain the labor force of the colonizing countries (Marini, 2011).

The linkage between metabolic rift and capitalism thus appears to be determined by the scheme of private accumulation that governs social relations of production in this historical period, shaping patterns of raw material consumption and the appropriation of the natural environment under capitalism. Marx (2014) distinguishes between two types of reproduction: simple and expanded reproduction. Simple reproduction entails the

unproductive consumption of the entire surplus value generated by production by capitalists (that is, surplus value is fully spent on the purchase of consumer goods). Expanded reproduction, by contrast, implies accumulation, whereby a portion of total surplus value is reinvested in additional variable and constant capital, thereby increasing the scale of production. Capitalist accumulation thus consists of a movement of perpetually expanded reproduction of capital.

Under the capitalist mode of production, social relations of production are not oriented toward meeting societal needs; rather, the “use-values” produced function merely as bearers of exchange value (Marx, 2014). This occurs because it is precisely through commodity production based on wage labor that surplus value is generated for accumulation. Consequently, the objective of production is private accumulation, which reproduces itself on an ever-expanding scale through the reinvestment of surplus value to enlarge production (Marx, 2014). The expanded reproduction of capital intensifies pressure on natural resources, such as water, mountains, soil fertility, and energy, which are typically finite within the environment or are unable to regenerate at the pace at which they are consumed in the productive process.

Another fundamental law of capitalist social relations of production is the drive to increase the rate of profit, defined as surplus value relative to total production costs (capital and labor) (Marx, 2014). As Marx (2014) explains, reducing production costs increases the profit rate of the individual capitalist. Accordingly, decisions regarding which natural resources to exploit, extraction methods, impacts on communities, and broader environmental consequences will be governed by the imperative to reduce costs.

The collective damages resulting from these technical choices will be considered by capitalists only when there is a legal obligation backed by effective enforcement and meaningful sanctions, so that non-compliance becomes more costly than the gains from violating the regulation. This is because, within a private economy, the increase in the rate of profit constitutes the ultimate objective of capitalists, regardless of the consequences of these social processes for humanity. As can be observed, the issue is thus expressed as an economic movement intrinsic to capitalist relations of production, rather than as a matter of differing viewpoints, improved awareness among social actors, or any subjective dimension of consciousness (or lack thereof).

The rupture in the metabolism between humans and nature, generated by the intensification of production relations under the capitalist mode of production, appears to be observable across multiple fields of analysis, including studies on water consumption, energy systems, waste production, transgenic crops and agrochemicals in food, ocean pollution, and climate science, among others. If the laws governing the historical form of capitalism orient a

metabolic rift with nature, then regulating this metabolism would require overcoming this mode of production itself.

In this sense, the metabolism between humans and nature must be restored as the regulating principle of social production. Marx (2014) thus seeks to transcend the contemporary form of social production in order to recover a harmonious relationship between humans and their inorganic body. The need to preserve this vital relationship with the land—and to secure it for future generations—underpins one of the fundamental imperatives for overcoming the idea of private ownership of land, which organizes the specific contemporary form of exploitation. As Marx argues:

> "From the standpoint of a higher socio-economic formation, the private ownership of the globe by single individuals will appear quite as absurd as the private ownership of one human being by another. Even an entire society, a nation, or all contemporaneous societies taken together are not the owners of the Earth. They are only its possessors, its usufructuaries, and, like *boni patres familias* [good heads of households], they must hand it down to succeeding generations in an improved condition" (Marx, 2018, p. 836).

This theoretical framework critiques the capitalist economy and recognizes the interrelation of these factors. It also considers the state of metabolic rupture between humans and nature in this historical period. The following section will discuss the rupture produced by capitalist agriculture and land concentration in Brazil.

The Agrarian Question, Land Concentration, and Agribusiness

The agrarian question and land concentration can be understood through Marx's theory of ground rent. Ground rent consists of the surplus produced by productive labor that is appropriated by the landowner (Marx, 2018). For Marx, the least fertile land determines the value of land, while more fertile lands enable the extraction of extraordinary profit. Marx identifies three forms of ground rent: differential rent, absolute rent, and monopoly rent (Marx, 2018). Differential rent is subdivided into two types: Type I, which varies according to differences in land location and/or fertility; and Type II, which arises from successive investments of capital in the soil, increasing productivity and reducing costs. Regarding absolute rent, the landowner obtains income even when owning less fertile land, since this form of rent derives from the monopoly of land itself (Marx, 2018). Given that agriculture generally exhibits a lower organic composition of capital than industry, it tends to have a lower price of production, which is sustained by land monopoly. By leasing land at the average price of production, the landowner appropriates the difference as absolute rent (Marx, 2018). Finally, monopoly rent arises from the ownership of rare land (land that cannot

be reproduced) which allows the landowner to charge a price above the average profit, thereby generating extraordinary gains in the form of monopoly rent (Marx, 2018).

One may interpret the increase in land concentration in parallel with absolute rent, as far as land concentration enhances monopoly power and sustains the possibility of lower productivity relative to industry. Concentration would thus lead to an increase in absolute rent, since the value of rent would remain below the average profit, allowing the landowner to appropriate that average profit.

The acquisition of more fertile and better-located land—such as through the occupation of Indigenous territories by agribusiness, for example—would contribute to the expansion of differential rent type 1. Likewise, the industrialization of agricultural production, marked by higher productivity and observed within agribusiness, contributes to the increase of differential rent type 2. It is also important to highlight disputes over rare lands or lands containing rare and non-reproducible raw materials. Undoubtedly, the political struggle over ownership of such lands, often underlying international wars and the colonial occupation of territories in peripheral countries, is deeply connected to Marx's concept of monopoly rent.[1]

The agrarian question is a complex issue and, consequently, far from presenting a unified perspective. Nevertheless, it has been consistently associated with land conflicts (Fernandes, 2008). In this sense, the perspective explored below addresses the set of problems and conflicts surrounding land tenure, use, and distribution, focusing on land concentration in Brazil and the relevance of agriculture and livestock production to the national economy, particularly over recent decades.

Although non-linear, land concentration has been historically promoted by the sesmaria system, the Land Law[2], and the absence of an effective agrarian reform, converging with the limited interest of the State in resolving this issue (Krajevski; Hernandez; Zeneratti, 2022). This situation persists in the present, despite significant transformations in agricultural production. The coffee cycle, industrialization, the Green Revolution of the 1970s, and the recent expansion of agribusiness constitute transformations that have not resulted in land deconcentration.

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[1] Another analytical possibility is to approach agribusiness through Marx's concepts of fictitious capital and interest-bearing capital (Marx, 2018). Fictitious capital consists of credit titles and property claims based on expectations of future returns and is therefore remunerated according to the average rate of profit rather than actual production (Marx, 2018). Agribusiness assets are not determined solely by production itself, but also by fictitious capital, such as stocks, derivatives, and securitization instruments, among others. Furthermore, agribusiness can be related to interest-bearing capital—that is, capital specialized in money lending and the extraction of interest—through mechanisms such as rural credit, bank credit notes, and debt securities issued by agricultural producers, among others. However, these analytical possibilities fall outside the scope of this study.

[2]Law No. 601 (the "Land Law") had as its main objective the establishment of private land ownership in the country (Stedile, 2005). According to Stedile (2005, p. 25), the law represents "[…] the baptism of latifundia in Brazil. It regulated and consolidated the model of large rural property, which remains the legal foundation of the unjust structure of land ownership in Brazil to this day."

The current hegemonic agricultural model in the country, commonly referred to as agribusiness, ultimately encompasses all productive relations in the Brazilian countryside (Silva, 2013). This perspective, however, obscures economic, social, and cultural relations. Although the term agribusiness carries multiple interpretations, the understanding underpinning this discussion can be synthesized in Michelotti's formulation, according to which agribusiness represents:

> "[…] a reconfiguration of agriculture that emphasizes its relations with industrial, commercial, and service sectors, revealing the updating of a long-standing power pact among different fractions of capital articulated with agro-industrial chains, large landholdings, and the State, within a context marked by the centrality of commodity exports" (Michelotti, 2024, p. 187).

Thus, agribusiness cannot be conflated with agricultural activities in general, much less with family farming, subsistence agriculture, or agrarian reform settlements. Moreover, agribusiness emerges directly from the capitalist mode of production, in which the relentless pursuit of capital accumulation is grounded, among other elements, in the intensive use of natural resources.

Financial globalization at the end of the last century, combined with trade liberalization in the early 1990s, contributed to the weakening of Brazil's industrial sector. Simultaneously, the rise in commodity prices at the beginning of the twenty-first century enabled a significant expansion of agriculture and livestock production, resulting in the reprimarization of the export agenda and deepening economic dependence. This model has therefore intensified the super-exploitation of natural resources while also contributing to the further concentration of land ownership. The pursuit of economic growth appears to disregard the limits imposed by nature. This limitation becomes increasingly evident in the context of global warming, ozone layer depletion, desertification processes, biodiversity loss, and the human appropriation of the products of photosynthesis (Merico, 1996).

Therefore, the economic relevance of agribusiness cannot be dissociated from the damages imposed on Brazilian society, since agribusiness has promoted, among other harms, "[…] extremely serious environmental problems (erosion, pollution, water waste, deforestation, genetic erosion through the destruction of biomes, the expansion of transgenics, etc.)" (Gonçalves, 2011, pp. 20–21). Although there are defenders of the slogan "agro is tech, agro is pop, agro is everything," reality indicates that adopting agribusiness as the central economic axis may be deeply compromising. Indeed, the negative environmental impacts—combined with their socially perverse effects—are economically and morally unsustainable (Moretti; Silva; Gonçalves, 2022).

Beyond the numerous benefits granted to agribusiness[3] at the expense of other economic sectors, environmental devastation and social injustice cannot be separated from agro-export activities (Acselrad, 2010). About environmental impacts, many of the damages caused by agribusiness are observed "[…] in the contamination of groundwater, rivers, wells, rainwater, soil, air, fauna, and flora" (Monteiro, 2022, p. 83). Quintana and Hacon (2011) emphasize that processes of expropriation and privatization mobilize nature primarily through an economic lens, noting that "[…] these processes share the progressive privatization of natural resources, and the concentration of wealth generated from their exploitation" (Quintana; Hacon, 2011, p. 442).

In this regard, three phenomena intricately linked to agribusiness stand out for their strong association with environmental devastation: wildfires, deforestation, and the use of agrochemicals (Carneiro *et al*., 2015). Wildfires and deforestation are "[…] technically responsible for the emission of carbon dioxide into the atmosphere" (Carneiro et al., 2015, p. 134), while the use of agrochemicals has promoted intense environmental contamination. Wildfires are directly associated with global warming and constitute the second largest source of greenhouse gas emissions (Mélo et al., 2011). Regarding deforestation,

> it is also a determining factor in the energy crisis, as it causes hydrological imbalance that affects hydroelectric power generation—hydropower accounts for more than two-thirds of the electricity produced in the country—reducing output and increasing prices, which in turn fuels inflation and suppresses economic activity (Saccaro Júnior, 2016, p. 27).

Regarding agrochemicals, their indiscriminate use has increased significantly in Brazil over recent decades. Some of these substances are "[…] scientifically recognized as harmful to public health and the environment, prohibited in other countries, yet continue to circulate in Brazil" (Carneiro et al., 2015, p. 129). This reality is consistent with the fact that Brazil has ranked first in global agrochemical consumption since 2008 (Batista, 2015).

Therefore, the relationship between the expansion of agribusiness, with the active participation of the State, cannot be dissociated from contemporary climate crises. This situation is further intensified by the increase in land concentration in Brazil, as evidenced by the two most recent Agricultural Censuses (2006 and 2017). For example, agricultural establishments larger than 1,000 hectares expanded their share of total land area from 45% to 47.5%, corresponding to 16.5 million hectares, while smaller units (up to ten hectares) account for 50.2% of rural properties but occupy only 2.3% of the total area (Alentejano, 2020).

[3]In most Brazilian states, agrochemicals are exempt from taxation (Carneiro *et al*., 2015). The costs borne by Brazilian society are substantial, including economic costs (subsidies and preferential financing conditions), social costs (inequality and land concentration), and environmental costs (energy sources and biodiversity loss).

When considering both the number of agricultural establishments and the land area they occupy during the 2006–2017 period, the changes are substantial. In 2006, the number of agricultural establishments totaled 5,175,636, decreasing to 5,073,324 in 2017 (IBGE, 2012, 2017). This represents a reduction of 102,312 agricultural establishments over the period. However, total land area increased by 17,609,779 hectares. These figures suggest an intensification of land concentration and corroborate the expansion of the agricultural frontier. Table 1 below presents these data disaggregated by Brazilian mesoregions.

Table 1: Agricultural establishments and land area, by mesoregion, 2006 and 2017.

Regions	Number of establishments (2006)	Number of establishments (2017)	Total land area of establishments (2006)	Total land area of establishments (2017)
North	475,778	580,613	55,535,764	65,213,349
Northeast	2,454,060	2,322,719	76,074,411	70,893,865
Central-West	317,498	347,263	105,351,087	112,004,322
Southeast	922,097	969,415	54,937,773	60,302,969
South	1,006,203	853,314	41,781,003	42,875,310
Brazil	5,175,636	5,073,324	333,680,037	351,289,816

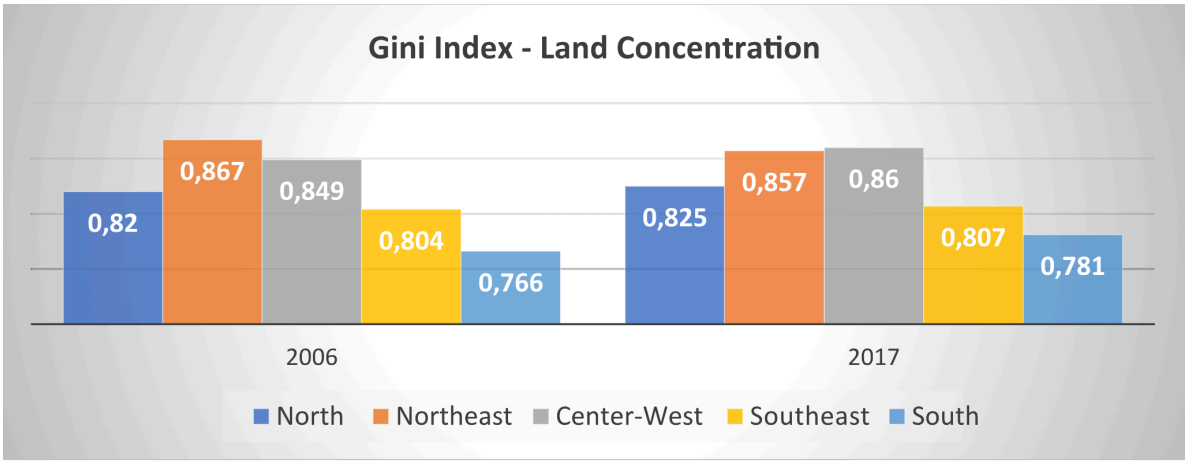
Source: Prepared by the authors based on IBGE (2012; 2017).

An examination of the mesoregions reveals significant differences. Regarding the number of establishments, the Northeast (–131,341) and especially the South (–152,889) experienced sharp reductions, while the remaining regions recorded increases, with the North standing out, having added 104,835 new establishments. In terms of land area, only the Northeast registered a reduction, amounting to 5,180,546 hectares. All other regions experienced expansion, with the North showing the largest increase, totaling 9,677,585 hectares.

Land concentration can also be observed through the Land Concentration Gini Index[4] (LCGI). Considering the most recent Brazilian Agricultural Censuses, changes indicate increasing concentration levels: 0.859 (1985), 0.858 (1996), 0.865 (2006), and 0.867 (2017) (Krajevski, 2022). Figure 1 illustrates this variation across Brazilian mesoregions based on the two most recent Agricultural Censuses.

Figure 1: Gini Index – land concentration, by mesoregion, 2006 and 2017.

[4]This indicator, calculated from census data, contributes to assessing transformations in land distribution patterns in the country. The index ranges from 0.000 to 1.000, with values closer to zero indicating lower land concentration and values closer to one indicating higher levels of land concentration.



Source: Prepared by the authors based on Agricultural Census data (IBGE, 2006; 2017).

The results indicate an increase in land concentration in four of Brazil's five mesoregions, with the Northeast as the sole exception. According to the classification[5] proposed by Câmara (1949), all regions can be categorized as exhibiting "strong to very strong" land concentration. In the comparison among Brazilian states, including the Federal District, land concentration increased in fifteen federative units and declined in eleven, while the state of Rio de Janeiro showed no variation (IBGE, 2012; 2017). All states also displayed "strong to very strong" levels of land concentration, with particular emphasis on Roraima, which shifted from the "medium to strong" range (0.683) to the "strong to very strong" category (0.811).

Expanded Reproduction of Devastation: A Regionalized Reading of Data

This section examines the environmental impacts of agribusiness in Brazil between 2006 and 2017, drawing on regionalized data on wildfires, deforestation, and the use of agrochemicals. This temporal and spatial framework—aligned with the IBGE Agricultural Censuses—allows for the identification of structural trends resulting from the metabolic rift between capital and nature, strongly associated with the land concentration that underpins agribusiness.

As discussed previously, land concentration sustains an agricultural model oriented toward commodity exports, characterized by the intensive use of land, inputs, and precarious labor. This configuration expresses an inverted metabolism typical of peripheral countries, in which environmental destruction and the deterioration of workers' living conditions constitute intrinsic components of capital reproduction (Marini, 2011).

[5] Câmara's (1949) classification system distributes the Land Concentration Gini Index (LCGI) into six ranges: 1st: 0.000–0.100 – null concentration; 2nd: 0.101–0.250 – null to weak; 3rd: 0.251–0.500 – weak to medium; 4th: 0.501–0.700 – medium to strong; 5th: 0.701–0.900 – strong to very strong; 6th: 0.901–1.000 – very strong to absolute concentration.

The advance of agribusiness over new agricultural frontiers (particularly in the North and Center-West regions) materializes the mechanisms of territorial domination and value extraction previously discussed. The incorporation of new areas into capital's productive circuit occurs through instruments that systematically destroy ecosystems: the use of fire as a land-clearing technique, the suppression of native vegetation for conversion into pastureland and cropland, and the intensification of agrochemical use as a structural support for the extensive monoculture model. These processes are not collateral effects, but rather structural components of agro-export expansion, whose production logic inherently requires environmental devastation as a precondition for accumulation.

The use of **fire** has become consolidated as a method for converting native vegetation into pastureland, driven by the expansion of agricultural frontiers and the search for cleared land through rapid and low-cost means (Ramos Júnior et al., 2023). The systematic use of burning across all regions (Figure 2) reflects the fragility of fire prevention policies and the limited effectiveness of fire control during prolonged dry seasons.

Figure 2: Fire hotspots by Brazilian region (2006–2017).

Source: Prepared by the authors based on MapBiomas, 2025.

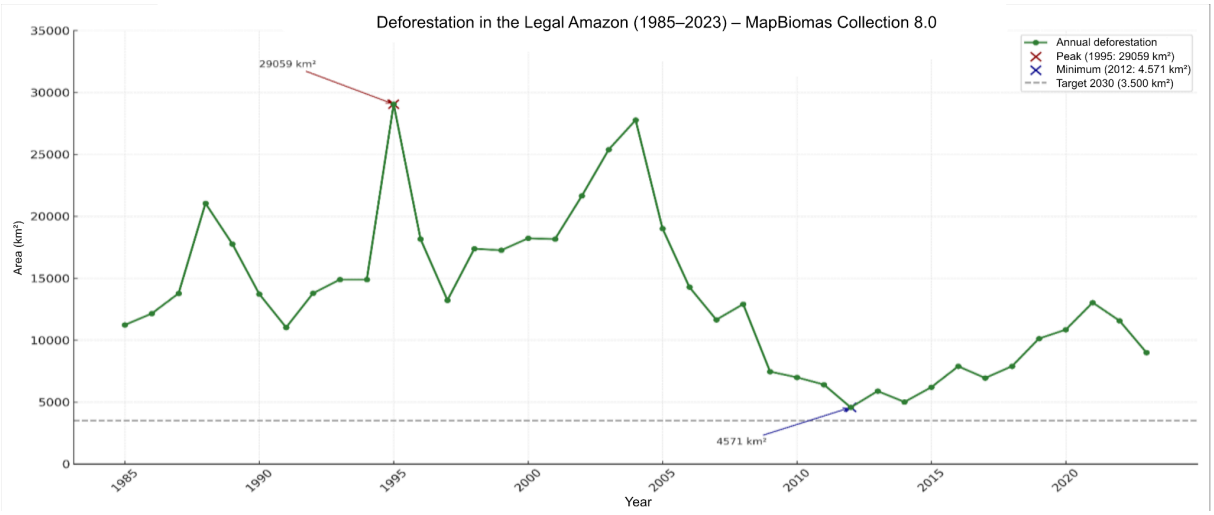
Between 2006 and 2017, there is a marked concentration of fire hotspots in the North and Center-West regions, with annual peaks exceeding 120,000 records in 2007, 2010, and 2017. These regions encompass the so-called Arc of Deforestation—a geographic belt located along the eastern and southern frontiers of the Brazilian Amazon—as well as the country's main hubs of soybean, corn, and cattle production (IBGE, 2022). The use of fire, converted into a soil preparation technology, occurs primarily in August and September, during the dry season preceding planting. This seasonal regularity indicates that fires are not sporadic events, but rather function as a formal stage of the agro-livestock cycle, synchronized with national and international cropping calendars. A study conducted by Chain Reaction Research (2020) demonstrated that 42% of all fire hotspots detected in Brazil

between July and October 2019 occurred within the potential purchasing zones of the largest meatpacking companies operating in the Amazon, such as JBS and Marfrig. This finding reveals a structural association between burning practices, the expansion of cattle ranching, and pressure for new productive areas. The same study indicates that, in the vicinity of silos operated by major grain trading companies—such as Bunge and Cargill—the intensive presence of fires likewise suggests environmental externalities embedded within the soybean value chain.

Fire statistics recorded in the Northeast, particularly between 2007 and 2012, indicate continuous pressure on semi-arid ecosystems such as the Caatinga. In the South and Southeast, fire peaks reveal agricultural frontiers still undergoing expansion, alongside shortcomings in environmental enforcement. The severe drought of 2007 intensified the spread of fires (Porto-Gonçalves, 2006), demonstrating the interrelation between anthropogenic pressures and extreme climatic conditions.

The use of **deforestation** as a land conversion strategy can be observed in Figure 3. The transformation of forests and savannas into pastureland and cultivated areas points to a long-standing practice in Brazil, rooted in a productivist logic that prioritizes immediate gains at the expense of ecosystems.

Figure 3: Historical Series of Deforestation in the Amazon (1987–2023).



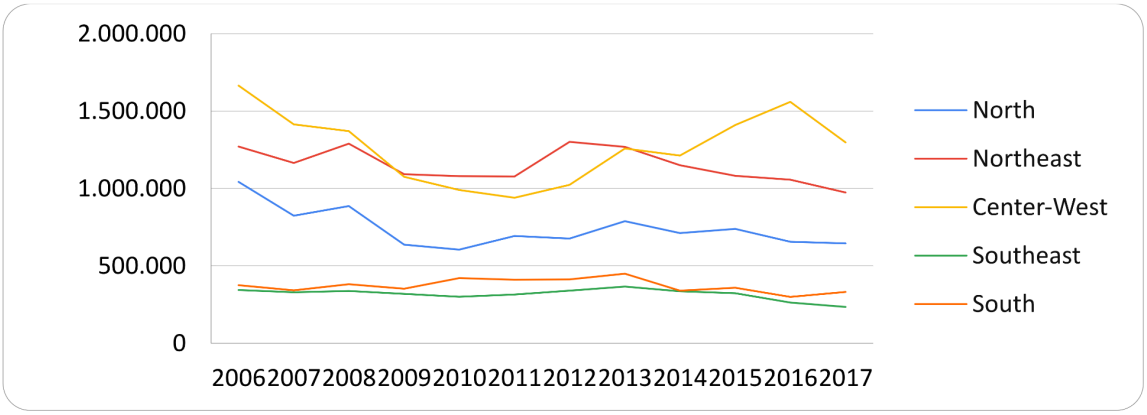
Source: Prepared by the authors based on MapBiomas, 2025.

Between 1985 and 2023, deforestation in the Legal Amazon reached its peak in 1995, with 29,059 km² cleared, followed closely by 2004, when 27,772 km² were deforested—an inflection point that marked the beginning of control policies such as the Action Plan for the Prevention and Control of Deforestation in the Legal Amazon (PPCDAm). The lowest value in the series was recorded in 2012, at 4,571 km². After a renewed increase,

deforestation rates began to decline again from 2019 onward, reaching 9,001 km² in 2023. Although still far from the target of 3,500 km² per year, these figures suggest a downward trend.

The historical trajectory of deforestation in the Amazon reflects sustained pressure from agribusiness on agricultural frontiers, with more than 90% of deforested areas converted into pastureland (MapBiomas, 2021). The MapBiomas Annual Deforestation Report (RAD) indicates that, in 2021, 97% of deforestation was driven by agricultural and livestock activities (MapBiomas, 2022). This result underscores the environmental impact of the expansion of extensive cattle ranching and monoculture farming, evidencing territorial occupation and the destruction of biomes for productive purposes. Figure 4 illustrates the suppression of native vegetation by Brazilian region between 2006 and 2017.

Figure 4: Suppression of native vegetation, in million hectares, by region (2006–2017).

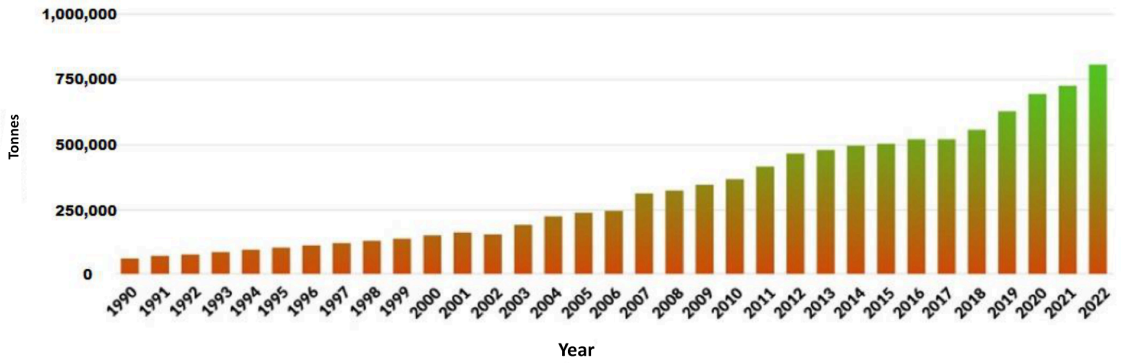


Source: Prepared by the authors based on MapBiomas, 2025.

The results indicate the persistence of elevated levels of vegetation suppression throughout the period analyzed, with a slight average decline until 2011, followed by a subsequent resurgence. The persistence of these elevated levels points to the continued expansion of agricultural frontiers in response to market incentives and adjustments in the regulatory framework. In the North, the conversion of the Legal Amazon into pastureland and cropland remained intense, driven by global commodity chains. In the Center-West, the Cerrado has experienced significant pressure to accommodate large-scale grain monocultures. In the Northeast, the transformation of Caatinga and Atlantic Forest areas reveals that agricultural expansion has also affected ecosystems historically marginalized in national development strategies.

The sharp increase in **agrochemical** use during the observed period (Figure 5) points to an agricultural model highly dependent on chemical inputs, aligned with the diffusion of transgenic seeds and the intensification of export-oriented agribusiness. Beyond scientific and technological dependence (typical of peripheral countries) this dynamic raises serious concerns regarding public health, contamination of water sources, and the loss of soil biodiversity, given the correlations between prolonged exposure to agrochemicals, the increase in chronic diseases, and cumulative damage to ecosystems (Lopes; Albuquerque, 2018).

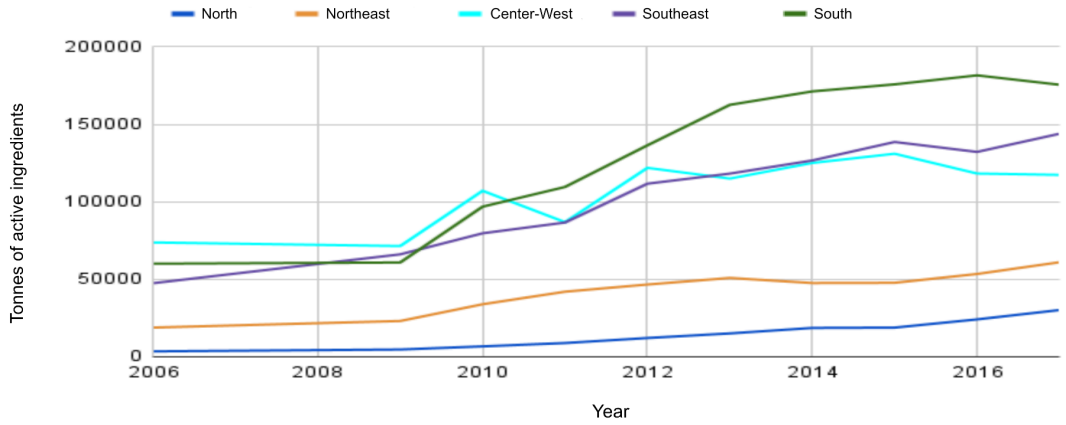
Figure 5: Historical Series of Agrochemical Consumption in Brazil (1990–2022).



Source: Prepared by the authors based on FAO, 2025.

The historical series of agrochemical use in Brazil reveals a trajectory of continuous growth since at least 2002, with successive year-on-year increases. This pattern evidences a structural trend toward the intensification of chemical inputs as a central pillar of the agro-export model. This growth is not associated with consumer demand, but rather with supply-side logic: agrochemicals constitute production inputs whose application benefits producers, while being imposed on the environment and the broader population as a negative externality. The massive use of agrochemicals (Figure 6), therefore, aligns with the productivist rationality of large-scale monoculture, favoring productivity gains while transferring social and environmental costs—such as soil and water contamination and health risks—to society as a whole.

Figure 6: Annual volume of agrochemicals marketed in Brazil, by region (2006–2017).



Source: Prepared by the authors based on IBAMA, 2018.

Figure 6 illustrates the marked expansion in agrochemical consumption between 2006 and 2017 (data for 2007 and 2008 were not published). In the Center-West region, volumes increased from 63,136 tons (2006) to 178,539 tons (2017), followed by similarly important levels in the South (from 57,744 tons to 143,902 tons) and the Southeast (from 70,963 tons to 119,156 tons). In the North, the predominance of continuous forest territories characteristic of the Legal Amazon imposes constraints on the expansion of large-scale monocultures and on the establishment of logistical distribution networks for inputs. As a result, the intensive agrochemical model has penetrated more slowly in this region (Anaruma Filho et al., 2015). Nevertheless, consumption increased sharply, from approximately 3,024 tons (2006) to 27,820 tons (2017). In the Northeast, although recent agricultural frontier expansion is observed, part of production remains concentrated in smaller family-based units with lower levels of mechanization, which reduces absolute agrochemical use. Even so, consumption increased from 16,782 tons to 50,142 tons over the period, possibly reflecting frontier expansion dynamics.

Additionally, when considering the average annual density of active ingredient sales per unit of agricultural area, states in the Southeast—such as São Paulo, which reached 10.37 kg/ha in 2012—and in the Center-West—such as Goiás and Mato Grosso, with 8.29 kg/ha in 2013 and 7.30 kg/ha in 2016, respectively—exhibit concentrations well above the national average (Landau et al., 2020). In recent years, states in the North region (Rondônia, 9.24 kg/ha in 2017; Acre, 9.88 kg/ha in 2017; Roraima, 9.68 kg/ha in 2014) have surpassed some Southern states (such as Santa Catarina, 8.22 kg/ha in 2015), evidencing the inland expansion of intensive agrochemical use. The Northeast continues to present lower densities, although on an upward trend (Bahia and Maranhão, 6.46 kg/ha and 5.73 kg/ha in 2017, respectively) (Landau et al., 2020).

Many of the agrochemicals used in Brazil are prohibited in the very countries where they are manufactured, being produced, and exported to supply a less regulated and more permissive market (Friedrich et al., 2021). As the world's largest consumer of these substances, Brazil alone surpasses the combined usage recorded in the United States and China, the two countries that follow in the global ranking (FAO, 2021). This scenario reveals a profound global regulatory asymmetry, which transforms Brazilian territory into a destination for substances rejected elsewhere. In the name of large-scale production and the profitability of an agrarian elite, less productive and less safe technological arrangements expose the population to severe environmental and health risks, imposing on society the burden of a poison that sustains the profits of a few.

Closing remarks

The integration of indicators related to wildfires, deforestation, and agrochemical use reveals that Brazilian agribusiness operates through an inverted metabolism, in which capital accumulation is sustained by the systematic destruction of natural resources. Territorial expansion, marked by land concentration, displaces frontiers of devastation that manifest in regionally specific ways, yet produce impacts of national and global reach. Wildfires have become a routine stage of soil preparation; deforestation persists at elevated levels; and the intensive use of agrochemicals consolidates technological dependence while exacerbating risks to public health and biodiversity.

The convergence of these three indicators demonstrates that regions characterized by high land concentration and export-oriented production—particularly the North and Center-West—also exhibit the highest levels of burning, deforestation, and agrochemical use. This complex set of pressures illustrates how agribusiness functions as a vector of the expanded reproduction of devastation, advancing agricultural frontiers at the expense of environmental integrity and human health.

In this sense, Brazilian land concentration— which has intensified in recent years and is strongly associated with agribusiness—stimulates the intensive and predatory exploitation of natural resources. The dominant pattern of Brazilian agribusiness, especially as expressed through wildfires, deforestation, and excessive agrochemical use, compromises the survival and integrity of ecosystems. Moreover, it accelerates greenhouse gas emissions, undermines soil fertility, and threatens biodiversity. By subordinating

territories and natural resources to capitalist logic, agribusiness promotes a rupture in the human–nature metabolism, intensifying regional and global climate change.

Overcoming the current model requires intersectoral articulation, social mobilization, and structural transformation that goes beyond mere incremental reforms. Only through such transformations will it be possible to restore natural cycles and secure a future compatible with the maintenance of human life and ecosystem integrity. In this regard, further research is needed to explore alternatives for constructing a new social metabolism with nature. Among future research agendas, particular attention should be given to deepening the hypothesis that environmental destruction does not merely constitute a negative externality of capitalist development, but rather a structural and indispensable component of its very logic of reproduction.

References

ACSELRAD, H. Ambientalização das lutas sociais – o caso do movimento por justiça ambiental. **Estudos Avançados**, Dossiê teorias socioambientais, [*S.l.*], v. 24, n. 68, p. 103-119, 2010. https://doi.org/10.1590/S0103-40142010000100010

ALENTEJANO, P. A hegemonia do agronegócio e a reconfiguração da luta pela terra e reforma agrária no Brasil. **Caderno Prudentino de Geografia***,* Presidente Prudente, n. 42, v. 4, p. 251-285, 2020.

ANARUMA FILHO, F.; MENGATTO JUNIOR, E. A.; SANTOS, J. L.; SILVA, J. S. V.; POSSAN, L. H. J. Importância do SIG no Zoneamento Ecológico Econômico da Amazônia Legal. SIMPÓSIO BRASILEIRO DE SENSORIAMENTO REMOTO, 17., 2015, João Pessoa. **Anais** […]. São José dos Campos: INPE, 2015. p. 7463–7470.

ANDERSON, Perry. **Passagens da Antiguidade ao Feudalismo**. Tradução de Beatriz Sidou. São Paulo: Brasiliense, 2000.

ARTAXO, P. Mudanças climáticas: caminhos para o Brasil. **Cienc. Cult.,** São Paulo, v. 74, n. 4, 2022. http://dx.doi.org/10.5935/2317-6660.20220067.

BATISTA, E. Crise econômica e crise ambiental: desenvolvimento e reestruturação produtiva (in)sustentável. SEMINÁRIO INTERNACIONAL DE PÓS-GRADUAÇÃO EM CIÊNCIAS SOCIAIS, 1., 2015, Marília, 2015. p. 1-16. **Anais** [...]. Marília: UNESP, 2015.

CÂMARA, L. A concentração da propriedade agrária no Brasil. **Boletim Geográfico**, [*S.l.*], v. 7, n. 77, p.516-528. Available at: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=719 Accessed on: June 10, 2025.

CARNEIRO, F. F.; DELGADO, G.; AUGUSTO, L. G. S.; ALMEIDA, V. E. S.; PESSOA, V. M. Os impactos dos agrotóxicos no contexto do agronegócio. *In:* Araújo, M. M. *et al*. (orgs.). **A agricultura familiar e o direito humano à alimentação**: conquistas e desafios. Brasília: Câmara dos Deputados, Edições Câmara, 2015. p. 168.

CHAIN REACTION RESEARCH. **Cattle-driven deforestation and supply chain risk in Brazil**. Amsterdam: CRR/Aidenvironment, 2020. Available at: https://chainreactionresearch.com/report/cattle-driven-deforestation-and-supply-chain-risk-in-brazil/. Accessed on: January 20, 2025.

ENGELS, Friedrich. [Prefácio à segunda edição de O Capital, Volume II, 1885]. In: MARX, Karl. **O Capital:** crítica da economia política. Livro II: O processo de circulação do capital. 2. ed. São Paulo: Boitempo, 2014. p. 11-18.

FAO. Organização das Nações Unidas para Alimentação e Agricultura. **Relatório sobre o uso de agrotóxicos no mundo**: comparações globais. Roma: FAO, 2021.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS – FAO. **Pesticides use and trade, 1990–2021**: analytical brief. Roma: FAO, 2025.

FRIEDRICH, K.; SILVEIRA, G. R.; AMAZONAS, J. C.; GURGEL, A. M.; ALMEIDA, V. E. S.; SARPA, M. International regulatory situation of pesticides authorized for use in Brazil: potential for damage to health and environmental impacts. **Cadernos de Saúde Pública**, Rio de Janeiro, v. 37, n. 4, e00061820, 14 maio 2021. https://doi.org/10.1590/0102-311X00061820.

FERNANDES, B. M. Conflitualidade e desenvolvimento territorial. *In:* BUAINAIN, A. M. (coord.). **Luta pela terra, reforma agrária e gestão de conflitos no Brasil**. Campinas, SP: Editora da UNICAMP, 2008. p. 173-230.

FOSTER, J. B. **A ecologia de Marx**: materialismo e natureza. São Paulo: Expressão popular, 2023.

PORTO-GONÇALVES, Carlos Walter. **A globalização da natureza e a natureza da globalização**. Rio de Janeiro: Civilização Brasileira, 2006.

GONÇALVES, S. A globalização do agronegócio e a destruição do campesinato no século XXI. **Ateliê Geográfico**, Goiânia, v. 5, n. 2, p. 1-23, 2011. https://doi.org/10.5216/ag.v5i2.15500.

GORENDER, J. **O escravismo colonial**. São Paulo: Perseu Abramo, 2016.

IBGE. Instituto Brasileiro de Geografia e Estatística. **Censo agropecuário 2006** – segunda apuração. Rio de Janeiro: IBGE, 2012.

IBGE. Instituto Brasileiro de Geografia e Estatística. **Censo agropecuário 2017**. Rio de Janeiro: IBGE, 2017. Available at: https://sidra.ibge.gov.br/pesquisa/censo-agropecuario/censo-agropecuario-2017/resultados-definitivos. Accessed on: June 18, 2025.

IBGE. Instituto Brasileiro de Geografia e Estatística. **Pesquisa da Pecuária Municipal**: resultados 2022. Rio de Janeiro: IBGE, 2023. Available at: https://biblioteca.ibge.gov.br/index.php/biblioteca-catalogo?view=detalhes&id=784. Accessed on: June 18, 2025.

INSTITUTO BRASILEIRO DO MEIO AMBIENTE E DOS RECURSOS NATURAIS RENOVÁVEIS – IBAMA. **Relatórios de comercialização de agrotóxicos – 2018**. Brasília, DF: Ibama, 2018. Available at: https://www.ibama.gov.br/component/phocadownload/file/5591-relatorios-. Accessed on: June 18, 2025.

KRAJEVSKI, L. C. A concentração fundiária no Território da Cidadania Planalto Norte – Santa Catarina, Brasil. **Revista NERA**, São Paulo, v. 25, n. 64, p. 203-227, 2022. https://doi.org/10.47946/rnera.v25i64.8521

KRAJEVSKI, L. C.; HERNANDEZ, M. G.; ZENERATTI, F. L. Estrutura fundiária no Território Cantuquiriguaçu/PR: problemas históricos e dinâmicas recentes. **Geosul**, Florianópolis, v. 37, n. 84, p. 233-255, 2022. https://doi.org/10.5007/2177-5230.2022.e83909

LANDAU, E. C.; SILVA, G. A.; MOURA, L.; HIRSCH, A.; GUIMARÃES, D. P. (orgs.). **Dinâmica da produção agropecuária e da paisagem natural no Brasil nas últimas décadas**: sistemas agrícolas, paisagem natural e análise integrada do espaço rural. Brasília, DF: Embrapa, 2020. v. 4, cap. 52, p. 1823-1901.

LOPES, C. V. A.; ALBUQUERQUE, G. S. C. Agrotóxicos e seus impactos na saúde humana e ambiental: uma revisão sistemática. **Saúde em Debate**, Rio de Janeiro, v. 42, n. 117, p. 183–196, abr./jun. 2018. https://doi.org/10.1590/0103-1104201811714.

MAPBIOMAS. **Relatório Anual de Supressão de Vegetação**. São Paulo: Projeto MapBiomas, 2021.

MAPBIOMAS ALERTA – Projeto MapBiomas. **Relatório Anual do Desmatamento no Brasil 2021** – Destaques (RAD 2021). São Paulo: MapBiomas, june, 2022. Available at:https://alerta.mapbiomas.org/wp-content/uploads/sites/17/2024/05/RAD2021_DESTAQUES_FINAL_rev1.pdf. Accessed on: June 18, 2025.

MARINI, R. M. Dialética da dependência. *In*: TRASPADINI, R.; STEDILE, J. P. **Ruy Mauro Marini -** vida e obra. São Paulo: Expressão Popular, 2011. p. 131-172.

MARX, K. **O Capital**: crítica da economia política. Livro I. São Paulo: Boitempo, 2014.

MARX, K. **O Capital**: crítica da economia política. Livro III. São Paulo: Boitempo Editorial, 2018.

MEILLASSOUX, Claude. **Mulheres, Celeiros e Capitais: Ensaio de Antropologia Econômica**. Tradução de Maria Leonor F. R. de Oliveira. Porto: Afrontamento, 1977.

MÉLO, A. S.; JUSTINO, F. LEMOS, C. F.; SEDIYAMA, G.; RIBEIRO, G. Suscetibilidade do ambiente a ocorrências de queimadas sob condições climáticas atuais e de futuro aquecimento global. **Revista Brasileira de Meteorologia**, [*S.l.*], v. 26, n. 3, p. 401-418, 2011. https://doi.org/10.1590/S0102-77862011000300007

MERICO, L. F. K. **Introdução à economia ecológica**. Blumenau: Ed. da FURB, 1996.

MONTEIRO, D. M. L. V. Processos de espoliações no Brasil atual: ofensivas do agronegócio sobre os direitos ambientais e territoriais. **Revista Tamoios**, São Gonçalo, v. 18, n. 1, p. 74-95, 2022. https://doi.org/10.12957/tamoios.2022.63317.

MONTOYA, M. A.; BERTUSSI, L. A.; LOPES, R. L.; FINAMORE, E. B. Uma nota sobre consumo energético, emissões, renda e emprego na cadeia de soja no Brasil. **Revista Brasileira de Economia**, [*S.l.*], v. 73, n. 3, 2019. https://doi.org/10.5935/0034-7140.20190016

MORETTI e SILVA, L. M.; GONÇALVES, A. H. O agronegócio brasileiro e as mudanças climáticas globais. **Encontro Internacional de Gestão, Desenvolvimento e Inovação (EIGEDIN)**, [*S.l.*], v. 6, n. 1, 2022. Available at:

https://periodicos.ufms.br/index.php/EIGEDIN/article/view/15764. Accessed on: June 18, 2025.

MICHELOTTI, F. Agronegócio. *In:* CRUZ, V. C. *et al* (org.). **Dicionário de ecologia política**. Rio de Janeiro: Consequencia Editora, 2024. p. 714.

QUINTANA, A. C.; HACON, V. O desenvolvimento do capitalismo e a crise ambiental. **O Social em Questão,** [*S.l.*], n. 25/26, p.427-444, 2011. Available at: https://www.redalyc.org/articulo.oa?id=552256749020. Accessed on: June 18, 2025.

RAMOS JÚNIOR, D. V.; AGUIAR, V. G.; KANTAMANENI, K. Mapping Fire: The Case of Matopiba. **IDS Bulletin**, [*S.l.*], v. 54, n. 1, 2023. https://doi.org/10.19088/1968-2023.108.

SACCARO JÚNIOR, N. L. A conexão entre crise econômica e crise ambiental no Brasil. **IPEA – Boletim Regional, Urbano e Ambiental**, Brasília, n. 13, 2016.

SILVA. A. B. Questão agrária em questão. *In:* REIS, A. T.; BATISTA, A. F. (org.). **Ensaios sobre a questão agrária**. São Paulo: Outras expressões, 2013. p. 137-149.

STEDILE, J. P. (org.). **A questão agrária no Brasil 2:** O debate na esquerda: 1960-1980. São Paulo: Expressão Popular, 2005. p. 17-33.

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The scientific contributions presented in the article were jointly developed by the authors. Author **Luis Claudio Krajevski** was responsible for conceptualization, formal analysis, investigation, methodology, supervision, validation, visualization, and writing (original draft, review, and editing). Author **Gabriela Caramuru Teles** was responsible for conceptualization, formal analysis, investigation, methodology, visualization, and writing (original draft, review, and editing). Author **Arthur Martins Bosquerolli** was responsible for conceptualization, data curation, investigation, methodology, validation, visualization, and writing (original draft, review, and editing).

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