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RIDES

THE PERSISTENCE OF FAMILY FARMING UNDER THE AEGIS OF CAPITALISM: FROM CLASSICAL DEBATES TO CONTEMPORARY DYNAMICS OF APPROPRIATION AND SUBSTITUTION

A persistência da agricultura familiar sob a égide do capitalismo: dos debates clássicos às dinâmicas contemporâneas de apropriação e substituição

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ABSTRACT: This essay analyzes the theoretical foundations explaining the persistence of family farming amidst the development of the capitalist mode of production. Although the classical Marxist formulations of Karl Marx, Vladimir Ilyich Lenin, and Karl Kautsky predicted the gradual dissolution of the peasantry and its replacement by a bimodal, purely capitalist agrarian structure, post-war empirical reality established family farming as the hegemonic form of rural production in developed countries. To explain this contradiction, the sociology of agriculture has formulated alternative theses within the realm of neo-Marxism. On one hand, the essay analyzes approaches based on "simple commodity production" — developed by Claude Servolin and Harriet Friedmann — which emphasize the logic of family reproduction and the functionality of this category for urban-industrial capital accumulation. On the other, it examines the "natural obstacles" theses of Susan Mann and James Dickinson, highlighting the mismatch between labor time and production time as a barrier to the direct penetration of capital into the primary production sphere. Finally, the essay discusses the fragmented industrialization of agriculture through the concepts of "appropriationism" and "substitutionism"—formulated by David Goodman, Bernard Sorj, and John Wilkinson—and celebrates the nearly 40-year legacy of this seminal work, updating it to interpret contemporary Brazilian dynamics of automation, bio-industrialization, and the consequent value compression within agricultural holdings, all of which are redefining productive autonomy and rural dualism.

Keywords: Family Farming; Capitalism; Appropriationism; Substitutionism; Crushing of Value.

RESUMO: *O ensaio analisa as bases teóricas que explicam a persistência da agricultura familiar no âmbito do desenvolvimento do modo de produção capitalista. Embora as formulações marxistas clássicas de Karl Marx, Vladimir Ilich Lênin e Karl Kautsky tenham previsto a dissolução gradual do campesinato e sua substituição por uma estrutura agrária bimodalizada e puramente capitalista, a realidade empírica pós-guerra consolidou a agricultura familiar como forma hegemônica de produção rural nos países desenvolvidos. Para explicar essa contradição, a Sociologia da Agricultura formulou teses alternativas no campo do neomarxismo. Analisam-se, de um lado, as abordagens baseadas na produção mercantil simples de Claude Servolin e Harriet Friedmann, que enfatizam a lógica de reprodução familiar e a funcionalidade dessa categoria para a acumulação de capital urbano-industrial. De outro, examinam-se as teses dos obstáculos naturais de Susan Mann e James Dickinson, que destacam o descompasso entre o tempo de trabalho e o tempo de produção como barreira à penetração direta do capital na esfera produtiva primária. Por fim, discute-se a industrialização fragmentada da agricultura por meio dos conceitos de apropriacionismo e substitucionismo formulados por David Goodman, Bernard Sorj e John Wilkinson, e celebra-se o legado de quase 40 anos dessa obra seminal, atualizando-a para interpretar as dinâmicas brasileiras contemporâneas de automatização, bioindustrialização e o consequente esmagamento do valor na propriedade agrícola, que redefinem a autonomia produtiva e o dualismo no meio rural.*

Palavras-chave: *Agricultura Familiar; Capitalismo; Apropriacionismo; Substitucionismo; Esmagamento do Valor.*

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INTRODUCTION

The relationship between the capitalist mode of production and the agricultural sector constitutes one of the most enduring and complex debates in rural social sciences. Historically, the transition from feudalism to capitalism triggered profound transformations in the agrarian structure, altering land ownership, the organization of labor, and the allocation of productive surpluses. At the heart of this modernization process was the so-called "agrarian question," whose initial concern was to investigate whether the establishment of the capitalist mode of production would inevitably lead to the destruction of peasant forms of production and the generalization of an agrarian class structure based on the polarization between large rural capitalists and agricultural wage laborers (Schneider, 2003; Plein, 2016).

In the classical formulations of late nineteenth-century social thought, particularly those rooted in the Marxist tradition, there was broad consensus regarding the diagnosis: peasants and small family producers would have no future under capitalism. The technical superiority of large-scale industrialized farms and the overwhelming force of the capitalist division of labor would relegate small-scale commodity production to the status of a historical anachronism, destined for dissolution and proletarianization. From this perspective, agriculture was expected to undergo the same process of centralization and concentration observed in industrial production, transforming the farm into an open-air factory controlled by large agricultural corporations (Schneider, 2003; Plein, 2016).

However, the economic history of the twentieth century, particularly during the post–World War II period (1945–1973), known as the "Golden Age" of capitalism (Hobsbawm, 1995), revealed an empirical scenario radically different from classical predictions. In core countries where industrial and financial capitalism developed most extensively and reached its highest degree of maturity, such as those in Western Europe and North America, peasants did not disappear. Instead, agricultural units based on family labor became consolidated and overwhelmingly predominant (Veiga, 1991; Abramovay, 1992; Lamarche, 1993). Family farming, far from being eliminated, became a dynamic pillar of the domestic supply of food and raw materials, demonstrating a degree of resilience and adaptability that challenged development theorists.

This empirical paradox prompted a conceptual shift in the Sociology of Agriculture. Beginning in the 1970s, the analytical focus moved away from predicting when the peasantry would disappear and toward a scientific understanding of the mechanisms and factors explaining the persistence of agricultural units based on family labor under capitalism (Schneider, 2003). The debate came to center on two major neo-Marxist explanatory approaches. The first, sociopolitical and organizational in nature, emphasizes the internal specificities of simple commodity production and the reproductive logic of the family unit, particularly in the works of Claude Servolin and Harriet Friedmann. The second approach emphasizes the biophysical and geographical particularities of agriculture, arguing that nature imposes structural obstacles to the direct and complete penetration of capital into primary production. Prominent contributions to this perspective include those of Susan Mann and James Dickinson, as well as the work of David Goodman, Bernardo Sorj, and John Wilkinson (Schneider,

2003).

The main objective of this essay is to revisit this extensive theoretical debate while extending the analysis to contemporary transformations affecting rural areas in the twenty-first century. To this end, the article first examines the classical theoretical legacy of Marx, Lenin, and Kautsky, contrasting their predictions with postwar empirical developments. It then discusses neo-Marxist formulations concerning simple commodity production and the natural obstacles to capitalist penetration. Subsequently, the analysis turns to the theory of the fragmented industrialization of agriculture through the concepts of appropriationism and substitutionism developed by David Goodman, Bernardo Sorj, and John Wilkinson, while commemorating nearly 40 years since the publication of *From Farming to Biotechnology*. Finally, the article updates these analytical categories to examine contemporary dynamics of automation and bioindustrialization, as well as the phenomenon of "value squeezing" at the farm level, discussing their implications for the agrarian development model and the autonomy of family farmers, with particular emphasis on the Brazilian context.

METHODOLOGICAL NOTES

The method consists of an extensive literature review and systematizations developed since the author's Master's program in Rural Development, continuing throughout the doctoral program and, more recently, as part of the preparation of teaching materials (Plein, 2016). Accordingly, this essay is also intended to serve as supporting material for undergraduate courses such as Agrarian Question, Ruralities and Regional Development in Social Work; Agroindustrial and Cooperative Management in Business Administration; and Agrarian Geography in Geography, as well as for the course Family Farming and Rural Development in the Graduate Program in Sustainable Rural Development.

Another point concerns the delimitation of the article's objective and focus. The text can be understood as having a threefold identity: (a) it presents a theoretical discussion on the persistence and transformations of the peasantry/family farming; (b) it establishes a dialogue with and pays tribute to the authors of *From Farming to Biotechnology* (Goodman; Sorj; Wilkinson, 1990); and (c) it has a pedagogical or didactic purpose aimed at undergraduate and graduate students.

It is also necessary to clarify the conceptual delimitation regarding the use of the terms "family farming" and "peasantry" throughout the text. In general, the terms *peasant*, *peasantry*, *small-scale production*, *small producers*, *low-income producers*, and *family farming* have historically been used to refer to closely related social actors and to forms of agricultural production in which the labor force is primarily based on family labor rather than wage labor. However, these expressions are historically situated and reflect different theoretical, political, and institutional contexts. In the literature up to the mid-1960s, the notions of *peasant* and *peasantry* predominated. These terms were also associated with political and ideological debates surrounding the Brazilian agrarian question and the perceived need for agrarian reform as part of the country's urban and industrial development.

During the period commonly referred to as the modernization of Brazilian agriculture (1965–1985), the terms *small-scale production*, *small producers*, and *low-income producers* became more prominent. It was only from the 1990s onward that the expression *family farming* gained wider currency, particularly in connection with the 1995/1996 Agricultural Census and the National Program for Strengthening Family Farming (PRONAF) in 1997. The term subsequently became institutionalized through the Family Farming Law in 2006 (Law No. 11,326/2006). Therefore, because this essay engages with authors and works spanning an extensive historical period, the terminology originally employed in the respective works has been maintained in order to preserve fidelity to the authors and to the historical and conceptual contexts in which their arguments were developed.

CLASSICAL MARXIST THESES AND THE PREDICTION OF THE DISAPPEARANCE OF THE PEASANTRY

The classical analysis of the future of the peasantry during the capitalist transition was structured around a strong historical and methodological premise: sooner or later, agriculture would succumb to the same general laws of capital accumulation and concentration that operated in urban industry. The peasantry was understood as a social form inherited from previous modes of production, particularly feudalism, characterized by rudimentary techniques, low productivity, and a subsistence-oriented logic incompatible with the dynamism of capital.

Karl Marx (1818–1883), in examining the dynamics of capitalist development, characterized the individual small peasant through the concept of the "smallholding producer." For Marx, small-scale landed property represented a barrier to the development of the social productive forces of labor. The dispersed distribution of rural producers, the social isolation of peasant life, and the inability to apply scientific knowledge and economies of scale to primary production would render small-scale subsistence agriculture unviable under capitalist competition. Marx argued that the smallholding producer was a historical anachronism destined to disappear as the advance of capitalist relations expropriated peasants from their land and transformed them into wage laborers, while concentrating land ownership in the hands of an agrarian bourgeoisie (Marx, 2011).

This thesis of peasant dissolution was vigorously systematized by Vladimir Lenin (1870–1924) in his classic work *The Development of Capitalism in Russia*, published in 1899. Lenin analyzed the socioeconomic transformations occurring in rural Russia following the abolition of serfdom in 1861 and concluded that the peasantry did not constitute a homogeneous social mass, but was undergoing an accelerated and irreversible process of class differentiation and internal decomposition. According to Lenin, the expansion of agricultural commodity markets and the monetization of the rural economy divided the traditional peasantry into two antagonistic poles: (a) the peasant bourgeoisie (wealthy peasants), composed of producers who accumulated capital, acquired additional land, incorporated technical improvements, and began hiring wage labor, thereby transitioning into capitalist agricultural entrepreneurs; and (b) the rural proletariat (poor peasants), composed of impoverished small farmers

whose plots of land became insufficient to ensure their families' subsistence. Deprived of their means of production through indebtedness or expropriation, these individuals were forced to sell their labor power, becoming rural wage workers or migrating to cities as part of the industrial reserve army (Lenin, 1985).

At the same time, Karl Kautsky (1854–1938) published his influential work *The Agrarian Question* in 1899, in which he sought to explain why peasant expropriation and land concentration in rural areas appeared to occur more slowly than industrial concentration in urban areas. Although acknowledging certain specificities of the agricultural sector, Kautsky reaffirmed the thesis of the technical superiority of large-scale farming over small-scale family production. He argued that large capitalist farms possessed a substantially greater capacity to incorporate technological advances, obtain bank credit, use heavy machinery, and implement crop rotation. Small landowners, lacking working capital and burdened by debt, would be technically unable to compete, surviving only through the "superexploitation" of their own family labor and a drastic reduction in their standard of living (Kautsky, 1986).

In summary, the classical Marxist debate consolidated the understanding that peasants lacked long-term historical viability under capitalism. The development of the productive forces and the commodification of social life would lead to their complete social and economic disintegration, paving the way for a purely capitalist agriculture structured around the classical relationship between capitalists and wage laborers.

THE ECONOMICS OF FAMILY REPRODUCTION

The mismatch between classical predictions of disappearance and the empirical consolidation of family farming in the postwar period called for new theoretical approaches. Beginning in the 1970s, neo-Marxist scholars sought to demonstrate that the persistence of family farming was not merely a remnant of pre-capitalism or a historical anomaly, but rather a social form of production characterized by a strong internal rationality and fully integrated into the broader process of capitalist accumulation.

Claude Servolin developed the thesis that family farming operates according to the logic of "simple commodity production," subordinately articulated with the capitalist mode of production through commodity exchange. Under this model, small family farmers establish a relationship of dependence on large agroindustrial corporations and the industrial-financial complex, both in the purchase of inputs such as seeds, pesticides, and machinery and in the commercialization of their primary production. Servolin argued that the persistence of this form of production is highly advantageous and functional for urban-industrial capital for the following reasons: (a) the supply of inexpensive food, since family farming produces food and agricultural raw materials at prices lower than those that would be charged by purely capitalist agricultural enterprises, thereby reducing the cost of reproducing the urban labor force and, consequently, increasing the overall rate of surplus value in urban industries; and (b) comparative cost advantages, because classical capitalist production requires the full payment of wages and the attainment of an average rate of profit on invested capital in order to remain economically viable, whereas family farmers operate without direct

wage costs and may accept an aggregate return sufficient only to cover household living expenses and the reproduction of their physical means of production (Servolin, 1989).

This approach was further refined by Harriet Friedmann, who structurally characterized the specific features of family production units within simple commodity production. According to Friedmann, family farms have a unique institutional organization: the owners of the means of production and the holders of labor power are the same individuals, connected by kinship and co-residence. This structural fusion of labor and ownership radically alters economic decision-making. Unlike the wage-based capitalist enterprise, whose primary objective and condition of existence is the extraction of surplus value and the continuous accumulation of capital, the family unit engaged in simple commodity production is oriented toward the reproduction of the family household. When market conditions are unfavorable, the peasant family may reduce the internal remuneration of its labor and extend working hours without immediately facing technical insolvency, thereby absorbing losses that could eliminate a wage-based agricultural enterprise. This mechanism of defensive self-exploitation, combined with the flexibility of intrafamily relations, provides family farming with a distinctive form of economic resilience, enabling it to persist in agricultural commodity markets characterized by extremely low or volatile profit margins, where strictly capitalist enterprises may be reluctant to operate.

In this way, neo-Marxism introduced an analytical reversal in relation to the classical approaches: family farming does not survive despite capitalism, but rather because it is highly adaptable and advantageous to the development of contemporary capitalism itself. Capital can appropriate the value generated by family farming indirectly, without directly bearing the risks and costs associated with primary agricultural production.

NATURAL OBSTACLES TO CAPITAL IN AGRICULTURE

Another fundamental approach to explaining the survival of family farming under capitalism lies in the physical and biological constraints that nature imposes on the process of capital valorization. In manufacturing industries, capital can exercise extensive control over the spatial and temporal variables of the production process, since raw materials enter the assembly line and are continuously and predictably transformed into finished commodities through the application of human labor and machinery, largely independent of climatic or biological conditions.

In agriculture, however, its biological basis imposes significant limitations. Susan Mann and James Dickinson, in their seminal article *Obstacles to the Development of a Capitalist Agriculture* (1987), developed the fundamental distinction between labor time and production time in agricultural activity. Labor time refers to the period during which human labor and machinery are actively applied to the land and crops, such as in soil preparation, planting, pesticide application, and harvesting. Production time is a much broader category encompassing the entire biological cycle of plant growth or animal development, including periods during which there is no direct application of labor but natural processes continue to operate, such as photosynthesis, gestation, and maturation (Mann & Dickinson, 1987).

Mann and Dickinson demonstrated that the greater the gap between labor time and production time, the more problematic the penetration of capital into agriculture becomes. This biological gap has significant economic consequences: (a) slow capital turnover, since capital invested in seeds, fertilizers, and land preparation remains "immobilized" in the production process for months while awaiting the biological maturation of crops before its value can be realized through the sale of the harvest. This substantially extends capital turnover time and delays the realization of profits; and (b) underutilization of labor and machinery, since the demand for labor in agriculture is markedly seasonal. Capitalist production based on wage labor depends on the regular employment of labor power to generate surplus value continuously. In agriculture, maintaining a permanent wage labor force can become particularly costly because workers may remain underutilized during intermediate stages of natural crop growth. Similarly, expensive machinery may remain idle for substantial portions of the agricultural year.

In addition to this temporal mismatch, the inherent perishability of many agricultural products, such as milk, vegetables, and fruits, creates significant challenges in the sphere of commodity circulation. The circulation time of these commodities is constrained by their physical deterioration, requiring complex logistics involving refrigeration, storage, and rapid transportation. From the perspective of capital, the limited ability to store final products and strategically time their sale according to market prices increases the financial risks associated with agricultural production (Mann & Dickinson, 1987).

As a result of these biological and natural obstacles, primary agricultural production becomes a sector characterized by relatively high financial risks and slower capital turnover compared with manufacturing industries or urban services. Under the imperative of profit maximization, industrial and financial capital tends to avoid direct involvement in land-based production, preferring to allocate investments to sectors in which production processes can be more continuously and predictably controlled. Capital thus effectively "delegates" direct crop and livestock production to family farmers, who bear climatic risks, seasonal price fluctuations, and the physical burdens associated with agricultural labor. Meanwhile, capital strategically positions itself upstream, through the supply of highly profitable technological inputs, and downstream, through agroindustrial processing, logistics, and the large-scale commercialization of food within agricultural value chains (Mann & Dickinson, 1987).

THE PARTIAL INDUSTRIALIZATION OF AGRICULTURE THROUGH APPROPRIATIONISM AND SUBSTITUTIONISM

The withdrawal of capital from direct production on the land does not mean that agriculture has remained immune to capitalist transformations. On the contrary, rural production relations have been profoundly reconfigured through indirect processes. David Goodman, Bernardo Sorj, and John Wilkinson, in their renowned work *From Farming to Biotechnology: A Theory of Agro-Industrial Development* (1990), demonstrated that the inability to transform agriculture into a homogeneous branch of industry, due to the biological barriers discussed above, led capitalism to industrialize agricultural

activity in a fragmented and selective manner. This dynamic of capital penetration into agriculture occurs through two complementary processes operating on a global scale: appropriationism and substitutionism.

Appropriationism refers to the process through which industrial capital appropriates specific stages and functions of primary agricultural production that were previously performed in an integrated manner within the farm through natural or artisanal methods, transforming them into commodified industrial sectors that sell manufactured inputs back to farmers. Historically, this process of appropriation developed through successive technological waves: (a) mechanical appropriation: animal traction and human physical labor, sustained by pasture and grains produced within the farm itself, were replaced by tractors and mechanical implements powered by fossil fuels purchased from the automotive and petrochemical industries; (b) chemical appropriation: the natural organic fertility of the soil, maintained through crop rotation and locally produced animal manure, was replaced by highly soluble synthetic mineral fertilizers (nitrogen, phosphorus, and potassium), while ecological forms of pest control were progressively replaced by industrially synthesized chemical pesticides; and (c) biological-genetic appropriation: traditional or farmer-saved seeds, retained from previous harvests and adapted to local ecosystems, were progressively replaced by industrial hybrid seeds whose hybrid vigor declines in subsequent generations, encouraging farmers to purchase new seeds regularly from biotechnology corporations. Appropriationism therefore disrupts the biological self-sufficiency of the farm, transforming family farmers once relatively autonomous producers of their own means of production into increasingly dependent purchasers of industrial and patented inputs (Goodman, Sorj, & Wilkinson, 1990).

Substitutionism operates at the downstream end of the agri-food chain and is characterized by the progressive and systematic replacement of agricultural products and rural raw materials with synthetic, industrial, or generically processed components produced by the food and chemical industries. The strategic objective of substitutionism is to reduce industry's dependence on the geographical, climatic, seasonal, and biological constraints of the agricultural base. Classical examples of this dynamic include the replacement of animal butter with hydrogenated vegetable margarine; natural dyes extracted from plants with synthetic petroleum-derived dyes; cane or beet sugar with high-fructose corn syrup produced through industrial enzymatic processes; and natural cotton and wool fibers with synthetic polyester and nylon fibers.

Under substitutionism, farms increasingly cease to produce readily identifiable final food products and instead supply basic biological raw materials undifferentiated commodities such as soybeans, corn, or sugarcane which large agri-food industries chemically fractionate into starches, sugars, proteins, and other generic components before recombining them into highly processed food products (Goodman, Sorj, & Wilkinson, 1990).

Table 1 provides a comparative synthesis of these two analytical processes that structure the industrialization of agriculture.

Table 1. Comparative matrix of the forces driving capital penetration into agriculture

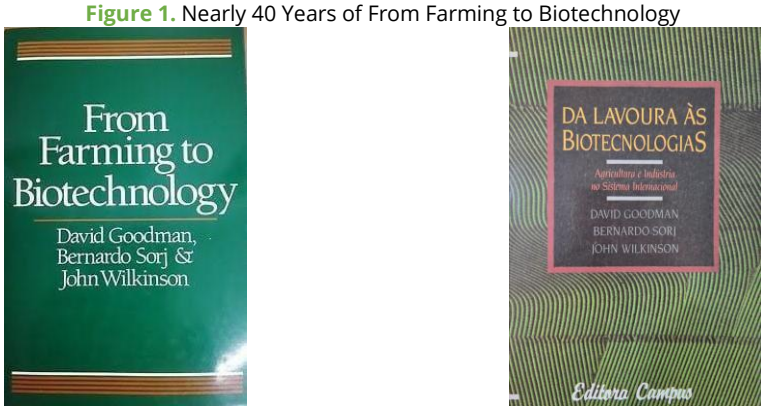
Dimension	Appropriationism	Substitutionism
Primary Target	The internal agricultural production process and the biological stages of farm production.	The final agricultural product and raw materials originating from farming.
Strategic Objective	To overcome the temporal and spatial constraints of natural biological reproduction in agricultural production.	To reduce industry's dependence on the supply and seasonality of agricultural harvests.
Mechanism	Replacement of ecological and productive functions previously performed within the farm by industrial inputs.	Chemical and biological decomposition, transformation, or replacement of agricultural products by industrial equivalents.
Classical Examples	Tractors, fertilizers, pesticides, and hybrid seeds.	Vegetable margarine, synthetic textile fibers, and artificial sweeteners.
Contemporary Examples	Herbicide-resistant genetically modified seeds and hydroponic production using controlled nutrient systems.	Cultivated meat, plant-based proteins, and synthetic biology.
Potential Development Trajectory	Increasingly automated farms operating through corporate digital technologies and input packages.	Increasing production of food components through controlled industrial and biotechnological processes, including bioreactors.

Source: Prepared by the author based on Goodman, Sorj, and Wilkinson (1990).

NEARLY 40 YEARS OF FROM FARMING TO BIOTECHNOLOGY AND ITS CONTEMPORARY RELEVANCE FOR ANALYZING RURAL BRAZIL

The publication in Brazil in 1990 of From Farming to Biotechnology: Agriculture and Industry in the International System, translated from the original English-language edition published in 1987 and authored by David Goodman, Bernardo Sorj, and John Wilkinson (Figure 1), marked a profound and enduring epistemological shift in agrarian studies. The work became an influential theoretical framework for understanding the biological and industrial transformations that have reshaped the contemporary agrarian question.

Figure 1. Nearly 40 Years of From Farming to Biotechnology



Source: Adapted by the author (2026).

According to the authors' accounts, the book underwent a long gestation and

faced numerous conceptual challenges, intercontinental relocations, and complex logistical arrangements. Among these aspects, the following stand out: (a) the challenge of writing from the "periphery": intellectually, the project emerged from the authors shared conviction that Marxist and neoclassical theories of agriculture and rural social change had reached an impasse. However, developing this new critique posed a significant geographical and academic challenge: analyzing the dynamics of the "center" the developed and industrialized countries while being located in the "periphery"; and (b) the logistics of circulating drafts in Brazil: during the initial stages of their collaboration, the authors were geographically dispersed across the country, making it necessary to establish a continuous flow of drafts and papers circulating among Rio de Janeiro, Belo Horizonte, and Salvador, a process facilitated by the work of Priscilla Kritz.

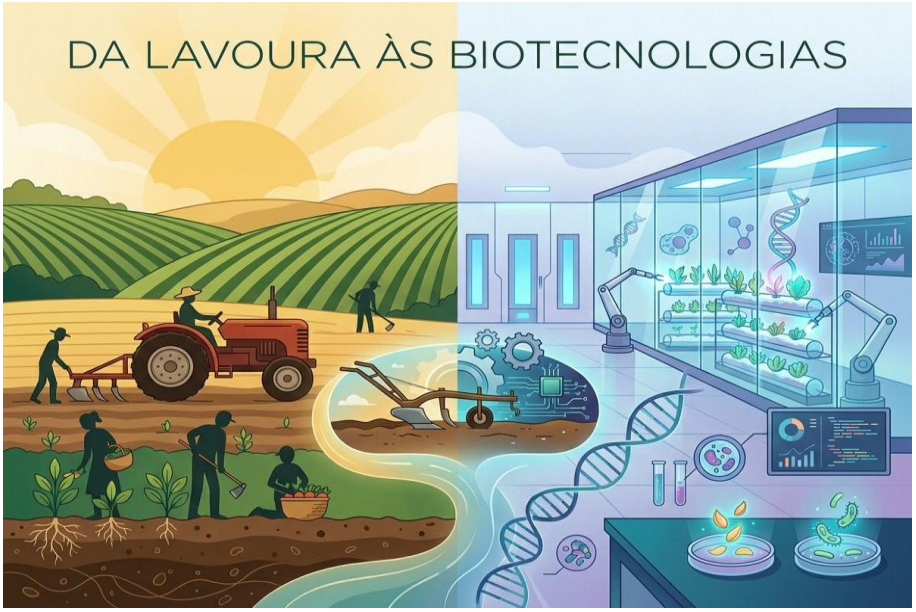
Subsequently, two other aspects shaped the development of the book: (c) the transition to Europe and access to new sources: the authors moved to London and Brussels, and although this relocation created new challenges for long-distance coordination, these difficulties were largely offset by easier access to current and up-to-date sources of information on scientific and biotechnological advances taking place in developed countries; and (d) the support of major institutions and the completion of the "saga": the maturation of the concepts of appropriationism and substitutionism was enriched by periods of research conducted by the authors at relevant international organizations in Europe. During the final stage of the project, University College London provided the institutional support necessary for the completion of the book. Thus, beyond its analytical relevance, the book has a distinctive history of intellectual development that began long before its publication in 1987. This tribute marking nearly 40 years since its publication therefore also looks back at the historical and intellectual context that shaped the work's development.

Prior to the formulations developed by Goodman, Sorj, and Wilkinson, the Sociology of Agriculture and Agricultural Economics faced a significant analytical impasse. On the one hand, some approaches continued to predict the direct proletarianization and inevitable, linear disappearance of the peasantry in the face of large-scale mechanized farming; on the other, alternative perspectives emphasized the autonomous survival of family farming through an internal logic of resistance and self-exploitation. The authors fundamentally reframed this analytical perspective by demonstrating that the barriers to capitalist development in agriculture do not lie exclusively in class contradictions or peasant resilience, but also in the fact that agriculture directly confronts capital with a natural and organic production process.

Because the conversion of solar energy into biomass, animal gestation, and photosynthetic cycles could not be fully incorporated into a continuous and centralized factory production line, capital developed a fragmented adaptive strategy: the dynamics of appropriationism and substitutionism.

Figure 2 presents a conceptual and commemorative representation of this long-term transition theorized by the authors, illustrating how the biological constraints of the traditional farm are systematically appropriated by corporate science and transformed into commodified technological packages.

Figure 2. Visual representation of the conceptual legacy of From Farming to Biotechnology: the transition from land-based labor and traditional farming (left) to laboratory processes and advanced biotechnology (right).



Source: Image created using artificial intelligence (NotebookLM) (2026).

The contemporary relevance of these analytical categories for interpreting rural Brazil in the twenty-first century is striking. Brazil has consolidated its position as one of the world's largest agricultural producers and exporters (Klen & Luna, 2020), yet this success rests on a pronounced structural dualism that reflects the advancement of the forces identified by the authors. On the one hand, agribusiness operates as a driving force of appropriationism and substitutionism. Brazil's large export-oriented monocultures soybeans, corn, cotton, and sugarcane operate under a model characterized by substantial technological dependence. Appropriationism is reflected in the significant control exercised by a limited number of multinational bioscience corporations over agricultural germplasm and technological inputs. Patented genetically modified seeds and new gene-editing techniques represent advanced forms of industrial control over biological reproduction. At the same time, molecular substitutionism has advanced through the industrial processing of commodities, as Brazilian grain and sugarcane production increasingly supplies low-cost biomass such as starch, sucrose, and cellulose that can be fractionated into basic chemical components and used as industrial inputs for animal feed, biofuels, and ultra-processed foods.

On the other hand, family farming constitutes a space of resistance and autonomy. Positioned between upstream input oligopolies and downstream agroindustrial and retail oligopolies, Brazilian family farmers face intense pressure on their profit margins. Nevertheless, they actively develop strategies of resistance and adaptation. To reduce their dependence on the appropriation and substitution of their productive resources, small family farmers in Brazil preserve and recover traditional farmer-managed seeds, adopt agroecological transition practices, diversify their production systems through organic gardens and agroforestry systems, and engage in direct sales through short food supply chains linked to urban markets. Family farming

is therefore not a feudal remnant destined for linear disappearance, but rather a social category that dynamically restructures itself, maintaining spaces of autonomy in the face of persistent pressures from corporate capital while playing a crucial role in national food sovereignty.

Although Goodman, Sorj, and Wilkinson developed their theses in the late 1980s, their analytical categories remain remarkably relevant for explaining the socioeconomic and technological transformations reshaping contemporary rural areas in the twenty-first century. The forces of appropriationism and substitutionism have accelerated under the influence of the digital revolution and modern biotechnology, generating profound impacts on productive autonomy and the distribution of value added throughout agricultural value chains, as summarized in Tables 2 and 3.

Table 2. Contemporary expressions of From Farming to Biotechnology in the international literature.

Dimension	Focus	Studies
Contemporary appropriationism and biological automation	These studies discuss capital's increasing efforts to directly control and manage the biological reproduction of nature through gene editing, CRISPR, hydroponics, and digital monitoring, potentially transforming farmers into "biomanagers" of standardized technological packages.	Klerkx et al. (2019); Rotz et al. (2019); Duncan et al. (2022)
Contemporary substitutionism and molecular bioindustrialization	These studies address the process through which traditional raw materials are broken down into their basic molecular components such as amino acids, starches, and generic lipids for subsequent industrial reconstitution, as in the case of cultivated meat produced in bioreactors and plant-based proteins. Such developments may reduce the importance of the traditional land-based foundations of agricultural production.	Sexton et al. (2019); Sexton & Goodman (2022); Stephens et al. (2018)
Polarization, social dualism, and value squeezing at the farm level	These studies examine how agricultural production is compressed within an hourglass-shaped value chain: between oligopolies controlling inputs, seeds, and machinery protected by intellectual property rights upstream, and processing corporations, commodity traders, and large supermarket and distribution networks downstream. This structure places pressure on family farmers' economic margins and may contribute to a polarized and bimodal agrarian structure.	Clapp (2019); Klerkx & Rose (2020); Parra-López et al. (2026)

Source: Prepared by the author (2026) with the assistance of artificial intelligence (NotebookLM).

Table 3. Contemporary expressions of From Farming to Biotechnology in the Brazilian literature

Dimension	Focus	Studies
Contemporary appropriationism and biological automation	These studies investigate how "Agriculture 4.0," digital data governance, and the technological centralization embodied in algorithmic systems are expanding across Brazilian rural areas, reshaping farm-level decision-making and potentially repositioning family farmers as operators or "biomanagers" of corporate technological systems embedded in software and seed technologies, including genetically modified crops and gene-editing technologies such as CRISPR.	Moraes (2023); UFSM (2021); EMBRAPA (2026)
Contemporary substitutionism and molecular bioindustrialization	These studies discuss the fractionation of traditional agricultural commodities particularly Brazilian soybeans and corn into chemical components such as protein isolates, maltodextrins, and processed fats for	Claro et al. (2026); LANUTRI (2023); STARTUPS (2025–2026)

	industrial reconstitution into ultra-processed foods, as well as advances in precision biotechnology and alternative proteins, including plant-based products, which may weaken the traditional connection between food, land, and agricultural labor.	
Polarization, social dualism, and value squeezing at the farm level	These studies address Brazil's polarized or bimodal agrarian structure and the declining share of value captured by small family farmers, who are positioned within an hourglass-shaped value chain between chemical and genetic input corporations upstream and large agroindustrial processors and retailers downstream.	Grisa & Isopo (2021); Costa (2022); Santos (2024–2025)

Source: Prepared by the author (2026) with the assistance of artificial intelligence (NotebookLM).

At the beginning of the twenty-first century, appropriationism advanced significantly toward the internalization and direct control of the biological reproduction of plants and animals. This process can be observed through three highly sophisticated and dynamic dimensions: (a) genetically modified seeds: transnational biotechnology corporations have not only appropriate aspects of seed reproduction but have also redesigned their molecular characteristics to introduce traits such as resistance to specific herbicides. Farmers may enter into technology-use agreements governed by patents and other intellectual property rights, which can restrict the saving and replanting of protected seeds; and (b) hydroponics, automated greenhouses, and intensive livestock confinement: these innovations represent attempts to reduce the exposure of primary production to climatic variability and other natural constraints.

By removing plants from conventional soil-based cultivation and animals from pasture-based systems and placing them in environments increasingly controlled by sensors, automated systems, and artificial climate management, agricultural production can move closer to the continuous and standardized production flows characteristic of manufacturing. A third dimension is (c) the emergence of the "biomanager": with the digitalization of agriculture, family farmers may increasingly operate as managers implementing prescriptive technological packages formulated through corporate algorithms embedded in machinery, software, and agricultural input systems, as occurs in precision agriculture. In this process, traditional farmer knowledge and autonomous decision-making may lose relative importance as real-time recommendations delivered through tablets, digital platforms, and automated machinery determine the quantities of water, fertilizer, and crop protection products to be applied to specific areas of farmland.

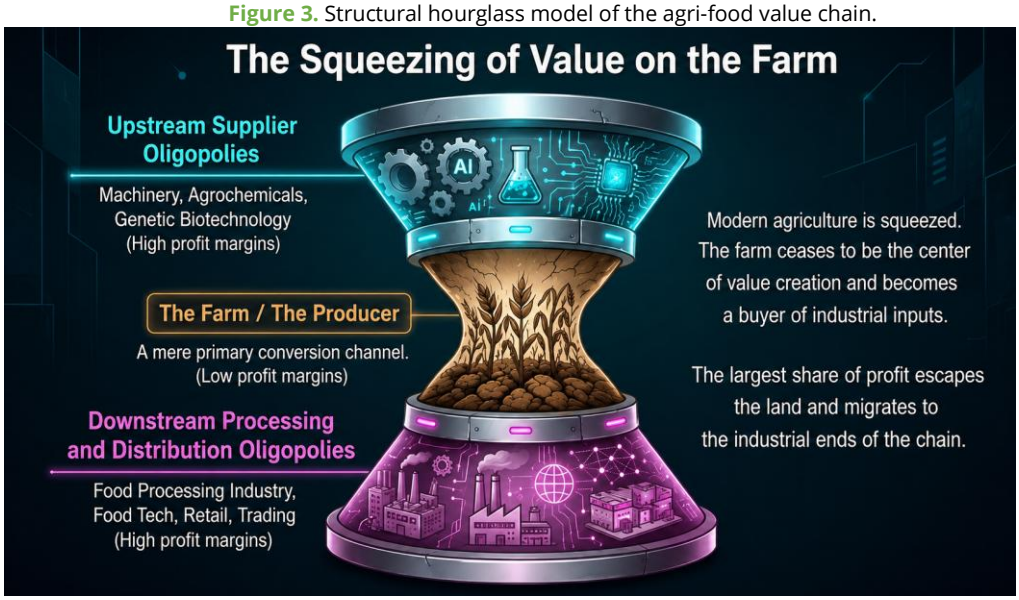
Contemporary substitutionism has also accelerated considerably through processes associated with bioindustrialization and the precision bioeconomy. Advances in genetic engineering, combined with artificial intelligence applied to molecular biology, have expanded the capacity to break down traditional agricultural raw materials into their basic molecular components such as amino acids, sugars, and specific lipids and subsequently recombine or reproduce them through controlled industrial processes. The emergence of so-called "engineered foods," including plant-based proteins designed to reproduce certain sensory characteristics of animal meat and cellular agriculture, such as cultivated meat produced through cell culture in bioreactors, represents an advanced expression of the substitutionist logic.

In this scenario, traditional agriculture and its land-based foundations may

increasingly be repositioned as suppliers of relatively low-cost biomass, including vegetable lipids and starches derived from crops such as soybeans and corn, which can serve as inputs for highly centralized industrial and biotechnological processes. As a result, the traditional identity of food as a product directly associated with land, farming, and rural labor may become progressively less visible within industrial production systems.

The socioeconomic outcome of the combined advancement of these contemporary technological dynamics may be an intensification of the structural dualism of rural areas, accompanied by a significant reduction in the autonomy of family farmers and in the share of value they capture within agri-food chains. From an economic perspective, this process can be understood through the phenomenon of "value squeezing at the farm level" (Figure 3).

Figure 3. Structural hourglass model of the agri-food value chain.



Source: Image created using artificial intelligence (NotebookLM), 2026.

Primary agricultural production itself, the activity carried out on the land becomes squeezed between two major oligopolistic corporate poles characterized by a high concentration of global capital: (a) upstream supplier oligopolies: a limited group of global corporations controlling genetic biotechnology, the manufacture of chemical pesticides, and high-technology agricultural machinery, whose profit margins are supported by patents and intellectual property rights; and (b) downstream processing and distribution oligopolies: large food-processing corporations, multinational agricultural commodity trading companies, global supermarket chains, and food delivery platforms that exert considerable influence over quality standards and prices in the commercialization of agricultural products, thereby capturing a substantial share of the total value added within the food system.

Squeezed between these two oligopolistic poles, family farms risk losing their central role in capturing economic value and becoming increasingly positioned as primary converters of costly industrial inputs into relatively low-value agricultural commodities, often marketed through highly coordinated contractual arrangements. Consequently, a significant share of profits tends to migrate away from primary

agricultural production toward the highly industrialized upstream and downstream segments of the food value chain. To withstand this systematic pressure on economic margins, family farmers operate within an increasingly polarized agrarian structure and may be compelled either to expand their scale of production, frequently through indebtedness, or to adopt pluriactivity by combining agricultural work with income generated outside the farm in order to maintain the economic viability of the household.

The application of these theoretical frameworks to the analysis of Brazilian agricultural development reveals the complexity and contradictions that structure the country's rural areas. Historically, the modernization of Brazilian agriculture, which intensified from the 1970s onward, was characterized by a process that the sociological literature describes as "conservative modernization." Under this model, the Brazilian state promoted extensive technological modernization of the rural productive base through subsidized credit for the acquisition of agricultural machinery, hybrid seeds, and chemical pesticides the so-called Green Revolution technological package without substantially transforming the historically concentrated landholding structure based on large estates.

Brazilian agrarian development thus became consolidated under a persistent and profound structural dualism: (a) corporate export-oriented agribusiness, centered on large landholdings and monocultures such as soybeans, corn, cotton, and sugarcane and highly integrated into the dynamics of contemporary technological appropriationism and molecular substitutionism. This sector operates in close coordination with multinational agricultural input corporations and global commodity trading companies, with a substantial share of production directed toward export markets; and (b) family farming, characterized by smaller-scale farms and the predominant use of family labor. Despite its historical disadvantages in access to credit, technical assistance, and land, Brazilian family farming has demonstrated remarkable persistence and continues to play an important socioeconomic role. Rural sociological literature has consistently highlighted its significant contribution to the production of fresh and traditional foods consumed in Brazil's domestic market, including beans, cassava, vegetables, milk, and products from small-scale livestock production.

To cope with the severe economic pressures associated with value squeezing within agroindustrial complexes, family farmers in Brazil employ a variety of social reproduction strategies. One prominent example is pluriactivity (Schneider, 2003), characterized by the increasing diversification of rural households' sources of income. Peasant and family-farm pluriactivity involves combining agricultural production with non-agricultural activities performed by household members, such as employment in local commerce, rural tourism, small-scale artisanal agroindustry, as well as income from government transfers and rural pensions. In this sense, pluriactivity functions as a strategy of adaptation and resilience, enabling family production units to obtain external monetary resources that contribute to financing their continued social and economic reproduction on the land, thereby mitigating pressures toward land dispossession associated with the expansion and concentration of capitalist agriculture.

FINAL CONSIDERATIONS

The persistence of family farming within the contemporary capitalist mode of production constitutes one of the clearest demonstrations of the adaptability and coexistence of different social forms under the hegemony of capital. The theoretical trajectory developed in this essay demonstrates that, contrary to the classical Marxist diagnosis formulated at the turn of the nineteenth to the twentieth century, which predicted the inevitable and linear disappearance of the small peasant, family farming has reaffirmed itself as a fundamental structure of contemporary rural development.

This remarkable historical persistence rests on two fundamental and interconnected foundations. On the one hand, there is the internal and reproductive rationality of simple commodity production described by Servolin (1989) and Friedmann (1978). The absence of direct wage costs and the combination of multiple roles within the family farmer, the classic "social platypus," who simultaneously embodies the historical roles of manager, owner of the means of production, and direct worker, provide the family unit with remarkable resilience, allowing production to continue even under zero or negative rates of economic return that would be incompatible with the survival logic of strictly capitalist agricultural enterprises.

On the other hand, the biophysical barriers imposed by nature, identified by Mann and Dickinson (1987) and expressed in the mismatch between human labor time and biological production time, operate as structural constraints on the direct and complete penetration of capital into primary land-based production.

Contemporary capitalism, however, has developed indirect and highly effective mechanisms for the economic subordination of family farming. As demonstrated by Goodman, Sorj, and Wilkinson through the categories of appropriationism and substitutionism (Goodman, Sorj, & Wilkinson, 1990), capital refrains from directly expropriating land and producing food itself, instead operating in a fragmented and profitable manner at different stages surrounding agricultural production. The industrial appropriation of biological processes and the molecular substitution of agricultural products can reduce the family farm to a dependent link squeezed within an extensive, corporate-controlled global value chain characterized by a bimodal structure.

In the Brazilian context, this dualism is expressed through the asymmetric coexistence between highly appropriationist, export-oriented agribusiness and the social persistence of family farming in supplying the domestic food market, with family farmers maintaining their livelihoods through strategies of social diversification and pluriactivity (Schneider, 2003).

The central challenge facing contemporary public policies for rural development and food security is therefore to strengthen the technological and economic autonomy of family farmers in the face of the value squeezing imposed by oligopolistic agroindustrial corporations, ensuring that the value generated by land and family labor remains within rural areas, contributes to local development, and generates greater value added throughout national production chains. Classical Brazilian authors such as Caio Prado Júnior (2012), Celso Furtado (2007), and Ignácio Rangel (2005) had already warned of the economic and social problems associated with an agricultural model

centered on the export of primary commodities. Approximately a century later, Brazilian agriculture continues, to a significant extent, to rely on the same underlying logic: producing and exporting commodities.

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