Between Fenix and Ceres

The Great Acceleration and the Agricultural Frontier in the Brazilian *Cerrado*

Entre Fênix e Ceres

A Grande Aceleração e a fronteira agrícola no Cerrado

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Abstract This article discusses the history of the advance of the agricultural frontier in the Brazilian Cerrado and its role in the intensification of human action related to the biogeochemical cycles of the Great Acceleration. More specifically, this work discusses how soil fertility research, the motivation for internal immigration from Southern Brazil to the Cerrado and the intensification of monoculture played a central role in the rupture with traditional processes of cultivation and occupation of the fields and savannas of Central Brazil. Finally, this article discusses how these elements worked as an instrument for the consolidation of development programs not only for Brazil's savannas, but also as a model for agricultural expansion in savanna areas in the American and African continents.

Keywords Great Acceleration; cerrado; agricultural frontier

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Resumo Este artigo tem por objetivo discutir a história do avanço da fronteira agrícola em direção aos campos cerrados e seu papel na intensificação da ação humana relativa aos processos de governança dos ciclos biogeoquímicos — a Grande Aceleração. Mais especificamente, este trabalho discute como a pesquisa em fertilidade dos solos, o incentivo à migração sulista e a intensificação da monocultura, ocuparam papel central na ruptura com os processos tradicionais de ocupação de campos e savanas na região central do Brasil. Por fim, observa-se como tais elementos serviram como instrumento para a consolidação de programas de desenvolvimento não limitado aos cerrados, mas como modelo para a expansão agrícola em áreas de savana nos continentes americano e africano.
Palavras-chave Grande Aceleração; cerrados; fronteira agrícola

Introduction: between Phoenix and Ceres in the brazilian *sertões*

The growth of the Brazilian presence in the global context coincides with the Great Acceleration (Pádua, 2017, p.37). Between 1900 and 2000, the population of country grew ten times, reaching 170 million inhabitants; on the other hand, the great socio-environmental transformations of the country have been occurring in reality since 1945 (Pádua, 2017, p.37). The aim of this article is to discuss how the agricultural expansion to the *cerrado*[1] of the central region of Brazil marked a point of inflection which McNeil and Engelke have called the Great Acceleration, in other words processes of governance of bio-chemical cycles — the carbon, Sulphur, and nitrogen cycles — intensified by human action and which formed an interlinked set of processes with global consequences in relation to their impact on the planet and biosphere (McNeil and Engelke, 2014, p.4). The advance of the agricultural frontier had a direct connection with the acceleration of these cycles, although

1 I use *Cerrado* with a capital C in reference to the biome, while the term *cerrado* with a lowercase c refers to the formations in the countryside, the principal concern of this article.

the savannas, forests, and countryside, which composed the biome, had experienced an intense trajectory of anthropic modification of over the centuries, whether through traditional methods, mining, subsistence agriculture, livestock raising, settlement projects, or through the construction of towns and cities (Ribeiro, 2006). On the other hand, this article concentrates on analyzing the history of specific elements which "personify" a rupture with the traditional forms of field management and technically permitted the advance of agricultural modernization projects through a new dynamic: soil fertility research, incentives for the migration of farmers from the Southern region of Brazil, and, finally, the introduction of largescale monoculture, especially soybean (*Glycine Max*). While Brazilian territorial expansion was seen as a solution for impasses to "development" (Issberner; Léna, 2017, p.6), the search for "suitable" farmers and fertilizers for the intensification of monoculture were decisive responses from the government and the newborn agribusiness to the challenges of the environment, technically allowing the creation of a new form of organization of production.

These different elements — whose influence on the "conquest of the *cerrado*"[2] is a consensus among agribusiness enthusiasts and little discussed in a global form among historians or social scientists — leveraged the growth of the so-called agribusiness in lands previously considered infertile, reconfiguring the environment and the relation of power in society. In other words, research in soil fertility, monoculture, and migration incentives — added to other factors ongoing since the Empire, such as extensive livestock farming — triggered a wide-ranging process of land occupation, with the purpose of intensifying economic

2 The expression "conquest of the *cerrado*" is an idea that is quite widespread among the defenders of agribusiness on the industrial scale, and represents an optimistic and not very critical interpretation of the history of the conversion of the large 'weak' or infertile agricultural areas through a combination of intensive research, governmental research, and incentives from private initiative. It evokes in an analogous form, the process of the conquest of the *wilderness*, known in the historiography principally through influential authors such as Frederick Jackson Turner. Similar to the American historian, these texts construct, reinforce, or appropriate heroic narratives to, in this case, demonstrate the power and the inventiveness of researchers in the transformation of an 'inhospitable' environment into a 'civilized' one apt for largescale agriculture.

exploration not only in areas of forests, but also in the fields and savannas. And in this aspect a schism can be identified: since the *Cerrado* is composed of a rich mosaic of phytophysiognomies, varying from open areas where there is a predominance of grasslands and shrubs to forests, the advance on the forests (approximately 32% of the biome) commenced before the Second World War (Dutra e Silva, 2017). On the other hand, the savanna formations, which covered 61% of the biome and the fields (7%) (Critical Ecosystem, 2016, p.41) were not considered for agriculture until the 1950s.

With the change in perception of soil fertility and the advance of agriculture, increasingly related to livestock, technical reports highlighted the dynamic of the Great Acceleration in the *Cerrados*: "the region is going through accelerated changes. The construction of the new capital in Brasília at the end of the 1950s intensified the occupation process of the agricultural frontier in the heart of the *Cerrado*".[3] As a result, this agricultural expansion, combined with livestock innovations, created an effect which was not only local, but also global and also still ongoing. For example, the increase in carbon dioxide emissions can be noted — resulting from an increase in deforestation and burning — and a significant population increase, which reached 43 million inhabitants.[4]

In this manner, the intensification of agricultural production in the fields and the savannas which compose the *Cerrado* are essential elements for the analysis of the technology and infrastructure introduction processes which formed the Brazilian Great Acceleration through the participation of national and international organizations. In addition, this theme contributed to the debate about the conceptions of these modifications, their circulation and points of inflection: migratory projects, the diffusion of soil fertilization techniques and technologies, and soybean cultivation are fundamental samples for this history. Finally, in

3 CRITICAL ECOSYSTEM PARTNERSHIP FUND. *Perfil do ecossistema hotspot de biodiversidade do Cerrado*. [s.l], ISPN/ Conservação Internacional, abr. 2016. p.26

4 CRITICAL ECOSYSTEM PARTNERSHIP FUND. *Perfil do ecossistema hotspot de biodiversidade do Cerrado*. p.26

this experience, an essential contribution was identified for the debate about how local systems induce local environmental changes on a broad, global scale, both in ecosystems and in the way of using resources. In relation to this, the Great Acceleration in the *cerrado* and its profound connection with the advance of agriculture created singularities which are not restricted to these territories, since they were transformed into agricultural intensification programs 'exported' to Paraguay, Indonesia, El Salvador, and Mozambique: an unequal system of exchanges, where the Brazilian state, international organizations, and representatives of industrial *agribusiness* promote technical cooperation agreements permeated by deforestation policies, the use of agrotoxins on a large-scale, and the intensification of monoculture.[5] More specifically, ProSavana has its origins in the Brazil/Japan cooperation called PRODECER, implemented in *cerrado* regions in the 1970s and 1980s. In this perspective, through the development and application of technologies, savannas with infertile soils were transformed into a hub of global agriculture (Ekman and Macamo, 2014, p.7).

5 Brazilian soybean farmers expanded their business in Paraguay during the dictatorship of Alfredo Stroessner, in the same period as the expansion of the agricultural frontier in the *cerrado*. During the 1980s and 1990s, the *IRI Research Institute* (IRI), a US institution founded by Nelson Rockefeller (1908-1979) which carried out research in soil fertilization in the *cerrado* soil, supported experiments in Indonesia and El Salvador. In the current day a model of agricultural intervention created through experiences in the Brazilian *cerrados* is advancing on the Nacala Corridor, in Mozambique (ProSavana Program). In common, a large part of these areas consist of lands devasted by continuous use without the indicated practices of fertilization or, on the other hand, are savannah areas, or which have a high level of aluminium and other components which limit the growth of plants. More specifically, ProSavana is aimed at transforming "the agricultural sector in northern Mozambique along the Nacala Corridor into a competitive and sustainable industry, by promoting private investments in cooperation with the public sector. That transformation has potential impacts on the Mozambican forest ecosystem dominated by leguminous *miombo* tree species and the economic interests of people who derive benefits from those forests." (Ekman and Macamo, 2014, p.7) Some criticism about the program arose after its beginning: "Although the area is sparsely populated, native communities are reported to have been marginalized. Another critique of agrarian development is that it threatens the indigenous savanna and its biodiversity. Such criticisms raise the question of whether it is desirable to replicate the *Cerrado* model in northern Mozambique, and, indeed, if it is replicable at all, given the socioeconomic and environmental differences between the two regions." (Ekman and Macamo, 2014, p.7)

In terms of historical context, the transformation of the *cerrado* into an agricultural area represents a certain continuity in relation to the challenges of converting large areas considered infertile into areas that can be cultivated. In the middle of the nineteenth century, the development of *Tall Grass Prairies*, the area known as the "Great American Desert", considered incapable of supporting settlers, began a process of intensive transformation. With the advent of technologies such as the steel plough, the combine harvester and the reaper, a breadbasket was created to supply grain to the United States. Even with singularities, the transformation of the *cerrado* is connected to other global attempts of converting marginal environments into powerful systems of agricultural production, molded through expectations that are more global than local.[6]

Those who see the *Cerrado* as a model of global intervention for the present time have difficulty in returning to the perceptions predominant in the 1950s, when the acidic and not very productive soils challenged the imagination of the groups interested in a new reconfiguration of the occupation of these vast territories. For this reason, the debate about the ideas which permeated historical institutions and agents at the end of the 1950s and the beginning of the 1960s is necessary. For example, in 1957 the Brazilian geographer Speridião Faissol argued that, in relation to agricultural production, Brazil found itself at a crossroads: "For four centuries, Brazilian agriculture has been restricted to areas of tropical forest", notably the Atlantic Rainforest. As a result, "the moment arrived when the forest, in areas that were still available and accessible, could not be used for agricultural expansion".[7] Counting on the collaboration of the German geographer Leo Waibel and the US geographer James Preston while carrying out fieldwork in the Brazilian Center-West between 1946 and 1952 (Dutra e Silva, 2017), Faissol emphasized the need for choices associated with the new directions of national development

6 In relation to this, see specifically CRONON, 1991 e BELICH, 2009.

7 FAISSOL, Esperidião. O problema do desenvolvimento agrícola do Sudoeste do Planalto Central do Brasil. In: *Revista Brasileira de Geografia*, ano XIX, n. 1, jan./mar. 1957. p.5.

projects: "The problem now is to decide about the convenience of trying to rejuvenate agriculture in the devastated forest areas or the agricultural use of the *cerrado*".[8] The first option demanded, in addition to the expansion of financial resources, the widespread application of already known techniques such as liming, commercial fertilizers, or traditional animal manure, with the challenge of restoring levels of fertility similar to the period before the agricultural expansion. On the other hand, the use of large extensions of savannas and fields in the *cerrado* region — which accounts for 68% of the total area of two million kilometers^2, located in the central part of Brazil — demanded large financial investments and the improvement of fertilization techniques. While the idea of the conquest of the West — or a type of Eldorado (Ribeiro, 2002) — remained in the social imaginary after the Second World War, on the other hand the development of agricultural practices on a commercial scale in the *cerrado* seemed more like a leap in the dark. Intellectuals at the service of the Brazilian state such as Faissol (head of the Center-West Section of the Brazilian Institute of Statistics and Geography) argued in a paradoxical manner: while there existed a certain optimism about the potential for the increase in agricultural products, if these lands were cultivated, they were faced with strong environmental resistance: the low fertility of soils in the fields of the *cerrado*.

Four and a half centuries after the beginning of the process of European conquest, of resistance and exchange, the fields and the savanna continued challenging the societies which entered them. Looking back retrospectively to when Faissol published his text (1957), local societies and the national state had developed specific techniques for dealing with the environment for each characteristic that could frustrate the advance of "civilization" into the *sertão.* Using this knowledge, the adverse climate, the dangerous animals, the inhospitable vegetation, and

8 FAISSOL, Esperidião. O problema do desenvolvimento agrícola do Sudoeste do Planalto, p.5.

the indigenous groups considered savages, were controlled or exterminated with the advance of colonial society: through the construction of houses with ventilation and near streams to ease the heat and the dry climate, the hunting or killing of animals, the cutting down of trees and the opening of roads or trails and clearings, as well as the extermination of indigenous populations or their settlement in villages. The scattered tracts of forest allowed the advance of extensive agriculture from the 1920s onwards, requiring the continued cutting down of forests and the use of vegetal ash as a corrective for soil acidity or as fertilizer. The traditional agriculture practiced in Brazil, based on indigenous and *sertaneja* techniques of cutting down and clearing forests, represented in a metaphorical form the generation of food for the continuity of life through ashes from burning and destruction: a Phoenix wandering through the Brazilian *sertões*. However, the intellectuals, economic elites, and the groups who exercised political hegemony were anxious to meet another mythological entity in those *sertões*: Ceres, the Roman goddess of fertility, who by coincidence who give her name to a municipality in the state of Goiás, originating from the establishment of the Agricultural Colony of Goiás (CANG) in 1941 (see Dutra e Silva, 2017). Nevertheless, the low fertility of the fields and the savannah for agriculture constituted a fundamental challenge for the effective occupation of the *cerrado* and the conversion of its raw materials into economic resources. A short while later, at the beginning of the 1970s, thanks to a combination of research in soil fertility, the adaptation of cultivation in acidic soils, and the encouragement of migration, the fields and savannahs of Central Brazil were reconfigured by the increase of agricultural production.

Fig. 1 – Perception of the Brazilian Environment: "Campo Cerrado area of Goiás State. This native vegetation is typical of vast areas of Brazil including the new capital site at Brasília".Courtesy of the Rockefeller Archive Center.

Source: Rockefeller Archive Center, Subseries 2, Brazil, 1027, AIA Photograph Collection. Box 4, Folder 109.

In summary, the transformation of the savanna and pastoral formations of the *cerrado* on agricultural lands greatly accelerated the process of the occupation and modification of the environment, favoring the intensification of urbanization and the advance of the agricultural frontier, principally after the 1970s. Since the advance of the frontier in the direction of the *cerrado* was prior to the beginning of the Second World War, exemplified through state programs such as the March to the West during the *Estado Novo* (1937-1945), three relatively new factors were fundamental and constitute the focus of this article: research and experiments in soil fertility, the migratory process of farmers from the south of Brazil, as well as the introduction and adaptation of plant varieties. These three dimensions are connected by common contexts:

the challenges proposed by the 'inhospitable' environment and the different responses of distinct social groups, specifically the difficulties with the construction of soil fertility models; national and international subsidies for the occupation and economic exploitation of the *cerrado*; and, finally, the obstacles to adaptation, lack of communication, human and non-human resistance, demonstrating that the process of the "conquest" of the *Cerrado* was not a rationally organized or completely successful task.

This article is divided into three sections: initially, I look at the fundamental role of the soil sciences in changing the perception of the fertility of acidic soils in these fields and savanna formations. Following this, I will concentrate the debate on the experience of migrants from the south, their experiences in agriculture, and the preference of governments and institutions for these social groups. Finally, this article will turn to the process of the introduction and adaptation of plants and the later construction of models based on monoculture. Initially, I will deal with the process of the introduction and intensification of experiments aimed at soil fertilization of soils in the *cerrado*, which began with the attempt to restore coffee plantation soils cultivated since the initial decades of the twentieth century in an Atlantic rainforest region in the state of São Paulo.

A turning point: research in soil fertility

For McNeil and Winiwarter, the survival, prosperity, and power of any agricultural community depends on its good performance in resolving the problem of the loss of nutrients over time (McNeil and Winiwarter, 2010, p.2). An inverse question, however, guided agricultural expansion into the *cerrado*: what is involved is not the improvement of fertility levels or replacing soil nutrients, but basically "constructing" a non-existence fertility. Afterwards, the satisfactory results of these

experiments in land conversion from *cerrado* to agriculture impressed a new configuration in the form of land use, opening extensive areas of fields and savannas in Central Brazil for large-scale cultivation. While the perception of Brazilian and foreign researchers of *cerrado* soils was initially centered on an idea of infertility, the action of the *IRI Research Institute* (IRI) modified this idea in the second half of the 1950s through a soil recovery program of degraded coffee plantations due to intensive cultivation plus an inadequate replacement of nutrients. This experience, which served as a model for the formulation of a basic science for *cerrado* soils is, above all, fruit of unexpected and almost random conditions. It required a certain amount of improvisation on the part of researchers who, by failing to translate the experiments into satisfactory economic results for their financers, sought to transpose the results of the research carried out in coffee plantations to acidic soils.

On their arrival in Brazil at the beginning of the 1950s, the *IRI Research Institute* (IRI) specialists prioritized the regeneration of coffee soils within the interior of São Paulo state. This institute, a part of the project conceived by the US multimillionaire Nelson Rockefeller, involved the creation of institutions concerned with the insertion of elements of agricultural modernization, such as machinery, fertilizers, the introduction of hybrid corn seeds, cattle and pig feed. Rockefeller strategically sought to convince local governments based on a premise: economic development necessarily involved an increase in productivity and the construction of infrastructure for the outflow of products, organized in a rural expansion and research system, similar to the United States.[9]

The degradation of once fertile soils in Atlantic Rainforest regions originated in the coffee plantation expansion to the municipality of Matão, in the Alto-Araraquarense region, which began in the final decades of the nineteenth century. This expansion was based on the advance of the agricultural frontier through a large plantation model,

9 In relation to the actions of Nelson Rockefeller in Brazil, see COBBS, 1988; SILVA, 2015; e TOTA, 2009.

replacing slave labor with European immigrants, with the predominance of a traditional coffee production system. This model followed stages similar to the colonial period: "the levelling of the forest, the burning of wood, and the planting of crops in the deforested areas." The natural fertility of the soil was exploited for 20 or 30 years" and "after this period, the productivity generally declined to lower than the point of interest, when the areas were abandoned and used as pasture and for livestock" (Lopes; Guilherme, 2007, p.26-27). As Warren Dean has demonstrated, this decline in soil fertility and productivity is linked to way of organizing production used since the times of the expansion of coffee to the region, primarily based on techniques for cutting down and burning the forest, intermittent planting without replacing nutrients, or the use of plants of different origins in unordered plots, for example (Dean, 1995, p.200).

With the market crises of the interwar period, a large part of the plantation owners from the *Oeste Paulista* — and Brazil in general — did not adopt technical innovations either in the organization of work or research in plant varieties or soil fertilization. In 1950, the first IRI technical report for its directors in New York outlined a situation that was practically chaotic, where the soils were devastated, productive techniques were rudimentary, and agricultural research was practically non-existent: the "scars in the landscape" demonstrated the constant "abuses suffered by the land"; coffee plantations according to the report were planted on steep lands, "where the naked earth is strongly eroded with each successive rainfall"; continuous cultivation had impoverished the nutrient resources and organic material which "generous nature" conceded. Finally, the technicians affirmed that the land had resisted this abuse for approximately 100 years.[10]

10 IBEC Research Institute. *Progress Report*: Brazil Operations. Jun. 01, 1951. p.2.

In 1951, IRI established a cooperation agreement with the Agronomic Institute of Campinas (IAC) and Cambuhy Plantation in Matão, in the state of São Paulo. The choice of Cambuhy, located approximately 200 kilometers from Campinas, had facilitated the process of experimentation, since there existed data about the "fertilizers used, frost damage, production costs, sale prices, and other variables" (Lopes; Guilherme, 2007, p.25-26). The experiments concentrated on approximately 23,000 *alqueires Paulistas* (2.42 hectares), set aside for the IRI's agricultural experiments. In part of the plantation, the IRI constructed a greenhouse for the introduction and adaptation of plants, in special areas, on a commercial scale. While part of the structure of the research area was made available in Matão, another section was developed in Campinas, with the assistance of IAC.

Fig. 2 – Condition typical of "exhausted" coffee lands. Courtesy of the Rockefeller Archive Center.

Source: Rockefeller Archive Center, Subseries 2, Brazil, 1027, AIA Photograph Collection. Box 4, Folder 109.

The *Rockefeller Brothers Fund* (RBF), interested in the expansion of research in basic crops, granted financial support to IRI research, allowing the contracting of US technicians to administer the experiments, as well as contributing to the cost of hiring Brazilian technicians, the construction of laboratories, and the experimentation structure in plantations (housing for researchers, greenhouses for the introduction and adaptation of plants). However, after the first five years of research, IRI specialists had not presented any optimistic technical results to RBF in relation to increased coffee production. In summary, all efforts to restore soil fertility ran into ecological questions, such frost or burning, and the lack of professionals and most especially not establishing levels of productivity similar to the "virgin lands" of Paraná.[11] In other words, IRI specialists reached the conclusion that the soil fertilization process in the coffee plantations would not reach the same level of productivity as Paraná, pointing to resistance to the application of innovations based on the use of limestone, NPK fertilizers, and micronutrients, by the plantation owners: "Although other practical experiments with coffee on the Cambuhy Plantation resulted in an increase in productivity," stated the US agronomist Jerome Harrington, former director of IRI, "the efforts to restore old and decadent plants in the degraded soils of the state of São Paulo did not reach the levels of production comparable to those obtained in the coffee plantations established in the recently deforested and virgin lands in the northern region of Paraná" (Harrington; Sorenson, 2004, p.7-8).

The decision to invest in the IRI research structure ran into the following dilemma: abandoning the project or finding new applications for the experiments carried out until then. The directors of IRI in Brazil, with a certain amount of improvisation, choose to demonstrate

11 IBEC Research Institute. *Report of 1953*. New York: IRI, Jun. 16, 1953. p.5.

optimism in their reports, while they waited for the arrival of a specialist in soil fertility with experience in degraded soils.[12] In 1955, the American soil scientist Andrew Colin McLung became part of the team and afterwards some experiments in the fertilization of coffee plantation were transposed to agricultural production in *cerrado* land in the region of Cambuhy Plantation.

When the soil fertility program began in 1956, its initial object was to identify the relevant factors for soil fertility for the development of other crops used at that time with a cycle equal to or less than three months, raising "a wide spectrum of possible treatments" which could be assessed in the greenhouses (Harrington; Sorenson, 2004, p.11). Based on the response of the crops, field experiments were then installed with "corn, soybean, and cotton, with an approximate duration of up to six months" (Harrington; Sorenson, 2004, p.9-10). In 1958, still in agreement with the former director of IRI, "there existed a sufficient quantity of results in vases which justified the beginning of an intensive series of field tests" (Harrington; Sorenson, 2004, p.10). Choosing two locations in the *cerrado* — one in São Paulo and another near Anápolis, in the state of Goiás — cotton and soybean were planted as test crops. The results obtained in these productions indicated that the soils "were much lacking in various nutrients and that they responded quickly to the use of limestone and fertilizers" (Harrington; Sorenson, 2004, p.10). At the end of the 1950s and the beginning of the following year, IRI published a series of technical bulletins aimed at cultivation in area of the *Cerrado*. Gradually, the experiments were discontinued, principally after the department of McClung to work with the Rockefeller Foundation in Colombia in 1960.

12 IRI Research Institute. *Report:* November 1950 to December 1956. Collection IRI, Record Group 3.1, Box 477, Folder 2903. p.3.

Fig. 3 – Experiment using NPK fertilization (left) and NPK and Sulfur (right). Courtesy of the Rockefeller Archive Center.

Source: Rockefeller Archive Center, Collection 1027, AIA, Subseries 2 – Brazil, Box 2, folder 25.

Following this, IRI reduced its range of activities, primarily concentrating on research related to tropical products. In 1961, the Institute of Agricultural Research and Experimentation (IPEACO), in Sete Lagoas, Minas Gerais, held the "First Brazilian *Cerrado* Meeting" and, the following year, the Department of Botany of Universidade de São Paulo (USP) held the "Symposium of the *Cerrado*." The meetings brought together researchers from various areas, involved both in the technical survey of botanical aspects or the fauna, or in the economic exploitation of the region. After these meetings, IRI research obtained recognition from some researchers as the fertilization model which offered greater profitability, allowing large scale agriculture in the *cerrado* fields (Silva, 2012).

The development of the National State and *agribusiness* found a point of reference in the IRI research. In 1963, on the eve of the military coup, an agreement signed by IRI and the *United States Agency for International Development* sought to give support to the Brazilian National Department of Research (DNPEA), stimulating "soil, animal, and plant research in eight regional institutes from Amazonia to Rio Grande do Sul" (Harrington; Sorenson, 2014, p.28). According to Harrington, "one of the objectives was to develop a General Plan for the Planaltina Experimental Station" — later called the Center for *Cerrado* Agricultural Research (CPAC) — close to Brasília (Harrington; Sorenson, 2014, p.28). Following a research agenda opened by the IRI experiments, in the 1960s the National Soil Fertility Program was created, also with the financial collaboration from the United States Agency for International Development, DNPEA, and the Brazilian Rural Credit and Assistance Association (ABCAR), with an emphasis on the "installation of plant beds to demonstrate the level of the plantation" (Harrington; Sorenson, 2014, p.31). Thus, around 1963 a basic science for the construction of soil fertility in the Cerrado was established (Wallys, 1997, p.95).

Experiments in soil fertility incorporated a rupture in the perception of the economic use of the *cerrado*. While until then extensive livestock farming had dominated the scenario, at that moment the cultivation of adapted plants gained space, also strengthening cattle production through pasture adapted to acidic soil (such as *brachiara decumbens*). The response of the soil to the new fertilization methods increased both the adaptation of new cultivation and increased migration to the territory, thereby exercising a new dynamic of interaction during the Great Acceleration. However, from the perspective of specialists and local and national governments, it was necessary to prevent the repetition of the migratory experiences considered failures in terms of agricultural colonization. In other words, technological advances had to be combined with agents considered suitable to continue agricultural development. Therefore, in the opinion of these specific sectors, not all social groups were qualified to carry out this task.

The 'grasshoppers' from the south: migration and the *cerrado*

> In the march of Gaúcho farmers to the north of Brazil the conquest of the soils of the *Cerrado* is fundamental. The great plains formed by the *Cerrados* of Central Brazil are similar to the pampas which cover the southern part of Rio Grande do Sul. The *pampa* is a sacred place for those living in that state, because the large and bloody battles to demarcate the frontier were fought there. According to historians, it is the hardest won part of Brazil. The battle for the conquest of the *Cerrado* was no less important. Just that in the place of arms, agricultural machinery, technology, and a lot of money were used. (WAGNER, 1995, p.65).

While the instruments for the fertilization of the *cerrado* soil emerged out of experiences in degraded areas of the Atlantic Rainforest in the Southeast of Brazil, agricultural expansion towards the *cerrado* started with the formulation of a new elite of rural producers, this time in the Southern region.[13] Represented as the principal social group which propelled largescale cultivation in various regions in Brazil, these 'farmers' undertook a process of agricultural modernization based on the widespread use of 'modern' raw materials which transformed the *cerrado*. In the social and political imaginary, "farmers from Rio Grande do Sul were preferred by the colonizers because they dominated soybean technology and possessed equipment and a little initial capital" (Wagner, 1995, p.36). On the other hand, the intensification of the modifications influenced by the Southern migration was dealt with in a critical manner by local populations, including giving these immigrants the nickname of 'grasshoppers' from the south, due to the intensified environmental devastation following their arrival. In relation to this topic,

13 An approach concerned with the ethnic aspect involved in the diffusion of credit policies was developed in SILVA; RADIN, 2015.

the discussion was concentrated on the idea that the migrants from the South of Brazil were crucial actors in the consolidation of an interventionist model which reconfigured the environment.

However, until the 1950s these farmers were part of the same imagination in relation to Brazilian rural populations, where tradition and poverty predominated (Silva, 2017). As Klanovicz stated, between the 1960s and the end of the 1970s, the actions of the Brazilian state decreed "the death of the traditional poor farmer", encouraging the emergence of a "modern, rich, and entrepreneurial producer". In a context of the reorganization of the agricultural production structure with great interferences in terms of international technical cooperation during the military dictatorship, "the only desirable agriculture was the one aimed at the production of excess for the market," which was increasingly globalized, and with an intense use of "raw materials, machinery, and modern equipment, funded by the state, and dependent on technical knowledge". Within the various social sectors which "made efforts to reproduce these modernizing discourses of agriculture" (Klanovicz, 2014, p. 7), the descendants of Italian, German, and to a lesser extent, Polish immigrants settled in the state of Rio Grande do Sul since the second half of the nineteenth century, stood out to the eyes of local and national governments as social groups who had broken away from 'backwardness' and 'poverty' (Silva; Radin, 2015).

From the 1970s onwards, more specifically following the launching of the Second National Development Plan (PND II, 1974-1979) by General Ernesto Geisel, the credit provision policy for the acquisition of land, machinery, and raw material reached the social groups considered suitable for the modernization of Brazilian agriculture. To a certain extent, these programs contrasted with other experiences on the lands of Central Brazil, such as the attempt to settle immigrants from Germany (Uvá Colony in 1924). According to Faissol, in the 1950s, the aim of establishing a planned colony of farmers "to improve the conditions of agriculture in Goias, in relation to techniques and the quality of life" had been transformed into "an expansion of [the colonies previously] invented for the Central Plateau". While the ideal of implementing the

colony was centered on 'teaching' Brazilian *caboclos* modern agricultural practices, the result was the inverse: "All the German colonists assimilated the habits of Brazilian *caboclos*".[14] In the eyes of the government, encouraging the flow of neo-European migrants 'acclimatized' to Brazilian lands since the nineteenth century in the South of Brazil, could function better than bringing German immigrants at the beginning of the twentieth century, as in the case of Uvá, directly to the *cerrado*.[15] Due to their high adoption of agricultural technologies, the generations of descendants of Japanese immigrants settled in the interior of the states of São Paulo and Paraná also fit the imaginary of the progressive farmer desired by the economic and political elites.

In the 1970s, the "southerners" or "Gaúchos", as farmers from the southern part of Brazil were commonly known, were attracted by cheap land and the availability of credit for regions in the *Cerrado*, Pantanal, and Amazonian biomes, principally for the plantation of soybean, while generations of descendants of *Paulistas* and *Mineiros* occupied — though not exactly as a rule — land intended for livestock raising on a largescale and the small scale growing of crops. In certain regions of the Center-West of Brazil the term *Gaúcho* refers not only to natives of the state of Rio Grande do Sul, but also migrants from the West of the states of Santa Catarina and Paraná. In common, these migrants were of European descent — mostly descendants of immigrants who settled in the "old colonies" of Germans or Italians — and who valued, at least in a differentiated manner from the other social groups, private property, official Catholic religiosity, the patriarchal family, and the idea of social ascension through hard work.[16] Celebrated by hegemonic political

14 FAISSOL, Esperidião. O problema do desenvolvimento agrícola do Sudoeste do Planalto, p. 32.

15 Other agricultural colonies "invented in the Central Plateau", according to Faissol, were considered satisfactory from the point of view of agrarian reform, but deficient in relation to the modernization of agriculture. In relation to national agricultural colonies, especially CANG, see DUTRA E SILVA, 2017, p.169.

16 In the West of Santa Catarina, the initial area of the expansion of these migrants outside Rio Grande do Sul, the term "*colono de origem*" signified for Luso-Brazilians, or *caboclos*, "the population of the rural area of European descent" (RENK, 2014, p.66).

groups since the beginning of the twentieth century — who facilitated and encouraged their dispersal through an alliance with colonization companies — the neo-Europeans constructed and reinforced a narrative of success in relation to their achievements in relation to social and economic ascension. On the other hand, these groups sought to hide determined elements which demonstrated the contradictory methods used in the construction of this symbolic and financial capital. The strategies for the expulsion or incorporation in a subservient manner of local populations by part of the Italo-Brazilians, as described by Renk, are justified through a supposed development 'need' or for the generation of employment and income. They could also be simply hidden from the narratives, with aspects of success being superimposed (Renk, 2014).

The first families who arrived from Europe in the second half of the nineteenth century and the beginning of the twentieth, established themselves in colonies in Rio Grande do Sul. Using the agricultural mode of production based on family work, gradually due to the growth of families, the subsequent division of land among descendants turned a large part of properties non-productive from the economic point of view, whether due to the reduction in the size of plantations, or the difficulty of using crop rotation techniques, causing soil infertility (Werlang, 2002).

In the social imaginary of these descendants, a strong idea of frontier was gradually constructed, represented by the search for better living conditions. By way of example, after the Second World War, groups of neo-Europeans were already established in regions in the West and Mid-West of Santa Catarina — attracted by the state government and colonization companies to settle the "inhospitable" *sertões* which were the stage of the Contestado War (1912-1916) — and in the Southwest and West of Paraná (Radin, 2009). In this state, and more specifically in the city of Planaltina, an important priest made an allusion to the social dynamic of these migrants: "Many who possessed just a few *alqueires* sold everything and went to buy more land, where they found it". And others, "who worked on their ten or twenty *alqueires*, with the desire

to expand their land, went in search of places with more space, going to Acre, Rondônia, Mato Grosso, or Goiás".[17]

Attracted by the propaganda of the colonization companies, in alliance with the state and local governments, or by those with whom they had family or fraternal ties (relatives or friends who 'advertised' the 'new lands' and sometimes housed and helped the recently arrived migrants), some remained in the frontier regions, others returned to their region of origin, while certain groups occupied new frontiers at different moments: in Paraguay, Mato Grosso do Sul, Mato Grosso and Goiás, Amazonian regions, and more recently the MATOPIBA region, part of a complex of *cerrados* in the regions of the states of Maranhão, Tocantins, Piauí, and Bahia (the North and Northeast regions). To cultivate the *cerrado*, these 'entrepreneur-farmers' adapted a dynamic of dealing with the environment defined as "civilizing deforestation" (Bublitz, 2008). In this point the social representations of German immigrants of the forest contrasted radically with the way it was administered with by *Caboclos*, for example: "While it remained exuberant and robust, the forest was considered a prison" (Bublitz, 2008, p.327). For the colonist to stop feeling "a slave of the forest," it was necessary to "work hard, in an unceasing struggle, to cut down the vegetation and impose their dominion over nature." For the German immigrants, "cutting down the forest was a synonym of civilization, of progress. In short, it was the guarantee of success in the new patria" (Bublitz, 2008, p.327). In summary, the need to guarantee survival in lands in which they had never previously lived in, with differentiated work instruments, and also pressurized by contracts which stipulated the devolution of uncultivated lots, the German immigrants had developed a particular form of land administration, seeking to transform the forests: "colonist and civilization become synonyms" (Bublitz, 2008, p.327). During the twentieth century, other groups of neo-Europeans and neo-Asians, principally the Japanese, also came to be represented as the most 'progressive' and the best qualified to carry out agricultural modernization projects in Brazil.

17 REGINATO, Pe. Pedro. *História de Palotina (1954-1979)*. Santa Maria: Pallotti, 1979. p.57.

Finally, the "opening" of extensive areas of *cerrado* vegetation for cultivation was associated with the arrival of the Southerners — social representatives of a wide-ranging project involving public credit policies, agricultural research, and landholding questions — and the use of an aggressive dynamic of environmental management, alternating the planting of *commodities* in accordance with the variation of prices in national and international markets. By way of example, a rural worker, born in the current state of Tocantins summarized the dynamic of the advance of the agricultural frontier thus: following the arrival of the "people from the South," "lands for cultivation" began to be opened, while the intensity of deforestation expanded a lot "in the 1980s and 1990s" (Batista de Sá, 2013). Since then, deforestation "never stopped": "first, part of the *cerrado* was taken" for the "planting of rice," which afterwards came to pasture"; finally, "soybean came," combined with the advance of other practices such as the planting of eucalyptus.[18] The narrative of this rural worker connects Southern migration to the third fundamental factor for the agricultural expansion into the *cerrado*: the adaptation of crops. Among these crops, present both in the social imaginary and economic statistics, one grain in particular stands out in the history of the agricultural occupation of the *cerrado* and substantially contributed to the increase of factors linked to the Great Acceleration: soybean.

The "united republics of soybean" and the *cerrado*

Among a large number of factors which propelled the Great Acceleration in a region as diverse as the *cerrado*, what stands out is the attempt to reduce a complex environment to a simplified scheme of agricultural and pastoral production. Private and public institutions resorted to the pragmatic introduction of varieties of plants and animals aimed at a globalized market. Gradually an extremely complex environment, peopled by populations who for centuries had administered the available natural

18 BATISTA DE SÁ, Antônio. *Entrevistado por Claiton Marcio da Silva, Jaine Menoncin e Melody Forcelini*, Palmas, Tocantins, mar. 2013.

resources, was faced with the rise of simplified schemes proposed by private companies and governments. In this sense, what had once been such a complex community of plants and animals that scientists could only understand it only with difficulty, "now it increasingly became an apparatus rigidly restricted to competing in expanded markets to obtain economic success" (Worster, 2003, p.35). The maximum expression of these transformations in the *cerrados* is the intensification and expansion of monocultures.

In this way, while livestock raising and the production of corn and other foodstuffs did not represent a novelty — livestock had propelled the economy since the nineteenth century while corn was the predominant crop in the Center-West region —, added to these elements were determined technical innovations and the introduction of varieties adapted to the climate and soil. Taking into account the numerous agricultural experiments adopted since then — coffee, peanuts, English potatoes, sugarcane, and bananas, amongst other — some elements which have stood out in relation to the origin of the great acceleration of the transformations of the *cerrados* include: the introduction and expansion of the planting of hybrid corn (Menoncin, 2017); the adaptation of varieties such as *brachiaria*; breeds of cattle such as Nelore; and finally the introduction of soybean. More specifically for this debate a digression will be made about how attempts to introduce soybean represented a point of inflection in the history of the *cerrados*, influencing Brazilian political and business spheres. For *agribusiness* the planting of soybean represented a conquest of science and technology in two manners: a) the development of crop varieties adapted to the acidic soils of the *cerrado* and b) adapted to lower latitudes, unlike the seeds produced by the United States and China, which dominated the global market. After the "invasion" of the *cerrado* by soybean, Brazilian *agribusiness* felt encouraged to introduce a large number of crops, such as irrigated rice, coffee, water melon, pineapple, and citric fruits, amongst others.

Fig. 4 – Perennial Soya growing in association Suwannee Bermuda Grass. Courtesy of the Rockefeller Archive Center.

Source: American International Association for Economic and Social Development and its IBEC Research Institute Division. Progress Report.

To understand the historic aspects related to the introduction of soybean cultivation in the *cerrados*, it is necessary to return to some the previously debated aspects. In first place, the experiments in soil fertility implemented by IRI in the Cambuhy Plantation also sought to introduce vegetables aimed at animal nutrition and 'new' types of cotton, corn, and soybean. Initially, the IRI specialist believed that the three crops would be economically justifiable in the *cerrados* (Mikkelsen, 1960). Among the crops mentioned, only the introduction of soybean represented a novelty.

Soybean was introduced in Brazil in the middle of 1882, in the state of Bahia. Later, Japanese immigrants planted it in São Paulo state. However, only in 1914 were some varieties coming from the United States acclimatized with some success in the state of Rio Grande do Sul (Martins de Freitas, 2011, p.2). The first commercial plantation registered occurred in the municipality of Santa Rosa (Dall´Agnol, 2016, p.2).

According to Dall'Agnol, "soybean was only successful in Brazil from the 1940s onwards", when planted in the same state, "located between the latitudes of 27°S and 34°S" (Dall'Agnol, 2016, p.20). Agricultural engineers attributed the success of soybean in Brazil because Rio Grande do Sul was at a middle latitude, similar to the southern states of the US. The challenge for the adaptation of soybean resided into the concentration of crops introduced from seeds manipulated by the largest global production centers during the first decades of the twentieth century: "the global producers of soybean at that time (China and the US) did not grow soybean at lower latitudes and, thus, did not develop crops for these conditions, which could benefit Brazil" (Dall'Agnol, 2016, p.26). Specifically, in the case of soybean, the fundamental objective was the development of "Tropical Soybean", in other words, adapted to lower latitudes: "until 1970, the cultivation of oleaginous crops was restricted to latitudes close to or above 30º" (Dall'Agnol, 2016, p.8).

In the state of São Paulo, the experiments made by IRI during the 1950s and 1960s produced encouraging results in economic terms — in 1967, the addition of micronutrients resulted in increases of 11%, 27%, and 78% respectively (Mascarenhas, 1967, p. 373-374) in the production of Perennial Soybean (*Glycine wightti Verde*), which was of an African origin and introduced in Brazil during the 1950s, mostly used in shared pasture. The encouraging result in terms of the increase in productivity, however, faced problems in the diffusion of perennial soybean grain. Although it was adaptable, other research from that time showed that it was possible to prepare more productive crop varieties, better adapted to the *cerrado*. In the 1960s, the agricultural engineer, Francisco Teresawa developed FT CRISTALINA soybean, later considered as one of the pillars of the production of soybean in the *cerrado*. Starting with experiments around 1964, in the Ponta Grossa Experimental Station, linked to the state government of Paraná, Teresawa's studies included a small number of cultivars coming from the United States.

Later, other lineages of soybean were introduced through technical cooperation between universities from Florida, Mississippi, Georgia, Tennessee, Arkansas, and North Carolina, which provided materials

which adapted well to the south of Brazil (Teresawa *et al*, 2017, p. 17). Gradually, during the second half of the twentieth century, there occurred "the dislocation of small fields of soybean to monoculture based on plantation and harvesting technology, the large use of chemical 'inputs'," as well as "an extreme rationalization of plantation space aimed at capital" (Mores; Klanovicz, 2014, p.181). The introduction of soybean, as well as coffee, moved the traditional polyculture practiced in family properties towards the direction of monoculture: in this period, the cultivation of soybean "began to demand the use of modern technology and practices which had not been used by the state in previous periods", adapting and using technologies "linked to a new agricultural science" and "strategies for convincing farmers to adopt determined practices" (Mores; Klanovicz, 2014, p.181).

In this context, in 1972 Francisco Terasawa founded *FT Pesquisa e Semente* in Londrina, in the North of Paraná. The fall in coffee production in the region — principally due to frosts in the middle of the 1970s, added to the economic results obtained from cultivars such as Bragg, Davis, IAS-1, IAS-4, IAS-4, IAS-5, Paraná, Mineira, and Visoja — facilitated the acceleration of the expansion of soybean in Paraná state (Terasawa *et al*, 2017, p. 17). Between 1953 and 1975, more than ten frosts attacked the north of Paraná, which not only "demonstrated the regularity of this phenomenon" (MORES, 2017, p. 42), but also the need to look for land that could be farmed with less climatic variations. Just after the strong 1972 frost, Terasawa received seeds from a lineage called Mutasoja from a farmer of US origin, Thomas Owens living in Itaporã, in the state of Mato Grosso do Sul. At the beginning of August of that year, experiments with Mutasoja began at Serrana Plantation in Londrina — Terasawa selected 42 plants with distinct traits of the Mutasoja lineage, characteristically taller, with long cycles, pubescence, and a different coloration of the flowers (Teresawa *et al*, 2017, p.17). This signified that in general Brazilian researchers "sought to develop adapted varieties" seeking to incorporate "genetic characteristics (a long juvenile period) which would inhibit the precocious flourishing of soybeans at the conditions if lower latitudes" (Dall'Agnol, 2016, p.26), resulting

"in cultivars perfectly adapted to the conditions of the *Cerrado*." For a second experiment in the Summer of 1972/73, once again 42 plants, individually named M-1 to M-42, with the letter M indicating reference to the original Mutasoja lineage — which later was recommended as a cultivar and named UFV-1 (Terasawa *et al*, 2017, p.17).

At the beginning of the 1970s, innovations in fertilizers had a limited diffusion, with the challenge of the infertility of the *cerrado* soils persisting. The purpose of the experiment with the M and UFV lineages was to evaluate their adaptability and productivity in the *cerrado* environment, determining the behavior of the individual traits of each one of the lineages and identifying the best material adapted and with traits of interest for the central region of the country. Comparatively, it is a differentiated strategy from the IRI venture — and from the various experiments which followed it in the 1960s and 1970s, especially in the Agronomic Institute of Campinas — which sought "to construct the fertility" of soils. In the case of the adaptation of soybean lineages, the researchers sought to "dribble" the lack of micronutrients and introduce seeds adapted to soils with relative acidity. In November 1973, Terasawa established an experiment in Unaí, in the state of Minas Gerais, a municipality bordering Cristalina, in Goiás state. The experiment was carried out in a location traditionally used as pasture, introducing once again 42 plants, this time using the cultivar IAC-2 as the comparative standard. In a transversal direction from the planting, different formulas for fertilizers and micronutrients were assessed. The soil analysis demonstrated that these were extremely acidic and chemically limited, not suited for cultivation, in a similar manner to the soils of Campos Gerais in Paraná, poorer in organic material. The M-4 lineage provided better results that the demonstrative seed bed containing IAC-2. A year later, in November 1974, the experiments were repeated in Vereda de Souza Lima Plantation, in Goiás. Once again, M-4 was the most productive, being named FT CRISTALINA in 1975, in tribute to the Goiás municipality where the experiments were carried out (Terasawa *et al*, 2017, p.21).

At the beginning of the 1980s the conditions for the systematic expansion of the agricultural frontier had been created. Programs such

as PRODECER[19] "personified" how this expansion occurred: in summary, the projects synthesized the ideas for the adoption of fertilization practices on a largescale, the monoculture of soybean and corn, the use of elements previously spread through Brazil, such as agrotoxins and agricultural machinery, and finally the encouragement of migration.[20] By this stage, the Brazilian state had begun to structure agricultural research, especially through the Brazilian Agricultural Research Company (Embrapa), conceived as model to counterpoise the 'bureaucratic' programs and governmental institutions which had existed until then (Nehring, 2016). Embrapa, created in 1973, during the military dictatorship, established research centers for agricultural products, "thematic research centers and eco-regional research centers" (Dall'Agnol, 2016, p.16), such as Embrapa Soja, created in 1975, in the municipality of Londrina. The public and private research structure to a certain extent was in harmony with the "anxieties of the military government, established during that period, and synthesized in the principal objectives of the National Development Plan" (Frederico, 2010, p.33). The Brazilian state intensified its centrality in the process of expanding into the *cerrado* through credit provision policies, the provision of technical assistance, and landholding policies, amongst other forms of intervention. It found in fertilization practices — with the widespread participation of the state and private companies such as Manah S.A. in production since the

19 The Nipo-Brazilian Program for the Development of the *Cerrados* (PRODECER) was created in 1974. The program later received financial assistance from the Japanese government for the settling of migrants — some of them from the South and also of a Japanese origin (22%) — in seven states with a total of twenty-one projects in a period of twenty-five years. HOSONO; HONGO, 2016.

20 These were some of the fundamental characteristics of PRODECER exported to the development of ProSavana in Mozambique. Due to its characteristics, agencies such as the World Bank consider that the '*Cerrado* model' may not be the ideal for the tropical savannah of Africa, because PROCEDER involved the expansion of large commercial plantations, while the idea that it is the small producers who have a large impact on the reduction of poverty in that continent is generally accepted. The PRODECER model created an elite of producers. In addition, the same World Bank report stated that both in Mozambique and in the other countries studies, there was a great potential to create agricultural ventures. EKMAN; MACAMO, 2014, p.10.

1970s —, in monoculture, and in groups of migrants in frank social ascension, a basic support to accelerate the transformations of the *cerrado*. Since then, although alternative sustainability projects have been part of the governmental agenda both during the democratic period (1985-2016) and following the recent soft or judicial-mediatic-parliamentary coup, the agenda of the groups forged during the Great Acceleration has predominated.

Final considerations: soils, migrants, soybean, and the great acceleration

The relationship between the *cerrados* and the Great Acceleration can be found in the history of changes in forms of interaction between human and non-human components, composing a new dynamic in land use. The perception that acidic soils could be transformed into fertile ones, the incentive for a determined type of migration and the intensification of monocultures reconfigured the *cerrado*. These elements propelled economic activities which had already impacted the landscape — the production of soybean generated the growth of the processing of foodstuffs from animal consumption, including cattle, for example — or facilitated the insertion of new characteristics in the *cerrado* — population growth, the expansion of crops such as eucalyptus, irrigation projects, amongst others —, forming economic and political elites with a strong participation in the direction of the national economy and their connection with global markets. The impacts and controversies of this process also reached astronomical scales: for example, "the first official report about the national emissions of GHGs showed that approximately 75% of carbon dioxide (CO2) emissions from the country were due to changes in land and forest use," in other words, "deforestation and burning, especially in the Amazon region and the *Cerrado*, were the principal sources of emissions from 1990 to 1994".[21]

21 CRITICAL ECOSYSTEM PARTNERSHIP FUND. *Perfil do ecossistema hotspot de biodiversidade do Cerrado*. [s.l.], ISPN/Conservação Internacional, abr. 2016. p.171.

Even with the diffusion of other cultivars, FT CRISTALINA continued being the most used seed in the *cerrados* region, covering 95% of the soybean cultivating areas (2004) in the geo-economic region of the Federal District, also being cultivated in the states of São Paulo, Minas Gerais, Mato Grosso do Sul, Goiás, and Rio Grande do Sul. At the end of the 1980s, "around 80% of soybean production was cultivated with the Cristalina variety and productivity reached 40 sacks per hectare" (Duarte, 2004, p.83). In relation to national soybean production, the participation of the *cerrado* increased from 14% (2.1 million tons) in 1980 to 61% (57.9 million tons) in 2015 (Dall'Agnol, 2016, p.26). To have a dimension of the importance of the agribusiness, in 2011, more than 30 million tons were used annually for the grinding industry, transforming grain into derivatives such as oil and meal. Soybean meal occupies second place in the preparation of feed, with an estimated internal consumption of 12 million tons, while 13 million were exported. In relation to biodiesel, soybean was responsible for more than 80% of the raw material used in almost 2.5 million liters then produced in Brazil, while beef fat and cotton oil were responsible for 12.4% and 2.1% respectively. Also in 2004, the soybean complex was responsible for five million direct and indirection jobs in Brazil (Martins de Freitas, 2011, p.7).

In addition to soybean cultivation, this extensive interaction between human and non-human elements caused substantial modifications and concentrates the principal threats to the *cerrado*, both in the present and in the near future: with "the annual cultivations (principally soybean, corn, and cotton), biofuels (sugarcane), vegetal charcoal, silviculture of mono-species, as well as fire and livestock",[22] constituting the principal causes of these environmental disasters.

Erosion, invasive species, permanent cultivation, pigs, transport, and heating (local and global) — elements with a direct or indirect relationship to the expansion of the agricultural frontier — are also relevant, inducing deforestation at a rate of 6000 km^2 per year. By 2016,

22 CRITICAL ECOSYSTEM PARTNERSHIP FUND. *Perfil do ecossistema hotspot de biodiversidade do Cerrado*. p.26.

the *cerrado* had lost around 50% of its natural coverage. [23] The intensification of soybean monoculture through programs such as PRODECER was linked to the increase in pests in surrounding crops. Other farmers related the increased in pests to the "formation of large areas of pasture with *brachiaria*, or a whole set of environmental impacts associated with the so-called modernization of agriculture in the *Cerrado*" (Ribeiro, 2006, p.227). Each complex situation, originating from the intensification of interaction between humans and non-humans in the *cerrado* regions required new responses from specialists. However, since not all the environmental elements are under human control, the Great Acceleration may represent according to the archeologist Sales Barbosa the extinction of the Brazilian *Cerrado*. [24]

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23 CRITICAL ECOSYSTEM PARTNERSHIP FUND. *Perfil do ecossistema hotspot de biodiversidade do Cerrado*. p.26.

24 BARBOSA, Altair Sales. "O Cerrado está extinto". *Jornal Opção* (Goiânia), n. 2048, 2014.

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