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# REGIONAL DEVELOPMENT FOR SUSTAINABILITY IN AMAZONIA: CONTROVERSIES AND CHALLENGES

ABSTRACT. Through a prospective study, structural issues that move Amazonia's ecological and cultural complexity and its internationalization are analyzed in this article. Its predatory development in a global context permeated by sustainability is presented. It shows that capitalism has no heuristic reach to economically exploit Amazonia preserving its biomes. It prioritizes issues such as: What are the political foundations that permeate Amazonia's global economic insertion? What are its links with the scientific and technological processes imbricated in worldwide environmentalism? Many proposals and uncertainties concerning Amazonia's ecological issues are presented. The environmental and social impacts of the large socioeconomic development projects implemented in the region are shown. Technical elements to clarify the sustainability concept and its correlation with the development of Amazonia are presented and analyzed. Amazonia's importance for the future of Brazil and the mankind, and the controversies on political and economic issues that impede its economic development are also discussed.

KEY WORDS: Amazonia, environment, regional development, sustainability, climate change, Great Railway, Highway, Mining, Hydroelectric Plants, Agribusiness In Amazonia, Controversies And Challenges

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## INTRODUCTION

The development of Amazonia is in question. The critique on the modernization incremented for the capitalism in this region has left an incalculable debt to the physical and sociocultural heritage of its people and territory. The historical forms of human adaptation have been replaced, in successive "economic cycles", for the inadequate, precarious, and failed national public policies; for the models had been deprived of knowledge on regional situations; for the denial to the Indigenous and local population and to other forms of occupation; for the interventionist character in the creation of its physical and political borders; for the its mistaken planning, and finally, for the brutal modes of appropriation of Amazonian biodiversity and its its social poverty (Freitas 2013).

There are moments in Amazonia's occupation and development processes can be underlined

in order to design the present situation of the region and to allow understanding of its human groups, its work forms, its permanent challenge in contact with nature, and its plural modes of existing.

This article analyzes Amazonia's dimensions. Several phenomena and on-going processes configure the contemporary Brazilian Amazonian region and imprint important innovative characteristics to the region: as a space for the appropriation and derogatory use of nature by means of large projects; as a free trade zone; as an extended territory for the militarist geopolitical; as a multiethnic space for diverse nationalities, either partially dependent or relatively autonomous of the national state; as ecosystems of planetary importance; as a laboratory and prospection ground for global scientific agenda; as places for decentralized productive developments; as disputed and challenged areas of people who are agents of global power. Such phenomena and processes reopen relationship issues among regions and nations. Its also reopen geographical and cultural issues in Amazonian region (Freitas 2013a; Freitas and Freitas 2013b).

## METHODS

This article analyzes the great development projects in Amazonia through a prospective theoretical study. It was organized according to the following steps:

-Bibliographic survey and typification of development projects, structuring and inaugural, implanted in Amazonia since the 20st century;

-Identification and utilization of representative and innovative thematic studies related to the implementation and institutionalization processes of these development projects;

-Grouping of these themes, projects and research results that have considered the socioeconomic development of Amazonia as an object of attention, giving priority to the intellectual conjunctures of the years 1980 to 2015;

-Identification of comprehensive approaches and analyzes that constitute mandatory inaugural references and that add specific interpretations to Amazonian regional realities;

-Identification and use of studies of analysis and synthesis considered emblematic as a critical balance of the produced works, with views to the exhaustion of economic cycles and also with the purpose of subsidizing governmental actions in the region;

-Characterization and fulfillment of intellectual gaps in scientific studies on Amazonian development, and the promotion of debate of generating ideas of integrated research topics into a system of national and international circulation of scientific interests and approaches;

-Identification of the connections of the economic development projects in Amazonia subject to the scientific interventions in the public policies and its dynamic functions in the production of new researches;

-Characterization and analysis of priority scientific topics not yet adequately studied in Amazonia's agendas of the economic cycles and in the critical dialogue of the knowledge groups of the regional societies;

-Proposing a schedule of study priorities, with national and international connections, capable of forming a research program to be institutionalized by regional scientific policies;

-Historical reconstruction of scientific programs and agendas developed and in progress in Amazonia in the identified intellectual conjunctures;

-Periodization of research efforts that have opened and consolidated fields of knowledge and identification of those that have become a reference for public policies in the region;

-Analysis and synthesis of intellectual traditions and gaps with views to encouraging further studies; and,

-Finally, promotion of intellectual interventions for the purpose of carrying out comparative studies.

## STUDY AREA

Amazonia's geo-historical and cultural characteristics are fantastic, although its relations with Brazil are conflictive and of political subalternity. Amazonia is the South American region with climatic conditions characterized by high temperatures, humidity and rainfall, covering parts of Brazil, Peru, Ecuador, Bolivia, Colombia, Venezuela, Suriname, Guyana and French Guiana, totaling about 6.5 million km$^2$, of which 5 million km2 are primary forests. In this region are the world's largest cultural and biological diversities in contiguous areas, one-third of the world's reserves of tropical rainforests, one-fifth of the planet's surface fresh water, one-tenth of the world's biota in solid-surface. The Brazilian part - known as Brazilian Amazonia or Northern Region - is formed by the Amazonas, Acre, Pará, Amapá, Roraima, Rondônia and Tocantins states. The Legal Amazonia, denominated in 1966, also covers the western part of Maranhão state, from the 44th meridian and part of Mato Grosso state, totalizing 4,987,247 km$^2$, 58 percent of the Brazil's total area and 40 percent of South America, which corresponds to 5 percent of the earth's surface. Of this area, 3.5-4 million km$^2$ constitute primary or vegetation cover without significant anthropogenic disturbances. It has about 25 million inhabitants, around 3.5 thousandths of the world population, among them 163 indigenous people corresponding to more than 384,000 people, or 40 percent of Brazil's indigenous (Freitas and Freitas 2013a).

At Amazonia the nature continues to challenge culture. The presence of indigenous cultures in the architecture of its development models is an essential element to its success. The successive governments have not yet been sensitized by the implementation of public policies for this Brazilian society segment. The growing processes of detribalization, deterritorialization and marginalization of these peoples have contributed to the loss of their identities and part of our history, not yet understood by critical historians (Freitas 2014a).

Amazonia has a complex hydrography, more than 1,000 rivers with about 75,000 km navigable, a fleet of 350,000 medium and large sized boats, about 22,000 isolated communities. It represents 50 percent of Brazil's hydroelectric potential, 12 million hectares of wetlands, 11,248 km of international borders, more than 200 million hectares of protected forests in state and federal conservation units (2010 data) that play an important role in stabilities of several biogeochemical cycles on a planetary scale, such as water, carbon and nitrogen.

The practice of large-scale illicit, specially, the drug trafficking, wood and forest products, uncontrolled biopiracy, the isolation of its populations, the constant incursions of international guerrilla groups and the incipient presence of the national state on the Amazonian borders are issues that have no short-time solutions. The implementation of public policies for more 22,000 isolated communities from Amazonia is a national state civic debt.

Amazonian region is crossed by the Amazonas River, which drains more than 7 million km$^2$ of land, and has an average annual outflow 176,000 m$^3$/sec, 176 million liters/sec. This makes it the world's largest river by volume of water, approximately 4 times bigger than the Congo in Africa (second largest) and 10 times bigger than the Mississippi River. Amazonian basin constitutes a region with low demographic density and one of the highest rainfall indices on the planet, with an average of about 2,200 mm/year . This represents an annual total volume of water of $12\times10^{12}$ m$^3$, 12,000 trillion liters, that this region receives each year resulting in the world's largest rainforest (Sioli 1991).

The humid Amazonian tropics are presented as a 'world of waters'. Its social and economic processes, its history and myths, its geography, its productive arrangements and its culture are moved by the cycles of nature permeated by the cycles of water and energy. Water management is a problem of global concern (Susskind 2013). Amazonia's zoology and botany are

intertwined inseparably from the cycles of nature. Meteorology, agroecology, naval engineering, tropical medicine, fine chemistry, anthropology, sociology of sciences, science education, pharmacology, tropics technologies with emphasis on fish farming, information and communication technology, fruitculture, ecological mining, designer, and ecotourism constitute areas of science and technology essential to its sustainable development. The sustainability of 'deep Amazonia' is very dependent on new permacultures of transformation (Henfrey and Ford 2018).

Brazil is ranked first in the world in terms of its diversity of plants, fish, fresh water and mammals, second for amphibians, and third for reptiles. It possesses 55,000 different vegetable species (22 percent of all plant species) and 524 different species of mammals, 517 amphibians, 1,622 birds, 486 reptiles, 3,000 fishes, 10-15 million insects, and millions of microorganisms (Cruvinel 2000). Majority of this Brazil's patrimony is located in Amazonia, further emphasizing its importance to the world economic mega-processes. Scientific literature also confirms that scientists are only aware of less than 10 percent of all existing biodiversity on Earth. There have been a number of phytogenetic accomplishments in the Ducke Forest Reservation, a preservation area (100 $km^2$) located close to Manaus city. Researchers from the National Institute of the Research of Amazonia, based in Manaus, verified the existence of 5,000 individual trees and 1,200 tree species on each hectare from this Reservation (Silva Ribeiro et al. 1999; Jesus Silva et al. 2016). This is superior to the total number of species in Europe, reaffirming its great biological diversity. The research also indicates that Amazonian forest has 320 tons of biomass per hectare and produces annually, 7.5 tons of vegetable litter (branches and leaves) per hectare. It constitutes one of the largest world sources of renewable biomass on solid surface.

These Amazonia's characteristics put challenges to the forest engineering, to basic sciences, particularly to biology, physics, chemistry and the engineering of new materials potentiating new forms of management, and the production of new methodologies and sustainable products at the humid tropics. The financing of Brazil's economic and social development from Amazonia requires high investments, about US$1 trillion over 10 consecutive years, in strategic Amazonian projects.

In a forest at the Archipelago of Anavilhanas, Central Amazonia, and subject to periodic flooding, a population of microbes with 116,409 individuals per $m^2$ was found in a superficial layer 10 cm deep (Antony 1997). This confirms the great biological diversity in this region, where new species are still being discovered. Emilio Goeldi Museum's researchers, based in Belém city and linked to the Ministry of Science and Technology at the Brazil, announced on February 19, 2014, the discovery of Amazonia's 169 new species of fauna and of the flora, being 14 of plants and 155 of animals (Goeldi Museum 2014).

Energy moves the splendor of the animal and plant lifes in the Amazonian basin. The Amazonian and Congo basins, and the tropical area around Borneo are important to Earth's ecological stability and efficient in the absorption of solar energy and its redistribution via the atmosphere. Any change affecting the operation of this "atmospheric heat machine" can result in major impacts on weather patterns and terrestrial ecosystems (Salati and Vose 1984). Equal importance should be attributed to carbon sequestration by its forests to cool the atmosphere and to maintain ecological stability of planet and the biomass accumulated by its biomes. Its abundant water and rich biodiversity also contribute to legitimize Brazil as main environmental power in the 21st century, and Amazonia as main world center of sustainable development (Freitas et al. 2015).

Together, the four countries that emitted more carbon dioxide, $CO_2$ in 2014, about 62 percent of the total global emission of this gas, were China (30 percent), United States of America (15 percent), European Union (10 percent) and India (7 percent) (Olivier et

al. 2015). From 1990 to 2014, total aggregate greenhouse gas emissions of $CO_2$ with emissions/removals from land use, land-use change and forestry decreased by 15.8 percent, from 18.98 billion tons $CO_2$ to 15.98 billion tons $CO_2$ (Framework Convention on Climate Change 2016). There are still great uncertainties in the methodologies of greenhouse gas emissions measurements as well as emissions of $CO_2$ by China and the planet. Amazonia is a key region to this worldwide process (Meir 1996).

The Amazonian ecosystems behave like a gigantic vacuum cleaner, absorbing, by photosynthetic effect, between 250 and 500 million tons of this gas per year (Gash et al. 1996). This projection represents an annual absorption rate around one ton per hectare in the 500 million hectares of these ecosystems. Studies indicate the storage of 90 billion tons of carbon in these biomes, 13 percent of the total carbon stored in the Earth's atmosphere (Higuchi 2007).

Amazonia is inserted in this conjuncture and it puts several contributions to the world, with emphasis on its participation at the construction of a mankind's new aesthetic concept; its status as planet's largest alive and natural library; its socioeconomic representation as surplus-value and reference for the world symbolic processes; its condition as strategic global and Brazilian space; its role as planet's source of recycling and world thermostat; its physical functioning as planet's mechanism of climatic stability; and its condition as main world natural laboratory for scientific experiments and sustainable practices.

Amazonia can not be held hostage to its past, marked by bloody colonization and predatory development models. Its disorderly occupation and intensive depreciation must stop. Globalization and the great projects have deepened this crisis in the region.

## DEVELOPMENT AND GREAT PROJECTS IN AMAZONIA; A PERVERSE INHERITANCE FROM THE 20ST CENTURY

## RESULTS AND DISCUSSION

Capitalism is in check. The resignifications of the concepts of citizenship and the economic models are the main challenges for the sustainable future of mankind and the planet. Experts predict a collapse in the planet's climatic and thermodynamics stabilities if there are no structural changes in the industrial matrixes, in the productive arrangements articulated with the natural resources and in the relationship between man and nature. The great projects implanted in Amazonia during the 20st century are paradigmatic examples of what should be avoided in the development models in this century. This condition is a prerequisite for the sustainability of this important region.

### Illustrative elements

Amazonia's historiography records several cycles of its organization, production and economic integration to the international capital. Cycles articulated to the demands and the strategic planning of great transnational conglomerates and the central countries. The economic activities in Amazonia are done in a closed circuit, where always prevail for the traditional and native populations, the extractive policies, the existence of a concentrated socio-economic structure and not integrated to the regional potentialities, the disorganization of worker's representations, and the lack of an organized civil society (Grégoire and Monzón 2017). This has conspired against the consolidation of sustainable development in this continental region.

In general, the great development projects in Amazonia have generated devastating effects on the living conditions of populations located in its areas of influence. Projects for the construction of highways and railways, the mines and the poles for mineral exploration, the installation of great hydroelectric and

the logging industry, the great physical and electronic monitoring projects, and the settlements in the region without a planning are framed in this perspective. The large-scale profit, the regional and national agreements, the prevalence of the interests of a corporate segment embedded in government benefits, the lack of political transparency, the inefficiency of government regulatory agencies, and the lack of public commitment with the Brazilian society and the Brazil's future are typical characteristics of the great projects that have been implanted in Amazonia, as shown below.

The processes of possession and occupation in Amazonia by the Europeans during the 16st, 17st and 18st centuries are paradigmatic examples. These colonial interventions were characterized by genocides and processes of physical and spiritual expropriation of the peoples and the Amazonian environments. These interventions have not yet been fully clarified and repaired (Silva Ribeiro 2018). It highlights the large-scale use and transfer of plants from the colonies to the European imperialist countries during the colonial period in all world's regions (Rangan and Carney 2012), especially in Amazonia, between the 17st and 20st centuries.

Emphasis to the construction of the Madeira-Mamoré railway, in the periods of 1878-9 and 1907-1912, which resulted in the death of at least 6,500 workers. This railroad with 364 km, linking Porto Velho to Guajará-Mirim cities and which was ready in 1912, cost to the public coffers the equivalent to 28 tons of gold by the exchange rate at the time. This international enterprise constitutes the first major technological project implemented in the 'deep Amazonian region'. It had as presupposition to guarantee the trade and export of regional rubber incorporating Amazonia to the world market.

The studies of Foot Hardman (1988, p. 113) emphasize that "(...) It is well known, (...) the economic relevance that the Collins's enterprise (North American constructors who contracted the works at the Madeira-Mamoré) had in the expansion of American capitalism beyond the national limits. The New York Herald said (...), for the first time in American history, here is an expedition equipped with American material, financed with our money and directed by patricians, to execute abroad, a public work of great magnitude, (...), the Collins expedition assumed an undeniable role in the conjuncture after the financial crisis of 1873. The great steel industry recovered its activities, eager for new markets. The US$6 million contract for P.T. Collins with the Madeira-Mamoré Railway acquired, in those conditions, an enormous capitalist conquest (...)".

Ruin and barbarism marked the passage of this bloody phantasmagoria in the Amazonian jungles. The highway without beginning and end, in a paradise untouched by modernity, had nothing more to transport.

The rubber cycle in the region is from that time. Rubber presented itself as a strategic product to the dynamics of the first industrial revolution consolidated at the European continent from the end of 19st century. During this period, the rubber production in the Amazonas and Pará States reached significant projections. The production of 394 tons in 1839-1840 was expanded to 39,266 tons in 1909, three-fifths of world rubber produced, reaching maximum value of 42,000 tons in 1912 (Rangel 2000). The public revenues of these two states were revitalized with impacts on Brazilian economic policy itself, at the time. In the first decade of the 20st century, Belém was the third richest Brazilian city (Jornal do Commércio 2001).

The subsequent Asian inclusion in the world supply of latex introduced new political-economic ingredients in the worldwide market of this natural product. The invention of substitute synthetic products in 1920 projected a rapid decline in demand and production of this Amazonian product. The failure to rationalize the plantation and production of rubber in the enterprise denominated 'Fordlândia', implanted by Henry Ford in

Amazonia jungle, collaborated towards the end of this Era. Developed initially in a region on the Tapajós River's banks and later in the city of Belterra, both in Pará State, in the period 1934-1945, this capitalism's audacious adventure in the humid tropics was 'swallowed' by the forest. The planting of 3,200,000 rubber trees on an area of 1 million hectares ceded by the Brazilian government to the international automobile industry did not resist the impacts of the world economic processes at the time. Research and exploration of precious minerals, timber, soybeans, among others, are also part of this global project aimed primarily at the development and production scale by the booming automobile industry at the United States of America. The impact of this cycle on the socioeconomic structure at the States from the northern Brazilian region was significant but incapable to potentialize a scientific and technological policy that would sustain an efficient industrial matrix and integrated to the interests and specificities of region. The economic and political controls of this cycle, through the British empire, allowed the appropriation and expropriation of the significant part of wealth generated by the regional populations at that time.

The next cycle in region was developed by Superintendence for Economic Valorization of Amazonia created by the Getúlio Vargas Brazilian government in 1953. The concentration of financing activities on the rubber collect and marketing processes did not prevent the growth of jute plantations in Lower Amazonas at the Santarém and Manacapuru cities, and black pepper in Bragantina Zone at the Pará State. These products were introduced in Amazonia by the Japanese. The lack of regional infrastructure, and a scientific and technological policy for the region, the rudimentary extraction, the lack of commercial scale and the low market value of materials raw extracted in the region, the lack of technological methodologies adapted to the tropics, the unhealthy working conditions, the lack of technical assistance, the emergence of new materials and substitute products, among other factors contributed to the failure of this Brazilian government project in Amazonia. The success in the pepper plantations is due more to the Japanese colony's work and tenacity in the Region Bragantina at the Pará State that to the governmental support.

New economic scenarios were projected to Amazonia after the change of the capital of Brazil from Rio de Janeiro to Brasilia, city inaugurated in April 1960, and strategically located in the central plateau at the Brazilian territory. The construction of a network of highways linking the Brazilian's southern and eastern regions to Amazonia through the Brasilia city originates from that time. The construction of the Brasilia-Belém highway, which was more than 2,000 kilometers long, in the early 1970s, definitively integrated Amazonia into the big capital's processes of expansion and circulation. The planned development by the Brazilian military regime to integrate the Amazonian region was intensified starting from that time. This project had the use of capital intensive, partnership of the federal government with the private sector requiring great international financing and the large-scale production because of the incorporation of advanced technologies. This type of development was based on the deployment of agricultural and metallurgical mineral poles, among which highlights the exploitation of strategic minerals in the Ridge of Navio at the Amapá State, in the Ridge of Carajás and the Trombetas River at Pará State (...) and in the village of Pitinga at the Amazonas State. The instability of petroleum prices in the financial market, with impacts on the world economy during the 1970s, potentiated the international pressure, especially by the Japanese industry, for the establishment of this pole in Amazonia.

The Program 'Great Carajás' created in 1980, through Decree-Laws 1,831 and 1,825, demarcated an area of 900,000 km2 in the Maranhão, Pará and Goiás States for the development of an international conglomerate for exploration and processing of non ferrous and ferrous minerals, bauxite, manganese, nickel,

cassiterite, gold, copper and others that form the industrial plant of iron mine from the Carajás, managed by Sweet River Valley Company. It comprises the mining and metallurgical sector of the Great Carajás Program, the Albrás-Alunorte in Barcarena at the Pará State, and Alumar, an alumina-aluminum pole in São Luiz, at the Maranhão State. This Program also include the agricultural development plans through rural enterprises of commercial and speculative character, the livestock raising and logging, agroforestry companies that are subsidiaries of steel companies or construction companies that are part of the Program (Hall 1991). It is the world's largest mineral pole in contiguous land.

The region's great hydroelectric potential, the existence of huge mineral reserves, particularly bauxite, the unconditional support of the military dictatorship established in Brazil and the existence of an uninformed and disorganized civil society, contributed to the implantation of this authoritarian project in Amazonia.

Lúcio Flávio (1983) states that "(...) in 1979, left Trombetas Harbor the first shipment of bauxite from Rio do Norte Mining to international market. It was the beginning of the commercial operation of the first 'great mining project' implemented by the federal government and the private initiative to accelerate the development from Amazonia.". Since then, explorations of gold deposits, iron, tin, cassiterite, titanium, copper, bauxite, uranium, potassium, rare earths, niobium, sulfur, manganese, copper, lead, zinc and diamond in the Brazilian Amazonia estimated at more than US$30 trillion, became part of the action plan at the great world economic conglomerates associated to metallurgical mining sector. The location of 96 percent of the worldwide reserves of niobium in Amazonia, a strategic mineral to the state-of-art technological processes, reaffirms its importance in this sector.

Simultaneously, a transportation and logistics infrastructure, ports and a hydropower network were installed in the region, an essential support for the new outbreak of development for Amazonia. Highlight the Coaracy Nunes hydroelectric plants at the Amapá State, Tucuruí at the Pará State and Balbina at the Amazonas State, projects at the time, controversial and expensive.

The mapping of the energy potential identified that 85 percent of the electric power generation in Brazil comes from hydroelectric plants, and that the northern region had 50 percent of this potential. The international context of the petroleum crisis, in line with the authoritarian developmentalist ideology, prioritized the construction of the Tucuruí and Balbina hydroelectric plants as strategic logistics for the Great Projects in Amazonia. "But these two hydroelectric plants are just the first of a hundred dams designed to avail the energy potential of the Amazonian basins. A real tragedy for the indigenous peoples." (Santos and Nacke 2003). Eletronorte Company, recently bankrupt and fief of traditional politicians, was created to manage the energy complex to meet the demands of production and services to the urban and rural populations of this region at the humid tropics. The market continues to conspire for its privatization.

Symbol of the military regime and a project from the early 1970s, the Transamazon Highway unfinished and abandoned, costing more than US$1.5 billion to the Brazilian citizens. More than 2.5 million people, coming from different regions of Brazil, live in the vicinity of this Highway, majority without access to government public policies. By the original plans, its layout should begin in João Pessoa city at the Paraíba State and in Recife city at the Pernambuco State, with these two parts joining in Picos city at the Piauí State, which would connect with Boqueirão da Esperança city, in the border from the Acre state and Peru, by means of 5,600 km of road (Villaméa 2001). Corruption, planning dissociated from regional realities, interests of political oligarchies crystallized in municipal, regional and national parliaments sustained this national tragedy, conceived in the 'basements' of the military dictatorship. 45 years later, this Project

resulted in a precarious road on 2,500 km, connecting two regions with the Brazil's worst social indicators.

In the same period, Amazonia was reached by the Northwest Pole Program. Through this Program, the Cuiabá-Porto Velho cities highway was paved and colonization projects directed to land regularization and extended to protection and health of several indigenous populations were implemented. This program, financed by the World Bank, and which covered the States of Mato Grosso and Rondônia, impacted several indigenous cultures accelerating the expropriation of their lands. It was done an intense and precarious settlement of migrants from the Brazilian center-south region to Amazonia. Around 200,000 people migrated to Rondônia; 80 new cities emerged from this human displacement; logging and mining fronts were settled in the area with deforestation of 2 million hectares in a decade (Mindlin 1990). Deforestation in Amazonia has already surpassed 75 million hectares with impacts on global climate stability. The deforestation in Amazonia is close to reaching a certain limit from which regions of this tropical forest can undergo irreversible changes (Lovejoy and Nobre 2018; Sud et al. 1996; McGuffie et al. 1995). Studies show that the major changes in land-use and land-cover in Amazonia are of anthropogenic nature (Klimanova et al. 2017).

The Tucuruí hydroelectric plant was inaugurated in 1984. It has the fourth largest world power, 8,000 megawatts, and flooded an area of 2,430 km$^2$. It cost US$5 billion to the Brazilian government, two thirds of which was financed by international loans. Tucuruí is an essential enterprise for the operation of the Great Carajás Program, consisting of a network of mining-metallurgical projects implemented in the region, as presented in this article. The new geospatial and socioeconomic configurations imposed on the region under the influence of this program are very unfavorable to the native peoples, accelerating its extermination and cultural uprooting. Since then, the conditions of the Parakanã and Gavião peoples have assumed dramatic contours (Souza 2000).

The consolidation of this Pole shaped the participation of Amazonia in the world mineral market under subaltern conditions. The cost/benefit relation of this cycle does not withstand the accounting cribble. The lack of political transparency, the corruption and the exacerbated subsidy involving billions of dollars from the Brazilian government have accompanied all stages of this cycle, with great social and economic damage to national and regional societies.

Lúcio Flávio (1983) estimated that the energy subsidies granted by the Brazilian government to Albrás and Aluminar - two aluminum industries located in the Pará State and that would consume 60 percent of the electric energy generated by Tucuruí or 3 percent of the Brazilian consumption [reference to 1983] - could exceed US$1 billion in the next 20 years. This shows the permissiveness of Brazilian governments to internationalist interests at the time.

Similarly, Oliveira (2000) emphasizes that the construction of the Balbina hydroelectric plant, located in the municipality of Presidente Figueiredo, 110 km from Manaus, and inaugurated in 1989, "(...) was the public projects recently executed in Amazonia most criticized. (...). During its planning period was assumed that this plant would supply 80 percent of the energy demand from the Manaus city between 1985 and 1994, with power installed of 250 megawatts. (...) The average power produced during five years (referring to the period 1989-1993) was 117.5 megawatts, representing 47 percent of the forecast generation (...). Information released by Eletronorte Company technicians in 1987 estimated the cost of implantation of this plant at US$839 million and a year later at US$1 billion. Beyond the exclusion of external rates in total above also the costs of maintenance of the plant are not included.". The process of appropriation of lands, as well as the destruction and cultural disintegration of

the indigenous peoples 'Waimiri-atroari' was one of the perverse inheritances of this great enterprise in Amazonia.

The construction Belo Monte's hydroelectric plant on the Xingu River in Altamira at the Pará State was estimated at US$3.8 billion. The Jirau and Santo Antônio hydroelectric plants, both on the Madeira River at the Rondônia Stae, are also being built despite resistance from the region's populations. The forecast of operation of these technological enterprises has great uncertainties, considering the growing pressure from NGOs and organized national and international sectors to stop the works, because of its environmental and cultural impacts.

The "Jarí Project" is the symbolic enterprise of this cycle. It was implemented by Daniel Keith Ludwig since 1967 through Jarí Ltda., which in 1970 became 'Agri-Livestock and Forestry Jarí', in an area of 2,400,000 hectares, at the mouth of Amazonas river. This Project had as goal the management and the agroforestry exploitation, the extraction of cellulose and the exploitation of kaolin and strategic mineral deposits, especially bauxite, in a scale sufficient to supply the world's demands.

The size of this Project can be evaluated by its numerical projections. In its first stage an area of 100,000 hectares was reforested, with planting of 100 million tree 'Gmelina arbórea'. The program envisaged a reforestation of 200,000 hectares, being the second stage planned for the 1980s. It was planned the establishment of a cellulose factory together to a thermoelectric plant, with capacity to process 750 tons per day. It was also developed the rice cultivation in an area of 15,000 hectares, with an average production of 4 to 5 tons per hectare; and the creation of 7,000 head of cattle and 5,000 of buffalo (Garrido Filha 1980).

Like the other major projects implemented in Amazonia, the Jarí Project left behind a trail of misery that directly affected more than 20,000 people in the region under its influence, with explosive demographic growth followed by collapse in the incipient local public policies.

The rearrangement and the resumption of industry and the world market of cellulose together to the accelerated development of new experimental methods in chemistry, physics, applied sciences and engineering generated great innovations in the technology of new materials. This impacted entire primary productive sector, mainly after the 1970s, having resulted in the worldwide decline in consumption of noble metals and the slowdown of this new 'economic outbreak in the region'. The technical difficulties of establishing a large-scale agroforestry program in tropical regions, together to intense mobilization of organized civil society sectors and the degeneracy of military regime imposed on the Brazilian people at the time, contributed to the dismantling of this authoritarian project.

Free Zone of Manaus (now called Industrial Pole of Manaus) was installed in the western Amazonia in 1967. This enterprise was an assembly line and export corridor of the largest transnational electro-electronic groups present in Brazil in the 1970s and 1980s. It mobilized a set of economic interests of a Brazilian elite's segment, and continues contributing to move the economy of this region, especially at the Amazonas State. The concentration of the industrial matrix of this development model in Manaus city, its small economic and social institutionality in the municipalities, and the lack of consistent and integrated alternative proposals to region constitute a political debt of the Brazilian State with the region's population. On the other hand, its clean energy matrix, its low environmental impact, and the generation of more than 120,000 direct jobs and 450,000 indirect are aspects that strengthen this development model. It also plays an important role in the maintenance of Amazas State's forests. This State has more than 95 percent of its 1,570,745,680 km2 primary forests preserved.

The generation of US$38 billion in this Industrial Pole in 2013 strengthens its importance, although it is globalized at the expense of fiscal incentives and technological innovations developed in

the laboratories of transnational industry headquarters.

Since the 1980s, Petrobras Company has intensified the research and exploration of fossil energy, in particular oil and gas exploration, at the Middle and Upper Amazonas. Since 2010, this company has an oil and natural gas production unit in the province of Urucu, municipality of Coari, 370 kilometers away from Manaus. The average oil production is 56,500 barrels per day, while the natural gas production is 9.7 million cubic meters per day (data 2014). This volume of production makes Amazonas State the second terrestrial producer of oil and the third national producer of natural gas, and the municipality of Coari at the Amazonas State, the largest terrestrial producer in Brazil.

There are also numerous reports about the bad impacts of the oil industry on the social structure of the Coari city, where the gas is stored. Its population grew by 7,000 inhabitants, inducing and accelerating the rise of child prostitution, marginality and infectious-contagious diseases (Paulo 2001).

In the 1980s, the federal government implemented the 'North Calha Project' in Amazonia. This project had strategic military interest for border security and formal justification for overcoming environmental protection difficulties. It covered four basic points: increase the military presence at the border, improve the bilateral relations, demarcate the frontiers, and appropriate indigenous policy towards to the areas of national boundaries with countries of the Latin American continent and Suriname (Oliveira undate). It was a reaffirmation of militarism within the framework of the redefinition of armed forces in Amazonia. The counterpoint of national press and public opinion, the reaction of the indigenous leaders, the difficulty in its operationalization, the discontinuity in its financing and, finally, the interventionist conception conspired against the success of this project. The resumption of this program starting in 2000, with partnerships between the security forces and the amazonian university institutions allowed to improve its infrastructure and logistics of attending to the basic public policies at numerous isolated Amazonian communities, although this was not its central focus.

Equally important, since the 1980s, Amazonia was incorporated to the globalized green market. It highlights the demands related to bioeconomics, bioindustry, environmental services, tropical technologies directed to atmospheric processes, climate change, monitoring and environmental management, dynamics of biogeochemical cycles and the heat and hydrological cycles with impacts on several productive sectors and global sociabilities. The establishment of this economic cycle in Amazonia allowed to construct the economic tendencies for the environmental services's costs that it provides to world. These costs, which reach several hundred billion dollars per year, reaffirm its strategic relevance to the global economic processes (Canalez 2018).

Agribusiness is another perverse economic cycle for Amazonia. According to Antônio Íoris "Since the 1990s, the State apparatus has changed from a position of defender and main financier of agriculture to become manager of complex production networks and coordinator of the insertion of national agribusiness into globalized markets. (...). Despite results in terms of economic growth and circulation of capital, agribusiness is also a process of land concentration, marginalization, pollution and proletariarization (...)." (Íoris 2017a, pp. 241-242). Antônio Íoris also analyzes its socioecological impacts that are derogatory and irreversible for Amazonia and the planet. He demystifies this global redemptive cycle of Amazonia that can not enhance the creation of a food security policy for majority of the surrounding population that has a very fragile human development index (Íoris 2017b, pp. 263-304). With the aggravating factor, the Brazilian state increasingly depends on the economic surplus generated by agriculture and has become hostage by the aura

of success associated with agribusiness. Brazilian Gross Domestic Product (GDP) in 2016 was US$1.77 trillion. Agribusiness accounted for 23.46 percent of this GDP, contributing US$415.24 billion. In the same year 213.08 million tons of grain were produced at Brazil in an area of 5.15 million hectares. Most in soybean plantations in Amazonia. Agribusiness continues to advance on the Amazonian forests, generating great deforestation, pollution, social misery, ecological depreciation, extermination of indigenous peoples and irreversible climate change for the region and the planet.

Since 1997, a complex surveillance system and the electro-electronic network called Amazonia Surveillance System has been installed as support structure to scientific, economic and political programs to the 5.2 million km$^2$ from Amazonia (Santos 2000, p. 8). It has cost about US$1.4 billion, and the real-time monitoring of Amazonia has become a feasible possibility, unfolding in the development of numerous programs of defense, support and public policy response to the communities in the region. In the 1970s, the Brazilian military government had already implemented the Program "Radar in Amazonia", which aimed to build an inventory of its natural and human resources.

In general, the federal development agencies omit the precarious social indicators resulting from great projects in Amazonia. The human development indexes of its municipalities are still among the worst in the world.

The Report presented by the Parliamentary Inquiry Commission of Lands with Illegal Possession to Brazilian society in August 2001 highlights the cancellation of 135 fraudulent records of rural properties in Amazonia. According to this report, because of proven denunciations were declared null by the Brazilian Land Justice, only in 2001, more 37 million hectares of land in Amazonas and Pará States, the two largest states of the Brazilian Amazonia (A Crítica 2001). Estimates made in 2001 projected the possible fraudulent possession of 100 million hectares in Amazonia, one-fifth of its total area, and just under one-eighth of the Brazilian territory. A network of influence and corruption trafficking,


**Fig. 1. Map of Amazonia with its two main cities, Manaus and Belem, and its main economic poles**

involving businessmen, sectors of Brazilian justice and political interests has sliced the Brazilian Amazonia into great hereditary farms. Most of these land is formed of primary forests. Symptomatic case refers to the arrest of Falb Saraiva de Farias, the largest illegal landowner in Brazil. He is owner of farms in Amazonia, equivalent to 1.5 percent of the national territory, an area equal to the sum of the territories of Portugal and Switzerland. There is no news from anyone else in the world who owns an area with this dimension (Schwartz 2001).

A new outbreak of reterritorialization emerges under the forms of zoning and the principles of environmentalism. By transcending the public and private domains of property, the forces of ecological preservation and protection, legitimized by scientific knowledge, were imposed on the traditional land structure. This is one of the tangible results of a global struggle for the Amazonian ecodevelopment (Ab'Saber 1996). The Era of sustainability reaffirms this tendency based on the inseparability between man, nature and culture.

Considering the failures of the great development projects in Amazonia as well as the demands of sustainability it is necessary to propose new economic structures for this region. These structures require implementation of the industrial, fiscal and tributary policies vocational and contextualized to the national and international markets. It also requires infrastructure, logistics, well-established innovation and entrepreneurship programs, efficient productivity, decentralization and diversification of productive arrangements (Lin 2013).

To Amazonia, it is fundamental to incubate vocational industries in networks, and to induce support for strategic technological platforms through public financing. Region's continental and ecological dimension also requires the implementation of clean development mechanisms, information and communication technologies and bio-economics programs. This reaffirms the importance of its integration through development policy to complex structures, and concessions and privatizations with different regulations and participations in region (Lin 2012).

A integration and economic development with preservation of the Panamerican Amazonia's biomes are urgent. The importance of the cultures of its 250 indigenous peoples, its complex biodiversity and its strategic role to humanity reaffirm its status as main global ecological sign. The future of this region is also very dependent on the development of the other countries that compose it. Colombia, Peru and Venezuela are Amazonian countries that have many social and economic conflicts on their borders with the Brazilian Amazonia, where illicit practices still exist, such as the growing contraband of wood and other products collected from the forest and rivers. The traffic of drugs, weapons and wild animals, precious minerals and the movement of guerrillas are also problems in this large region. The absence of public policies and development projects on these frontiers contributes to this situation, which generates great socioeconomic inequality.

In general, as part of the productive sector from the Brazilian Amazonia, the main economic sectors of these three countries are mining, agriculture and livestock. In the specific case of Peru, it should also include products derived from fishing. The economies of these countries are distributed among service sectors, more than 50 percent, industry and agriculture, livestock and fishing (www.suapesquisa.com/paises 2017). The fragile national science, technology and innovation policy of these countries contributes to their industrial parks remaining dependent on the industrial matrix from the developed countries. The current political and economic crisis in Venezuela has assumed dramatic proportions with great immigration to Brazil, through the Amazonian border. The lack of a policy of social assistance for immigrants has contributed to the growth of social inequality in the region with depreciative impacts on its social structure and environments.

Therefore, the sustained economic growth in Amazonia depends on structural

changes. Its sustainable development is still a complex challenge for modern organized knowledge.

## SUSTAINABILITY AND AMAZONIA; CONTROVERSIES AND CHALLENGES

Critical experts say that sustainable development is a capitalism's new stage of oppression. However, its process of technical legitimation still is being constructed, as well as its identification and contextualization to the socioeconomic processes from the regions and countries (Bourg 2002). Fight the human misery and the exacerbated depreciation of nature are its main assumptions, which are based on material structures and programs that generate social inclusion, entrepreneurship, employment and income, to improve people's quality of life, and environmental preservation (Dubois and Mahieu 2002).

The ongoing pillage of the regional and planetary environments has stimulated the creation of environmental movements and political actions by organized groups (Robbins 2012). The absence of perennial public policies at the poor regions and countries puts speculations and challenges identified with the sustainability.

At the technological field, the sustainability's technical operationality requires to replace the current energy matrix as central priority. It also imposes change in the foundations of educational policies, at all hierarchical levels, and requires the formulation of new paradigms for public policies and sciences, with impacts on its organization and application processes. The sharing of sustainability through public policies also has impacts on the privatist and alienating civilizing conception.

The exacerbated social and ecological depreciations have potentialized speculation about the senses and operationalities of this notion. The twenty-first century's concern with sustainable development raises six main issues, all related to the expansion and circulation of capital (Freitas and Freitas 2013b).

The first is symbolic, and therefore the most complex. There is a certain illusion concerning the notion of sustainability, considering that its operationalization mechanisms do not establish 'where, when, and how' to replace the classic development form. It is possible to wait for something that will never happen; we run the risk of constructing a socio-economic enterprise that is so unsound that it will never eventuate.

Second, there is an incompatibility between the notion of sustainability and the concept of growth - not financial growth, rather the growth of the flow of mass and energy. This will result in the market priority of goods with greater durability and change in the world's industrial matrix with implementation of clean development mechanisms.

The third problem concerns the dynamics surrounding the process of financial accumulation. Core countries are becoming richer to the detriment of periphery countries that are becoming poorer. From their standpoint, it is necessary to incorporate the notion of sustainability, including those essential requirements for a basic standard of living. There is also an additional problem: the increasing wave of the privatization of production conspiring against the management of the planet's natural wealth.

Fourth, hypocrisy exists within central governments. History has recorded the discourses of these governments that oppose practical action. These governments will not take any action that will risk the welfare of their voters and economic and political stability.

Fifth, the notion of sustainable development only has historical validity in local experiences. Yet, there is a common objective: the preservation of the biodiversity associated with cultural diversity. The objective conditions of such preservation remain controversial. The disregard for the biosphere and the general capitalist approach to exploiting natural resources impede attempts to find solutions.

Finally, there is an increasing tension between the notion of sustainability and the universal principle of national security. The friction between these will depend on the evolution of political processes on a worldwide scale.

These six issues move worldwide sustainability processes are all apparent in Pan-American Amazonia. Its have direct relationships with the new forms of concentration, organization, reproduction and circulation of capital, led by transnational groups and central countries.

The contributions of education, science and technology should accelerate and to qualify this new 'worldwide enterprise' towards the sustainable processes (Freitas and Freitas 2013b). Its will also contribute to incorporate Amazonia to future of mankind with a growing tendency of technification and ecologization.

Amazonia's future is hostage of three major tendencies: the first projects its increasing ecological destruction by agribusiness, livestock and large-scale logging industry. The second predicts a increasing implantation of sustainable development programs and projects in this region, reaffirming its ecological and symbolic importance to Brazil and to humanity. Finally, the third tendency presupposes greater international control for its preservation and a growing worldwide collaboration for its development in accordance with international economic and political protocols and agreements. Scenarios combining elements of these three tendencies, in contextualized form, are also feasible.

## CONCLUSION; COMMITMENTS FOR A SUSTAINABLE AMAZONIA

Amazonia's development is a challenge for all. It is very dependent on the technological innovations and Brazilian government's political decisions. Institutionalize public policies in Amazonia in full form requires to implementing sustainable development models integrated to its cultural, ecological and socioeconomic complexities. It also requires its regional and national integration and the organization of social structures and technologies accessible to all, generating income, social inclusion and citizenship for its populations, and environmental preservation at the region.

For these reasons, the following political commitments with Amazonia are demanded: Mobilization of Brazilian society to reaffirm the importance of Education, Science and Technology as a process of humanization and socioeconomic development of Amazonia and the Brazil; Investment US$1 trillion in science, technology and innovation to regional and national integration of Amazonia to the national Project, during 2020-2030; Guarantee of sovereignty and institutionalization of the presence of the national state in the region, with integration, decentralization and internalization of the state and federal agencies for planning and execution of public policies; Implementation of diagnostic and control centers for illegal deforestation and land use, and public policies for integrated environmental services to all Amazonia, with recovery of degraded areas, biodiversity conservation, water resources and mitigation of climate change; Guarantee of scientific education and constitutional rights for indigenous peoples and traditional communities, and promotion of social equity, considering gender, generation, race, social class and ethnicity; and the strengthening of cooperation between Brazil and the Amazonian countries through science and technology programs.

Capitalism still has no heuristic reach to economically exploit Amazonia while maintaining its biomes preserved. Its development is very dependent on clean development mechanisms. Its sustainable future depends of the impact of education, science and technology in the region, in the same proportion as Brazil's future also depends its degree of sustainable development, new challenges and institutional commitments.

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