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Dynamics of occupation and landscapes changes in the Amazon, Brazil

Dinâmicas de ocupação e as transformações das paisagens na Amazônia, Brasil

Dinámicas de ocupación y transformaciones de paisajes en la Amazonía, Brasil

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The Amazon has a great sociocultural richness due to the historical processes of occupation that led to the coexistence of riverine, indigenous, *quilombola*, extractive populations and, more recently, farmers, loggers, miners, and large rural entrepreneurs. These populations and their respective techno productive patterns of intervention on nature relate in different ways to the biome, producing differentiated and diversified landscapes [1,2].

Recent studies in the Amazon show how human presence helped form the rainforest. The hyperdominance of managed species such as açaí, cocoa, and Brazilian nuts suggest that the Amazon rainforest was occupied and transformed over 8,000 years ago [3]. Long before Europeans, human settlements were the main sites of production and storage of knowledge about biodiversity, involving ancestral agroextractive or agroforestry practices that can still be found in the region as a portfolio of techniques and knowledge about the biome. These practices have diversity characteristics that resemble ecological components and that underlie the maintenance of the Amazonian biome as an integrated and living system. Subsequently, agroextractive practices and activities were developed and improved by local communities as a result of the colonization, one of the main assets of the historical process of formation of human societies in the Amazon, including caboclo societies [4].

Until the mid-20th century, historical transformations had not caused major changes in the landscape and sociocultural and ecological diversity of the Amazon. During the 1960s, however, the policies of occupation of the military governments lead to profound changes in the biome. The new spatial pattern of expansion of the agricultural frontier – based on monoculture techniques – following the expansion of highways construction and the implementation of large settling projects [5], triggered transformations in the biome with important socio-environmental alterations leading to possible threats to the ecological balance of this system. Other than promoting migratory waves that brought a large and diverse population to the Amazon, this new occupation greatly contributed to the disorganization and fragmentation of the territory by introducing many techniques and technologies of forest, mineral, and agricultural exploitation.

This new occupation model of the territory and the expansion of homogenizing economic activities, disregarding the conservation of the forest and its populations, had as a consequence the loss of extensive forest areas, thus reaching its highest rate of deforestation in 1995 (29,059km^2) [6]. Stimulated by an economy based on the search for the expansion of the degree of commoditization of exports, in the 2000s, grain production advanced from the Cerrado to the Amazon. Due to the increasing forest

loss, negative effects were observed, such as forest fragmentation and the loss of ecosystem services, leading to biodiversity loss, change in water and soil quality, increasing reservoirs and vectors of diseases, and the spread of tropical diseases [2,7].

The development projects of homogenization implemented since the 1960s brought to the biome economic activities whose land and its subsoil are the main natural resources exploited and commercialized. On the land without forest, the new economic activities are expanding in the Amazon, competing with the economies practiced by local populations over the centuries, which have long trajectories based on the use of forest resources. These small-scale production economies on agroextractive bases disappear under the forest canopy and are invisible in mappings of satellite land use and regional development policies.

As a result of this process, the land market in the Amazon increasingly grows, and establishes prices for the land, treating it as a generic commodity. The land production as a commodity occurs transforming the original forests, a public good, into a private patrimony. Deforestation represents the moment when the land becomes the "Treeless Land" (*Terra sem Mata*) commodity for the creation of land stocks for agrarian activities [8]. Thus, the most expensive product in the market becomes the one in which the forest is removed to give way to other covers of exotic or native species, genetically adapted for industrial-scale production, in monoculture systems. The maintenance of land as productive capital without forest occurs due to the strong use of chemical, mechanical, and genetic inputs, with the use of specialized and foreign labor, resulting in unsustainable homogeneous landscapes, with impacts on water, soil, air, biodiversity, and human health.

Encouraging this type of occupation neglects the presence of local populations and their ancestral ways of living and producing, which makes any type of forest conservation strategy unfeasible, suppressing the practical knowledge and technologies developed by these local populations and their modes of productive and sustainable use of the forest. Moreover, most of these populations were victims of violent actions, with threats and invasions of their territories. National estimates show that 55% of the conflicts in the rural areas from 2011 to 2020 occurred in the Brazil's Legal Amazon, affecting more than 100,000 families with more than 300 murders, resulting from the expansion of illegal mining activities, disputes for land and other natural resources. In 2021 alone, the Amazon recorded 52% of land conflicts in Brazil [9].

In a study conducted in the western of the State of Pará, Brazil [10], comprising the municipalities of Santarém, Belterra, and Mojuí dos Campos, which compose the Metropolitan Area of Santarém, the expansion of soybean monoculture led to land concentration processes and the advance of this agriculture on rural communities' and riverine's lands, causing the homogenization of the landscape and forest loss. The grain cropping area expanded from 23km^2 in 2000 to 1,093km^2 in 2019. About 25% of the small-scale farming area in 2000 was converted to large-scale agriculture and monoculture in 2019. However, this advance did not fully eliminate the traditional local production forms and techniques. In the interstices of export grain production, communities and forms of traditional production persist, with the systems shifting cultivation with products related to family production, as well as agroextractive activities, characterized by artisanal production employing technology and non-formal knowledge about the biome.

Furthermore, Belterra and Mojuí dos Campos began to integrate the poorest population the one eventually expelled from the rural area by the advance of monoculture, because the physical site (plateau and flooded) has limited the urban expansion of Santarém. The territory of Metropolitan Area of Santarém is disputed by agroextractive settlements, grain crops, rural communities, and private enterprises, such as gated communities and allotments. Consequently, Santarém became a differentiated case of polynucleated urban settlement [11], formed by traditional habitations, expressed by the set of villages and nuclei connected through rivers, since the pre-Columbian period, and by the most recent continental connection through highways – such as BR-163 and PA-370. These connections have several different sociospatial forms structuring the territory [12].

Agroextractive regions in the Lower Tocantins, in the northeast region of Pará, are similar to these connections. In this region, until the mid-2000s, açaí production was restricted to lowland areas and islands. Due to the increase in demand from the national and international market, varieties of palm trees adapted to the upland were developed, which expanded the production of açaí, previously carried out only by traditional agroextractive populations, to the employer's agrarian systems. This

dynamics and appreciation of açaí, as well as the establishment of industries that buy and locally process this fruit, intensified the management and the replacement of palm trees and trees by the açaizeiro. In rural areas [13], the effect of tree management and substitution on the homogenization of the landscape can be perceived, especially on solid ground, where açaí is cultivated in patterns similar to what has been called paradigm based on mechanics, chemistry, and genetics [14].

The west and northeast regions of Pará illustrate the current dynamics of an economy that pass over traditional agrarian systems, such as the shifting cultivation and agroextractivism, intensely transforming these landscapes. The history of these populations and their ways of producing were almost always marked by marginalization and attempts to overcome their economy, associated with the idea of delay, precariousness, and lack of innovation capacity.

Currently, bioeconomy has been indicated as an alternative for sustainable economic development for the Amazon. However, it is necessary to qualify the desired bioeconomy model in order to not repeat the current models with homogenizing impacts on the structure and agrarian and urban landscape, excluding the local populations and their traditional knowledge about the biome. Bioeconomy models associated to the logic of traditional agroextractive or agroforestry systems are the ones to be favorably adopted, such as the bioecological vision of the bioeconomy [15], which has ecological characteristics and are organically linked to the requirements of operation of the Amazon biome as an integrated and dynamic system.

Based on this model, the important role played by urban economies in the mediation between society and nature, their structures, and their practices should be associated. The combination of nature and urban dynamics, based on forest cities [16] and socialization of nature [17], connects traditional knowledge to scientific and technological development to resume regional biodiversity as an element of generation and distribution of wealth. Planning and management strategies that contemplate the local demands of the territory and people, considering their socio-spatial attributes, are essential to guarantee the right to the city and to reposition urban territories in the national and global agendas of sustainable development [18].

In the relationship between environmental and health, environmental conditions differ between agrarian systems that create varied environments and landscapes of diseases. Moreover, it is essential to consider the interdependence between the integrity of ecosystems, land uses, and their impacts on health [2]. These impacts go beyond those directly related to habitat loss, biodiversity reduction, and contamination of soil and water, for example. We highlight the dispute over lands and the violence inherent to this process, as a crucial component that becomes a serious public health problem in the region. This problem requires, for its prevention and treatment, a thorough knowledge on the agrarian systems and forms of land appropriation in the Amazon, to develop specific and integrated policies, which together consider the environmental, social, cultural, and economic dimensions of this region.

Contributors

M. I. S. Escada contributed to the writing and review of the study, and approved the final version. S. Amaral contributed to the writing and review of the study, and approved the final version. D. A. Fernandes contributed to the writing and review of the study, and approved the final version.

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