

Peri-urban territories and WEF nexus: the challenges of Brazilian agrarian reform areas for social justice

Thainara Granero de Melo , Bruno Lacerra de Souza & Rosemeire Aparecida Scopinho

To cite this article: Thainara Granero de Melo , Bruno Lacerra de Souza & Rosemeire Aparecida Scopinho (2020) Peri-urban territories and WEF nexus: the challenges of Brazilian agrarian reform areas for social justice, Journal of Integrative Environmental Sciences, 17:2, 45-67, DOI: [10.1080/1943815X.2020.1844757](https://doi.org/10.1080/1943815X.2020.1844757)

To link to this article: <https://doi.org/10.1080/1943815X.2020.1844757>



© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.



Published online: 15 Dec 2020.



Submit your article to this journal [↗](#)



Article views: 140



View related articles [↗](#)



View Crossmark data [↗](#)



Citing articles: 1 View citing articles [↗](#)



Peri-urban territories and WEF nexus: the challenges of Brazilian agrarian reform areas for social justice

Thainara Granero de Melo , Bruno Lacerra de Souza 
and Rosemeire Aparecida Scopinho 

Graduate Programme in Psychology, Federal University of São Carlos (Ufscar), Brazil

ABSTRACT

Over the past three decades, agrarian reform areas have transformed urban and rural spaces across Brazil. Although these areas' creation reduced inequalities and environmental problems, their residents still experience several constraints and vulnerabilities associated with water, energy, and food provision. Drawing on the water-energy-food (WEF) nexus' critical and territorial perspectives, this paper aims to better understand the agrarian reform areas' challenges in peri-urban interfaces towards social justice. We analyse a territory in the Northeast portion of the São Paulo State, where it is located the Sepé Tiaraju agrarian reform settlement in interface with two municipalities. We suggest that agrarian reform areas can activate a progressive and concrete environmental change at the local level where food is the key element to redefining the area's nexus. However, socio-political and spatial dynamics involving water and energy for the sugarcane sector, the municipal government, and tense relationships among residents around food also reproduce unequal access to resources. This paper contributes to the emerging critical literature and its efforts to politicize the nexus debate, giving more nuanced views to the complex and contradictory dynamics involving environmental problems and social justice struggles.

ARTICLE HISTORY

Received 7 January 2019
Accepted 12 October 2020

KEYWORDS

WEF nexus; peri-urban territory; agrarian reform areas; social justice; Brazil

1. Introduction

Brazil is a continental territory of environmental richness, but one of the most unequal, exclusionary, and predatory societies. With a rural structure concentrated on the agribusiness sector and diffuse patterns of urbanization, many Brazilians live apart from the rights of adequate access to resources, infrastructure, and collective services (Brandão 2016). Over the past three decades, civil society groups and social movements have been claiming political solutions, proposing appropriate and sustainable forms of land occupation and natural resources management (Fernandes et al. 2012). The 2000s were a milestone for these political struggles in Brazil's most populous state, São Paulo. Innovative policies transformed portions of land dedicated to monoculture into agrarian reform settlements nearby urban areas. Since then, settlements play a crucial role in reducing social inequities and the damages that sugarcane agribusiness provoked in local ecosystems (Goldfarb 2011; Matheus 2017). This

CONTACT Thainara Granero de Melo  thainaragm@gmail.com  Rodovia Washington Luís, km 235 - SP-310, Departamento de Psicologia, Sala 18, São Carlos - São Paulo - Brazil, CEP 13565-905

© 2020 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

role comes in a critical time when settlements became hubs for donating tons of agroecological-based food production to urban dwellers hard hit by the Covid-19 pandemic (Wedig and Ramos 2020). However, while creating these areas represented an opportunity for environmental and social justice for thousands of working poor, their residents still experience several constraints and vulnerabilities associated with water, energy, and food.

Issues related to these challenges over environmental change resources have become the strong interest of the nexus framework. This approach addresses the water-energy-food (WEF) interdependencies in scenarios of trade-offs, inefficient, and unequal provision of resources, discussing solutions to establish synergies in the nexus (Bazilian et al. 2011). Recently, more critical conceptions of the nexus have been emerging, ensuring a socio-political view at the resources interdependencies cutting across concrete urban and rural territories (Cairns and Krzywoszynska 2016; Williams et al. 2018; Moss and Hüesker 2019). Although interests in urban-rural dynamics are far from being a novelty in the nexus debate, critical perspectives make room to dialogue with complex and overlooked particularities of peri-urban territories (Adam 1999; Allen 2003). In these areas, environmental change is not merely couched in the natural aspect but is a social and political contested terrain (Hommes et al. 2016). In this direction, scholars suggest that the nexus discussion needs further contributions from the social sciences in understanding the many scales that bring the nexus together with complex relationships between people, places, infrastructures, policies and, therefore, affecting decision-making processes in resources governance (Cairns and Krzywoszynska 2016; Monstadt and Coutard 2019; Urbinatti et al. 2020).

In light of this context, this paper's central argument is that the nexus' socio-political and spatial dynamics are crucial to understanding how the environmental change occurs in peri-urban territories, particularly the agrarian reform areas; and the extent to which these changes enable and constrain social justice. Because agrarian reform areas in peri-urban territories come into being through complex urban-rural dynamics, where a single territory is the material support for both the struggles of oppressed groups and agribusiness expansion, we argue that the nexus dynamics constitute contradictory changes. On the one hand, they challenge dominant relations over the resources, operating a substantial territorial change. On the other, they deepen inequities in resource access, establishing limited forms of social justice.

To this end, this paper aims to understand better the challenges of peri-urban territories towards social justice, with a view to Brazilian agrarian reform areas. We bring empirical evidence from qualitative research in the macro-region of Ribeirão Preto, State of São Paulo, where we investigated the Sepé Tiaraju agrarian reform settlement in interface with other two municipalities, Serra Azul and Serrana. We examine the critical links between the water-energy-food nexus of the territory, linking them to the macro-regional, socio-political, and spatial dynamics at the local level.

In doing so, this paper contributes in two directions. It adds to the emerging critical literature and its efforts to politicize the nexus debate, giving more nuanced views to the complex and contradictory dynamics involving environmental problems and social justice struggles. Also, it highlights the importance of a deeper understanding of the nexus through a territorial perspective, giving attention to these dynamics in overlooked realities beyond the typical urban-rural dichotomy.

The text proceeds as follows. [Section 2](#) problematizes the Brazilian agrarian reform policy and the challenges faced by the settlements in peri-urban territories. [Section 3](#) presents the theoretical framework based upon the nexus's critical perspective and the notion of peri-urban

territory. [Section 4](#) describes the case-study area and methodological strategies employed. [Section 5](#) presents the results. The paper concludes with the contributions of the study.

2. Agrarian reform areas in Brazil: inequalities and struggles crossing the urban and rural spaces

In Brazil, agrarian reform areas are the territories created by the redistributive land policy, involving a range of economic, political, environmental, and social changes (Heredia et al. 2002). With an economy mainly dependent on the agro-export model, the country has accumulated a colonial trajectory of unequal and exclusionary development. In association with the transnational capital and the state, powerful landowning elites have been ensuring an ongoing expropriation of land and natural resources through the centuries. It becomes evident when we compare the data on current agricultural land distribution. While 10% of the largest agribusiness' rural unities occupy 73% of the national agricultural area, 90% of smaller areas only occupy 27% (Pinto et al. 2020).

Nonetheless, the agribusiness domain cannot be attributed only to the monopoly of land, but also to the forms of access and control of natural resources and related impacts over cities. According to Brandão (2016), the capitalist accumulation in the rural spaces resulted in paradoxical urbanization, characterized by metropolitan areas, regional intermediary hubs, and dispersed small towns. While taking different forms across the regions, these spaces have, in common, the reproduction of significant inequities and social injustices in the access of resources.

These inequities fuelled the emergence of struggles over land in different periods of Brazil's political history. The origins of agrarian reform activist movements, such as the Landless Workers' Movement (MST), can be traced back to the 1980s. In the wake of the crisis after two decades of military dictatorship, thousands of dispossessed peasants, urban and rural working poor called for agrarian reform policy (Robles 2018). In 1988, the new Brazilian Democratic Constitution reaffirmed the basis for agrarian reform to democratize land access by emphasizing the so-called social function of property. The central principle is that the owner must meet obligations that contribute to the collective good, for example, by making use of land in compliance with labour rights and protecting natural resources. Otherwise, the federal government can expropriate an estate to implement agrarian reform areas when it does not perform the social function (Ondetti 2016).

Activists for agrarian reform then struggle to pressure authorities to ensure the people's right for the land and other constitutional rights, such as access to housing, food, and environmental resources. The movements' pressures held agrarian reform on the policy agenda in the last three decades by organizing mass mobilizations and occupation of disused properties, with varying degrees of tensions. Until 2017, the Brazilian state created 9.374 settlements that reach over 972,000 families across the country (Incrá 2020b). Overall, the federal government is in charge of agrarian reform policy conducted by the state's land agency, the National Institute for Colonization and Agrarian Reform (Incrá). This actor is responsible for setting and implementing the necessary infrastructure for the areas (e.g., housing, water, energy, roads), and the policy for agricultural production (e.g., rural loans and technical assistance). Incrâ also shares administrative responsibilities with state and municipalities, mostly regarding the governance and provision of collective services, such as water, energy, and waste collection. Furthermore, social movements are still present in several

areas, acting together with local associations and cooperatives as the residents' representative bodies (Fernandes et al. 2012).

In many Brazil regions, agrarian reform areas were implemented by different arrangements, thus ordering varied territorialities, levels of rural-urban interactions, and process of change. There are currently five federal-sponsored agrarian reform models, ranging from settlements designated to traditional peasant communities to areas that emphasize agriculture with environmental preservation near large urban centres (Incra 2020a). These institutional arrangements arose from a shift in agrarian reform agenda in the 2000s, in the wake of discussions on the increasingly precarious living conditions in the cities associated with environmental problems. This discursive orientation entailed changes in the agrarian reform policy that, until then, was mostly implemented in hinterlands and did not directly address the environmental issue. In this perspective, natural resources conservation became as crucial as food production and land redistribution (Gonçalves and Scopinho 2010).

Accordingly, scholars and social movements have advocated creating agrarian reform areas in peri-urban territories as a critical setting for articulating urban and rural problems towards more sustainable and equitable use of resources (Goldfarb 2011). These settlements can produce food, reduce water pressures, improve soil quality, and recompose the local environment (Caporal and Costabeber 2006). Because of their strategic position in urban-rural interfaces, settlements can also supply cities with affordable fresh food, contributing to spend less energy on transportation and reduce footprints (Goldfarb 2011; Matheus 2017). The adoption of agroecological practices in these areas has been changing ecosystems, promoting food security, and generating income (Nobre et al. 2012; Marques et al. 2014).

Duval et al. (2008) note that agrarian reform also diversifies rural and urban landscapes, modifying the monocultures spaces through the sustainable food production that reaches cities. Besides, the agricultural diversification and income generation impacts the rest of the urban economy. Another effect is the political strengthening of local residents. Agrarian reform areas establish a dialogue between the public authorities at local and regional levels with historically excluded social groups from political decision-making (Leite and Ávila 2007). For Goldfarb (2011), agrarian reform in urban centres' interface strengthens the territory, creating other cohesive forms to influence politics on local and regional levels.

Although these areas have enacted changes in the urban-rural interface, critical problems still affect local livelihoods. Surrounding monoculture areas remain pushing the local resources, while the agribusiness sector pressures the federal administration to relax environmental regulations. Another critical problem for agrarian reform is the lack of adequate infrastructure for resources provision (e.g., lack of sanitation; solid waste collection; treated water for consumption and agricultural production; precarious roads and energy systems) (Dornfeld et al. 2013; Gaspari et al. 2018). Without infrastructure, creating new flows of food between urban and rural areas is another challenge. In broader scales, settlements dispute market space with conventional food farming, which conveys an idea of practicality, affordable prices, aesthetic and sanitary quality of food. Short food circuits can transform this relationship. The cities' consumption of agroecological food creates visibility and social recognition of the settlements' role for socio-environmental change (Silva and Tassara 2014). However, changes in the urban dwellers' behaviour to consume the settlements' food also demand progressive learning (Carvalho and Bezerra 2017). These interactions become more complex, considering

that the social stigmas of agrarian reform areas in Brazil imaginary. Locally, the spatial stigmas underlie tensions between settlements and urban dwellers.

These increasing challenges of settlements also refer to governmentality forms that continuously attribute a peripheral and residual character to agrarian reform areas (Wanderley and Favareto 2013). The lack of articulation between urban and rural governance for agrarian reform areas in peri-urban territories reflects an “institutional vacuum,” which resonates with people’s vulnerabilities to exercise alternative agriculture strategies and their environmental and social security rights.

As we can see, agrarian reform is a terrain where complex relations frequently express the disputes on resources. With state participation in the structuring of these areas, the implementation of agrarian reform in peri-urban territories materializes the people’s struggles against inequalities, envisioning other forms of land use and environmental change and more equitable access to resources. However, this is a process constantly challenged by the ongoing predatory accumulation of agribusiness, structuring profound inequalities in Brazilian society. Considering this context, we want to understand better how these processes occur in local realities, how people produce, access, and dispute resources in peri-urban territories, and to what extent they enact or constrain social justice.

3. The nexus framework: critical and territorial perspectives for urban-rural interfaces

This paper follows a critical and territorial perspective on the nexus to analyse peri-urban territories. In the past decade, the water, energy, food nexus approach became a trend analysis in the sustainable development literature by addressing the interlinkages, interactions, trade-offs, pressures, conflicts between water, energy, and food, and the related impacts on the ecosystems (Bazilian et al. 2011). This approach attracted interest from debates about natural resources governance globally and national levels, suggesting solutions for synergic ways of accessing, delivering, optimizing the capacity and use of essential resources to build more resilient societies (Biggs et al. 2015).

Critical studies have a wary eye to this mainstream framing of the nexus. They see that much of the managerial discussion about trade-offs, synergies, and scarcity/optimization of resources often disregard the political and social dynamics affecting the nexus. Such an apolitical view can consequently support the established order that reproduces structural inequalities (Williams et al. 2018; Moss and Hüesker 2019). We cannot disregard that people shape resource governance with the power to make decisions around weighing benefits for specific areas, sectors, and social groups while affecting disproportionately vulnerable populations. Therefore, a nexus approach must critically consider the works of political and social contradictions to rethink opportunities for reducing inequalities in resource access and decision-making processes (Stringer et al. 2014). As such, scholars indicate the need for social sciences critiques in developing a more realistic and transformative debate of the nexus, addressing the environmental problems in terms of social justice (Cairns and Krzywoszynska 2016)

Framing a discussion towards social justice also implies highlighting the forms that the nexus takes in local everyday realities and place-based situations (Terrapon-Pfaff et al. 2018). From this perspective, the notion of territory is relevant because it allows us to position the nexus entwined in socially constructed spaces where people and nature “influence and

produce each other in multiple ways and on multiple scales” (Hommes et al. 2016, p. 11). It means that the processes through which the nexus components are co-produced involve contextual and spatial assemblages of different actors, resource flows, ecosystems, infrastructures, economic means, politics, institutional arrangements, and practices (Williams et al. 2018; Monstadt and Coutard 2019). In this same sense, spaces are continuously reconfigured, contested, and disputed by the diversity of local communities and livelihoods, interests, ways of thinking, and experiences. As a result, the impacts and struggle over resources are not merely physical or environmental but a socio-spatial process producing competing imaginaries and effects for different people in the same territory (Hommes et al. 2016).

This critical and territorial perspective of the nexus allows us to connect the notion of peri-urban and its distinctiveness regarding environmental change and related challenges. Although the concept of peri-urban is polysemic, having different interpretations and meanings according to the regions (Pereira 2013), some of its features are critical to framing the nexus’s complexity in particular agrarian reform areas, as the case of this study. Here, we follow Allen’s (2003) formulation of peri-urban as a territory that expresses an interface situation between urban and rural spaces. That is not defined by geographical boundaries but by varied flows of people, resources (natural, economic, material), policies, and institutions that mutually affect the city and the countryside.

Such a transitional dynamic informs at least three key features, according to Allen (2003). First, peri-urban interfaces compose a mosaic of environmental, rural, and urban ecosystems that exacerbate urban and rural competition for natural resources, resulting in dispossession, inequities on resource distribution, and vulnerability of the local population to environmental risks. Second, it follows that the uneven and expansive process of resource appropriation often involves shifts in land uses and economic activities, thus making peri-urban a socially heterogeneous territory where different social groups coexist with competing interests, distinct imaginaries, and psycho-social identities (Tassara 2007). Third, due to environmental and social rapid changes, peri-urban territories hardly involve precise or permanent institutional arrangements. These territories share overlapping and sectoral institutions, either urban or rural, among administrative unities that can intervene without clear articulation. Such fragmentation often results in uncertainties about governance and water provision, energy, transportation, and waste services.

On the other hand, peri-urban territories can play a crucial role in improving local dwellers’ environment and livelihoods. Spaces for housing and subsistence agriculture, associated to food provision for adjacent areas, can enhance the welfare and security of poor populations while ensuring the state and access of natural resources (Mougeot 2000; Rojas-Caldelas et al. 2010; López-Goyburu and García-Montero 2018).

The nexus’ critical and territorial approach helps map out the flows of water, energy, and food in urban-rural interfaces and analyse how these flows occur in complex dynamics between people, politics, and places. With this in mind, we frame the nexus dynamics in agrarian reform areas within the political struggles for social justice, which imbricate asymmetrical powers in the production, access, and use of resources. Because these areas are contested terrains through which Brazil’s core contradictions and inequalities are structured, crossing rural and urban spaces, the nexus discussion will consider the everyday interactions and spatial imaginaries that frame meanings and possibilities for these territories.

4. Case-study area and method

This paper's findings derived from three simultaneous social research from a qualitative perspective (Minayo and Costa 2018) carried out between 2015 and 2019 in a peri-urban territory in the macro-region of Ribeirão Preto, São Paulo State. These studies focused on the Sepé Tiaraju settlement, located in the municipality of Serra Azul and surrounded by the municipality of Serrana. Serra Azul and Serrana are small-sized municipalities with a combined population of around 60.000 inhabitants. Their economies rely on the seasonal workforce for the sugarcane sector, serving as commuter towns for Ribeirão Preto. Sepé Tiaraju is an agrarian reform area with about 400 inhabitants, whose main activity is agricultural food production based on agroecological systems.

The settlement started in 2000 as an informal occupation of a former sugarcane farm transferred to the State government to repay its former owners' tax debts. The occupation consisted of the urban and rural working poor of the sugarcane sector, organized by the MST. In 2004, the Federal administration officialized the area, settling 80 families in 796 hectares of land. The area is a Sustainable Development Project (PDS), one of the institutional arrangements for agrarian reform settlements allocated to public land to protect the local environment by using sustainable agricultural systems. Under the PDS rules, the residents must collectively manage the resources, not use chemical inputs, reforest 35% of the area, and use agroecological farming systems.

Figure 1 shows the territory's satellite image, locating the Sepé Tiaraju settlement between Serra Azul and Serrana (7 miles away from each municipality). These areas (red marks) are connected by a highway (yellow line) that serves as an outlet for industrial sugarcane production in the State of São Paulo. The highway also facilitates daily commuting between urban and rural dwellers and the possibility of direct commercialization. A tributary of the Pardo River (blue mark) runs around the settlement, as shown in Figure 1. The sugarcane farms and mills (green mark) also make up the territory. One of the plants is inactive since 2012.

We chose this case because the territory presents possibilities to address the nexus and challenges of social justice in different levels and dynamics: the tensions between the main economic activity in the region (sugarcane agribusiness) and its socio-environmental impacts for the cities; the settlement struggles over resources to ensure their social reproduction and restore local ecosystem; and tense relationships between the settlement and surrounding cities.

Another reason is the particular character of the studied area. Sepé Tiaraju is the first agrarian reform settlement in the State of São Paulo under the PDS arrangement. Originally designed to protect the forest communities' biodiversity of the Amazonian region, the PDS represented a milestone for agrarian reform in the Ribeirão Preto region since its implementation and socio-environmental conditions would be utterly different from the conceived model. Thus, Sepé Tiaraju served as an experimental site to transport the PDS to a region heavily degraded by monoculture near urban areas. Moreover, the settlement is a symbolic mark of the struggles against the powerful sugarcane agribusiness. The implementation of this type of area gave strength to other voices for claiming social and environmental rights.

A preliminary analysis suggested intense flows between Sepé Tiaraju and Serra Azul. In this urban-rural interface, commuters moving in-between Serra Azul, Serrana, Ribeirão Preto, and Sepé Tiaraju to live and work. Rural dwellers use cities' services (e.g., health care, education, trade, leisure). In contrast, the cities depend on the rural ecosystems (e.g.,

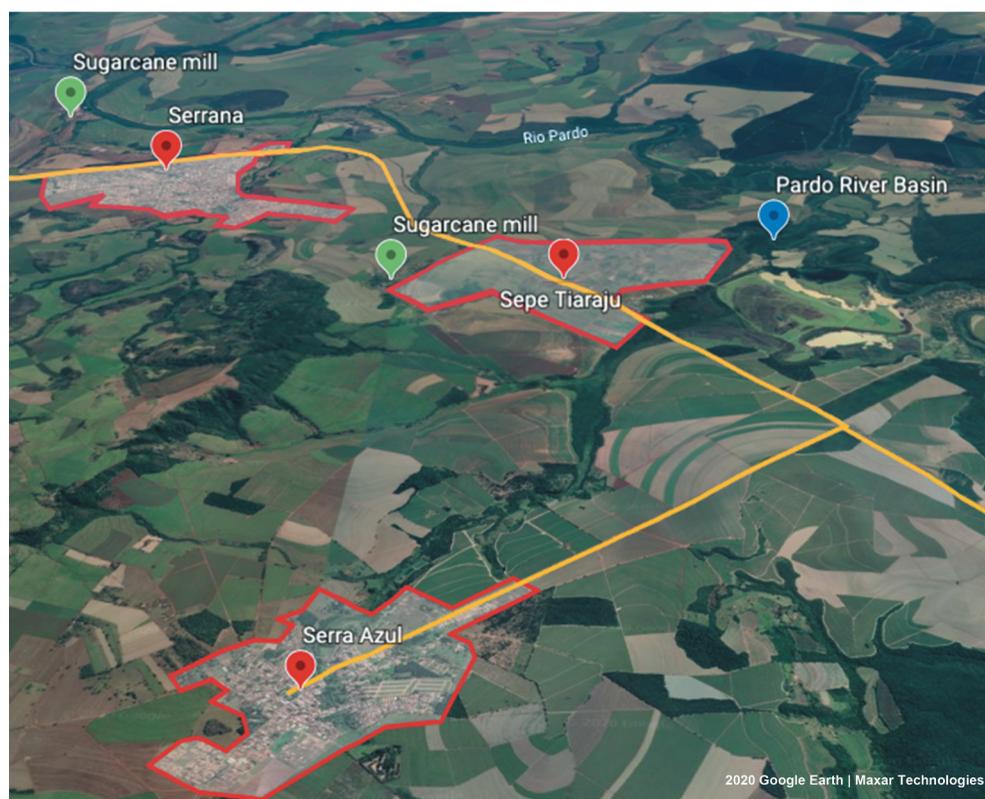


Figure 1. Case study area: the urban-rural interface of Sepé Tiaraju, Serra Azul and Serrana (source: Google Earth, 2020. Re-used allowed under licence of Google and Maxar technologies).

water, food, biodiversity) recovered by the agrarian reform area. In contrast, although the municipality was co-responsible for promoting and implementing environmental, sanitation, health, and local agriculture policies in the settlement, there were mismatches in providing municipal services for the rural area.

To operationalize the study, we draw on the nexus approach not only to mapping the flows of water, energy, and food in urban-rural interfaces, but also to analyse how these flow take place in social, political, and spatial dynamics; and related effects on the territory in terms of environmental change and social justice. Precisely, we follow the proposed steps of Terrapon-Pfaff et al. (2018) to make a qualitative analysis of the nexus at the regional and local levels. These steps included:

(a) *quantitative mapping*: we first traced the WEF linkages regarding the macro-region of Ribeirão Preto. We used secondary data from the literature to characterize the dominant economic sector, the land uses and environmental impacts, and urbanization patterns, identifying the extent to which environmental resources are affected. This first mapping was necessary to contextualize the extensive use of resources in the region and how PDS's agrarian reform areas, like Sepé Tiaraju, emerged as the political response to the socio-environmental impacts.

(b) *qualitative mapping*: the second step was trace and qualifying these links at the local urban-rural interface by bringing empirical evidence from the fieldwork in the Sepé

Tiaraju settlement, which took place between 2015 and 2019. We employed observations of the settlement's everyday life in terms of public policies, infrastructures, and practices of resources management and access (e.g., implementation and functioning of water system provision; practices of individual/collective agroecological-based production and marketing; implementation of public programmes and initiatives of sustainable development). To observe how these interactions took place with urban spaces, we observed the "*Feira do Produtor rural*," a public initiative implemented. With support from state institutions for small farmers and the city hall of Serra Azul, the initiative aimed to create more linkages between urban and rural areas through food markets. We also conduct semi-structured in-depth interviews with Sepé Tiaraju's household members. Of the 79 total households, 72 agreed to participate in the interviews. Each one of the interviews took place at the residents' households for about 60–90 minutes. Informally, we also chatted with Serra Azul's dwellers and state officers. Also, dialogue spaces were set up through the Reflexive Monitoring in Action (RMA) timeline workshops (van Mierlo et al. 2010). We heard residents about their memories of the settlement's history, experiences with policies and programmes for sustainable development, main problems about infrastructure and resources access, and relationships with local municipalities.

(3) *analysis of critical links*: by triangulating these different sources of information with the theoretical framework, the last step examined the nexus links concerning the critical socio-political and spatial dynamics. We identified how the government institutions and decisions affect these links; how mutual perceptions come close to/take apart urban-rural interactions and resources access throughout the settlement's territorial change; to what extent these interactions undermine or enhance nexus at that territory towards environmental change and social justice.

5. Results

5.1. Sugarcane agribusiness and peri-urban settlements: mapping the nexus at the macro-region of Ribeirão Preto

Looking at the settlement's macro-region context, we need to reconstruct two intertwined processes that articulate the water-energy-food nexus in the study area: the hegemony of sugarcane power in the State of São Paulo and the emergence of agrarian reform in the Ribeirão Preto region.

With 44 million people and Brazil's main industrial complex, São Paulo is the country's most populated state. It is also Brazil's biggest producer of sugarcane for ethanol exports. There are 6.15 million hectares destined for sugar and alcohol production, which corresponds to 53.7% of all ethanol produced in the country (Conab – Companhia Nacional de Abastecimento 2019). Most of this production is located in the northeast portion of the state – the region of Ribeirão Preto – known as the "the National Capital of Agribusiness."

Since the 1970s, the Brazilian government stimulates the sugarcane sector, transforming Ribeirão Preto into an international hub for the sugar and ethanol industry. The international agenda advocates sugarcane-based agrofuel as a sustainable alternative for reducing greenhouse gas emissions (GHG) in comparison to fossil fuels. However, the water required by this type of energy is inconsistent with the alleged sustainability. The production of one litre of ethanol requires 1,400 litres of water (Ballester 2013).

Furthermore, sugarcane is the crop with the largest irrigated area in Brazil. The State of São Paulo represents 37% of consumptive water allocated for sugarcane crops (ANA – Agência Nacional de Águas 2019). Such consumption contrasts with the severe water crisis that the state has been going through since 2014. Government measures restricted the domestic water supply for 2,1 millions of people, from inner cities to metropolitan peripheries (Rodrigues and Brenha 2020). In this scenario, the sugarcane sector has demanded state action to enable the irrigation of crops on a large scale, competing for water with residential, industrial, and other rural areas (Zullo et al. 2016).

Ribeirão Preto region lays over the Guarani Aquifer (the second most crucial ground-water storage of South America) and the Pardo River basin. Studies have identified water contamination by agrochemical inputs used in sugarcane crops in Guarani and Pardo's reservoirs (ANA – Agência Nacional de Águas 2019). Only Ribeirão Preto, the largest city in the region with 700,000 urban dwellers, consumes 59.3 billion litres of water from the Aquifer (Pavini and Silva 2019). The Pardo river supplies other municipalities in the region.

Such a hegemony in the region has become quite critical for food production. More than 170 plants process around 350 thousand hectares of sugarcane throughout the state. Consequently, environmental availability for food production has suffered significant impacts. Between 1970 and 2006, the production of raw food for intern markets has dropped significantly, such as rice (–97%), beans (–84%), and corn (–54%) (Ramos Filho 2013).

Sugarcane also uses regular burnings as practices to facilitate the cutting process and, thus, increase productivity. Soot particles modify the carbon cycle of river basins and rainwater ecosystems when deposited in the soil and water (Lara et al. 2005). Until 2014, Ribeirão Preto was the region that most burned cane straw. Environmental impacts of sugarcane also pose risks to the health of São Paulo's population. An epidemiological study in 645 municipalities of the state has identified an association between the previous burning of sugarcane and respiratory diseases (Paraíso 2014).

The sugarcane expansion also intensified the rural exodus, provoking paradoxical urbanization. Until 1957, only 16% of rural workers were living in urban areas of the region. In 1985, this number increased to 85%. (Silva et al. 2017). The implementation of sugarcane mills and the populational growth pressed the urban peripheries, increased poverty and unequal access to resources. While the municipality of Ribeirão Preto is one of the country's wealthiest cities – ranked as the 21st largest GDP in Brazil (IBGE 2017), it absorbed a more significant number of temporary or unemployed rural workers, with an increase in the number of *favelas* (slums). In the early 2000s, 18.000 dwellers were living 31 *favelas* of Ribeirão Preto. In 2018, this number rose to 43.000 dwellers and 96 *favelas* (Catanho 2018).

In terms of the land market, sugarcane production's profit expectations have transformed the region into one of the country's most expensive land areas. The price per hectare is 39% higher than the average for the entire state of São Paulo (Virides 2015), impacting on growing population in suburbs or peripheries of cities. Surrounding towns have a more floating population as they function as commuter towns for temporary migrant workers during sugarcane harvesting periods, thus becoming highly dependent on the sugarcane sector (Scopinho 2003).

These socio-environmental impacts provoked by the sugarcane sector led to land struggles in the region in the early 2000s. The MST and thousands of working poor claimed for agrarian reform in the region. With local groups' support, the movement occupied large rural estates in the region with significant environmental liabilities. The sugarcane industry continuously

exploited estates that had already been expropriated by the state to pay fines. Although the violation of the land's socio-environmental function was evident, the law's effective implementation required other political arrangements. MST, Incra, and São Paulo's Public Ministry had to negotiate a feasible way to implement agrarian reform considering the property speculation and the risks of future des-territorialization of the settlement by local agribusiness. In the PDS arrangement, these actors found a method to set up collective settlements by a concession of the state, preventing the land-grabbing and demanding the settlement's environmental recovery as a place of living and work. Since then, 17 PDS areas were implemented across the state; five of them in the Ribeirão Preto region, such as its first area: the Sepé Tiaraju settlement.

5.2. Sepé Tiaraju settlement and the nexus at the local level

This section traces how these critical links between water, energy, and food take place in the peri-urban territory, since the Sepé Tiaraju settlement's creation. Extreme uncertainties and scarcity of resources marked the first years of the area, still an informal occupation. At that time, Sepé Tiaraju's settlers lived in vulnerable conditions of degraded soil, water scarcity, in shelters covered by a tarp and without electricity (see [Figure 2](#)). According to the settlement's residents, three times a week, the municipality of Serra Azul provided trucks with reclaimed water to supply the settlers, which was unfit for consumption. The lack of water and degraded soil by the sugarcane crops affected the initial attempts to cultivate food in the area. For this reason, settlers depended on food donations from urban dwellers. That was the first tension between the settlement and the cities, motivated by the prejudice and social stigmas against the landless occupations and their "illegal" condition.

Production for subsistence was gradually giving its first results with donated seeds and much creativity. Once the first agricultural surplus was produced, settlers made several food donations to the urban dwellers. In their view, that was a strategy to overcome the stigmas and show the local population that it was possible to produce healthy food in the "Capital of Agribusiness." Crops were mostly composed of food items that did not depend on direct water irrigation, such as bananas, manioc, corn, and squash combined with bushes, fruit, and native trees of the region (see [Figure 3](#)). The settlements' residents started to sell products to intermediaries or directly at the highway margins (see [Figure 4](#)). In three years, the landscape changes regarding vegetation cover and food production were already visible.

When the federal administration officialized Sepé Tiaraju, the 80 families settled in the area signed an agreement with the Incra and Public Ministry. They took responsibility for using agroecological systems and reforesting the area. Meanwhile, Incra must be responsible for implementing the infrastructure (e.g., electricity, dirt roads, housing, water). However, it only took place after 2005, taking about five years to be implemented. The water supply system was the last infrastructure constructed in 2009. During this period, Sepé's residents organized mobilizations to pressure the municipality to provide the water network. An impromptu water network was installed by using water pipe materials unfit for human consumption. Araújo et al. (2011) analysed the Sepé's water quality and the lack of adequate treatment. Authors suggest that the unequal access to clean and treated water not only impacts the food production but mainly the provision of everyday activities, such as drinking and cooking in safety conditions.



Figure 2. Occupation in 2004 (source: the authors).



Figure 3. Corn harvest in 2005 (source: the authors).

The improvised plumbing frequently overloads the system (see [Figure 5](#)). Consequently, the four water pumps distributed over the area often collapse, so that water cannot reach all households. Indeed, interviewees indicated the lack of water as the main problem of the settlement, although we cannot find precise how many residents are individually affected by that. During the fieldwork, we witnessed various situations in which residents lacked water, thus restricting irrigation for agricultural activities.

The residents developed some strategies to deal with the lack of water access. Some families stored water in plastic containers and transport them to their houses. Those who have their plots near the water springs and better economic resources could instal their irrigation systems or rainwater tanks (see [Figure 6](#)) to cope with drought periods. On the one hand, these individual strategies entailed more regular and diverse production for some residents, such as the vegetable items most bought by consumers in direct sales (see [Figure 7](#)).

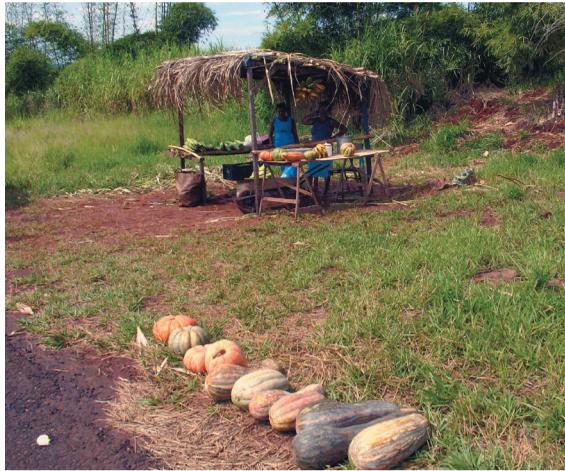


Figure 4. Stall in 2005 (source: the authors).



Figure 5. Pipe burst in 2015 (source: the authors).

Collectively, these problems also fostered internal cooperative or conflictive practices. For example, a group managed to establish a rule to use water pumps among their closest neighbours, as an interviewee explained: *"We have a rule that is as follows: it gave 6 p.m., we turn off the pump. Did you hear the thunder? Turns off. Thank God, this has been functioning for two years, we did not have problems anymore"*. The strategy prevented the regular collapse of water pumps. In other cases, people refused to share the costs of pumps' repair, by the lack of money or difficulties in making the equipment's collective management. For instance, among a group of 20 residents, only three agreed to pay 250,00 USD for the repair. We witnessed residents staying almost two consecutive weeks without water until they got resources and an agreement for the repair. Moreover, interviewees reported suffering boycott practices of water access by other residents, such as water diversion and blocking of taps.



Figure 6. Rainwater tank in 2015 (source: the authors).



Figure 7. Vegetable garden with irrigation system in 2019 (source: the authors).

Even with the chronic water infrastructure problem, interviewees see a significant improvement in their food security, mainly due to pesticide-free products' accessibility. The food is remitted to the previous scarcity or the lack of economic conditions when they consumed "poisoned food," said an interviewee. In addition to food security, food production through the agroecological systems also had evident effects on the local environment. The variety of agroforestry crops reaches more than 100 species, including fruit, timber, medicinal, and food trees (Peruchi et al. 2016). The new coverage of the area contributed to improving the soil, the microclimate, and the land's work. It also contributed to recovering the four water springs within the settlement (Ramos Filho 2013). A compared view of the area in 2003 (see Figure 10) and 2020 (see Figure 11) illustrates the territorial changes of housing, combined crops, and vegetal coverage, notably the Pardo River's recharging area.

Agroecological systems and the PDS's collective land tenure were critical mechanisms contributing to socio-environmental changes and protecting the area against the sugarcane reincorporation. However, the predominance of sugarcane keeps pressuring the ecosystem recovering through other "unseen" places. During the field research, settlers

narrate several burnings that destroyed its reforestation areas associated with sugarcane burning practices and drought periods. They also mentioned damages and contamination of crops and water caused by aerial drift of pesticides by airplanes over the sugarcane surrounding farms.

While the sugarcane sector continued to pressure the local resources, the surrounding cities were vital to counter-balance these asymmetries by establishing food linkages with the settlement. These food consumption links with Serra Azul and Serrana were critical to maintaining the settlements' environmental work with agroecology and the residents' livelihoods.

Public food procurement programmes shaped the primary food linkage between the Sepé Tiaraju and the cities. From 2003 to 2016, that was one of the leading development strategies of Brazilian federal administrations for agrarian reform areas. States and municipalities purchase food production from small farmers and settlements and distribute them to assist institutions and public schools, providing a regular income to farmers and improving food access to vulnerable groups. Through these connections, the settlements' residents recognized their key role in transforming the territory, including the cities, but also claimed for more recognition from the urban dwellers, as quoted below:

It would be good if they [urban dwellers] had more knowledge [about us], visited us more, right? To know that we are doing work here not only to preserve species. In my plot, there are even monkeys, much fruit. We are protecting what the sugar mill owner destroyed; we are changing the environment where we live. Moreover, this improves the quality of life for urban dwellers. They may not realize it, because there we only perceive materialism. However, life is generated by the transformation of the earth, of the planet where we are. So, if you let it be destroyed, every human being will suffer from it. What we are doing here is the opposite. It is rescuing the old [knowledge] and transforming former monoculture areas into a biodiversity one.

This quote resonated with a critical but contradictory relationship between the settlement and local municipalities through the food flows, which affected even the public food procurement. For example, these initiatives' multi-sectorial arrangement required complex coordination between government, states, and municipalities, depending on different decision-making levels. In this case, Serra Azul would be the most potential place for governmental food purchases since the settlement belongs to this municipality. Serra Azul underexplored the food procurement programmes, according to interviewees. As a settler suggested, there was a lack of interest in the production and particularities of the settlement: *"they [Serra Azul] don't understand much about agrarian reform [...] so they prefer to negotiate with the mill owner, with the big farmer"*.

On the other hand, regular purchases have established a stronger food connection with Serrana. Until 2016, settlers sold an average of six tons of food to Serrana every 15 days. Interviewees described the municipality's administration as more "friendly" with the settlement. Some settlers believed that access to services and resources would be better if the area belonged to this municipality.

Sepé's residents also looked to other marketing strategies to flow food production. In 2018, The National Rural Learning Service (Senar) – a non-profit organization – attempted to formalize the first settlement's food street market at a spot in Serra Azul downtown. This initiative would help make more visible the settlement's environmental improvements through agroecological food and improve the settlers' markets. Besides, it would be an opportunity to improve interactions with Serra Azul. After 15 years of Sepé Tiaraju's

creation, it was one of the first public initiatives to bring together dwellers from both areas through the agroecological food market.

Senar held courses to settlers on financial education, product pricing, spending control, accounting. It also provided materials for setting up the stalls, such as structure, uniforms, branding (see [Figure 8](#)) following a single standard for participants all over the country. In Senar's perspective, standardizing contributes to the aesthetic of stalls and would attract potential customers. Fresh food available at the street market was the regular crops (banana, manioc, and pumpkin). There were also some minimally processed products, peeled, cut, and vacuum-packaged. The potential consumers were sceptical about the products. During informal chatting, dwellers that visited the street market mentioned preferring buying food at supermarkets, where they found all kinds of products. Also, agroecological food was argued to be less patterned and more expensive in comparison to conventional ones.

Settlers, in turn, bought products from neighbours and other suppliers to compensate for the lack of variety. Even so, Serra Azul dwellers were indifferent to the street market. With low adhesion and sales, settlers reported having tried to negotiate to switch the street market to Serrana. Senar rejected the proposal, arguing that they already had a formal deal with the municipality. Settlers who could afford the costs for a new stall moved to Serrana's spot. In Serrana, the food stalls mixed with street vendors and various products (clothing, accessories, toys). Unlike Serra Azul, this spot had the highest activity among city dwellers (see [Figure 9](#)). Held on Sunday mornings, the street market was an everyday place for shopping, eating, and leisure for local dwellers.

Tensions between the settlement and municipalities take place since the occupation period. In the Serra Azul trade, many stores refused to make sales to settlers in the early years. Settlers also reported being often insulted by city dwellers with words like "lazy," "filthy," and "down-and-out." Teachers and city students from Serra Azul and Serrana's schools insulted the settlement's children and their mothers. Hostility also occurred in municipal public offices, where settlers faced constant back and forth to present documents and issue certificates required for marketing, often lost or delayed by public officials. Besides, successive municipal administration neglects that the settlement also belongs to the Serra Azul municipality. Thus, it has equal rights for service provision and



Figure 8. Street market in Serra Azul in 2018 (source: the authors).

decision-making forums. According to the interviewees, the municipal food councils formally ensured the settlement's residents participation to discuss the public food procurement programme's strategies. However, some interviewees declared their participation as "useless" as they got no appreciation from other members.

Sepé Tiaraju's pioneerism with agroforestry systems in the region has created new opportunities for connections with the city. However, it is still restricted to a niche of supporters sympathetic to environmental causes and agrarian reform. During the research, we observed a growing number of initiatives by researchers and students looking for a place to learn from the settlers about agroecological practices and reproduce their knowledge elsewhere. A new network emerged from these activities, resulting in a crowdfunding platform to support both the Sepé Tiaraju's food production and the



Figure 9. Street market in Serrana in 2019 (source: the authors).



Figure 10. Satellite view of Sepé Tiaraju's area in 2003 (source: Ramos Filho 2013. Re-used allowed under licence of Biblioteca Universidad de Córdoba).



Figure 11. Satellite view of Sepé Tiaraju's area in 2020 (source: Google Maps, 2020. Re-used allowed under licence of Google and Maxar technologies).

local urban peripheries affected by the pandemic crisis. In two months, the settlement donated food to over 1000 Ribeirão Preto households, living in vulnerable conditions.

5.3. Socio-political and spatial dynamics of the nexus and the challenges towards social justice

The dynamics of the nexus in this territory are activated and undermined by different actors involving municipalities, local dwellers, and the sugarcane sector. On the one hand, the political and environmental conjuncture in the 2000s favoured agrarian reform's struggle to promote a substantial change in the territory, thus ensuring the people's right to land and natural resources.

Before the settlement's creation, the access to resources was highly asymmetrical, imbalanced by the sugarcane impacts on energy production. At the local level, the new territorial interface facilitated water and food linkages that have substantially re-balanced the local ecosystem, improving the living conditions of the residents of the settlement and its surroundings.

On the other hand, the precarious provision of infrastructure directly impacts the everyday routine of the settlement. Although the mutual agreement has been signed between the federal administration and residents to ensure the area's socio-environmental function, the fulfilment of the public authorities' commitments leaves the settlement in vulnerable conditions, especially concerning water access.

In this regard, the everyday practices to deal with the lack of water infrastructure demonstrate the many ways in which the actors can address the complex interaction of resources and the infrastructure provision (Monstadt and Coutard 2019). In a combination of active exploration and place-based conflictive practices, the settlements' residents dealt with the infrastructure problems, but their effects also reproduced internal inequalities.

Moreover, the nexus dynamics also connect the territory to broader scales and levels of risks and pressures on local resources (Terrapon-Pfaff et al. 2018). Broad impacts of the sugarcane sector represent risks on the quality of water and air (with implications on the health of local dwellers) and climate change of the region (impacting water availability for agroecological production and fresh food).

Different socio-spatial and political dynamics also shaped food linkages. The settlement concretely improved food security for its residents and urban dwellers. The links between food and environment were the means to which they re-signified their role in the territory. According to Hommes et al. (2016), this process is critical to frame solutions and possibilities to transform the resource arena by shaping different territorial imaginaries.

The set of experiences with governmental programmes of food purchase and street markets also highlighted the coexistence of diverse territorial imaginaries that articulated the food flows between municipalities and the settlement. The lack of voice in decision-making forums and tensions with urban dwellers in marketing transactions emphasizes the settlement's continuous dispute – both for the place and resources – in the dominant social imaginary. In this case, these imaginaries are still deeply attached to the sugarcane sector's dominance in local and national economies and the social stigma of agrarian reform that often questions the settlement legitimacy and the settlers' rights. However, the daily commuting in-between settlement and municipalities is a critical coping strategy to ensure the place maintenance and people's livelihoods. As dynamic processes, different relationships with municipalities, urban dwellers, and agroecology supporters have contributed to reconfiguring the nexus while shaping "territorial counter imaginaries" (Hommes et al. 2016).

The case also highlights that peri-urban territories are not limited to their administrative or geographical boundaries, as Allen (2003) states. As contested terrains, these territories bring together competing imaginaries, affecting the people's access and decision-making over the resources. In Sepé Tiaraju, this was evident in the nexus contradiction that facilitated the environmental change and resulted in unequal access to resources. Those who most benefit the local ecosystem are responsabilized for the nexus but are less politically supported and socially recognized for that.

Agrarian reform policy faces its most dramatic moment, under the execution of neoliberal reforms linked to the authoritarian anti-social and anti-environmental agenda of Jair Bolsonaro's administration. Meanwhile, measures that relaxed the sector's environmental restrictions benefit the sugarcane agribusiness, such as the approval of hundreds of new pesticides used in aerial applications. Throughout Brazil history, agribusiness and agrarian reform bring together asymmetrical powers and conflicts over resources. More than ever, the political struggles for social justice are urgent for the nexus discussion and the role of agrarian reform settlements.

6. Conclusions

This paper discussed the challenges that peri-urban territories, particularly the Brazilian agrarian reform areas, towards social justice. By combining critical and territorial perspectives on the WEF nexus, we argued that the nexus' socio-political and spatial dynamics were crucial to assessing these challenges better. Indeed, as the analysis of the Sepé Tiaraju settlement suggested these dynamics matter. As a territory with complex urban-rural interactions, the nexus operated contradictory processes of change in the territory. On

the one hand, powerful workers' struggles materialize a concrete environmental change that promotes more equitable access to resources. Through the agroecological systems, the area has recovered the territorial biodiversity, enhancing water availability for cities and providing food for cities through direct sales and donations. On the other, the lack of adequate infrastructure for water provision, systematic pollution from sugarcane, and tense relationships with local municipalities reproduce inequalities in the access to resources.

Political struggles, infrastructures, power asymmetries, and conflicting territorial imaginaries are key to the nexus dynamics, in this case, both enhancing and constraining the role of agrarian reform areas towards environmental change and social justice. Thus, socio-political and spatial dynamics matter to how the nexus dynamics occur in the peri-urban territories, affecting people and places differently. As Moss and Hüesker (2019) suggest, the nexus is a complex dynamic forged by human and non-human elements, more than a simple matter of resources management and trade-offs. In this sense, we reinforce what critical studies have already pointed out regarding the need to critically analyse the nexus in multiple levels, scales, and inequality structures. Beyond that, we highlight the importance of a deeper understanding of the nexus through a territorial perspective, giving attention to these dynamics in overlooked realities that go beyond the typical urban-rural dichotomy.

Acknowledgments

We acknowledge financial support received from FAPESP - São Paulo Research Foundation, Brazil (Process 2014/25042-0). We also gratefully acknowledge the journal reviewers' contributions.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

This work was supported by the Fundação de Amparo à Pesquisa do Estado de São Paulo [2014/25042-0].

ORCID

Thainara Granero de Melo  <http://orcid.org/0000-0001-9898-1289>

Bruno Lacerra de Souza  <http://orcid.org/0000-0002-2866-5421>

Rosemeire Aparecida Scopinho  <http://orcid.org/0000-0002-2771-4770>

References

- Adam M. 1999. Definition and boundaries of the peri-urban interface: patterns in the patchwork. In: Drechsel P, Kunze D, editors. Waste composting for urban and peri-urban agriculture. New York: CABI Publishing; p. 193–208.
- Allen A. 2003. Environmental planning and management of the peri-urban interface: perspectives on an emerging field. *Environ Urban*. 15(1):135–148. doi:10.1630/095624703101286402.
- ANA - Agência Nacional de Águas. 2019. Manual de Usos Consuntivos da Água no Brasil. Brasília: ANA.

- Araújo GFR, Tonani KADA, Julião FC, Cardoso ODO, Alves RIDS, Ragazzi MF, Sampaio CDF, Segura-Muñoz SI. 2011. Microbiological and physical-chemical quality of water for human consumption and the relationships with health: study in an agricultural community in state São Paulo. *O Mundo Da Saúde*. 35(1):98–104. doi:10.15343/0104-7809.201135198104.
- Ballester MVR. 2013. Impacts of changes in land use on bodies of water. Interview to Agência Fapesp. Fapesp. [accessed 2019 Feb 3] <https://fapesp.br/japanbrazilsymposium/31>
- Bazilian M, Rogner H, Howells M, Hermann S, Arent D, Gielen D, Steduto P, Mueller A, Komor P, Tol RSJ, et al. 2011. Considering the energy, water and food nexus: towards an integrated modelling approach. *Energy Policy*. 39:7896–7906. doi:10.1016/j.enpol.2011.09.039.
- Biggs EM, Bruce E, Boruff B, Duncan JMA, Horsley J, Pauli N, McNeill K, Neef A, Van Ogtrop F, Curnow J, et al. 2015. Sustainable development and the water–energy–food nexus: a perspective on livelihoods. *Environ Sci Policy*. 54:389–397. doi:10.1016/j.envsci.2015.08.002.
- Brandão CA. 2016. Spaces of destitution, and urban and regional policies in Brazil: a panoramic view. *Nova Economia*. 26(spe):1097–1132. doi:10.1590/0103-6351/3961.
- Cairns R, Krzywoszynska A. 2016. Anatomy of a buzzword: the emergence of ‘the water-energy-food nexus’ in UK natural resource debates. *Environ Sci Policy*. 64:164–170. doi:10.1016/j.envsci.2016.07.007.
- Caporal FR, Costabeber JA. 2006. Segurança alimentar e agricultura sustentável: uma perspectiva agroecológica. *Cadernos De Agroecologia*. 1(1):1–8.
- Carvalho SM, Bezerra I. 2017. “Today is street market day” – pathways to agroecology in the municipal food supply policy of Curitiba-Paraná. *Revista Paranaense De Desenvolvimento*. 38 (133):97–112.
- Catanho L. 2018. Em menos de dois anos, número de favelas quase dobra em Ribeirão Preto. CBN Ribeirão Preto. [accessed 2019 Feb 3] <https://www.cbnribeirao.com.br/noticias/cidades/NOT,0,0,1312896,em+menos+de+dois+anos+numero+de+favelas+quase+dobra+em+ribeirao+preto.aspx>
- Conab - Companhia Nacional de Abastecimento. 2019. Safra Brasileira de Cana-de-Açúcar. Companhia Nacional de Abastecimento. [accessed 2020 Aug 7] https://www.conab.gov.br/info-agro/safras/cana/boletim-da-safra-decana-deacucar/item/download/17727_4e54c5103a0ab4a15529e35307c79b2e.
- Dornfeld CB, Leite MA, Lima EACF, Simonato DC. 2013. Saneamento básico em dois projetos de assentamento rural no oeste paulista – Brasil. In: Carvalho MLS, Henriques PDS, Narciso V, editors. *Proceedings of the ESADR 2013*; Oct 15–19; Evora, Portugal. Evora: Universidade de Evora; p. 1751–1769.
- Duval HC, Valencio NFLS, Ferrante VLSB. 2008. Autoconsumo num Assentamento Rural: Segurança Alimentar e Agroecologia em Debate a Partir de um Estudo de Caso. *Retratos De Assentamentos*. 11(1):101–132.
- Fernandes BM, Welch C, Gonçalves EC. 2012. *Land Governance in Brazil. A geo-historical review of land governance in Brazil*. Framing the Debate Series. Rome: ILC.
- Gaspari LC, Khatounian CA, Marques PEM. 2018. The role of agriculture among pluriactive families settled around on metropolitan region: the case of the Milton Santos settlement in Americana and Cosmópolis/SP. *Revista Nera*. 21(41):85–101.
- Goldfarb Y. 2011. A luta pela terra entre o campo e a cidade: reforma agrária, movimentos sociais e novas formas de assentamentos. São Paulo: Annablume.
- Gonçalves JC, Scopinho RA. 2010. Reforma Agrária e Desenvolvimento Sustentável: a Difícil Construção de um Assentamento Agroecológico em Ribeirão Preto-SP. *Retratos de Assentamentos*. 13(1):239–262.
- Heredia B, Medeiros LS, Palmeira M, Cintrão R, Leite SP. 2002. Análise dos impactos regionais da reforma agrária no Brasil. *Estudos Sociedade E Agric*. 18:73–111.
- Hommes L, Boelens B, Maat H. 2016. Contested hydrosocial territories and disputed water governance: struggles and competing claims over the Ilisu Dam development in southeastern Turkey. *Geoforum*. 71:9–20. doi:10.1016/j.geoforum.2016.02.015.

- IBGE - Instituto Brasileiro de Geografia e Estatística. 2017. Produto Interno Bruto dos Municípios. [accessed 2020 Aug 7] <https://cidades.ibge.gov.br/brasil/sp/ribeirao-preto/pesquisa/38/47001?tipo=ranking>
- Incra - Instituto Nacional de Colonização e Reforma Agrária. 2020a. Modalidades. Instituto Nacional de Colonização e Reforma Agrária. [accessed 2020 Aug 1] <http://www.incra.gov.br/pt/assentamentosmodalidades.html>.
- Incra - Instituto Nacional de Colonização e Reforma Agrária. 2020b. Painel de assentamentos. Instituto Nacional de Colonização e Reforma Agrária. [accessed 2020 Aug 1] <http://painel.incra.gov.br/sistemas/index.php>.
- Lara LL, Artaxo P, Martinelli LA, Victoria RL, Ferraz ESB. 2005. Properties of aerosols from sugar-cane burning emissions in Southeastern Brazil. *Atmos Environ*. 39(26):4627–4637. doi:10.1016/j.atmosenv.2005.04.026.
- Leite SP, Ávila RV. 2007. Reforma agrária e desenvolvimento na América Latina: rompendo com o reducionismo das abordagens economicistas. *Revista De Economia E Sociologia Rural*. 45 (3):777–805. doi:10.1590/S0103-20032007000300010.
- López-Goyburu P, García-Montero LG. 2018. The urban-rural interface as an area with characteristics of its own in urban planning: a review. *Sustainable Cities Soc*. 43:157–165. doi:10.1016/j.scs.2018.07.010.
- Marques PEM, Lucas A, Gaspari L. 2014. Desenvolvimento territorial em questão: estudo sobre assentamento periurbano no estado de São Paulo. *Retratos De Assentamentos*. 17(1):161–177.
- Matheus D. 2017. Comuna da Terra: outra concepção de reforma agrária. In: Pires JH, Novaes HT, Lopes JA, Mazin AD, editors. *Questão agrária, cooperação e agroecologia*. Uberlândia: Navegando Publicações; p. 139–162.
- Minayo MCS, Costa AP. 2018. Theoretical base of the qualitative research techniques. *Revista Lusófona De Educação*. 40:139–153.
- Monstadt J, Coutard O. 2019. Cities in an era of interfacing infrastructures: politics and spatialities of the urban nexus. *Urban Stud*. 56(11):2191–2206. doi:10.1177/0042098019833907.
- Moss T, Hüesker F. 2019. Politicised nexus thinking in practice: integrating urban wastewater utilities into regional energy markets. *Urban Stud*. 56(11):2225–2241. doi:10.1177/0042098017735229.
- Mougeot LJA. 2000. Urban agriculture: definition, presence, potentials and risks, and policy challenges. Ottawa: International Development Research Centre. *Cities Feeding People Series Report 31*.
- Nobre HG, Junqueira AC, Souza TJM, Ramos Filho LO, Canuto JC. 2012. Use of agro-ecological practices in building sustainable projects for land reform: a case study in the settlement Sepé Tiaraju - SP. *Revista Brasileira De Agroecologia*. 7(1):3–13.
- Ondetti G. 2016. The social function of property, land rights and social welfare in Brazil. *Land Use Policy*. 50:29–37. doi:10.1016/j.landusepol.2015.08.028.
- Paraíso MLS. 2014. Avaliação de impacto à saúde causado pela queima prévia de palha de cana-de-açúcar no Estado de São Paulo. São Paulo: Tese de doutorado em Medicina Preventiva, Universidade de São Paulo.
- Pavini C, Silva A. 2019. Objetivos de Desenvolvimento Sustentável. Instituto Ribeirão 2030. [accessed 2020 Jul 30] <https://www.ribeirao2030.com.br/ods6/>.
- Pereira AS. 2013. Analysis of trends in the application of the concept of peri-urban. *Terr@Plural*. 7 (2):287–304. doi:10.5212/TerraPlural.v.7i2.0007.
- Peruchi F, Ramos Filho LO, García-Barrios LE. 2016. Sistemas agroecológicos biodiversos como estratégia de segurança alimentar: um estudo de caso no Assentamento Sepé Tiaraju - São Paulo. In: Proceedings of the VII Simpósio Reforma Agrária e Questões Rurais; Jun 29-02; Araraquara, Brazil. Araraquara: Uniara.
- Pinto LFG, Faria VG, Sparovek G, Reydon BP, Ramos CA, Siqueira GP, Godar J, Gardner T, Rajão R, Alencar A, et al. 2020. Quem são os poucos donos das terras agrícolas no Brasil - O mapa da desigualdade. *Sustentabilidade Em Debate*. 10:1–21.
- Ramos Filho LO. 2013. Reforma agraria y transición agroecológica en una zona de grandes monocultivos de caña de azúcar: el caso del Asentamiento Sepé Tiaraju, región de Ribeirão Preto, Brasil. Córdoba: Tese de Doutorado, Pós Graduação em Agroecologia, Universidade de Córdoba; p. 381.

- Robles W. 2018. Revisiting Agrarian Reform in Brazil, 1985–2016. *J Dev Soc.* 34(1):1–34. doi:10.1177/0169796X17749658.
- Rodrigues A, Brenha H. São Paulo tem 2,1 milhões de pessoas sob racionamento. Folha de São Paulo. [accessed 2020 Jul 20] <https://folha.uol.com.br/cotidiano/2014/08/1498512-sao-paulo-tem-21-milhoes-de-pessoas-sob-acionamento.shtml>
- Rojas-Caldelas R, Pena-Salmon C, Ranfla-González A, Venegas-Cardoso R, Leyva-Camacho O, Ley-García J. 2010. Approaches to analyzing the rural-urban interface: comprehensive development views from town and countryside. *WIT Trans Ecol Environ.* 129:359–370.
- Scopinho RA. 2003. *Vigiando a vigilância: saúde e segurança no trabalho em tempos de qualidade total.* São Paulo: Annablume.
- Silva APS, Tassara ETO. 2014. Sistemas Agroflorestais: resignificação de Vivências em Assentamento Rural Periurbano. *Psico.* 45(3):328–339. doi:10.15448/1980-8623.2014.3.17347.
- Silva IJ, Oliveira JHC, Oliveira LL. 2017. From coffee to sugar cane: the impact of economic transformations on labor relations in the micro-region of Ribeirão Preto (SP), between 1945 and 1985. *História Econômica & História De Empresas.* 20(2):361–374.
- Stringer LC, Quinn CH, Berman RJ, Le HTV, Msuya FE, Orchard SE, Pezzuti JCB. 2014. *Combining nexus and resilience thinking in a novel framework to enable more equitable and just outcomes.* Leeds (UK): Centre for Climate Change Economics and Policy.
- Tassara ETO. 2007. Urbanity and peri-urbanity. Thinking about psico-social dimensions of the historical dynamics. *Série Documenta.* 17:1–19. Rio de Janeiro.
- Terrapon-Pfaff J, Ortiz W, Dienst C, Gröne MC. 2018. Energising the WEF nexus to enhance sustainable development at local level. *J Environ Manage.* 223:409–416. doi:10.1016/j.jenvman.2018.06.037.
- Urbinnati AM, Benites-Lazaro LL, Carvalho CM, Giatti LL. 2020. The conceptual basis of water-energy-food nexus governance: systematic literature review using network and discourse analysis. *J Integr Environ Sci.* 17(2):1–23.
- van Mierlo BC, van Regeer B, van Amstel M, Arkesteijn MCM, Beekman V, Bunders J, Buning TC, Elzen B, Hoes AC, Leeuwis C. 2010. *Reflexive monitoring in action. A guide for monitoring system innovation projects.* Wageningen: Communication and Innovation Studies, WUR.
- Virides G. 2015. Hectare de Ribeirão Preto e região é o mais valorizado em todo o Estado. *Jornal A Cidade.* [accessed 2019 Feb 4] <https://www.acidadeon.com/economia/NOT,2,2,1052166,Hectare+de+Ribeirao+Preto+e+regiao+e+o+mais+valorizado+em+todo+o+Estado.aspx>
- Wanderley. MNB, Favareto A. 2013. A singularidade do rural brasileiro: implicações para as tipologias territoriais e a elaboração de políticas pública. In: Miranda C, Silva H, editors. *Concepções da ruralidade contemporânea: as singularidades brasileiras.* Brasília: IICA; p. 413–464.
- Wedig JC, Ramos JDD. 2020. Resistências camponesas em tempos de pandemia. *Tessituras.* 8(1):41–47.
- Williams J, Bouzarovski S, Swyngedouw E. 2018. The urban resource nexus: on the politics of relationality, water–energy infrastructure and the fallacy of integration. *Environ Plann C.* 37(4):652–669.
- Zullo Jr J, Furtado AT, Pfeiffer CC. 2016. *Planejamento da produção de cana-de-açúcar no contexto das mudanças climáticas globais.* Campinas: Editora da Unicamp.