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MANAGEMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONFLICTS IN THE BRAZILIAN SEMIARID REGION[1]

GESTÃO DE RECURSOS NATURAIS E PRODUÇÃO AGROPECUÁRIA NO SEMIÁRIDO BRASILEIRO

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Abstract

The objective is to analyse the agricultural and natural resource management practices adopted by family farmers. Political ecology was adopted as a theoretical reference, which starts from the idea that the appropriation of natural resources is governed by social relations that put pressure on the environment. The methodology consisted in the formulation of a regional agrarian profile and application of semi-structured interviews. The results showed that family farmers are not fully aware of the new environmental legislation and that the actions of the public bodies responsible for environmental enforcement are almost always punitive.

Keywords: Family Agriculture, Political Ecology, Natural Resources, Northeast Brazil.

Resumo

O objetivo é analisar as práticas agropecuárias e de manejo de recursos naturais adotadas pelos agricultores famliares. Adotou-se a ecologia política como referencial teórico, a qual parte da ideia de que a apropriação dos recursos naturais é orientada por relações sociais que presionan o meio ambiente. A metodologia se pauto na formulação de um perfil agrário regional e na realização de entrevistas semiestruturadas. Os resultados demonstraram que os agricultores familiares não conhecem plenamente a nova legislação ambiental e que a atuação dos órgãos públicos responsáveis pela fiscalização ambiental é quase sempre punitiva.

Palavras-chave: Agricultura Familiar, Ecologia Política, Recursos Naturais, Nordeste do Brasil.

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Introduction

This article aims to analyse the agricultural practices of family farmers in the Sertão Paraibano mesoregion between the decades of 1970 and 2010, in the context of cotton crisis and rise and crisis of irrigated agriculture. Attention was focused on understanding conflicts caused by possible violations of environmental legislation by family farmers in their production practices. The low volume of water in the hydrographic basin of the Piancó-Piranhas-Açu rivers stimulated the creation of the Joint Resolution ANA/IGARN-RN/AESA-PB No. 640 of June 18, 2015, which suspended, as of July 1, 2015, the abstraction of surface water from the Piancó-Piranhas-Açu rivers, destined for irrigation and aquaculture activities (BRASIL, 2015).

This situation contradicts some experts who see family farmers playing a central role in food security and in the development of environmentally "more correct" practices when compared to production strategies carried out by non-family farming. It is not common for this academic field to refer to violations or inadequacies of environmental regulations by family farming. Thus, production processes performed by family farming are often in the centre of debates in the field of sustainable development, generation of employment and income, food production and local development (GUANZIROLI, 2001).

There are studies that interpreted the contradictions and the effective use of natural resources as environmental conflicts and demonstrated that there were cases in which some family farmers did not comply with environmental legislation when using Permanent Preservation Areas (PPAs) and Legal Reserve Areas (LRAs) for food crops and livestock farming. However, in relation to other regulations – especially those regarding the timber management of LRAs and the prohibition of control of hunting, fishing and burning – some family farmers carried out a very efficient management (CUNHA; NUNES; MIRANDA, 2006, CUNHA; SILVA; NUNES, 2008).

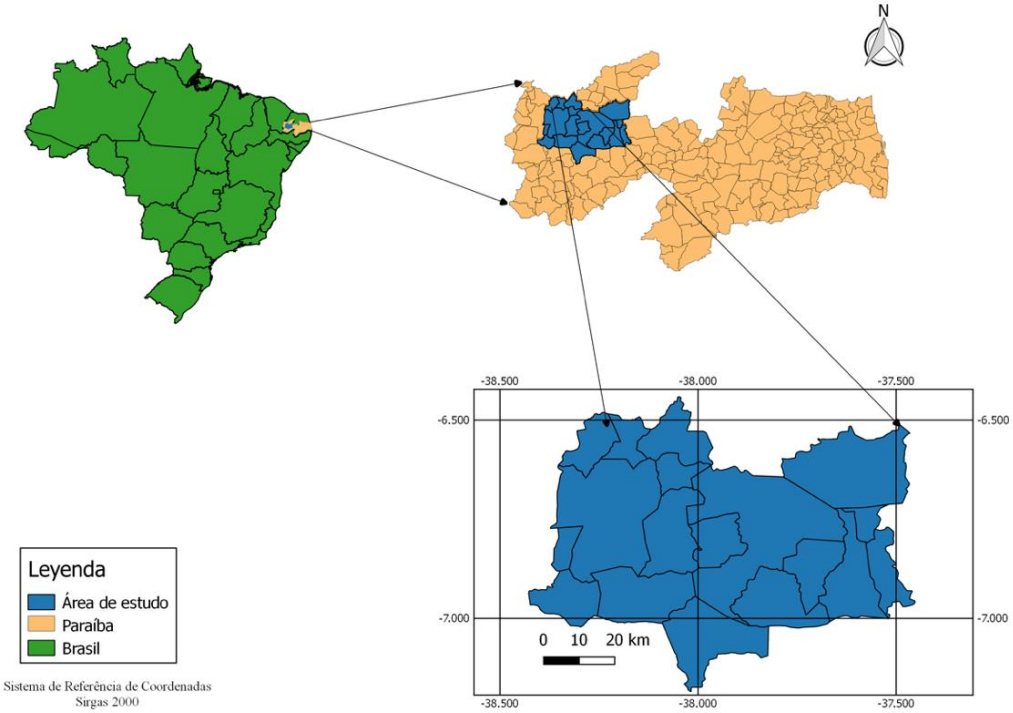
Environmental legislation is essential to regulate and ensure the conservation of biodiversity and the protection of flora and fauna. However, the process of drafting the New Brazilian Forest Code did not occur through a broad debate between the sectors of society directly affected by the legislation, especially social groups with low representation in the National Congress, such as family farmers. The result of this process was the generation of conflicts from a vertical "ecological awareness", derived from different interests (PEREIRA, 2013).

This article is structured in six sections. First, we present the methodological design of the research study and, secondly, we discuss about political ecology and environmental conflicts. Thirdly, we present the data and description of family farming and of the new Brazilian environmental legislation. In the fourth section, we analyse the use of natural resources by family farmers and, in the fifth section, we investigate family farming production and the different environmental conflicts in the Sertão Paraibano mesoregion. Finally, we conclude with some postulates of political ecology on the fragility of the process of legitimization of environmental discourse and on the demand that received by farmers to stop producing under the argument that production practices can exhaust natural resources. The latter obscures the veiled discourse in favour of prioritizing urban interests.

Methodological design

The study was carried out in the Microregions of Sousa and Piancó (Figure 1), contemplated by the Piancó-Piranhas-Açu Hydrographic Basin. The methodological procedures were divided into three stages: consulting the *Automatic Recovery System of the Brazilian Institute of Geography and Statistics* (SIDRA/IBGE), to elaborate an agrarian profile of family farming; defining riverside communities to be studied after consulting the regional offices of the *Technical Assistance and Rural Extension Company of Paraíba* (EMATER-PB) and the cartographic basis of the *Brazilian Institute of Geography and Statistics* (IBGE) to correct distortions in locations (IBGE, 2016), because EMATER-PB did not have up-to-date information on which communities were riverside communities; and evaluating effective land use and deforestation, through the analysis of satellite images.

Figure 1: Location of the Microregion of Sousa and the Municipality of Coremas, Sertão Paraibano



Source: The authors.

Between 2016 and 2017, visits were made to family farmers in these riverside communities for interviews, based on a semi-structured script, to obtain information on different aspects, such as the main sources of income, production practices and environmental preservation, productive use of PPAs and LRAs, level of understanding about environmental legislation and presence and action of the bodies of control and management of natural resources. Ninety one interviews were conducted in the municipalities of *Aparecida*, *Cajazeirinhas*, *Nazarezinho*, *Paulista*, *Pombal* and *Sousa* (Microregion of *Sousa*) and in Coremas (Microregion of *Piancó*).

Throughout the research, we sought to visit as many riverside communities as possible to collect geographic coordinates using a Global Position System (GPS) device, GPSMAP® 76CSx model from Garmin, to enable the construction of maps and the use of geoprocessing techniques to analyse satellite images of the years 1987, 1997, 2007 and 2016, in order to evaluate the effective use of land and verify the process of deforestation, maintenance or removal of riparian forest in the course of rivers, so that, from a long-term perspective, the analysis of the environmental impacts caused by family agriculture in these areas was performed.

Finally, as the last stage of the research study, images of LANDSAT 5 and LANDSAT 8 satellites, available on the website of the United States Geological Survey (USGS), were processed using *Qgis* software to construct thematic maps used in the verification of land use and occupation in the study area, between 1987 and 2016. The analyses considered not only the three municipalities chosen for the previous stages, but also the entire Microregion of *Sousa*, besides including in the territorial section the municipality of *Coremas*, which, despite being part of the *Piancó* Microregion, is where the Coremas/Mãe-d'água reservoir is located, one of the responsible for the perennialization of the *Piancó-Piranhas-Açu* rivers.

Political ecology and environmental conflicts

Political ecology is a field of research formed in the late 1960s and early 1970s, when explanations for environmental problems were based on population growth, inadequate technology and poor management, with most arguments being apolitical. In the following decades, political ecology reflected on the unequal distribution of benefits and costs associated with social and environmental changes, reinforcing social and economic inequality (BRYANT; BAILEY, 1997), and on the processes of industrialization, deindustrialization and environmental degradation resulting from neoliberal globalization (PEET; ROBBINS; WATTS, 2011).

It cannot be denied, therefore, that political ecology since its beginning has sought to analyse the processes of valorisation and appropriation of nature and has constituted a field of struggle for the denaturalization of nature. In seeking to denaturalize nature, political ecology brought to the debate the relations of power, as mediators of the relations between humans and between humans and nature (LEFF, 2003). Thus, environmental degradation is the result of the interaction of different social actors and political processes (LASCHEFSKI; COSTA, 2008) that reflect relations of power (MIRANDA, 2013).

For political ecologists, nature conservation actions generate conflicts by: privatizing natural resources (ROBBINS; LUGINBUHL, 2007); creating conservation units that limit the free movement of hunters and gatherers (COELHO; CUNHA; WANDERLEY, 2010); establishing food traceability, used by large corporations to exploit small producers and cooperatives by requiring them to bear the high costs of obtaining certification (EDEN, 2011). Evaluating conservation projects is fundamental to understand the institutional structures encompassing nature, integration, local and global, and interests of rich countries (BUMPS; LIVERMAN, 2011).

Political ecology has developed around four themes: the idea that the use of resources is organized from social relations that put pressure on the basis of natural resources; recognition of the plurality of positions, interests and rationalities, so that profit of one person profit can represent the poverty of another; the idea of a global connection through which external political and economic processes structure and are influenced by local spaces; and the defence that land degradation is both a result and a cause of social exclusion (GEZON; PAULSON, 2004).

In Brazil, political ecology focused on the struggle of social, rural and local movements for access to land (WOLFORD, 2007), in association with the social movements of Latin America (MILANI, 2008), on conflicts and environmental changes (MIRANDA, 2013) and water resource management (EMPINOTTI, 2011; IORIS, 2009, 2012). The look at Latin America involves the analysis of the introduction of transgenic cultivars in agriculture (WAINWRIGT; MERCER, 2011), incorporation of the indigenous worldview into legislation (GUDYNAS, 2009), increase in land purchases by foreigners (COSTANTINO, 2013) and commercialization of water (CAMACHO, 2012; MEEHAN, 2013).

Family farming and environmental legislation

The inclusion of the family farmer in the social sphere was a conflicting and long process, which has always been related to the production of food for the internal market (SILVA; BATISTA, 2011). However, as a theoretically referenced social category, it is relatively recent and began to be used by researchers and representatives of rural workers in the 1990s (NEVES, 2007; PICOLOTTO, 2014). Its definition is not consensual and it can be said that there are two dominant views: (a) a quantitative one, which is based on the predominance of family work over hired work, and the size of the agricultural establishment of no more than four times the fiscal module (BUAINAIN, 2007); and (b) a qualitative one, which analyses the family aspects of family farming in order to define it, emphasizing local culture, social organization and the production and economic strategies adopted (NEVES, 2007; CARNEIRO, 2008).

Family farming and public policies

Until the 1990s, rural producers today recognized as family farmers had been regarded as small producers, subsistence producers or as low-income producers, which has gradually changed due to the struggle of social movements to have access to public policies that would allocate credits for agricultural practices and actions capable of promoting the increase in prices of agricultural commodities produced, in addition to incentives promoted by the regulation in the legal sphere of rural social security, initiating the process of conceptualization and knowledge of this sector as family agriculture, aiming at the elaboration of public policies aimed at benefiting the rural environment (CHEUNG, 2013; MATTEI, 2014).

The legitimation and recognition of family farming was marked by three distinct moments. First, in the scope of politics, this definition emerges as responses to the union movements, in the mid-1990s, which sought social and economic security for individuals who fell into this new category. The second moment concerns the responses to the union movements, which pressured the

government to elaborate and implement, in 1996, the National Program for Strengthening Family Agriculture (PRONAF). The third, no less important than the previous ones, was a major concern of the Brazilian academy, seen in research focused on rural areas and agricultural production (SCHNEIDER, 2003).

PRONAF represents the milestone of the legitimation of the term and the category family agriculture, which was deprived of any benefit offered by the public authorities (MATTEI, 2014). From a legal point of view, Law No. 11,326, of July 24, 2006, establishes the guidelines for the formulation of the National Policy of Family Agriculture and Rural Family Enterprises and defines, in article 3, the Family Farmer in the following terms: he who practices activities in the rural environment and does not own an area greater than 4 fiscal modules, uses his own family's labour in production activities, has family income originated from activities related to his own establishment and directs his establishment with his family (BRASIL, 2006).

It is important to highlight that family farmers are recognized for the production of different types of products, fundamental not only for feeding their own family, but also for the general population. By making these products available to the market, family farmers become actors of great importance for food security and nature preservation (FINATTO; SALAMONI, 2008). In addition, Family Agriculture contributes to job creation and can be considered a factor for reducing rural exodus and generating wealth in the national economy (GUILLOTO *et al*., 2007).

Law No. 11,346 of September 15, 2006, which established the National System of Food and Nutrition Security (SISAN), highlights that family farming is the main food supplier to ensure adequate food and establish the origin and quality of food that will be distributed to the population. Food and nutrition security include:

> [...] a ampliação das condições de acesso aos alimentos por meio da produção, em especial da agricultura tradicional e familiar, do processamento, da industrialização, da comercialização, incluindo-se os acordos internacionais, do abastecimento e da distribuição dos alimentos, incluindo-se a água, bem como da geração de emprego e da redistribuição da renda (BRASIL, 2006).[5]

Thus, the importance of family farming for the food security of the Brazilian population is undeniable, due to the diversity of crops produced by this segment of agriculture (FINATTO; SALAMONI, 2008). In addition to PRONAF and SISAN, other government programs seek to value and encourage the sustainable exploitation of natural resources by traditional communities and family farmers: the National Plan for Promoting Socio-biodiversity Product Chains, the National Policy for the Sustainable Development of Traditional Peoples and Communities (PNPCT) and the Federal Community and Family Forest Management Program (PMCF) (PINTO, 2014).

Brazilian environmental legislation and environmental conflicts

The debate on environmental issues that led to the establishment of protected areas is due to the recurrence of the disordered use of natural resources throughout the twentieth century, as well as the unsustainable occupation of the physical environment by global society. Legally protected areas are established in certain locations to delimit a space to be conserved by reducing the use of natural resources present there, to generate benefits to the environment and consequently improve environmental quality (MEDEIROS, 2006).

The existing interests around conservation actions first appeared in the Brazilian Constitution of 1934, considering that attitudes towards environmental benefit were of great importance to the country (CASTELO, 2015). The starting point of legislators regarding the protection and preservation of environmental resources was the elaboration and implementation of the Water Code, the Mining Code and the Forest Code in 1934, encompassed under two perspectives: "a racionalização do uso e exploração dos recursos naturais e a definição de áreas de preservação permanente" (SALHEB *et al.*, 2009).[6]

[5] [...] the expansion of the conditions of access to food through production, especially by traditional and family agriculture, processing, industrialization, commercialization, including international agreements, supply and distribution of food, including water, as well as job creation and income redistribution (BRASIL, 2006).

[6] "the rationalization of the use and exploitation of natural resources and the definition of permanent preservation areas" (SALHEB *et al.*, 2009).

The Forest Code of 1934 brought in its context some revolutionary norms of contribution to the environment. From it, the use and occupation of rural properties was limited, requiring the preservation of 25% of the area of real estate, so the priority was to protect forests without affecting the economy with regard to the timber market (PRIOSTE *et al.*, 2009). After a few decades, with the repercussions about the need for economic growth of the country, provided that it was interconnected to environmental preservation practices, Law No. 4,771 of September 15, 1965 was instituted, which repealed the decree of 1934 (CASTELO, 2015) and established the Brazilian Forest Code of 1965, which had as its main advance the promotion of the peaceful relationship between the act of preserving and performing the sustainable management of natural resources with land use and occupation practices (BRANCALION; RODRIGUES, 2010).

In 2001, Provisional Measure No. 2,166-67 of August 24, 2001 was enacted to amend the Forest Code in force at the time, bringing with it the concept and obligation of PPAs and LRAs (FASIABEN, 2011). However, there have been new changes in environmental protection and preservation practices. On May 25, 2012, Law No. 12,651 was enacted, which established the New Forest Code. In Article 1 of that law, it is emphasized that:

> [...] estabelece normas gerais sobre a proteção da vegetação, áreas de Preservação Permanente e as áreas de Reserva Legal; a exploração florestal, o suprimento de matéria-prima florestal, o controle da origem dos produtos florestais e o controle e prevenção dos incêndios florestais, e prevê instrumentos econômicos e financeiros para o alcance de seus objetivos (BRASIL, 2012).[7]

Some concepts are elucidated in Article 3 of Law 12.651/2012, in order to define them and unify the understanding, for the purposes of interpretation of the law. For the present study, the definitions of PPA and LRA, and their respective functions, stand out. PPA is the protected area, covered or not by native vegetation, with the environmental function of preserving water resources, landscape, biodiversity, facilitating the gene flow of fauna and flora, protecting the soil and ensuring the well-being of human populations. LRA is the area located inside a rural property or possession, with the function of ensuring the sustainable economic use of the natural resources of the rural property, assisting the conservation and rehabilitation of ecological processes and promoting the conservation of biodiversity (BRASIL, 2012).

The territorial portion that property owners are required to destine and preserve for the composition of LRA is defined according to the characteristics of the biome and the region in which the property is located. Article 12 of the New Brazilian Forest Code, establishes that:

> Todo imóvel rural deve manter área com cobertura de vegetação nativa [...] observados os seguintes percentuais mínimos em relação à área do imóvel [...]: I - localizado na Amazônia Legal: a) 80% (oitenta por cento), no imóvel situado em área de florestas; b) 35% (trinta e cinco por cento), no imóvel situado em área de cerrado; c) 20% (vinte por cento), no imóvel situado em área de campos gerais; II - localizado nas demais regiões do País: 20% (vinte por cento) (BRASIL, 2012).[8]

The environmental legislation was elaborated without a previous analysis of its effects on society and without taking into account the necessary measures to familiarize the population with the new restrictions, resulting in socio-environmental conflicts with family farmers located in areas subject to environmental protection. The creation of PPAs brings benefits to the environment and establishes means for the sustainable use of common resources by the population (AVANCI, 2009). By establishing regulations that limit the use of natural resources, aiming at the environmental protection and well-being of the collectivity of the present and future generations, that is, in the search for environmental quality in the short and long term, family farmers can be economically

[7] [...] establishes general rules on the protection of vegetation, Permanent Preservation areas and Legal Reserve areas; forest exploitation, supply of forest raw materials, control of the origin of forest products and control and prevention of forest fires, and provides economic and financial instruments to achieve its objectives (BRASIL, 2012).

[8] Every rural property must maintain an area with cover of native vegetation [...] with the following minimum percentages in relation to the area of the property [...]: I - located in the Legal Amazon: a) 80% (eighty percent), in the property located in a forest area; b) 35% (thirty-five percent), in the property located in a Cerrado area; c) 20% (twenty percent), in the property located in a grassland area; II - located in the other regions of the country: 20% (twenty percent). (BRASIL, 2012).

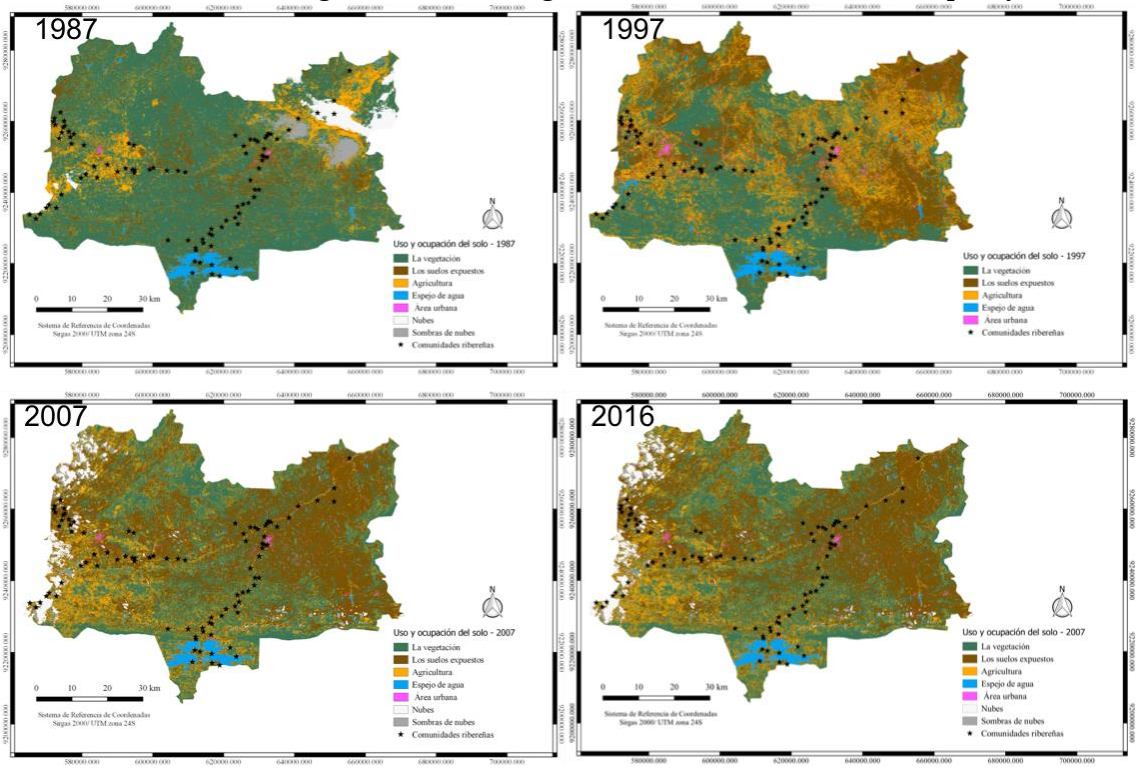
compromised throughout the process of adequacy of their rural establishments to the PPA and LRA (NEUMANN; LOCH, 2002).

The implementation of protected areas can be understood from a point of view of valuing natural resources, whose action leads to the limitation of the use of resources and occupation of these areas in a given territory that aims to preserve the native vegetation of the region, endangered species and the ecosystem. Despite the existence of PPAs, there are conflicts between social groups and the public authorities that have different expectations regarding the use and occupation, on the one hand, and the implementation of protected areas, on the other hand (MEDEIROS, 2006). The criticism stemming from the requirement to maintain protected areas is strengthened by the argument that restrictive measures mainly affect those with less land availability, i.e., small producers, who find themselves unable to produce in the entire property, which limits family economic activity (FASIABEN, 2011).

The use of natural resources and environmental changes

To evaluate the dynamics of environmental changes that occurred over three decades, mainly in the environment of rural communities located on the banks of the Piancó and Piranhas-Açu rivers, a set of thematic maps was created (Figure 2). An attempt was made to present in each map (of the years 1987, 1997, 2007 and 2016) seven useful classes of interest to detect changes in the landscape: vegetation, bare soil, agriculture, urban area, water bodies, clouds and cloud shadows.

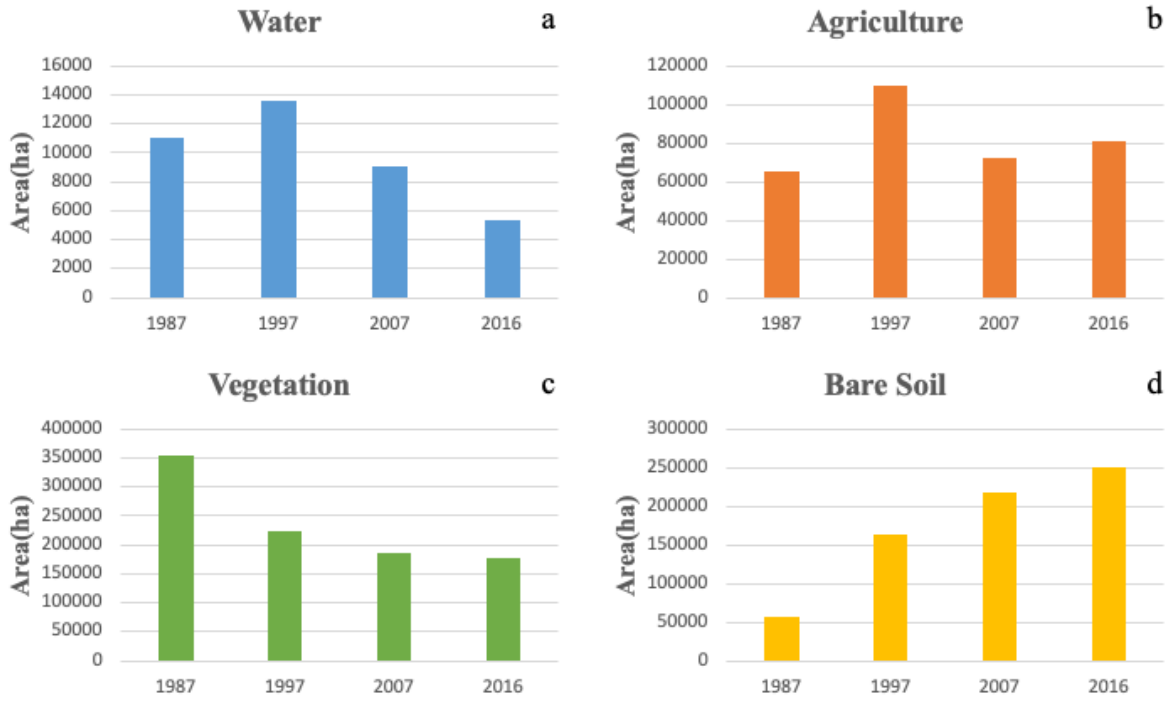
Figure 2: Environmental change in the Microregion of Sousa and in the Municipality of Coremas.



Source: The authors.

From the classification of the pixels of each image, which aimed to detect the classes and their respective representations in the maps presented above, it was possible to quantify, in hectares, the extent of each of the classes that represent the land use and occupation, after removing cloud-covered areas. The total area of 518,023.3 hectares corresponds to the area delimited for the study. Graph 1 shows the historical variation of each factor analysed (vegetation, bare soil, agriculture and water bodies).

Graph 1: Comparative analysis on a temporal view of surface areas covered by water (a), agriculture (b), vegetation (c) and bare soil (d).



Source: The authors.

Agricultural production in the investigated area shows an apparent contradiction between Figure 2 and Graph 1b. According to Graph 1b, the largest area used for agricultural cultivation was recorded in 1997. However, Table 1 shows that in 1987 the area destined for the cultivation of agricultural products exceeded those of the following years, which demonstrates a reduction of areas destined for agriculture. This situation is a consequence of the pixel tone classification of satellite images made in the *Qgis* program. Probably this program confused pixels of areas that in 1987 were still being used for cotton cultivation with pixels of areas classified as vegetation, due to the similarity.

Table 1: Areas (ha) destined for agricultural cultivation in the years 1987, 1997, 2007 and 2016 in the Microregion of *Sousa* and in the municipality of *Coremas*

Agricultural crops	Areas destined for agricultural cultivation in each year studied				
	1977	1987	1997	2007	2016
Tree cotton	10,2375	4,669	0	0	0
Herbaceous cotton	8,998	1,566	2,902	1,053	0
Rice	4,535	5,834	1,942	797	14
Banana	950	1,352	1,172	767	546
Sweet potato	53	966	145	84	57
Sugarcane	1,345	976	706	278	76
Coconut	158	220	836	1.294	296
Beans	17,297	18,837	6,831	5,565	3,152
Guava	0	0	67	87	47
Papaya	0	0	9	0	0
Cassava	27	27	27	10	3
Mango	86	95	177	64	39
Watermelon	0	0	86	6	0
Corn	2.1200	19.446	9.101	6.420	3.563
	∑157.024	∑53.988	∑24.001	∑16.425	∑7.793

Source: Municipal Agricultural Surveys of 1977, 1987, 1997 and 2016 (IBGE, 2018).

After checking the agricultural data of 1977, where the areas destined for agriculture (especially cotton, corn and beans) were larger than in all subsequent years, the trend of deagriculturalisation is confirmed. It is inferred that the result of this trend was the evolution of bare soil areas, which began to be used for the planting of pastures aimed at the composition of animal feed and increase in livestock, on the other hand, investment in irrigated agriculture in areas close to rivers, especially using mango, guava, banana and coconut crops, until 2007, and forage species destined for intensive feeding of cattle, in this last prolonged drought period (2012-2017).

It is noteworthy the increase in areas destined for agriculture in 2016 compared to 2007 (Graph 1b). If, according to Medeiros and Brito (2017), the region has faced a long period of drought since 2012, and the reservoirs have low volumes of water as seen in Graph 1a, reduction in the cultivated area is expected. However, the opposite is observed on the maps. Agricultural practices increase even with the reduction of precipitation and water availability in reservoirs, and this occurred precisely on the banks of rivers, which indicates an increase in irrigated agriculture in the PPAs, or the increase in pasture areas in areas that were previously used for rainfed agriculture.

Family farming production and conflicts

When the diagnosis considered in the previous item is taken as reference, from the construction of maps and analysis of satellite images, it is possible to associate a current socioeconomic and production context with a process of changes that has been going on since the 1970s. The crisis of the cotton-livestock system is related to the direction taken by the studied area towards irrigated agriculture, which was favoured by policies aimed at promoting this activity. In view of this, it is necessary to demonstrate the situation that developed from the process of change.

Initially, the current production profile of the region is presented, and then the production strategies and the management of natural resources by riverside farmers are analysed.

Cotton and family farming

In regard to agricultural production, the statements of farmers regarding the end of the cotton cycle are emphatic and confirm the data already mentioned from the surveys conducted by IBGE. Cotton was considered the main source of income by farmers. The income resulting from the commercialization of lint benefited the whole family involved in the production and, consequently, promoted good living conditions to them. However, according to the reports of several farmers, with the appearance of boll weevil, there was a significant reduction in the production of this crop.

While cotton was cultivated in the region, it was considered by farmers as the main source of family income. However, there are references to a process of significant change in the composition of family income. Reports mention the substitution of revenue stemming from agriculture by income from income transfer policies (*Bolsa Família* and *Garantia Safra*) and continued provision policies (retirement). A 78-year-old farmer, when asked about the main source of family income, taking as reference the time lapse of 40 years, informed about the composition of revenues that, at present, basically come from retirement: "Eu cheguei aqui em 1968, era bom para agricultura, mas tinha que se esforçar para ganhar o pão de cada dia, e hoje tem muita vantagem para quem é aposentado, porque não trabalha mais, e o pão de cada dia fica mais fácil".[9]

It can be seen, therefore, that over these four decades, there has been a process of economic and environmental changes that have had consequences on the lives of family farmers. With regard to these changes, the following causal situation can be drawn: the cotton crisis that occurred between the 1970s and 1980s led to a reduction in the income of farmers who, under pressure, sought alternatives to ensure subsistence by investing in livestock, fish farming and irrigation. However, over the years, it is observed that retirement and assistance policies have gained prominence in the composition of family income due to the reduction of rainfall levels and, especially, due to the limitations imposed by the government, in the use of water for fish farming and irrigated agriculture.

Family farming and environmental conflicts

The context of economic changes that involved the relative reduction of income from agriculture, the difficulty of access to water and limitations in the use of natural resources has generated many conflicts between family farmers and management bodies that oversee access to these resources. In order to begin to understand the environmental conflicts generated by the regulation of access and use of natural resources – here understood as non-compliance with the standards that require the maintenance of PPAs and LRAs on private properties and resolutions prohibiting the abstraction of water from rivers, reservoirs and canals of irrigated perimeters for agriculture and aquaculture – it is necessary to investigate the causes of possible non-compliance and whether farmers know and are familiar with the nature protection standards imposed on them.

Regarding compliance or not with environmental legislation, we initially sought to verify the degree of knowledge about a particular aspect, the existence of the standards that deal with PPAs and LRAs. Analysis of the interviews showed that 35% of the farmers knew about the subject, 30% had never heard of it, so they did not know what it was about, and 32% had already heard, but did not know exactly what they were or what the purpose of the PPAs and LRAs was. In view of this situation, it was possible to produce data that refer to the action (or non-action) of the *Brazilian Institute of the Environment and Renewable Natural Resources* (IBAMA) and EMATER-PB in the communities visited, with regard to the presentation of the current environmental legislation. Among the family farmers interviewed, 71% reported that they never received visits from IBAMA.

Only 27% of respondents stated that IBAMA has already provided enforcement services, but in most cases, this enforcement was intended only to curb illegal hunting, burning, deforestation and sand extraction, but never to transmit information about the preservation and conservation of PPAs and LRAs. The remaining 2% abstained from answering. When referring to EMATER-PB, 49% of the interviewees stated that they never received any type of technical assistance or rural extension

[9] "I arrived here in 1968; it was good for agriculture, but you had to strive to earn the daily bread, and today there is a lot of advantage for those who are retired, because they don't work anymore and the daily bread is easier to earn".

service, 45% stated that they received technical assistance at some point and 6% did not answer. As shown below, a farmer stated that the action of EMATER-PB is limited to dealing with *Seguro Safra* (Crop Insurance) and that he never saw technicians of the institution talk about the PPAs and LRAs: "a EMATER-PB só aparecia quando era para dar o Seguro Safra. E sobre a APP e ARL, só ouvi comentários, mas eles nunca apareceram aqui não, só sei que não pode desmatar perto do rio, 100 m e não pode 'brocar' para plantar uma roça se não vai e leva multa" (Family farmer, 51 years old).[10]

On the other hand, from the same group of people who received visits from either IBAMA or EMATER-PB, only 22% say that they have already received information about the preservation and conservation of PPA and LRAs. In the excerpt below, a farmer clarifies about the lack of assistance from EMATER-PB and confirms IBAMA's participation in providing general information on environmental protection and preservation laws. At the same time, the farmer reveals that he is complying with environmental legislation, not because he recognizes the need to preserve and conserve these areas, but because he fears the sanctions provided for by law.

In this context, thinking from the theoretical framework suggested to understand these social processes understood as environmental conflicts, the previous statement reveals that the farmer acts rationally in accordance with collective interests (represented by the institutes of PPAs and LRAs) not because he considers the environmental discourse transformed into law legitimate, but because there are constraints that materialize in the presence and action of the institutions that threaten him with the possibility of applying sanctions. Thus, for some farmers who experienced the actions of the enforcement and training bodies, the institutions' action was effective in legitimizing the territorial project for the preservation and conservation of nature consubstantiated in the Forest Code.

From all that was presented, it is possible to conclude that the lack of knowledge on the part of farmers about the mandatory conservation and protection of areas of environmental interest, within the scope of their properties, may be related to the absence of the enforcement and training bodies – here considered IBAMA and EMATER-PB – in the communities and the corresponding lack of guidance in relation to these legal aspects. The lack of guidance and technical assistance are highlighted by one of the family farmers interviewed when he associates this abandonment by public bodies with the incentive for the next generations not to engage in agricultural activities.

Conclusions

This study made it possible to analyse the production strategies performed by family farmers who produce on the banks of the rivers and reservoirs that make up the Piranhas-Açu hydrographic basin. Analysis of satellite images and production of thematic maps demonstrated significant changes in the dynamics of land use and occupation and water resources in the Microregion of Sousa and in the municipality of Coremas. It was possible to visualize, on the one hand, the reduction of the areas occupied by the vegetation and rainfed agriculture and, on the other hand, the increase in areas of bare soil and irrigated agriculture, in addition to the reduction in the levels of reservoirs and watercourses. The interpretation of these dynamics is in accordance with the regional profile constructed with census data produced by IBGE and confirms the context of changes that involved the crisis of rainfed agriculture and the rise and crisis of irrigated agriculture, associated with the near-collapse of water resources.

The conflicts over the legal requirements of maintenance of PPAs and LRAs are often caused by the inefficiency of the control bodies in informing about the standard, as well as by the absence of enforcement actions, which leads to unawareness of these legal requirements. It is possible to relate non-compliance with unawareness. However, some of those who know the rules deliberately decide not to comply, arguing that these areas are considered as the most productive place of the property. These farmers prefer to break the law instead of stopping producing in these areas, because they do not recognize the environmental discourse about the territorial project of preservation of these areas as legitimate.

The limitations of the abstraction and use of water for irrigation and aquaculture generate conflicts that have often resulted in fines and seizure of motor pumps. These conflicts were more hostile because the management bodies were more present, but they were inefficient in legitimating the discourses about the limitations, which was aggravated by the uncertainties created by the

[10] "EMATER-PB appeared only to give the Crop Insurance. And about the PPA and RLA, I have only heard comments, but they never appeared here; I just know that you cannot deforest near the river, 100 m, and you cannot clear land to plant a family orchard or you will be fined" (Family farmer, 51 years old).

constant changes in the content of the resolutions. For some farmers who, despite knowing the restrictions, continue to use water for irrigation and aquaculture, the restrictions make no sense because they have a perception that this resource is being wasted because they see water "passing" and cannot use it. For them it also makes no sense to stop their economic activities to ensure the supply of the cities of Paraíba and Rio Grande do Norte. They have the perception that it is only they who bear the costs of related to the difficulty of access to water.

When these conflicts are submitted to the appreciation of political ecology, it is observed that there is indeed a fragility in the process of legitimization of environmental discourse. By requiring farmers to stop producing under a flimsy argument that if they continue with production practices the resource would be depleted, it obscures the veiled discourse in favour of prioritizing economic activities and urban interests. If the public bodies fulfil their training, capacitation and enforcement functions and clearly explain why the standards exist; if they were efficient in legitimizing the environmental discourse by clearly exposing the political and economic interests; if the costs of restrictions were equally divided among those making use of natural resources; if there were incentives to comply with the standards, perhaps family farmers would manage natural resources more efficiently in connection with the principles that govern and support environmental policies.

References

AVANCI, T. F. S. A reserva legal como instrumento de efetividade da proteção da biodiversidade. **Revista USCS de Direito**, Caxias do Sul, n. 5, p. 187-209, jan./jun. 2009. Disponível em: <http://ojs.fsg.br/index.php/direito/article/view/243>. Acesso em: 13 ago. 2018.

BRANCALION, P. H. S.; RODRIGUES, R. R. Implicações do cumprimento do Código Florestal vigente na redução de áreas agrícolas: um estudo de caso da produção canavieira no Estado de São Paulo. **Biota Neotropica**, Campinas, v. 10, n. 4, p. 63-66, out./dez. 2010. Disponível em: <https://doi.org/10.1590/S1676-06032010000400009>. Acesso em: 13 ago. 2018.

BRASIL. **Lei nº. 11.326**, de 24 de julho de 2006a. Estabelece as diretrizes para a formulação da Política Nacional da Agricultura Familiar e Empreendimentos Familiares Rurais. Disponível em: <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11326.htm>. Acesso em: 13 ago. 2016.

BRASIL. **Lei nº 11.346**, de 15 de setembro de 2006b. Cria o Sistema Nacional de Segurança Alimentar e Nutricional – SISAN com vistas em assegurar o direito humano à alimentação adequada e dá outras providências. Disponível em: <http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2006/lei/l11346.htm>. Acesso em: 13 ago. 2016.

BRASIL. **Lei n. 12.651**, de 25 de maio de 2012. Dispõe sobre a proteção da vegetação nativa; altera as Leis nºs 6.938, de 31 de agosto de 1981, 9.393, de 19 de dezembro de 1996, e 11.428, de 22 de dezembro de 2006; revoga as Leis nºs 4.771, de 15 de setembro de 1965, e 7.754, de 14 de abril de 1989, e a Medida Provisória nº 2.166-67, de 24 de agosto de 2001; e dá outras providências. Disponível em: <http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2012/lei/l12651.htm>. Acesso em: 13 ago. 2016.

BRASIL. **Resolução conjunta ANA-IGARN-AESA nº 640**, de 18 de junho de 2015. Disponível em: <http://arquivos.ana.gov.br/resolucoes/2015/640-2015.pdf>. Acesso em: 13 ago. 2016.

BRYANT, R. L.; BAILEY, S. **Third world political ecology**. New York: Routledge, 1997

BUAINAIN, A. M. **Agricultura familiar e inovação tecnológica no Brasil**: características, desafios e obstáculos. Campinas: EDUNICAMP, 2007.

BUMPS, A. G.; LIVERMAN, D. M. Carbon colonialism? Offsets, greenhouse gas reductions, and sustainable development. In: PEET, R., ROBBINS, P. y WATTS, M. J. (Eds.). **Global political ecology**. London: Routledge, 2011, p. 203-224.

CAMACHO, F. M. Competing rationalities in water conflict: mining and the indigenous community in Chiu Chiu, el Loa Province, northern Chile. **Singapore Journal of Tropical Geography**, Singapura, v. 33, n. 1, p. 93-107, Mar. 2012. Disponível em: <https://doi.org/10.1111/j.1467-9493.2012.00451.x>. Acesso em: 13 jul. 2017.

CARNEIRO, M. J. Em que consiste o familiar da agricultura familiar? In: COSTA, L. F. C., FLEXOR, G.; SANTOS, R. **Mundo rural brasileiro**: ensaios interdisciplinares. Rio de Janeiro: Mauad, 2008, p. 255-269.

CASTELO, T. B. Legislação Florestal brasileira e políticas do governo de combate ao desmatamento na Amazônia Legal. **Ambiente & Sociedade**, Campinas, v. 18, n. 4, p. 221-242, out./dez. 2015. Disponível em: <https://doi.org/10.1590/1809-4422ASOC1216V1842015>. Acesso em: 13 ago. 2018.

CHEUNG, T. L. Desenvolvimento da Agricultura Familiar: investigação sobre o espaço rural e o território como referência para estudar o caso do município de Terenos, MS. **Interações**, Campo Grande, v. 14, n. 2, 189-195, jul./dez. 2013. Disponível em: <https://doi.org/10.1590/S1518-70122013000200005>. Acesso em: 13 ago. 2018.

COELHO, M. C. N.; CUNHA, L. H.; WANDERLEY, L. J. M. Conflitos em áreas de mineração na Amazônia: os casos dos quilombolas e dos moradores de beiras de lagos, dos canais fluviais e de estradas em Oriximiná. In: ZHOURI, A.; LASCHEFSKI, K. (Ed.). **Desenvolvimento e conflitos ambientais**. Belo Horizonte: EDUFMG, 2010, p. 276-300.

COSTANTINO, A. Apuntes para una ecología política de la dependencia. El caso del acaparamiento de tierras. **Revista Sociedad y Economía**, Cali, n. 25, p. 39-54, jul./dic. 2013. Disponível em: <http://www.scielo.org.co/scielo.php?pid=S1657-63572013000200003&script=sci_abstract&tlng=es>. Acesso em: 13 ago. 2018.

CUNHA, L. H.; NUNES, A. M. B.; MIRANDA, R. S. Colapso e reconstrução dos regimes de propriedade e o manejo dos recursos naturais em áreas de assentamento. In: ENCONTRO DA REDE RURAL, 1., 2006, Niterói. **Anais...**, 2006.

CUNHA, L. H.; SILVA, J. I. A. O.; NUNES, A. M. B. A proteção da Natureza em assentamentos rurais e nas RPPN's: conflitos ambientais e processos de territorialização. **Revista Raízes**, Campina Grande, v. 27, n. 1, p. 80-96, jan./jun. 2008. Disponível em: <https://doi.org/10.37370/raizes.2008.v27.289>. Acesso em: 13 ago. 2018.

EDEN, S. The politics of certification: consumer knowledge, power, and global governance in ecolabeling. In: PEET, R.; ROBBINS, P.; WATTS, M. J. (Eds.). **Global political ecology**. London: Routledge, 2011, p. 169-184.

EMPINOTTI, V. L. E se eu não quiser participar? O caso da não participação nas eleições do comitê de bacia do rio São Francisco. **Ambiente & Sociedade**, Campinas, v. 14, n. 1, p. 195-211, jan./jun. 2011. Disponível em: <http://dx.doi.org/10.1590/S1414-753X2011000100011>. Acesso em: 13 ago. 2018.

FASIABEN, M. C. R. Impacto Econômico da Reserva Legal Florestal Sobre Diferentes Tipos de Unidades de Produção Agropecuária. **Revista de Economia e Sociologia Rural**, Brasília, v. 49, n. 4, p. 1051-1096, out/dez. 2011. Disponível em: <http://dx.doi.org/10.1590/S0103-20032011000400010>. Acesso em: 13 ago. 2018.

FINATTO, R. A.; SALAMONI, G. Agricultura familiar e agroecologia: perfil da produção de base agroecológica do município de Pelotas/RS. **Sociedade & Natureza**, Uberlândia, v. 20, n. 2, p. 199-217, dez. 2008. Disponível em: <https://www.scielo.br/scielo.php?pid=S1982-45132008000200012&script=sci_abstract&tlng=pt>. Acesso em: 13 ago. 2018.

GEZON, L. L.; PAULSON, S. Place, power, difference: multiscale research at the dawn of the twenty-first century. In: PAULSON, S.; GEZON, L. L. (Eds.). **Political ecology across spaces, scales, and social groups.** New Brunswick: Rutgers University Press, 2004, p. 1-16.

GUANZIROLI, C. E. **Agricultura Familiar e reforma agrária no século XXI**. Editora Garamond, 2001.

GUDYNAS, E. La ecología política del giro biocéntrico en la nueva constitución de Ecuador. **Revista de Estudios Sociales**, Bogotá, n. 32, p. 34-46, abr. 2009. Disponível em: <http://www.scielo.org.co/pdf/res/n32/n32a03.pdf>. Acesso em: 13 ago. 2018.

GUILHOTO, J. J. M.; ICHIHARA, S. M.; SILVEIRA, F. G.; DINIZ, B. P. C.; AZZONI, C. R.; MOREIRA, G. R. **A importância da agricultura familiar no Brasil e em seus estados**. Brasília: NEAD, 2007.

IBGE. **Censo Agropecuário 2006**. Disponível em: <https://sidra.ibge.gov.br/home/pms/brasil>. Acesso em: 13 ago. 2017.

IBGE. **Pesquisa Agrícola Municipal**. Disponível em: <https://sidra.ibge.gov.br/pesquisa/pam/tabelas>. Acesso em: 13 ago. 2018.

IORIS, A. A. R. Desenvolvimento nacional e gestão de recursos hídricos no Brasil. **Revista Crítica de Ciências Sociais**, n. 85, p. 23-41, jun. 2009. Disponível em: <https://doi.org/10.4000/rccs.329>. Acesso em: 13 ago. 2018.

IORIS, A. A. R. Applying the Strategic-Relational Approach to Urban Political Ecology: The Water Management Problems of the Baixada Fluminense, Rio de Janeiro, Brazil. **Antipode**, v. 44, n. 1, p. 122-150, Apr. 2012. Disponível em: <https://doi.org/10.1111/j.1467-8330.2011.00848.x>. Acesso em: 13 ago. 2018.

LASCHEFSKI, K.; COSTA, H. S. M. Segregação social como externalização de conflitos ambientais: a elitização do meio ambiente na APA-SUL, região metropolitana de Belo Horizonte. **Ambiente & Sociedade**, Campinas, v. 11, n. 2, p. 307-322, jul./dez. 2008. Disponível em: <https://doi.org/10.1590/S1414-753X2008000200007>. Acesso em: 13 ago. 2018.

LEFF, E. La ecología política en América Latina: un campo en construcción. **Sociedade e Estado**, Brasília, v. 18, n. 1/2, p. 17-40, jan./dez. 2003. Disponível em: <https://www.scielo.br/pdf/se/v18n1-2/v18n1a02.pdf>. Acesso em: 13 ago. 2018.

MATTEI, L. O papel e a importância da agricultura familiar no desenvolvimento rural brasileiro contemporâneo. **Revista Econômica do Nordeste**, Fortaleza, v. 45, p. 71-79, out./dez. 2014. Disponível em: <https://ren.emnuvens.com.br/ren/article/view/500>. Acesso em: 13 ago. 2018.

MEDEIROS, R. Evolução das tipologias e categorias de áreas protegidas no Brasil. **Ambiente & Sociedade**, Campinas, v. 9, n. 1, jan./jun. 2006. Disponível em: <https://www.scielo.br/pdf/asoc/v9n1/a03v9n1.pdf>. Acesso em: 13 ago. 2018.

MEEHAN, K. M. Tool-power: water infrastructure as wellsprings of state power. **Geoforum**, v. 57, p. 215-224, Nov. 2013. Disponível em: <https://doi.org/10.1080/2325548X.2016.1191302>. Acesso em: 13 ago. 2018.

MILANI, C. R. S. Ecologia política, movimentos ambientalistas e contestação transnacional na América Latina. **Cadernos CRH**, Salvador, v. 21, n 53, p. 289-303, maio/ago. 2008. Disponível em: <http://dx.doi.org/10.1590/S0103-49792008000200007>. Acesso em: 10 ago. 2017.

MIRANDA, R. S. Ecologia política e processos de territorialização. **Sociedade e Estado**, Brasília, v. 28, n. 1, p. 142-161, jan./abril 2013. Disponível em: <http://dx.doi.org/10.1590/S0102-69922013000100008>. Acesso em: 13 ago. 2018.

NEUMANN, P. S.; LOCH, C. Legislação Ambiental, Desenvolvimento Rural e Práticas Agrícolas. **Ciência Rural**, Santa Maria, v. 33, n. 3, p. 398-406, jun. 2009. Disponível em: <https://doi.org/10.1590/S0103-84782002000200010>. Acesso em: 10 ago. 2018.

NEVES, D. P. Agricultura familiar: quantos ancoradouros! In: FERNANDES, B. M., MARQUES, M. I. M., SUZUKI, J. C. **Geografia agrária: teoria e poder**. São Paulo: Expressão popular, 2007, p. 211-270.

PEET, R.; ROBBINS, P.; WATTS, M. Global nature. In: PEET, R.; ROBBINS, P.; WATTS, M. J. (Eds.). **Global political ecology**. London: Routledge, 2011, p. 1-47.

PEREIRA, V. C. O novo código florestal brasileiro: dilemas da consciência ecológica em torno da proteção ambiental. **Ambiente & Educação**, Campinas, v. 18, n. 1, p. 211-228, jan./jun. 2013. Disponível em: <https://periodicos.furg.br/ambeduc/article/view/3014>. Acesso em: 13 ago. 2018.

PICOLOTTO, E. L. Os atores da construção da categoria agricultura familiar no Brasil. **Revista de Economia e Sociologia Rural**, Brasília, v. 52, n. 1, p. 63-84, fev. 2014. Disponível em: <http://dx.doi.org/10.1590/S0103-20032014000600004>. Acesso em: 10 ago. 2018.

PINTO, D. M. **O uso de recursos de propriedade comum em áreas de propriedade estatal por populações tradicionais e assentados da reforma agrária**. 2014. Tese (Doutorado em Administração) – Universidade de Brasília, Brasília, 2014.

PRIOSTE, F. G. V.; AVANCI, J; PACHER, L.; VIEIRA, J. **Mudanças na legislação ambiental e os reflexos na Agricultura Familiar camponesa e povos e comunidades tradicionais: subsídios técnicos e políticos para o debate**. Curitiba: Terra de direitos, 2009. Disponível em: <https://br.boell.org/sites/default/files/downloads/Estudo_sobre_Codigo_Florestall.pdf>. Acesso em: 13 ago. 2018.

ROBBINS, P.; LUGINBUHL, A. The last enclosure: resisting privatization of wildlife in the western united states. In: HEYNEN, N.; ROBBINS, P.; PRUDHAM, S.; McCARTHY, J. (Eds.). **Neoliberal environments**: false promises and unnatural consequences. London: Routledge, 2007, p. 25-37.

SALHEB, G. J. M.; PERES NETO, H. A. P.; OLIVEIRA, I. M.; AMARAL JÚNIOR, M. F.; BOETTGER, R. J. C. S.; MONTEIRO, V. C. S.; SUPERTI, E. Políticas públicas e meio ambiente: reflexões preliminares. **Planeta Amazônia: Revista Internacional de Direito Ambiental e Políticas Públicas**, n. 1, p. 5-27, 2009. Disponível em: <https://periodicos.unifap.br/index.php/planeta/article/view/57>. Acesso em: 13 jul. 2018.

SCHNEIDER, S. Teoria social, agricultura familiar e pluriatividade. **Revista Brasileira de Ciências Sociais**, São Paulo, v. 18, n. 51, p. 99-121, fev. 2003. Disponível em: <https://www.scielo.br/pdf/rbcsoc/v18n51/15988>. Acesso em: 13 jul. 2018.

WAINWRIGT, J.; MERCER, K. L. Transnational transgenes: the political ecology of maize in Mexico. In: PEET, R.; ROBBINS, P.; WATTS, M. J. (Eds.). **Global political ecology**. London: Routledge, 2011. p. 412-430.

WOLFORD, W. Neoliberalism and the struggle for land in Brazil. In: HEYNEN, N.; MACCARTHY, J.; PRUDHAM, S.; ROBBINNS, P. (Eds.). **Neoliberal environments**: false promises and unnatural consequences. London: Routledge, 2007. p. 243-254.