


*What is the part that falls to this latifundium? an analysis of the land structure in the Riacho do Pontal-PE watershed*


**Qual é a parte que cabe deste latifúndio? uma análise da estrutura fundiária na bacia hidrográfica do Riacho do Pontal-PE**

*¿Cuál es la parte que le corresponde a este latifundio? un análisis de la estructura fundiaria en la cuenca hidrográfica del Riacho do Pontal-PE*


**Josimar Vieira dos Reis**

Federal University of Pernambuco (UFPE)  
Av. Prof. Moraes Rego, 1235 - Cidade  
Universitária, Recife – PE  
 <https://orcid.org/0000-0002-4466-1244>  
e-mail: [prej86@gmail.com](mailto:prej86@gmail.com)


**Josicléda Domiciano Galvíncio**

Federal University of Pernambuco (UFPE)  
Av. Prof. Moraes Rego, 1235 - Cidade  
Universitária, Recife – PE  
 <https://orcid.org/0000-0002-4204-2685>  
e-mail: [josicleda@ufpe.br](mailto:josicleda@ufpe.br)

**Márcia Batista da Fonseca**

Federal University of Paraíba (UFPB)  
Av. Campus da Cidade Universitária, Cidade  
Universitária, João Pessoa – PB   
<https://orcid.org/0000-0002-0937-2172>  
e-mail: [mbfmarcia@ccsa.ufpb.br](mailto:mbfmarcia@ccsa.ufpb.br)

**Luciana Mayla de Aquino França**

Federal University of Pernambuco (UFPE)  
Av. Prof. Moraes Rego, 1235 - Cidade  
Universitária, Recife – PE  
 <https://orcid.org/0000-0001-6844-8846>  
e-mail: [lucianamayla@gmail.com](mailto:lucianamayla@gmail.com)

***Abstract:** A latifundium refers to a large tract of land in a rural area that is little or not at all cultivated; the Northeast Region of Brazil commonly features such areas, characterized by an excessive concentration of land ownership. This study analyzes the dynamics of land tenure in Northeast Brazil within the Riacho do Pontal-PE watershed, a tributary of the São Francisco River basin in the Brazilian semi-arid region. The study is based on land cover and land use data from 1985 to 2020 and estimates from the Brazilian Fiscal Module (MF), obtained from the National Rural Cadastre System (SNCR), which was used to calculate the Gini coefficient based on the Lorenz curve. The main results of the land use analysis show that agricultural and pasture areas have reached approximately one-third (31.42%) of the Pontal basin in recent years and are associated with irrigated agriculture. In the region of the municipality of Petrolina, Pernambuco, there is a high concentration of land dominated by large landowners. The Gini coefficient indicated that most of the basin in the municipalities of Afrânio and Dormentes, Pernambuco, is characterized by small-scale landholdings. It is evident that over the period 1985–2020, there was a shift from Caatinga areas in the Riacho do Pontal basin to regions of irrigated agriculture. The conclusion reached regarding the analysis of the land tenure structure presented is that there is a land tenure profile characterized by concentration in large estates.*

***Keywords:** Land use and land tenure. Rural land registry. Land concentration.*

**Resumo:** Latifúndio refere-se a uma grande área de terra em zona rural pouco ou não cultivada, a Região Nordeste do Brasil apresenta corriqueiramente este tipo de áreas caracterizadas pela excessiva concentração de terra. Este estudo analisa a dinâmica da estrutura fundiária no Nordeste do Brasil na bacia hidrográfica do Riacho do Pontal-PE que é tributária da bacia do Rio São Francisco no semiárido brasileiro. O estudo se baseia em dados de cobertura e uso do solo de 1985 - 2020 e estimativas de dados do Módulo Fiscal (MF) brasileiro, adquiridos do Sistema Nacional de Cadastro Rural (SNCR) que foi empregado no coeficiente de Gini calculado a partir da Curva de Lorenz. Os principais resultados da análise do uso do solo mostram que as áreas de agricultura e pastagem atingiram cerca de um terço 1/3% da bacia do Pontal (31,42%) nos últimos anos, e estão relacionadas ao uso da agricultura irrigada. Na região do município de Petrolina-PE existe uma elevada concentração de terras dominadas

por grandes latifundiários. O coeficiente de Gini indicou que o montante da bacia nos municípios de Afrânio-PE e Dormentes-PE a característica é do pequeno latifúndio. Percebe-se que ao longo do período 1985 – 2020 houve uma mudança das áreas de Caatinga na bacia do Riacho do Pontal para regiões da agricultura irrigada. A conclusão a que se chega em relação à análise da estrutura fundiária apresentada, é que há um perfil fundiário concentrador em relação aos latifúndios.

**Palavras-chave:** Uso e ocupação do solo. Cadastro Rural. Concentração de terras.

*Resumen:* El término «latifundio» hace referencia a una gran extensión de terreno en zonas rurales poco o nada cultivadas; la región noreste de Brasil presenta habitualmente este tipo de zonas, caracterizadas por una concentración excesiva de la propiedad de la tierra. Este estudio analiza la dinámica de la estructura de la propiedad de la tierra en el noreste de Brasil, en la cuenca hidrográfica del arroyo Pontal (PE), afluente de la cuenca del río São Francisco en el semiárido brasileño. El estudio se basa en datos de cobertura y uso del suelo de 1985 a 2020 y en estimaciones de datos del Módulo Fiscal (MF) brasileño, obtenidos del Sistema Nacional de Catastro Rural (SNCR), que se emplearon en el coeficiente de Gini calculado a partir de la curva de Lorenz. Los principales resultados del análisis del uso del suelo muestran que las áreas de agricultura y pastos alcanzaron alrededor de un tercio (31,42 %) de la cuenca del Pontal en los últimos años, y están relacionadas con el uso de la agricultura de regadío. En la región del municipio de Petrolina (PE) existe una elevada concentración de tierras dominadas por grandes terratenientes. El coeficiente de Gini indicó que, en los municipios de Afrânio (PE) y Dormentes (PE), la característica predominante es la de los pequeños latifundios. Se observa que, a lo largo del periodo 1985-2020, se produjo un cambio de las áreas de Caatinga en la cuenca del Riacho do Pontal a regiones de agricultura de regadío. La conclusión a la que se llega en relación con el análisis de la estructura de la propiedad de la tierra presentado es que existe un perfil de concentración de la propiedad en lo que respecta a los latifundios.

*Palabras clave:* Uso y ocupación del suelo. Registro rural. Concentración de la propiedad de la tierra.

## Introduction

There is no part that fits in this latifundium! The allusion to the classic "Funeral of a Farmer" by Chico Buarque de Holanda is necessary to emphasize what has been repeated for centuries in the Brazilian Northeast. This study does not delve into the analysis from the very beginnings of land tenure profile studies in Brazil, nor in the municipalities of the Riacho do Pontal-PE basin, to understand its pattern of occupation over time in this Brazilian semiarid region.

The intention here is to explore and interpret a reality that has been occurring in certain latifundium areas of the Brazilian semiarid region. Thus, our reference to latifundium is social and spatial, therefore subject to geographic analysis (Oliveira & Oliveira Amaral, 2018). In this sense, in this study, the latifundium is not treated as a large land concentrator, but rather as a metric to reference small and large agricultural properties (INCRA, 2022).

Semiarid lands constitute approximately 31% of the Earth's surface and are home to more than one billion people worldwide (Araújo Pereira et al., 2021). Due to water scarcity and other natural resources, arid lands are prone to desertification, i.e., the deterioration of land condition due to climate change and human action (UNITED NATIONS, 2018). In Brazil, the semiarid region covers 1,182,697 km<sup>2</sup>, encompassing about 12% of the national territory (IBGE, 2020). This region is characterized by low annual rainfall and high spatiotemporal variability, as well as high evapotranspiration (Brunello et al., 2024).

Even under adverse conditions in the Brazilian semiarid region, it is possible to observe

the presence of several important river basins, especially the São Francisco River basin. The river basin comprises functional structures and processes resulting from the interaction between geomorphology, hydrology, and its socioeconomic aspects (Abreu et al., 2020).

The São Francisco River basin is of great importance to the Northeast region, as it is directly linked to water transposition for irrigation of latifundia and population use in the Brazilian Northeast (Paiva et al., 2024). Most activities that sustain economic growth in the São Francisco River basin and its sub-basins require water, with irrigated agriculture being the activity that consumes the most water in the basin (Ferrarini et al., 2020). This also leads to the demand for large tracts of land for planting (Silva et al., 2022). As a consequence, the need to acquire land arises, and from this, the current configuration of the land tenure structure in the semiarid region of Brazil begins.

Land tenure structure is the way in which rural properties are arranged, organized, and appropriated within a given space, considering their dimensions at a particular historical moment (Melo Machado & Albuquerque, 2013). In this context of land tenure structure, we have the São Francisco Valley, in the irrigated fruit-growing hub of Petrolina, which is one of the most important regions in Brazilian agribusiness, especially in fruit production with the irrigation system that allows cultivation throughout the year.

Given the importance of irrigated fruit growing in the São Francisco River basin and its economic arrangements in this semiarid region, and to contribute to a better understanding of the dynamics of land tenure structure in the Brazilian semiarid region, the Riacho do Pontal river basin was used as the geographic scope for this study. Furthermore, in some parts of the basin that are not provided with water, there is a great vulnerability among the poorer population, who are forced to consume products from the Caatinga forest to survive, thus generating an overload on the biome, which experiences large annual vegetation losses and intense land use and occupation.

Land use and occupation studies can be divided into two main categories: sustainable practices and environmental degradation. Studies on sustainable practices focus on techniques that allow the production of high-quality raw materials, such as fibers, food, and biofuels in large quantities, without allowing rapid land destruction processes (Xu, 2024). Environmental degradation, on the other hand, focuses on the negative impacts of human activities on soil (Solascasas et al., 2024).

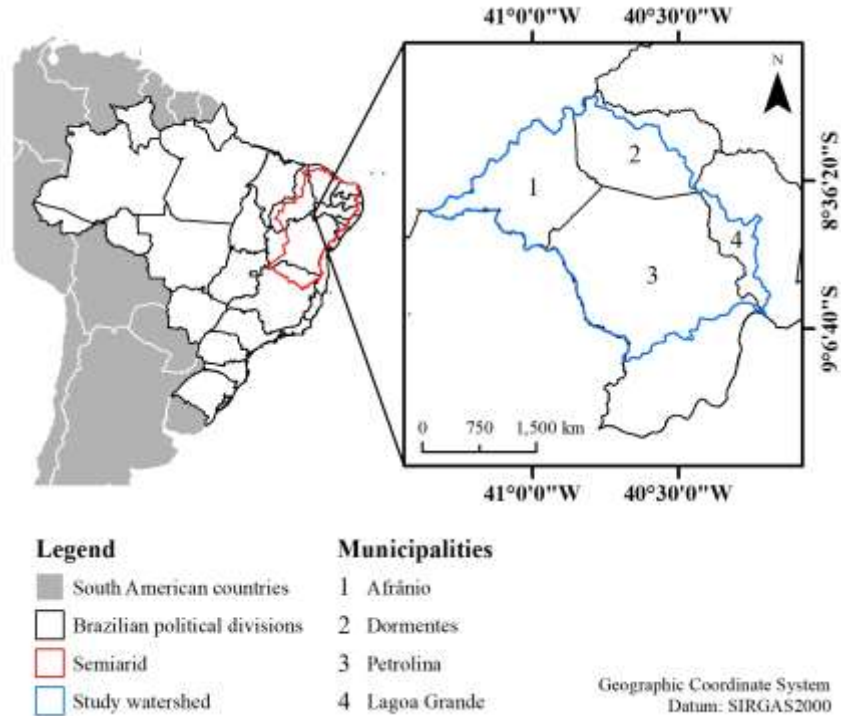
Knowing that the study of land use and occupation in a basin constitutes a factor in assessing environmental degradation (Ahakwa, 2024), the analysis of different land use and occupation scenarios is essential for the planning, organization, and management of river basins. In this study, the concept of land use analysis from the perspective of environmental degradation was applied.

This study analyzed data from MAPBIOMAS for the years 1985, 2000, 2010, and 2020, data from the National Rural Cadaster System (SNCR) of the National Institute of Colonization and Agrarian Reform (INCRA) for the year 2018, and data from the Municipal Agricultural Production (PAM) of the Brazilian Institute of Geography and Statistics (IBGE) for 2020. Finally, the study is structured as follows: introduction, methodological elements of the research, results and discussion, and final considerations.

## **Methodological Elements of the Research**

The Brazilian semi-arid region includes the states of Alagoas, Bahia, Ceará, Maranhão,

Pernambuco, Paraíba, Rio Grande do Norte, southeastern Piauí, Sergipe, Espírito Santo, and northern Minas Gerais (IBGE, 2020). The geographic scope of this study is the Riacho do Pontal watershed, located in the far west of the state of Pernambuco (Silva *et al.*, 2016), precisely in the heart of the Brazilian semi-arid region.



**Figure 1** – Location Map of the Riacho do Pontal-PE Watershed  
**Source:** Prepared by the author (2024).

To make the visualization of transformations over these four moments more accessible, we developed thematic maps illustrating land occupation and use. Geotechnology techniques and the use of ArcGIS software were employed, together with MAPBIOMAS images, to produce land use maps for the years 1985, 2000, 2010, and 2020. Data collection was carried out through the Brazilian Annual Land Use and Land Cover Mapping Project (MapBiomias), in a comprehensive time series for the Caatinga biome from 1985-2020 of collection 6 (MAPBIOMAS, 2021).

To analyze the land tenure structure of the Pontal-PE basin, secondary data were collected from the National Rural Cadastre System (SNCR) of the National Institute of Colonization and Agrarian Reform (INCRA) for the year 2018 and from the Municipal Agricultural Production (PAM) of IBGE for 2020, through general data of the basin's municipalities (in hectares) related to the number of establishments, area used, and average size of rural properties. Additionally, the Gini Index was used in this study, which refers to a measure of concentration or inequality commonly used in the analysis of income distribution, but which can be used to measure the degree of concentration of any statistical distribution (Medeiros, 2016).

Thus, one can measure the degree of concentration of land ownership in a region, the distribution of a country's urban population across cities, or of an industry considering the value of production or the number of employees per company (Demsou, 2023). In this study,

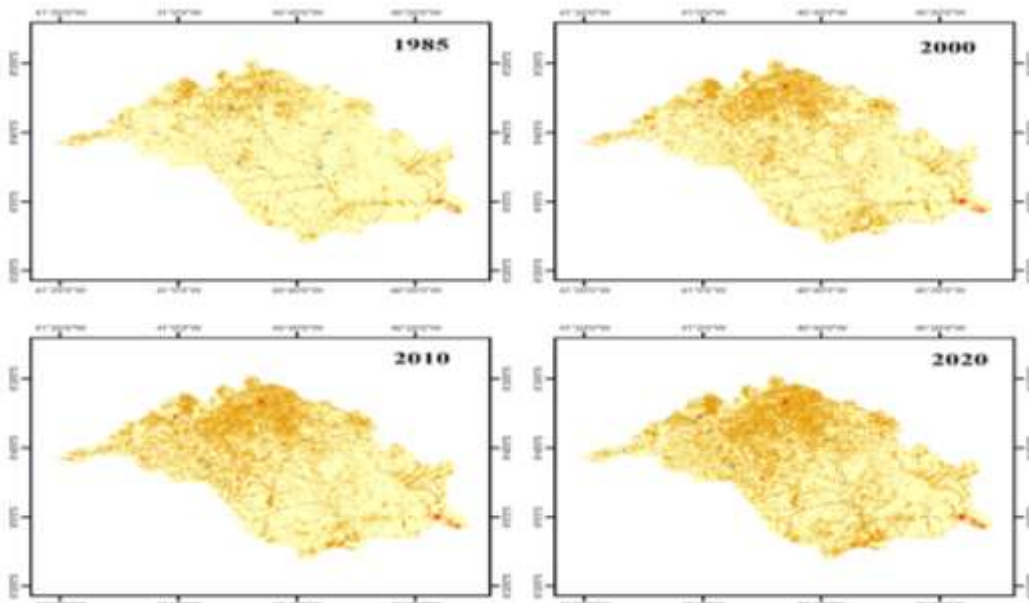
the Gini index is applied to measure the degree of land concentration; therefore, we did not seek to deepen the analysis to the beginnings of land tenure profile studies in Brazil, consequently in the municipalities of the Riacho do Pontal-PE basin, to analyze its occupation pattern over time.

Data from the Rural Environmental Registry (CAR) were also used. In the SICAR environment, all information regarding the total area of each registered property located in the four municipalities of the Pontal-PE basin was downloaded, where registration information up to the year 2021 was processed in the vector database. After data integration, it was possible to identify the exact number of CAR registrations made by each municipality within the basin. The next section shows the results and discussion obtained from the study.

## Results and Discussion

Figure 2 and Table 1 depict the classifications and quantitative data regarding land use and occupation for the years 1985, 2000, 2010, and 2020 for the region in question. Observing Figure 2 and Table 1, it is notable that in 1985, the Pontal basin predominantly maintained Caatinga as the main class at 85%, followed by agricultural and pasture areas, especially in the northern part of the territory (13%). In the study by CODEVASF (2000) for a region of the São Francisco Basin, it was observed that the predominance of areas stemmed from the classification of the Caatinga biome, with small portions of irrigated agriculture (Lopes et al., 2019).

In Figure 3, for the year 2000, it is observed that after 15 years in the territory of the Pontal basin, there was an increase in the Agriculture and Pasture area to 23% compared to the Caatinga zones at 76.6%, in which it is possible to notice that in addition to the expansion of areas in the northern part of the basin that already existed in 1985, clusters in the southern part emerged from irrigated perimeters driven by agricultural incentive programs.



**Figure 2** – Land Use and Land Cover in the Pontal Basin (1985, 2000, 2010, 2020)

**Source:** Prepared by the author (2024).

**Table 1** – Quantitative data on land use and land cover classes in the Pontal-PE Basin (1985, 2000, 2010, 2020)

<b>Classes - 1985</b>	<b>Value %</b>	<b>km<sup>2</sup></b>	<b>Classes - 2000</b>	<b>Value %</b>	<b>km<sup>2</sup></b>
Forest Fragments	0,05	3,06	Forest Fragments	0,03	1,84
Caatinga / Savanna	85,86	5259,7	Caatinga / Savanna	76,63	4694,3
Agriculture and Pasture	13,39	820,27	Agriculture and Pasture	22,72	1391,8
Urban Area / Exposed	0,43	26,34	Urban Area / Exposed	0,54	33,08
Water	0,27	16,54	Water	0,08	4,9
<b>Total Area</b>	<b>100</b>	<b>6126</b>	<b>Total Area</b>	<b>100</b>	<b>6126</b>
<b>Classes - 2010</b>	<b>Value %</b>	<b>km<sup>2</sup></b>	<b>Classes - 2020</b>	<b>Value %</b>	<b>km<sup>2</sup></b>
Forest Fragments	0,04	2,45	Forest Fragments	0,14	8,58
Caatinga / Savanna	72,37	4433,3	Caatinga / Savanna	67,7	4147,3
Agriculture and Pasture	26,71	1636,2	Agriculture and Pasture	31,42	1924,7
Urban Area / Exposed	0,76	46,56	Urban Area / Exposed	0,49	30,02
Water	0,12	7,35	Water	0,26	15,93
<b>Total Area</b>	<b>100</b>	<b>6126</b>	<b>Total Area</b>	<b>100</b>	<b>6126</b>

Source: Prepared by the author (2024).

In line with the classification performed in this study, the research by Lopes et al. (2019), using a hybrid classification (unsupervised and supervised) for the same region, achieved values close to 80% for Caatinga. However, the classifications implemented by the authors break down the Caatinga into two categories: bare soil and irrigated agriculture specifically, accounting for 3.54% of the area for irrigated agriculture in Pontal and approximately 13% for bare soil. It is known that one of the practices of subsistence agriculture is the release of animals into open areas (Barcellos et al., 2019), favoring environmental degradation, territorial transformation, and the preparation of potential areas for agriculture.

In 2010, Agriculture and Pasture areas doubled in value (26.71%) when compared to 1985, resulting in a reduction of nearly 5.5% in Caatinga area (72.71%). Miranda et al. (2018) observed an increase and changes in degradation for the region after 2007, especially in the southern part of the basin. It is noteworthy that the potential availability of water and favorable slope conditions for agriculture drove the transformation and consequent replacement of Caatinga by pasture or conventional agricultural environments (Costa et al., 2022).

In 2020, Agriculture and Pasture areas reached approximately one-third (31.42%) of the Pontal basin, occupying large proportions in the northern, northwestern, and southern zones. Caatinga remains at 67.7% and is more concentrated in the central area, aligning with the regions that maintain the lowest average rainfall indices. Nogueira et al. (2023) observed the presence of open Caatinga and degraded open Caatinga areas in the southern portion of Pontal, an environment that favors anthropic encroachment and the use of this fragile territory for commercial purposes.

Overall, over the period from 1985 to 2020, a shift is observed in the Pontal basin from Caatinga areas to pasture and agriculture, whether under rainfed, subsistence, conventional, or irrigated conditions. Similarities are found in the studies by Miranda et al. (2018) and Lopes et al. (2019) for the same region, which align with the results of this research and add to it, as these studies present compositions and responses regarding the dynamics of climate, slopes, soils, and their generalized vulnerabilities. Reflecting on the land tenure structure in the Brazilian Northeast requires an effort to analyze the processes of land use change (Maia & Gomes, 2020).

Thus, we sought to examine the degrees of land concentration and its profile in each of

the municipalities (Afrânio, Dormentes, Lagoa Grande, and Petrolina) within the Riacho do Pontal-PE basin. Therefore, the uniqueness and novelty of this study lie in its contribution to future research by addressing questions aimed at filling the gap in this study area, utilizing new parameters.

Regarding the land tenure structure numbers in the municipality of Afrânio, Table 2, the size class of 10 to 25 hectares (small property) stands out, accounting for 1,428 units. In terms of total area, the size classes of '25 to 50 hectares' (small property) stand out, with a total area of 33,826.3328 ha, characterizing the land tenure structure for the municipality of Afrânio as predominantly composed of small properties. The municipality has the smallest total registered area within the basin, at 132,391.6534 ha.

**Table 2** - Agricultural holdings and total area by stratum in the municipality of Afrânio, Pernambuco

CATEGORY (Hectares)	NUMBER (Properties)	TOTAL AREA (ha)
1 to less than 2	7	9,5904
2 to less than 5	316	1.109,4457
5 to less than 10	656	4.593,3587
10 to less than 25	1.428	22.450,7828
25 to less than 50	1.014	33.826,3328
50 to less than 100	495	32.048,2270
100 to less than 250	163	22.577,9086
250 to less than 500	22	7.716,0647
500 to less than 1,000	13	8.059,9427
Inconsistent Properties Excluded	112	0,0000
T O T A L	4.226	132.391,6534

Source: National Rural Land Registry System – SNRC/INCRA (2018).

The figures for the land tenure structure in the municipality of Dormentes, Table 3, show that the most frequent profile is 10 to 25 hectares, small property, followed by 25 to less than 50 hectares, indicating that the land tenure profile found in the territory is that of small properties. The Northeast region also exhibits a high concentration of land in the hands of a few large landowners, contrasting with most of the population that lives on small properties (Medeiros, 2012).

**Table 3** - Agricultural holdings and total area by stratum in the municipality of Dormentes, Pernambuco

CATEGORY (Hectares)	NUMBER (Properties)	TOTAL AREA (ha)
1 to less than 2	5	7,4208
2 to less than 5	416	1.405,1108
5 to less than 10	751	5.410,5907
10 to less than 25	1.981	32.088,7915
25 to less than 50	1.238	42.305,5269
50 to less than 100	594	38.270,3055
100 to less than 250	181	23.880,8792
250 to less than 500	15	5.108,2431

500 to less than 1,000	5	3.452,7772
1.000 to less than 2.000	1	2.280,8204
Inconsistent Properties Excluded	54	0,0000
T O T A L	5.241	154.210,4741

Source: National Rural Land Registry System – SNRC/INCRA (2018).

In general, agricultural development is largely achieved through the transformation of small family farm processes (Melo & Braz, 2018). In contrast, there are few properties with the land tenure profile of large estates in the region, which are those with 250 hectares or more, totaling 21 large properties in the overall profile count.

In contrast, the municipality has only five properties ranging from 1 to less than 2 hectares, covering a small area of 7.4208 ha in the territory. The municipality of Lagoa Grande has the lowest percentage of agricultural establishments registered in the SNCR within the Pontal basin, with only 1,679 registrations, Table 4. It is the second largest municipality in the basin, receiving direct influence from the municipality of Petrolina in economic and agricultural dynamics. The land tenure profile with the highest number of properties is 10 to 25 hectares (small property), followed by the profile of 25 to less than 50 hectares, indicating that the second most common land tenure profile found in the territory is also predominantly small properties.

**Table 4 -** Agricultural holdings and total area by stratum in the municipality of Lagoa Grande, Pernambuco

CATEGORY (Hectares)	NUMBER (Properties)	TOTAL AREA (ha)
Greater than 0 and less than 1	1	0,4774
1 to less than 2	4	5,3854
2 to less than 5	214	657,0386
5 to less than 10	156	1.056,2121
10 to less than 25	393	6.608,6256
25 to less than 50	335	11.638,8217
50 to less than 100	291	20.644,9868
100 to less than 250	191	29.449,5623
250 to less than 500	56	19.186,5839
500 to less than 1,000	16	10.947,6272
1.000 to less than 2.000	10	13.550,3724
2.000 to less than 2.500	2	4.590,1801
2.500 to less than 5.000	1	4.685,2785
10,000 to less than 20.000	1	14.383,0104
Inconsistent Properties Excluded	8	0,0000
T O T A L	1.679	137.404,1624

Source: National Rural Land Registry System – SNRC/INCRA (2018).

It is important to highlight that since 1985, the highest value of land tenure deconcentration has been recorded for the Northeast Region, with a decrease in the indicator value occurring in 1996 and 2006, signifying a modest process of land tenure deconcentration in the region (Medeiros, 2016).

This deconcentration of land tenure in the Brazilian Northeast can be attributed to several factors. Some of these include agrarian reforms; in the years following 1985, efforts were made to promote and redistribute land from large landowners to small farmers (Cruz,

2023). This policy may have contributed to the reduction of land concentration. Legislation and land tenure regularization have also played a role (Graciano et al., 2023).

The municipality of Petrolina has the largest territory among the municipalities in the basin with registered records in the SNCR, Table 5, and in economic terms, its greatest strength lies in irrigated fruit farming and exports. In the Brazilian semiarid region, fruit farming and related activities contribute to local development (Lima et al., 2021). In this context, according to Lima et al. (2021), the Petrolina-PE/Juazeiro-BA hub stands out as a nationally important fruit-producing region, supported by investments in public irrigation projects.

**Table 5** - Agricultural holdings and total area by stratum in the municipality of Petrolina, Pernambuco

CATEGORY (Hectares)	NUMBER (Properties)	TOTAL AREA (ha)
Greater than 0 and less than 1	83	45.1317
1 to less than 2	136	185.5919
2 to less than 5	1.902	6.270,0163
5 to less than 10	3.199	21.887,1557
10 to less than 25	3.279	52.653,5324
25 to less than 50	2.334	81.943,3441
50 to less than 100	1.373	91.731,3857
100 to less than 250	719	101.042,6983
250 to less than 500	124	42.164,6831
500 to less than 1,000	37	25.135,1175
1,000 to less than 2,000	19	24.503,3702
2,000 to less than 2,500	6	13.951,1669
2,500 to less than 5,000	5	18.861,9312
5,000 to less than 10,000	1	5.798,2104
10,000 to less than 20,000	2	31.868,2104
Inconsistent Properties Excluded	362	0,0000
T O T A L	13.581	518.041,5458

**Source:** National Rural Land Registry System – SNRC/INCRA (2018).

According to CODEVASF (2019), in 2019 the region had approximately 54 thousand irrigated hectares, with the capacity to expand to 200 thousand hectares. Between 2000 and 2019, fruit exports grew by 363.6%—from US\$ 56.7 million to US\$ 263.1 million—resulting in a 350.9% increase in the trade balance surplus, from US\$ 51.9 million to US\$ 233.8 million (Lima et al., 2021).

The Petrolina-PE/Juazeiro-BA hub drives economic activity across all municipalities in the basin territory, generating employment and income for the population. The majority of this workforce comes from the nearest municipalities, such as Afrânio, Dormentes, and Lagoa Grande. The municipality of Petrolina has the highest number of agricultural establishments (13,581) and a total area of 518,041.5458 ha (INCRA, 2018).

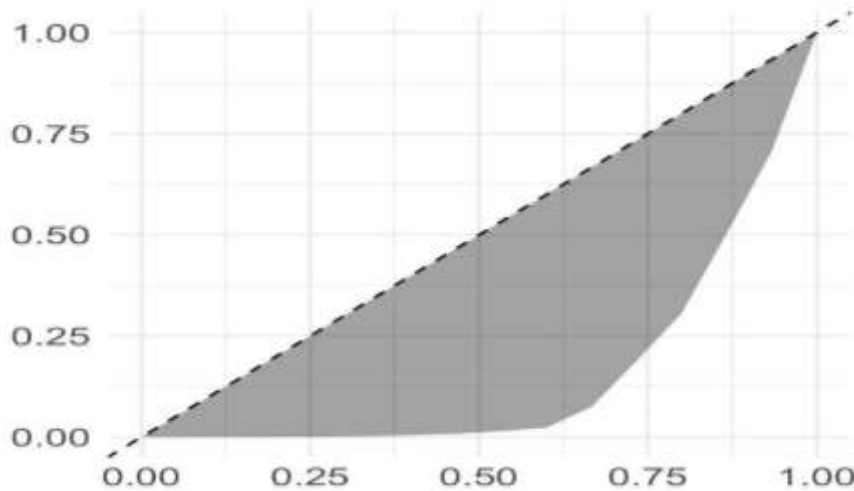
The land tenure profile with the highest number of properties in the territory of Petrolina is 10 to 25 hectares (small property), with 3,279 units, followed by the category of 5 to less than 10 hectares, with 3,199, and third, the profile of 25 to less than 50 hectares, with 2,334, demonstrating that the land tenure profile of the municipality of Petrolina is that of small properties. It is recorded that the municipality has the highest number of excluded inconsistent

properties (362).

The municipality also records the highest number of large estates and super large estates in its territory, largely due to having the largest number of irrigated perimeters. In overall numbers, regarding the land tenure structure of the municipalities in the territory of the Pontal-PE Basin, there are 24,727 properties registered in the SNCR, covering a total area of 942,047.834 ha, based on data from the latest published survey of the SNCR from 2018.

The land tenure profile, according to SNCR data for the four municipalities that make up the Pontal-PE Basin, is characterized by small properties in the 10-to-25-hectare range, with 7,081 properties, second only in total area. The profile with the largest total area is 25 to less than 50 hectares, which falls within the small property category. Although small rural properties in the Brazilian Northeast are advancing, the largest land extensions are held by a small number of rural landowners, while the smallest land extensions are held by many rural landowners in the region (Ollinaho & Kroger, 2023).

The mean, median, and mode of the establishments were calculated, as seen in the tables related to land tenure structure, in addition to calculating the Gini index and generating the Lorenz Curve in Figure 4 (cumulative area on the vertical axis and cumulative number of properties on the horizontal axis), using 2018 data from the SNCR.



**Figure 4** - Lorenz curve for the distribution of properties in the four municipalities that make up the Pontal-PE basin

**Source:** Prepared by the author (2024).

With the aim of analyzing land tenure concentration in the four municipalities that comprise the territory of the Pontal-PE basin, the Gini index was examined, yielding a mode value of 0.688%, signifying a moderate to strong land concentration in the period under consideration. The moderate concentration in the basin indicates that there are inequalities in the distribution of hectares per property.

It is necessary to emphasize that when discussing the rigidity of the land tenure structure from the perspective of concentration, it does not mean that changes may have occurred in specific strata of establishments in the Northeast region. Medeiros (2016) highlights that at the macro level, as measured by the Gini index in studies on land tenure structure in the Northeast in recent years (Dias, 2019; Amantino & Cardoso, 2021), concentration has remained very high

and practically unchanged (Medeiros, 2016). In this sense, the data presented in this study confirm the same situation observed in previous studies. It is concluded that in all municipalities within the territory of the Pontal-PE basin, large land extensions are predominantly held by a few landowners, even though the number of small properties is greater.

The agricultural configuration in the Pontal-PE Basin, in relation to land use practices for planting permanent crops, shows that the largest portion of land in the basin is reserved for mango and grape cultivation, totaling 15,290 ha, Table 6. However, over the past 10 years, grape and mango production in the Petrolina-PE/Juazeiro-BA hub has occupied a significant share of both domestic and international markets, with exports to several countries (Lima et al., 2021). The region stands out as the largest producer of mango and grapes in the country, with production destined for both domestic and international markets (EMBRAPA, 2019).

**Table 6** - Temporary and permanent crops per hectare in the municipalities of the Pontal-PE basin

Crop area (ha)	Afrânio	Dormentes	Lagoa Grande	Petrolina
	Planted area	Planted area	Planted area	Planted area
<b>Permanent</b>				
Banana	-	-	145	1.820
Bay Coconut	-	-	-	1.800
Guava	-	-	100	2.100
Mango	-	-	440	9.000
Passion fruit	-	-	20	170
Grape	-	-	1.550	6.290
<b>Total</b>			<b>2.255</b>	<b>21.180</b>
<b>Temporary</b>				
Sugarcane	-	11	-	125
Onion	-	-	65	75
Beans	3,2	3.600	1.500	3.270
Cassava	-	-	70	250
Corn	4,5	4.500	1.000	4.900
Watermelon	-	-	370	-
Melon	-	-	270	-
Tomato	-	-	160	-
<b>Total</b>	<b>7,7</b>	<b>8.111</b>	<b>3.435</b>	<b>8.620</b>

**Source:** Compiled by the author based on Municipal Agricultural Production (PAM) (2020) and IBGE CIDADES (2020).

Regarding temporary crops, beans and corn stand out, Table 6. Temporary agriculture in the Pontal-PE Basin is linked to rainfed agriculture. In the Brazilian Northeast, the predominant form of agriculture is subsistence farming, practiced on small rural properties under rainfed conditions, where agricultural productivity depends on rainfall distribution and the natural fertility of the soil. Under these conditions, soils are eroded, poor in nutrients, and have low levels of organic matter (Diniz, 2012). The term "sequeiro" (rainfed) originates from the word "seco" (dry), and this type of cropping system is largely developed in underdeveloped regions and follows an extensive model (Carvalho et al., 2022).

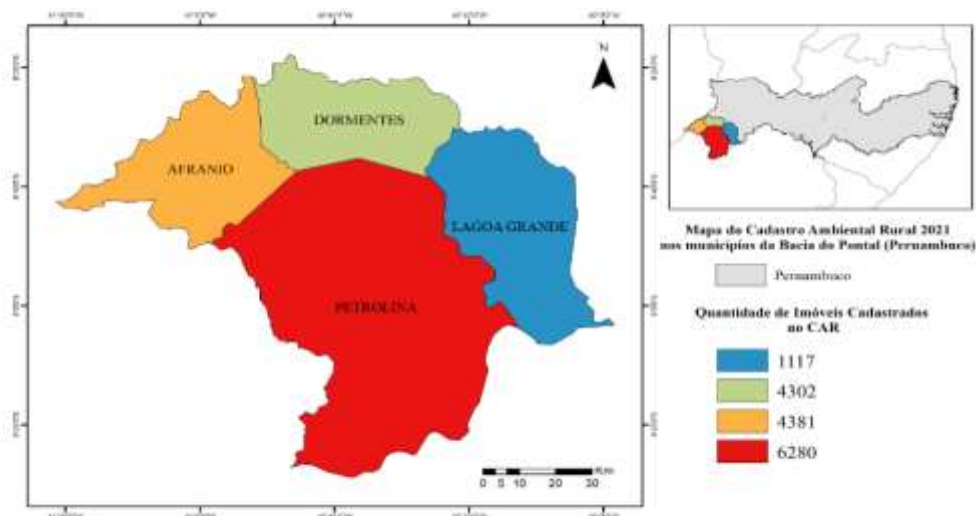
Irrigated agriculture is generating jobs in the countryside, primarily for the population of the municipalities within the basin and employs high-tech irrigation methods. Regarding production value, data from the Agricultural Census indicate that the production capacity of

fruit farming in Petrolina generated revenues of 106.5 billion reais (Rosa Neto et al., 2020). The authors state that this activity plays an important role for most horticultural and food crops, as the São Francisco Valley has more than 30 thousand hectares of irrigated land. This includes 700 kilometers of pipes, over 156 kilometers of canals, and approximately 2,600 producers (IPEA, 2020; Lima et al., 2021).

On the other hand, rainfed agriculture is characterized by low productivity and scarce technological input, producing some surplus in rainy years, yet without sustainable guarantees for the population, who migrate from rural areas to municipalities in the semiarid region with irrigated areas (Alves & Souza, 2015). Initially, irrigated areas were designated for low-income inhabitants from rainfed areas and surrounding micro-regions, including migrants from the states of Ceará, Maranhão, and Piauí. In this way, irrigation was intended to address land tenure complications.

Nevertheless, due to the need for high financial investment and technical assistance in the production of new crops, medium and large enterprises have entered irrigated areas (Lima et al., 2021). Irrigated agriculture becomes exclusionary, as large estates dominate irrigable territories and possess the financial capital to utilize technology (Burja et al., 2020). Recent studies (França, 2023; Santos & Gomes, 2024) highlight the exclusionary nature of the model replicated in the territory, insofar as it has been unable to incorporate the local population into the complex productive apparatus. These aspects may result in adverse impacts on regional development, requiring policies and practices aimed at mitigating such consequences.

An important part of this study is the Rural Environmental Registry (CAR) and its figures for the Pontal-PE Basin. It is worth highlighting that the CAR is a primary database for public policy planning and for assessing social transformations, especially in the context of rural land tenure arrangements (Jung et al., 2020). In this regard, it is noted that the Pontal-PE Basin has 16,080 properties registered in the CAR (CAR, 2021). Figure 5 shows the distribution of these figures across the municipalities of the Pontal-PE Basin. It indicates that the municipality of Petrolina has the highest number of properties registered in the CAR (6,280), followed by the municipality of Afrânio (4,381), Dormentes (4,302), and finally the municipality of Lagoa Grande, with 1,117 registered properties.



**Figure 5** – Number of properties registered in the CAR in the municipalities of the Pontal-PE Basin  
**Source:** Prepared by the author (2024).

From the examination of Figure 5, it can be inferred that the municipality of Petrolina has the highest number of CAR registrations due to its status as a major hub for global fruit exports. One hypothesis is that certifying properties with the CAR is advantageous for export businesses. Public transparency and image are important for fostering positive perceptions of public entities, especially regarding issues related to environmental control. In this sense, the adoption of the CAR may reflect on market and import considerations, enhancing the image and transparency of fruit farming businesses while contributing to environmental conservation in the Pontal-PE Basin region.

## **Final Considerations**

It is perceived that "there is no part that falls to this latifundium!" Regarding the analysis of the land tenure structure presented for the Riacho do Pontal-PE basin, it is noted that it has a concentrating land tenure profile in relation to latifundia. The closer these territories are to the irrigated perimeters, the more a relatively high index of large latifundia is expressed, thus contemplating a classification for land concentration from medium to very strong.

In this context, understanding the production relations among local stakeholders is necessary to verify the path in which the production chain lies and the possibilities for generating economic strengthening with equity and social inclusion in the region, and to prevent the current exclusionary advance of the model employed in the region, in the way it became incapable of integrating the population into the intricate productive web of the region. It was observed that most of the basin's territory is managed by large latifundia.

Beyond its objectives, this study also allows providing data about stretches of the watershed that suffer from social, economic, and environmental susceptibility or difficulties in land distribution, so that different actors in public administration and government institutions can form partnerships and integrated studies seeking to improve social aspects and in pursuit of regional and local vocations, aiming at long-lasting public policies active in the conservation of water resources in the basin and equitable agrarian issues.

Although historical and socioeconomic investigation is one of the pillars for understanding knowledge about Brazilian agrarian property in the semi-arid region, this study emphasized the economic agenda, land use and occupation, and the rural environmental registry of properties as an analytical bias. Thus, bringing new horizons for analysis techniques for land tenure structure in watersheds for semi-arid regions or adapting them to other areas. The results issued can provide important information about the territory, assisting in decision-making for sector expansion and future investments, as well as guiding the formulation of more equitable public policies for the territory's population. Finally, it is hoped that this research will guide other initiatives and studies, shedding light on new ideas.

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