

Patterns of natural vegetation removal in the Caatinga biome in Prodes Project scope

Gustavo Felipe Balué Arcoverde¹, Aline Rocha Silva¹, Renato Alves Pinto¹, Filipe Gomes Dias¹, Júlia Arantes Pereira¹, Ulisses Alencar Bezerra², Gabriela Alves Carreiro¹, Edgard Alves Bontempo e Silva¹, Luís Francico Mello Coelho³, John Elton de Brito Leite Cunha², Marcelo Francisco Sestini¹, Cloves Vilas Boas³, Luciana Soler¹, Claudio Almeida¹

1: National Institute for Space Research – INPE, Av. dos Astronautas, 1.1758, Jd. Granja, CEP 12227-010, São José dos Campos, SP, Brazil – prodes.caatinga@gmail.com

2: Universidade Federal de Campina Grande – UFCG, Av. Aprígio Veloso, Bodocongó, CEP 58109-970, Campina Grande, PB, Brazil – ulisses.alencar17@gmail.com, john.e.cunha@gmail.com

3: Núcleo de Ecologia e Monitoramento Ambiental da Universidade Federal do Vale do São Francisco – NEMA/Univasf, Rodovia BR-407, KM 12 Lote 543 - Projeto de Irrigação Nilo Coelho - S/N C1, CEP 56300-000, Petrolina, PE, Brazil – coelholf@yahoo.com.br, clovesvilasboas@gmail.com

Abstract : This work aims to present the NVR in Caatinga biome from Prodes data, in terms of its trajectory and main geographical patterns, concerning the municipalities, and areas that are the focus of monitoring, conservation or restoration. According to Prodes results, by 2023, the cumulative NVR in the entire Caatinga reached 43,05%; in 2000, this figure was 29,54%. The major NVR occurred in the easternmost areas of Caatinga and regions of Serrinha and Feira de Santana in Bahia State. Also, there are areas with considerable NVR further inside the biome, such as, Irecê and Guanambi region in Bahia, west of Pernambuco and Paraíba States and South and North of Ceará State. Areas prioritized for conservation actions showed high NVR values, indicating the urgent need for implementation of such actions. The fact that Desertification Cores showed low NVR values is important, and these regions should be closely monitored to prevent uncontrolled NVR rates. The two regions with high anthropic pressure or speculation showed contrasting behaviors; while the Araripe Gypsum Pole exhibited higher NVR levels compared to the control area, the São Francisco River integration project (PISF) so far does not appear significantly different from the rest of the biome.

1. Prodes and Caatinga

Mapping native vegetation removed by clear-cutting (NVR) by Prodes in Caatinga biome (Prodes Caatinga) is a major challenge compared to biomes where the tree canopy prevails as native vegetation. Caatinga has highly seasonal vegetation, presenting diverse phytophysognomies ranging from Seasonally Dry Tropical Forests (SDTF) to sparse Shrublands and Savannas (Fernandes & Queiroz 2018). This biome is one of the least protected of Brazilian biomes and is located in one of the most pressured semi-arid regions on the planet. It has only 8.8% of its area spared in Conservation Units (Brasil, 2000), being only 2.2% of Full Protection (Nogueira et al., 2024).

Since 2023's Prodes Caatinga mapping some methodological adjustments were made. The main ones were adapting the image acquisition calendar, including more months for acquisition, from July (the westernmost parts of the biome) to December (the easternmost parts of the biome); exclusive use of 20-meter Sentinel 2 satellite images; cloud detection by digital classification or vector edition assisted; expansion of bookmarks (reference communication between interpreters and reviewers), and; expansion of auxiliary data to solve interpretation misclassification issues and doubts. Due to the importance, history of pressures and low protection situation of the Caatinga, this work aims to present the NVR in this biome from Prodes data, in terms of its trajectory and main geographical patterns, concerning the municipalities, and areas that are the focus of monitoring, conservation or restoration, such as, priority areas for biodiversity, desertification areas, and high pressure or speculation areas.

2. Methodology

In order to present a main geographical patterns of Caatinga's NVR distribution, we computed the NVR accumulated until 2023 and NVR rate between 2000 to 2023 for all municipalities with predominance of Caatinga biome. In order to analyse areas of greater attention in relation to conservation and restoration, the NVR was generated and analysed for Priority Areas for Biodiversity (MMA, 2023) and for Desertification Cores (Perez-Marín et al., 2012). And to focus on analyse NVR monitoring areas, we choice two large areas under high pressure or speculation, the São Francisco River integration project (PISF) and Araripe Gypsum Pole. The Figure 1 presents a map with the Caatinga limit, the predominant municipalities and the four layers of analysis. In all the situations mentioned, except for the NVR for municipalities, the NVR was calculated outside the areas of interest of this study – called here a Control Areas - in order to have a reference for comparison with the rest of the biome.

3. Results

According to the Prodes results, the entire Caatinga has reached 43,05% of cumulative NVR in 2023 (371.387,78 km²), in 2000 this figure was 29,54 % (254.859,44 km²), considering that the potential area for deforestation in the Caatinga was calculated at 862.639,52 km². The Figure 2 presents the geographical distribution of NVR accumulated until 2023 year.

The Figures 3 and 4 presents the NVR in Priority Areas for Biodiversity, respectively, for the Biological Importance and Action Priority categories in their three classes. Comparing the NVR between categories of Biological Importance and Action Priority, the second one presents greater classes proportional differences than the first one. It means that NVR is more sensitive to the social, economic, and environmental costs associated with the implementation of conservation actions, than to strictly biological and ecological differences. The classes of Biological Importance presents less NVR than the rest of Caatinga – Control Area –, while NVR in Action Priority areas, the Extremely High class is higher than the Control area.

The Figure 5 presents the NVR accumulated in Desertification Cores, comparing to the Control area. Is curious see a lower NVR in Desertification Cores with a higher NVR than the rest of Caatinga – Control area. A noteworthy aspect is the NVR means a clear cut of native vegetation, which is associated for some conversion of land use. Lands with low land productivity requires greater investment to convert to agriculture or pasture uses, in order to become a productive land again.

The Figure 6 presents the NVR accumulated in PISF influence area and the Control area. There is very little difference between the two NVR patterns. However, in the period around the first half of the 2000s there was a noticeable increase in NVR in the areas of influence of the PISF, which refers to a period of Pre-Installation Licenses, but it decreases along the next years.

The Figure 7 presents a great difference in NVR accumulated in the Araripe Gypsum Pole in relation to the rest of Caatinga. This pattern is consistent with the type of use of the region, pasture and extraction of firewood for calcination. It is important to emphasize this result does not necessarily mean that there is little vegetation cover in the Araripe Gypsum Pole. Lately, the use of forest management with exotic species for the purpose of using firewood has been expanded.

It is important to note that the 2023's NVR increment presented a somewhat unusual increase, in relation to the historical NVR trend. This is due to the methodological change employed in the year 2023.

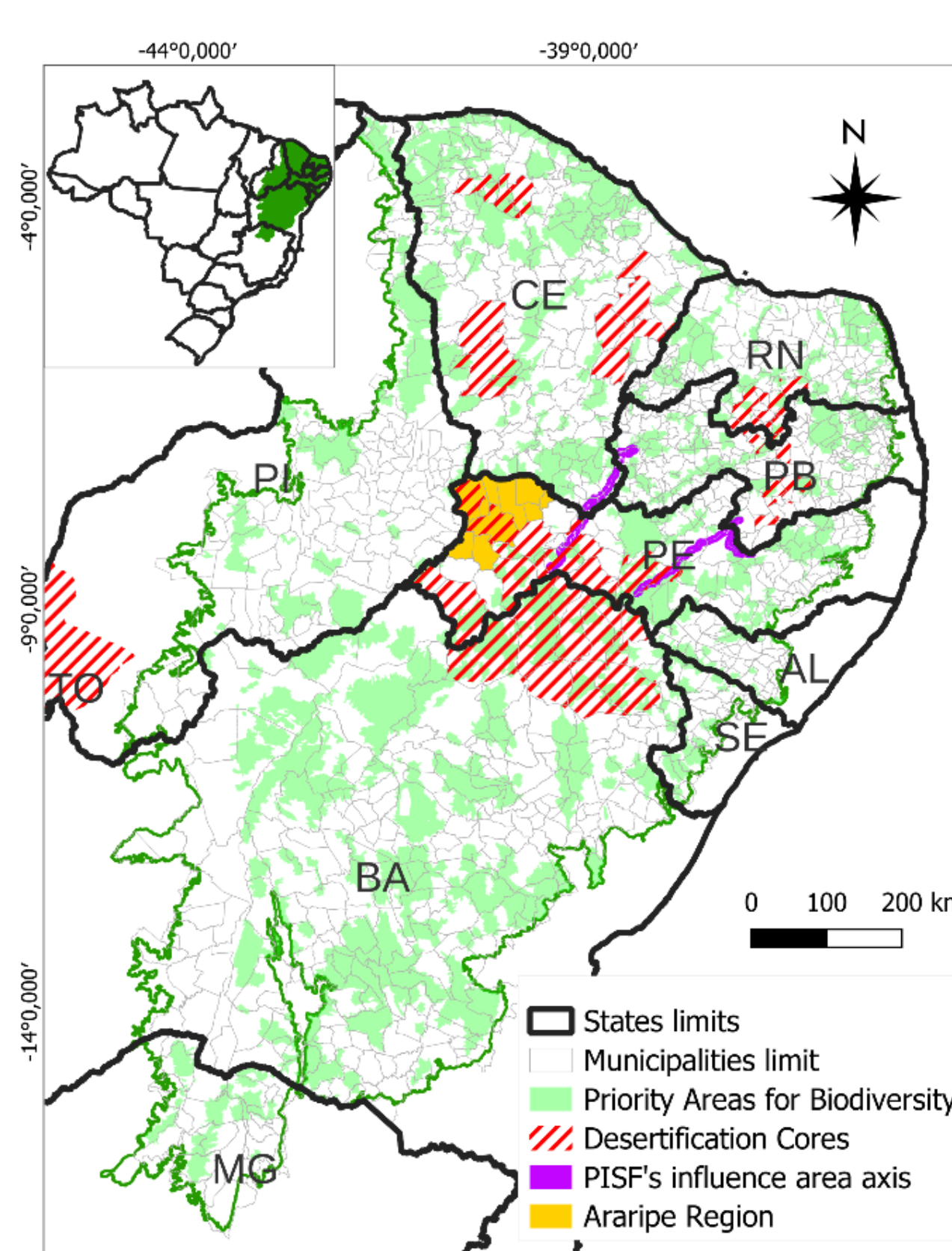


Figure 1. Caatinga limit with the layers to NVR analysis

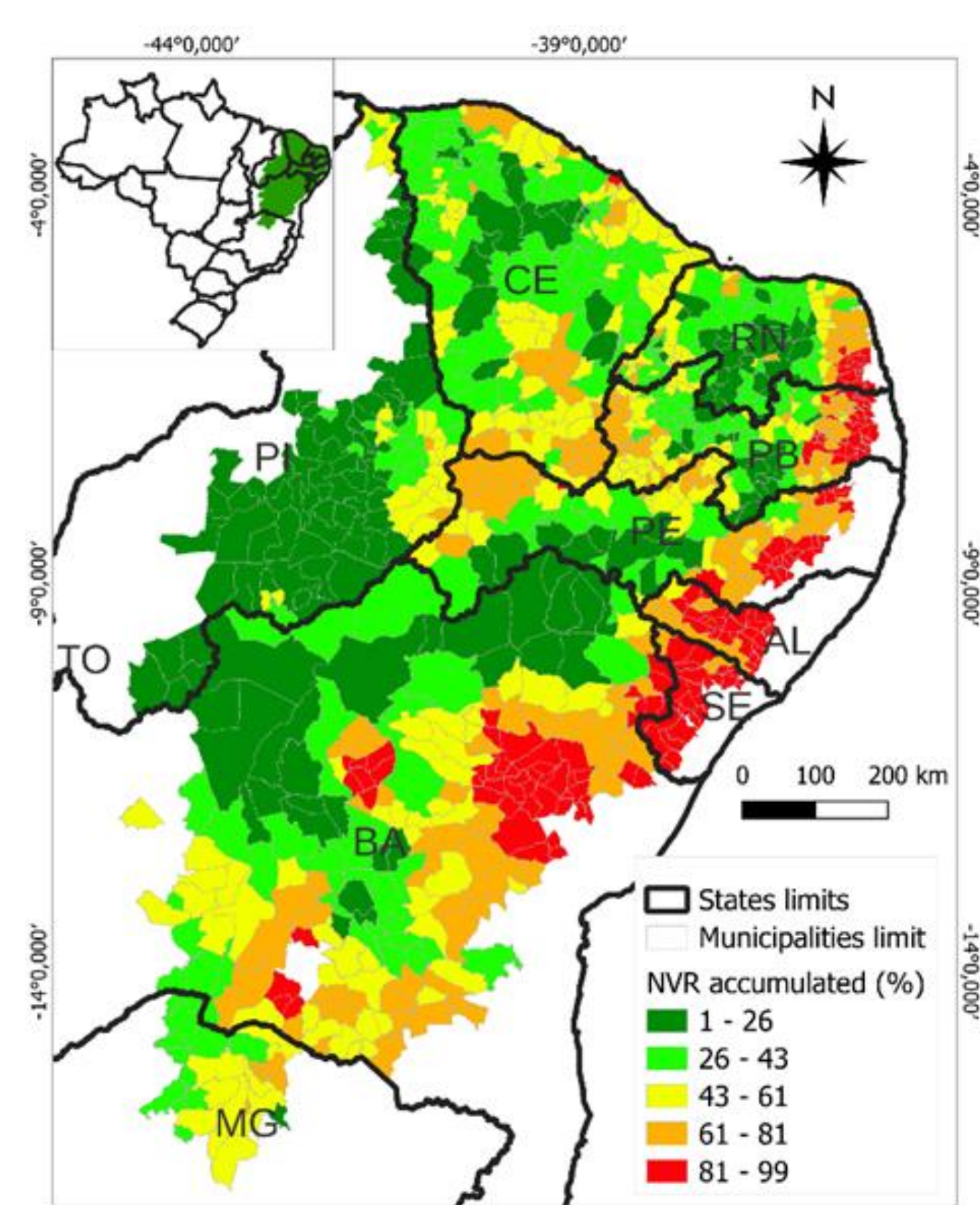


Figure 2. Distribution of NVR accumulated in Caatinga municipalities until 2023 year by Jenks natural breaks

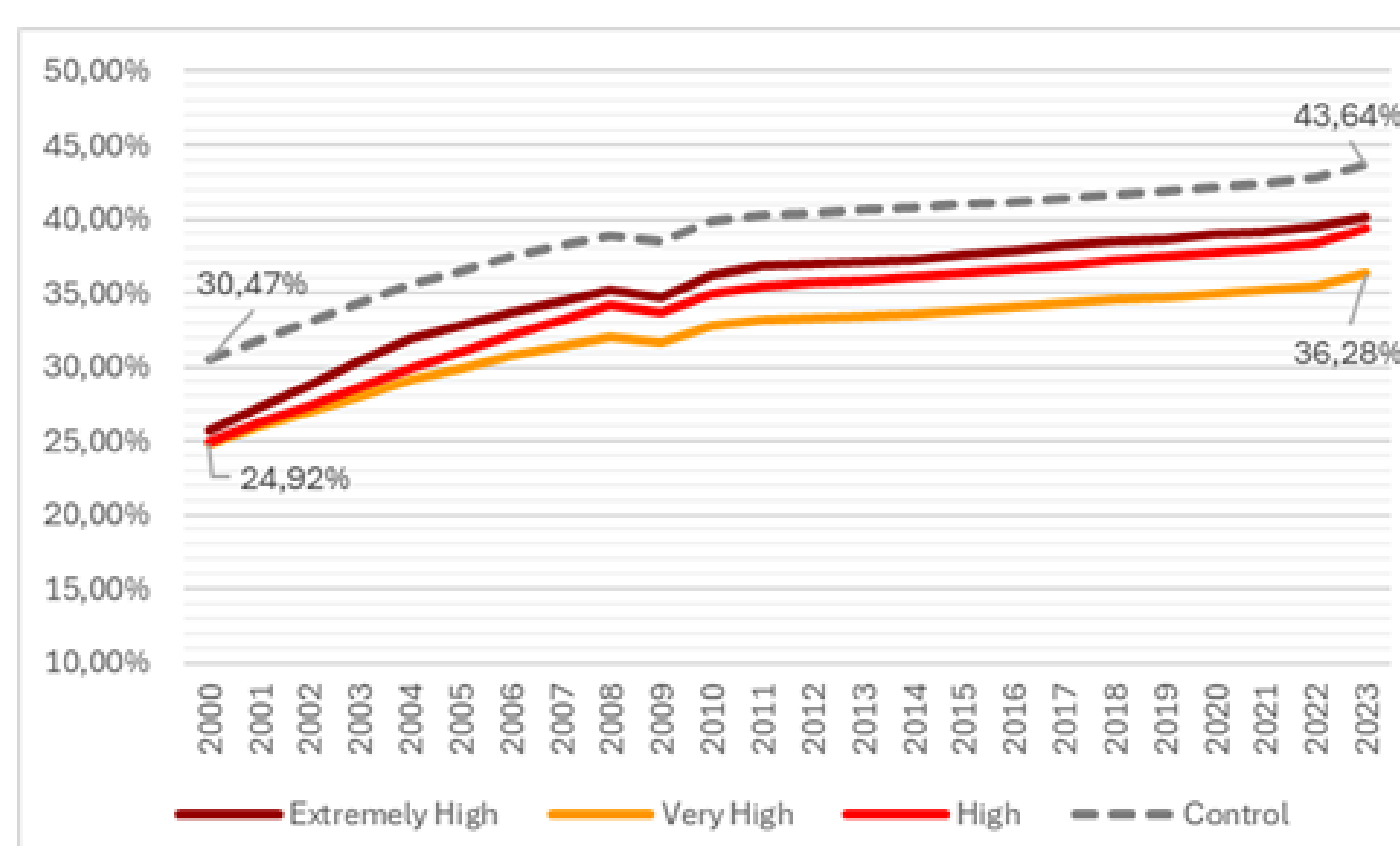


Figure 3. NVR in Biological Importance areas

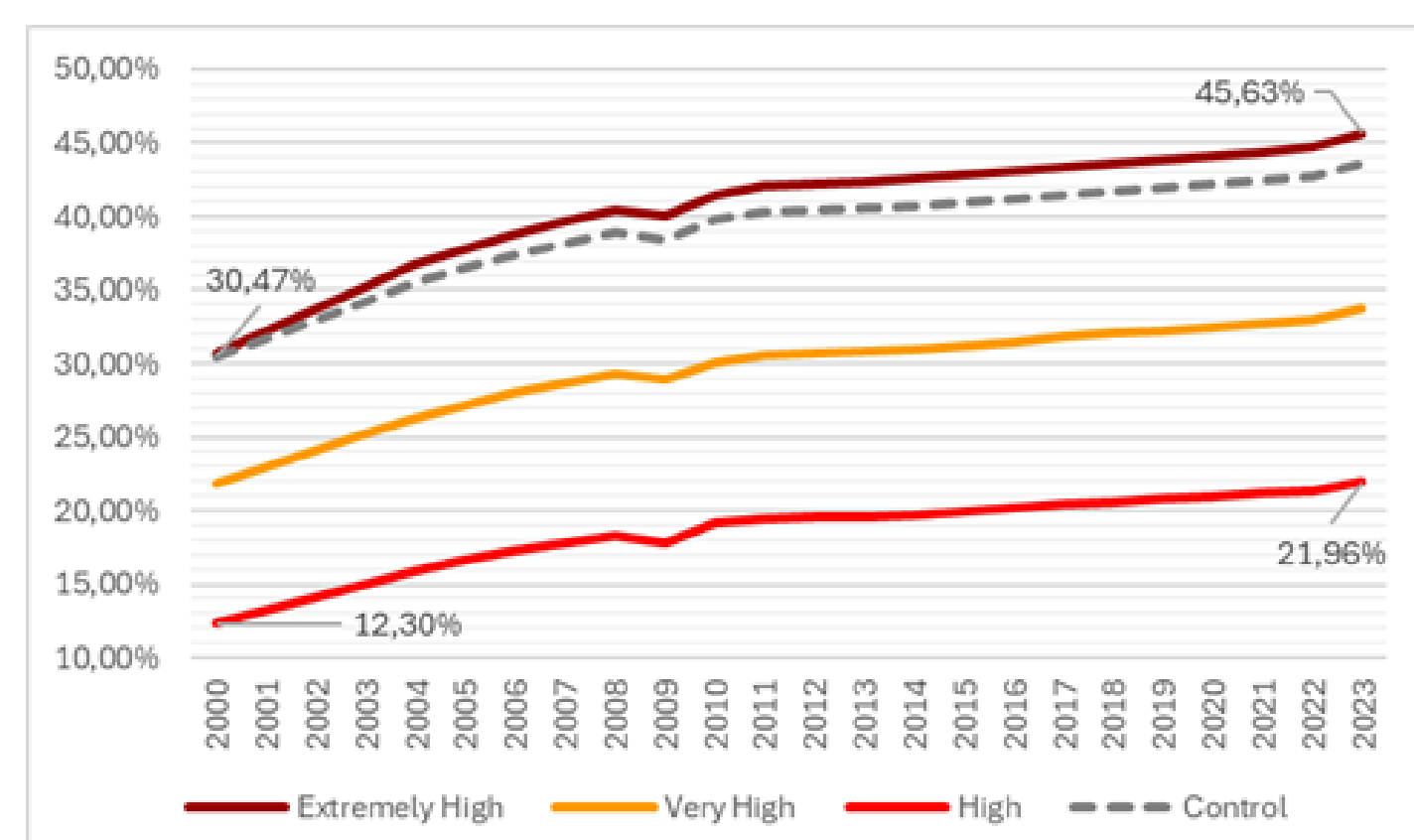


Figure 4. NVR in Action Priority areas

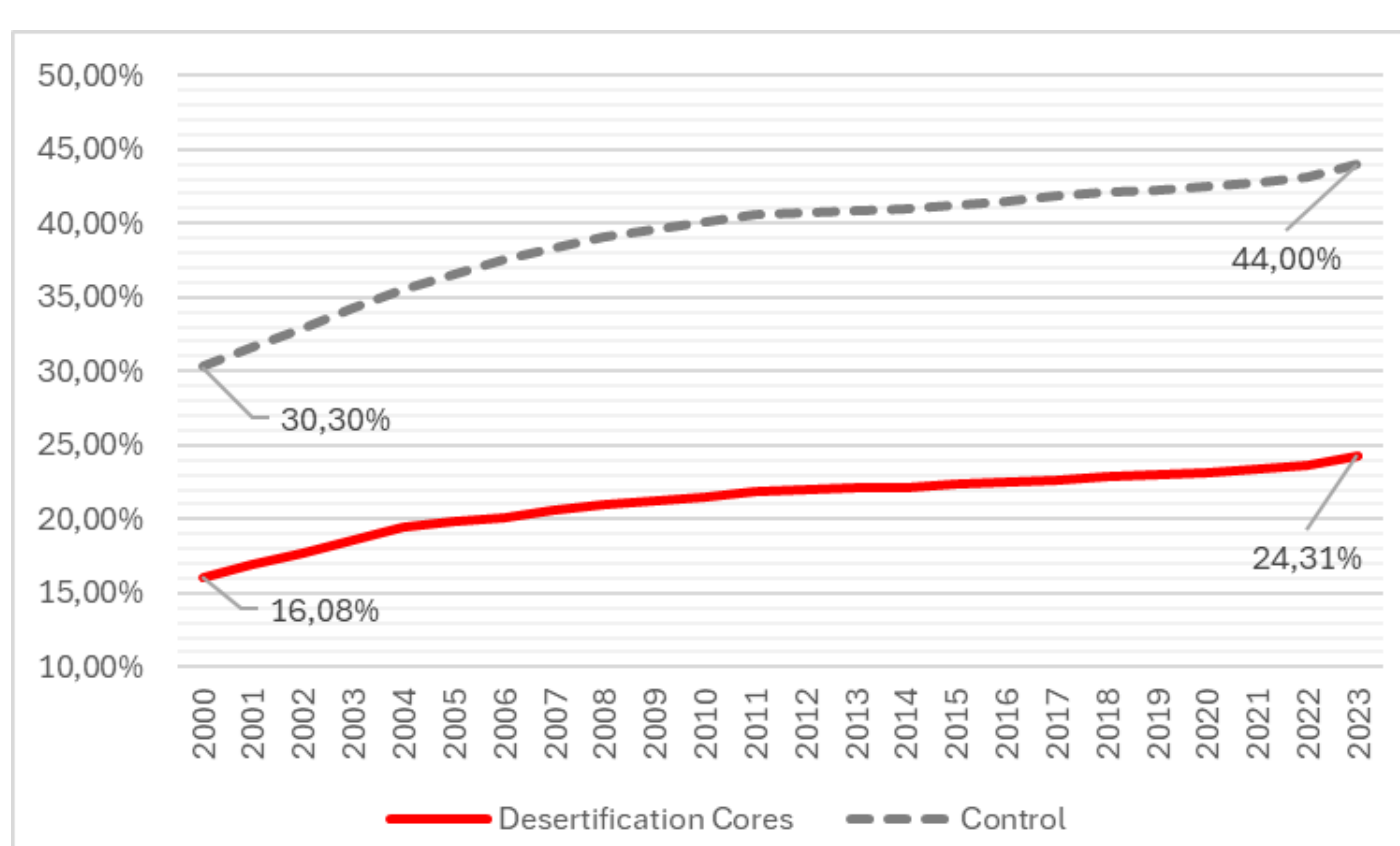


Figure 5. Desertification cores

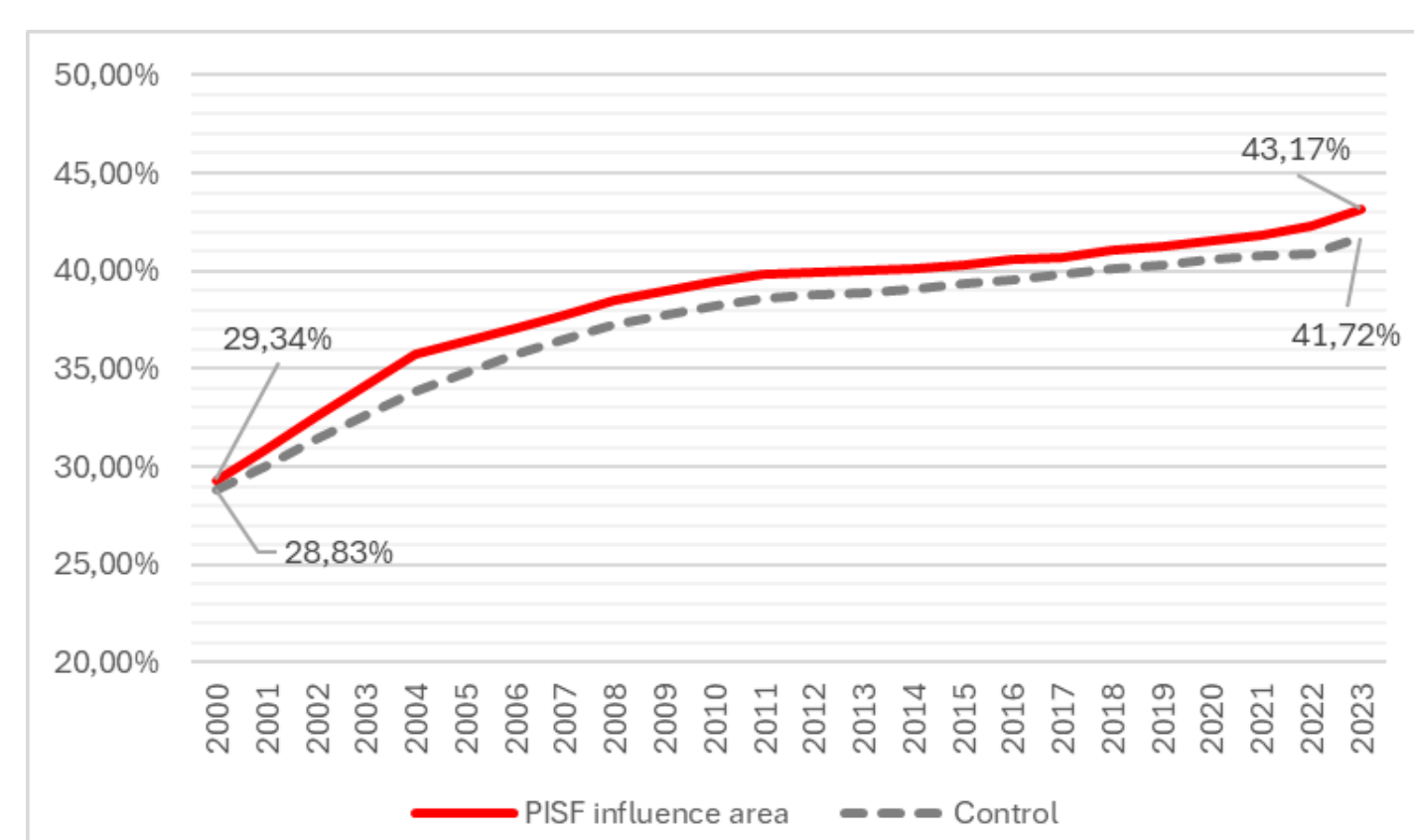


Figure 6. NVR in PISF influence area

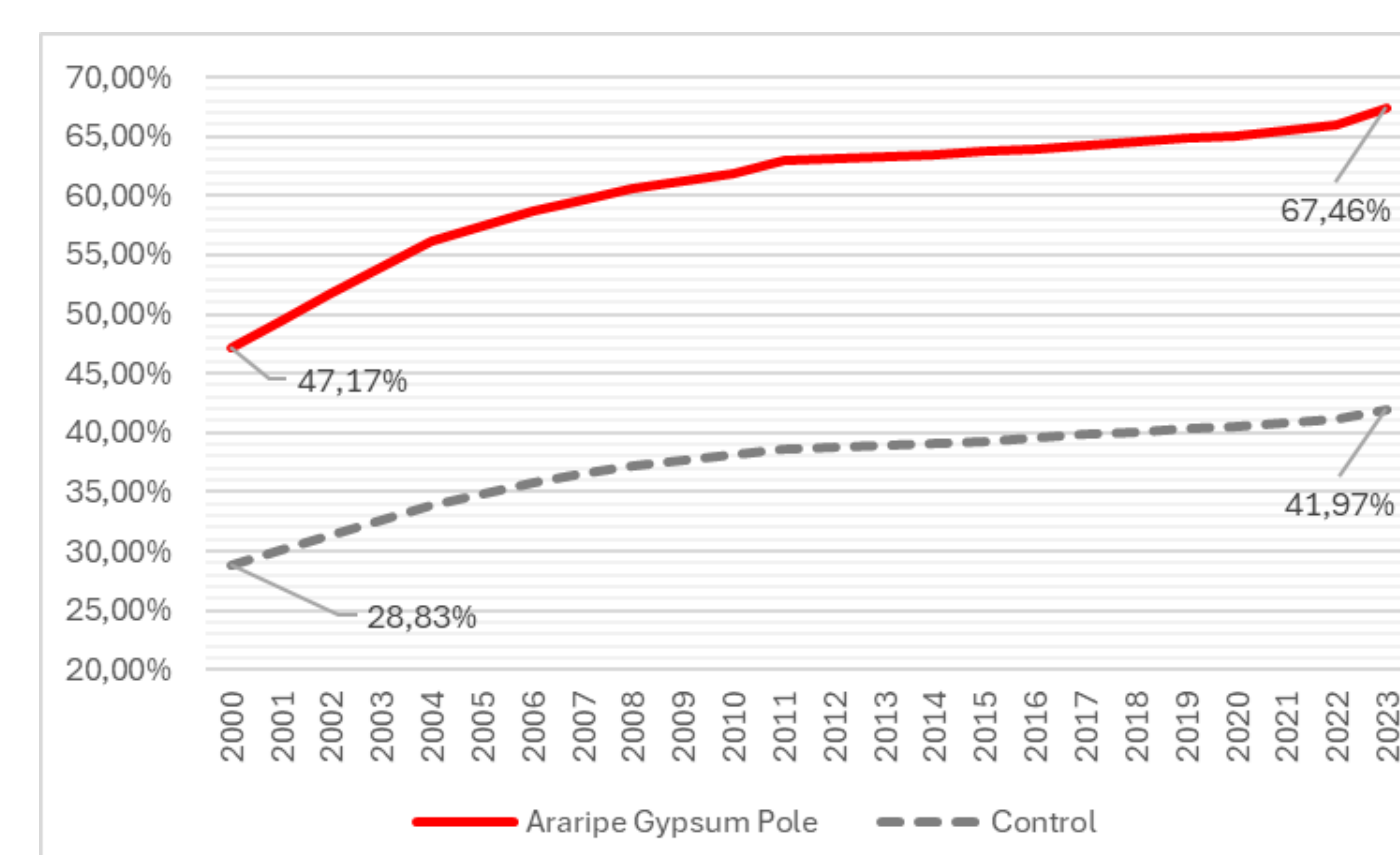


Figure 7. NVR in Araripe Gypsum Pole

4. Main discussions

The geographical patterns of NVR are coupled with some distribution patterns of cattle herds, based on IBGE surveys for the years 2000 and 2022, which are an important vector for NVR and a relevant source of pressure on the native vegetation of the Caatinga (Araujo et al., 2023).

Such results reinforce the need for more studies that present specificities of each case presented.