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Decadal precipitation in the municipal area of Paudalho - Pernambuco, Brazil

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Abstract

The objective is to carry out a climatological analysis of decadal precipitation and its historical comparisons using the historical series of rainfall from 1967 to 2015, which can contribute to decisions in sectors such as the economy, agriculture, irrigation, energy production, water resources, agronomic engineering, agricultural engineering, irrigation fire department, civil defense and government decision makers in case of extreme precipitation events that may occur in the future. The data were acquired from the Pernambuco Water and Climate Agency of the state of Pernambuco in the period from 1967 to 2015, for which the calculations of basic statistics were applied to define the decades of studies and their respective averages. The inter-neighborhood variability of rainfall distribution and local activities in conjunction with the active meteorological factors contributed or did not contribute to agricultural productivity, human and animal storage and supply. The study can be a tool for planning and actions aimed at the best way to manage water resources using capture and storage systems (taking advantage of the first months with high precipitation rates) and avoiding the problem of water scarcity.

Keywords: Spatial and Temporal Variability; Precipitation; Meteorological Factors; Agriculture; Irrigation

1. Introduction

For [1] stated that rainfall is of significant importance in characterizing the climate of a region, interfering with crop yields. Long periods of drought, causing damage to agriculture in the region, the water level of springs and reservoirs of hydroelectric plants, cause damage to urban supplies [17]. However, it is directly influenced by large-scale atmospheric and oceanic phenomena that take place over the Tropical Pacific and Atlantic [10].

Precipitation is an essential element in agricultural activities, based on the volume of rain and its distribution, it determines the types of agricultural activities in a certain location, according to [2].

[13] analyzed the occurrence of extreme rainfall events in Campina Grande, with daily rainfall data covering the years 1970–2010. The extreme events analyzed were those with the highest daily rainfall intensity for the years studied. The results showed that there was a change in the behavior of precipitation occurrences in the 70's. There was an intensification in the maximum precipitation, presenting a greater number of events with precipitation values greater than 80 mm. In general, there was no direct relationship between the intensification of precipitation and occurrences

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of ENSO events. Extreme events were evident in the rainy season months, with 88% of occurrences and 12% in the dry season, yet [14] analyzed the climatology of precipitation in the municipality of Bananeiras - Paraíba, in the period 1930-2011 as a contribution to Agroindustry and found that rain gauges are essential for agro-industrial sustainability.

Negative trends in precipitation nuclei, somehow, may denote the increase in times without rain over the years, both in the rainy season and in the dry season, further studies did not assess whether there is an increasing or decreasing trend in the importance of precipitation and in the number of extreme events for the semi-arid region of northeastern Brazil, thus the need to explore further studies is clear, especially when it comes to a semi-arid region such as the northeast, which experiences prolonged periods of drought in accordance with [7].

Segund [8] recalls that a natural disaster leaves marks on public health, aggravating the deficiencies of the public health system and increasing social differences between classes, since each family experiences the post-disaster in a unique and exclusive way. The poorest are usually sent to makeshift shelters, and those with greater purchasing power are able to temporarily move to another city.

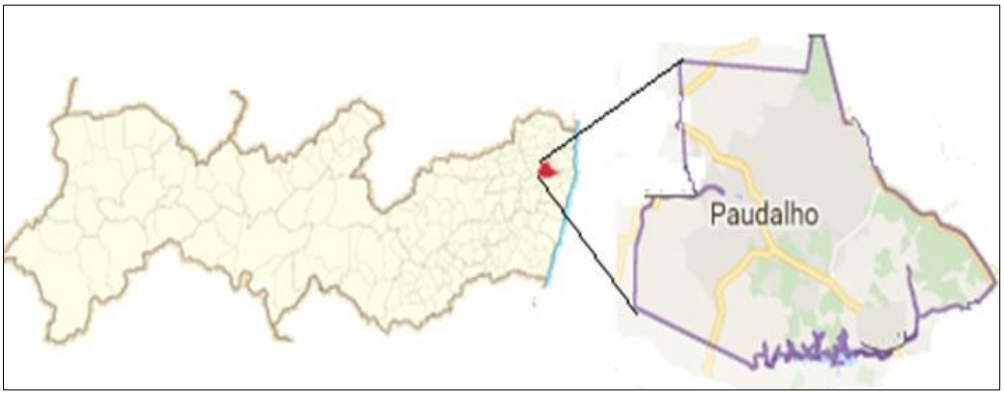
[9] Studied the climatological decadal rainfall and its historical comparisons for Recife - PE. The local contributions, the Intertropical Convergence Zone, the Maddem - Juliem Oscillation acted with intensity and caused mostly above-normal rainfall in some decades, registering disasters of moderate to intense proportions. The inter-neighborhood variability of rainfall distribution and local activities in conjunction with the active meteorological factors contributed or did not contribute to agricultural productivity, human and animal storage and supply. The influences of the El Niño and La Niña phenomena, for the decades under study in the form of adverse phenomena, had their isolated contributions.

[4] Characterized the variability of precipitation in the municipality of Cabaceiras, which may contribute to the planning and distribution of rainwater harvesting. The results showed that from September to December they have below average rainfall. Its annual rainfall is 336.6 mm with 86 years of observations.

The objective is to carry out a climatological analysis of decadal precipitation and its historical comparisons using the historical series of rainfall from 1967 to 2015, which can contribute to decisions in sectors such as the economy, agriculture, irrigation, energy production, water resources, agricultural and agronomic engineering, fire brigade, civil defense and government decision makers in the event of extreme precipitation events that may occur in the future.

2. Material and methods

Paudalho is located in the Mata mesoregion and in the Mata Setentrional Microregion of the State of Pernambuco, bordering to the north with Tracunhaém, to the south with São Lourenço Mata, Chã Alegria, Glória de Goitá and Camaragibe, to the east with Paulista and Abreu e Lima, and to the west with Lagoa de Itaenga and Carpina. The municipal area occupies 269.2 km2 and represents 0.27% of the State of Pernambuco. The seat of the municipality is located: latitude of 07°53'S and longitude of 35°10'W with an average altitude of 69 m, figure 1.



Source: Medeiros (2022)

Figure 1 Positioning of Paudalho in the State of Pernambuco

.The vegetation is predominantly subevergreen forest, with parts of subdeciduous forest and cerrado/forest. The soils of this geoenvironmental unit are represented by Latosols and Podzolics at the tops of plateaus and residual tops; by

Podzolics with Fregipan, Plinthic Podzolics and Podzols in the small depressions in the trays; by Concretionary Podzolics in dissected areas and slopes and Gleissolos and Alluvial Soils in floodplain areas. (CPRM, 2005).

The Intertropical Convergence Zone (CZIT) is the main rainfall system. The space-time irregularities of its occurrence, it is possible to predict when the CZIT will be over the municipality of Paudalho, and even its occurrence from year to year is subject to great variability in accordance with Per¬nambuco (2006). The formations of High Level Cyclone Vortex Systems (ASVC) when they form in the months of February to April and with their edges over the Brazilian Northeast (NEB) especially above the state of Pernambuco increase the cloud cover and cause rains of high intensity and short time interval, causing damage to communities such as flooding, floods, and the socioeconomic and agricultural sector [12].

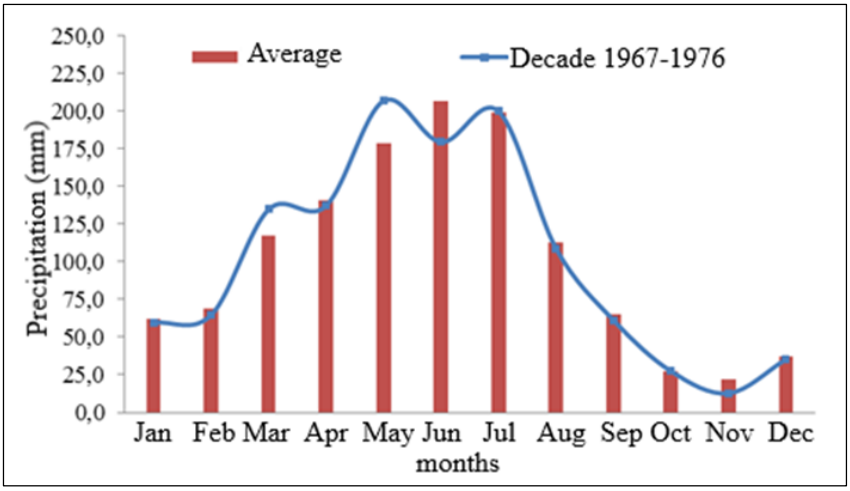
In the last decade Paudalho has endured changes in its climate, in years when the El Niño phenomenon occurs, the air temperature increases, as well as the thermal sensation, always above 30 ºC. The days with extreme rainfall are concentrated from April to August. The La Niña phenomenon causes the opposite effect, brings relief to the municipality, given that there is an increase in rainfall and a reduction in air temperature. In La Niña years the rainy season is more intense and its rains exceed 7 hours a day.

The climatic elements give rise to the climate that is observed in a restricted point of the territory such as a city, a region or a specific place, they are those that represent the values related to each type of climate characteristic of the study, with their variations in topography, relief , in vegetation, in both surface and underground water tables and the soil surface; temperatures, precipitation, air humidity, total insolation, cloud cover, evaporation and evapotranspiration, wind intensity and direction and the movement of air masses. The global climatic factors and the elements, which give rise to the climate on the planet, interact and act together.

The data were acquired from Pernambucan Water and Climate Agency of the State of Pernambuco in the period from 1967 to 2015, for which the calculations of basic statistics were applied to define the decades of studies and their respective averages.

3. Results and discussion

Climatological Precipitation and its comparison with the decade of 1967-1976 for the municipality of Paudalho - PE (Figure 2) demonstrate its decadal variability with climatological rainfall equaling the decadal indices for the months of January, February, April, July to October and December, in the months of March, May, the climatological rainfall indices were higher than the decadal ones. The months of June and November the decadal pluviometry was superior to the climatology. Studies with similarities were developed by [5; 6].

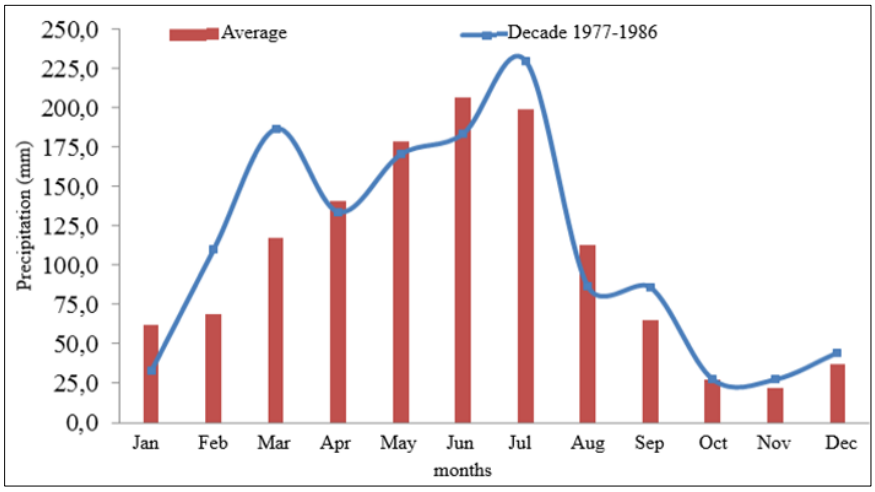


Source: Medeiros (2022).

Figure 2 Climatological precipitation and its comparison with the decade of 1967-1976 for Paudalho – PE

With historical rainfall above decadals (1977-1986) (Figure 3) for the months of February, March, July. With climatological rainfall below the decadal period, recorded in January, April, May, June, August, September, November

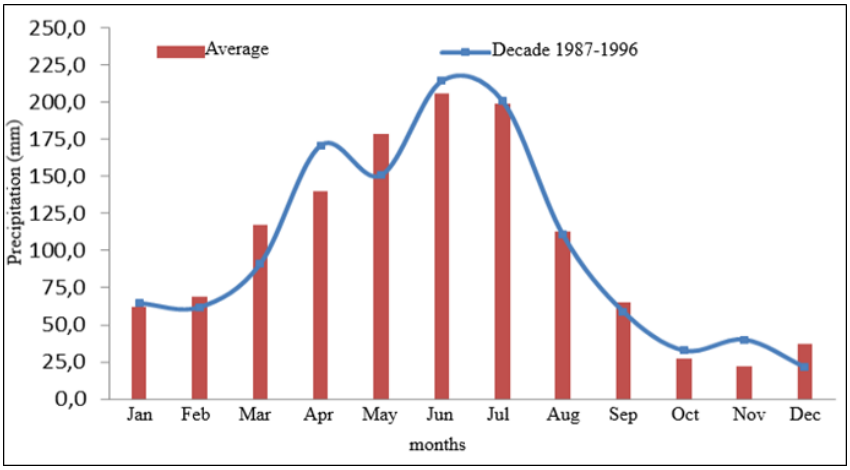
and December, these rainfall variability are linked to the synoptic systems operating in the region and in the study area [12; 9].



Source: Medeiros (2022)

Figure 3 Climatological precipitation and its comparison with the decade of 1977-1986 for Paudalho – PE

Figure 4 shows the decadal rainfall (1987-1996) and climatological oscillations for the study area. Historical precipitation was greater than decadal in the months of April, June and December. The decadal indices are equal to the climatological ones in the months of January, July, August and September. In the months of February, March, May, October and November the climatology was inferior to the decadal index, such variability is demonstrated in the studies of [9; 15b, similarities were found in the study of [15a].



Source: Medeiros (2022)

Figure 4 Climatological precipitation and its comparison with the decade of 1987-1996 for Paudalho – PE

With irregular rains both in the decade and in the climatology, its variability can be observed in Figure 5. The decadal rains from February to May, July, September and December flowed below the climatology. In the months of January and May, the decadal rainfall rates were the same as the climatological ones, such similarities were found in studies by ([15b; 9 and 11].

Figure 6 shows the climatological rainfall variability and its comparison with the decade 2007 - 2016 for the municipality of Paudalho - PE. The rainfall indices were above the climatological average, except for the months of February, March, September and November. The study by [15a] corroborate the results discussed. These variabilities are in accordance with studies by [9; 16b].

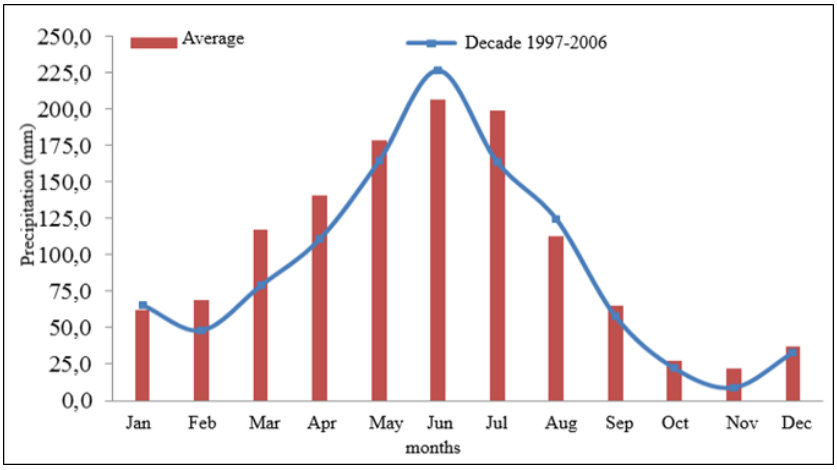
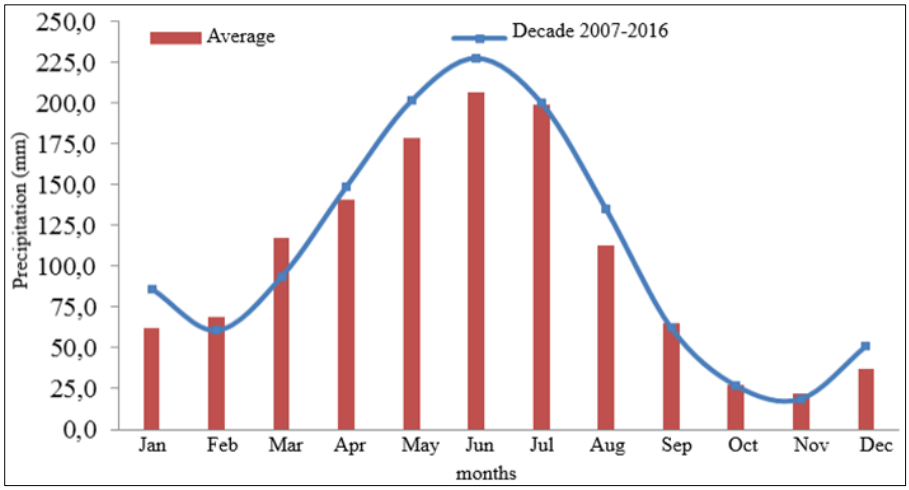


Figure 5 Climatological precipitation and its comparison with the decade of 1997-2006 for Paudalho – PE



Source: Medeiros (2022)

Figure 6 Climatological precipitation and its comparison with the decade of 2007 - 2016 for Paudalho - PE

4. Conclusion

The local contributions, together with the Intertropical Convergence Zone, and the Maddem - Juliem Oscillation acted with moderate to strong intensity and caused above-normal rainfall in some decades, caused by environmental, regional and local disasters such as prolonged drought, extremes in short intervals of time causing flooding, flooding of streets, neighborhoods, traffic disruption, floods, landslides, silting of streams, streams, rivers, lakes and ponds, overflow and drying up of medium to large dams, affecting the water table of water from lakes and ponds, losses and excess of crops, altering human and animal thermal comfort, causing disturbance in agribusiness, agriculture, pasture and urban and rural afforestation, reduction or total drought of streams, rivers, streams, ponds and lakes and the lack of water and its scarcity for human survival and agriculture.

The inter-neighborhood variability of rainfall distribution and local activities in conjunction with the active meteorological factors contributed or did not contribute to agricultural productivity, human and animal storage and supply. The study can be a tool for planning and actions aimed at the best way to manage water resources using capture and storage systems (taking advantage of the first months with high rainfall) and avoiding the problem of water scarcity.

Compliance with ethical standards

Disclosure of conflict of interest

The authors' participation was equal in the development of the article

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