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Paudalho – Pernambuco Its Fluctuations in Precipitation and in The Number of Days of Rain and The Implications for Agriculture

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ABSTRACT

The objective is to analyze the relationship between the number of rainy days and precipitation in the city of Paudalho - PE, making information that can serve as an indication for the proper use of rainwater, with better planning in the agricultural, agribusiness, and water storage areas for human and animal survival and their respective monitoring in urban and rural areas and to decision-makers in case of extreme precipitation events. Means, standard deviation, coefficient of variance, maximum and minimum absolute values of the study area were calculated. An electronic spreadsheet was used for the graphic elaboration and its analysis. Precipitation and the number of days with rain data were analyzed in terms of annual totals and quarterly totals. The existence of a temporal trend for annual and quarterly precipitation was verified by applying the F test of the linear regression analysis at the 5% probability level, and when the F value is equal to or less than 0.05, it verified the significance of the temporal trend of the data. Aiming to contribute to rainwater catchers more significant information for better planning of this catch. The occurrence of climate phenomena on a global scale, such as El Niño and La Niña, also modify the rainfall pattern, increasing or decreasing volumes in the State of Pernambuco and in the municipality of Paudalho. The rains that occurred in the period from 1968 to 2015 show great spatial and temporal variability, noting that even with the occurrence of days with rain above 160 days, there was a rainfall index between normality and the occurrence of days with smaller rainfall, the rainfall index were good for those of the climatological; These oscillations were due to large-scale factors in the period that caused floods, floods, flooding, landslides, overflows of lakes and lakes, streams, and streams.

INTRODUCTION

The knowledge of the seasonal variability of rainfall and the number of rainy days and, consequently, their variation over a cropping cycle is imperative to obtain satisfactory yields in agriculture and water storage. It is through this information that it is possible to plan the best planting time, plan and scale irrigation systems, monitor favorable conditions for the occurrence of pests and diseases, in addition to a series of other activities inherent to agribusiness, and hydrology.

Not only does agribusiness benefit from such information, but the entire productive sector that is directly or indirectly influenced by the occurrence or not of rain, such as tourism, civil construction, transport, logistics, etc. thus, prior knowledge of the variation of these meteorological elements throughout the year, allows for safer planning of the most diverse activities, reducing risks and minimizing the losses inherent to such events, consequently reducing operating costs.

According to Arai et al. (2009), precipitation is of significant importance in the characterization of the climate of a region, directly intervening in crop yield changes. Long periods of drought, in addition to causing damage to agriculture in the region, affect the water level of water sources and reservoirs of hydroelectric plants, which can cause damage to urban supply and electricity generation, according to a statement by Silva et al.(2011).

Medeiros et a*l.* (2012) showed that the correlations between the number of rainy days and precipitation were verified by the F test at the 5% level for the municipality of Cabaceiras. With annual precipitation of 1,337.8 mm recorded in 80 days with rainfall. The months with the highest rates of precipitation were February, March, and April, totaling 860.5 mm distributed over 46 days over the three months. In the quarter of August, September, and October there was the least rainfall, with 60.6 mm in 12 days. In years with below-average rainfall, there was a better temporal distribution of rainfall, as opposed to when it rained above average, where rainfall was more concentrated in time. There was a significant increase in precipitation and the number of rainy days in the 1st quarter of the year, while in the 2nd and 4th quarter, this trend is inverse, that is, there is a reduction in precipitation and the number of rainy days, when considering the period from 1913 to 2005, thus helping rainwater catchers to better plan their catchment.

In Northeastern Brazil (NEB), a region where most of the population survives from rainfed agriculture, crop success strongly depends on the amount and regularity of rainfall, by the statement to Silva et al.

(2011). Studies such as the one by Chiaranda et al.(2012), on rainfall rates, showed that it is essential for planning agricultural activities, as it allows for more consistent forecasts and more reliable decisions.

Climate variability is considered to be the climate variations as a function of the natural conditions of the globe and their interactions, according to the statement by Tucci (2003). Yevjevich (1972) defines trend or variation "as a systematic and continuous change in any parameter of a given sample, excluding periodic or quasi-recurrent changes". Nunes and Lombardo (1995) discuss scalar interactions, highlighting the difficulty in detecting possible changes. And it also points out the difficulty of detecting those global processes were affected by facts arising at other scales.

Population growth, the industrialization process, and the consequent increase in the demand for water in large urban centers have caused the insufficiency and degradation of surface and underground springs close to these regions, generating the need to seek greater volumes of water, in places each time. more distant, with a high energy charge.

The objective is to analyze the relationship between the number of rainy days and precipitation in the city of Paudalho - PE to produce information that can serve as an indication for more appropriate use of rainwater, with better planning aimed at the agricultural issue, agribusiness, and water storage for human and animal survival and their respective monitoring for urban and rural areas and decision-makers in case of extreme rainfall events.

MATERIALS AND METHODS

Paudalho is located in the Mata mesoregion and in the Northern Forest Microregion of the State of Pernambuco, bordering on the north with Tracunhaém, on the south with São Lourenço Mata, Chã Alegria, Glória de Goitá and Camaragibe, on the east with Paulista and Abreu e Lima, and to the west with Lagoa de Itaenga and Carpina. The municipal area occupies 269.2 km^2 and represents 0.27% of the State of Pernambuco. The seat of the municipality is located: latitude 07°53'S and longitude 35°10'W with an average altitude of 69 meters. (CPRM, 2005).

The vegetation predominantly in the municipal area is of the sub-evergreen forest type, with parts of sub-deciduous forest and cerrado/forest. The soils of this geoenvironmental unit are represented by Oxisols and Podzolics in 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 municipality of Paudalho is inserted in the domains of the Hydrographic Basin of the Capibaribe River. Its main tributaries are: the Capibaribe, Sampaio and Goitá rivers, in addition to the streams: Gameleira, Pau Amarelo, Barrigão, dos Macacos, Araçá, Piação, Murioga, Fortaleza, Dendê, Cavalcante, Vargem Grande, Caipora, Caiana, Jacaré, do Cajueiro , Tabaruma, Tabatinga, Pitangueiras, Camurim and Córrego Verde. The main bodies of accumulation are the weirs: Cursaí (7,624,000m^3), Pau Amarelo, Zumbi, Tabaruma, Bicopeba, Carvalho and the dams: of ora and Goitá. The main water courses in the municipality have a perennial flow regime and the drainage pattern is dendritic. (CPRM, 2005).

The Intertropical Convergence Zone (ITCZ) is the main meteorological system that causes rainfall. The formations of the High-Level Cyclonic Vortex Systems (VCAS) during their formation in February to April and with their edges over the NEB, especially above the state of Pernambuco, increase the cloud cover and causes high intensity and short rains time interval, causing damage to communities such as flooding, floods, floods, and the socioeconomic and agricultural sector. (MEDEIROS 2018).

Rainfall data were obtained from APAC (Pernambucan Water and Climate Agency) covering the period from 1968 to 2015. Means, standard deviation, coefficient of variance, maximum and minimum absolute values for the study area were calculated. An electronic spreadsheet was used for the graphic elaboration and its analysis. According to the Köppen-Geiger classification, the climate is tropical with a dry season (SA). According to the Thornthwaite climate classification, the climate is of the sub-humid dry type (C1s).

It was evaluated as a rainy day, any day in which its index was greater than 0.0 mm. Precipitation and the number of days with rain (ndcc) data were analyzed in terms of annual and quarterly totals. The existence of a temporal trend for annual and quarterly precipitation was verified by applying the F test of the linear regression analysis at the 5% probability level, and when the F value is equal to or less than 0.05, it is verified the significance in its temporal trend. These contributions are of fundamental importance to rainwater catchers whose information is significant for better planning of these catches.

RESULTS AND DISCUSSION

The annual precipitation of the municipality of Paudalho-PE in the period (1968-2013). It is shown through graphics with rainy days and their variability, the highest rainfall rates, the rainy quarters and dry quarters, the dispersion, and the coefficient of determination.

In Figure 1, irregular variability in the occurrence of precipitation and rainy days for the municipality of Paudalho can be observed, in the average annual rainfall for the period 1968-2015. for the series under study. In 1968 it rained 1,100 mm in 140 days; in 1987, 2,200 mm were recorded with 140 days of rain.

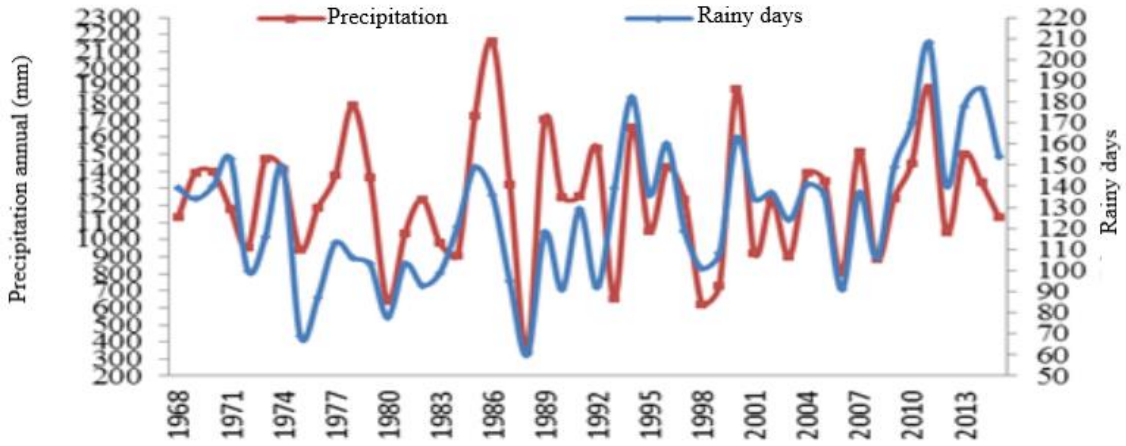

Figure 1. Average annual totals of precipitation and rainy days in the municipality of Paudalho for the period 1968-2015.

Source: Medeiros (2021).

In 1988 there were 60 days of rain with annual precipitation of 350 mm; 1975 the occurrence was 70 days of rain with precipitation of 950 mm; 1980 there were 80 days for precipitation of 650 mm; in 2006, it rained 90 days totaling 800 mm of precipitation; the highest rainfall rates recorded in the series were in 2010 with 210 days with an annual rainfall of 1,900 mm; in 2013 there were 190 rainy days and a precipitation index of 1,600 mm; in 1993, 180 days with 1,700 mm were observed; already in the years 1996 and 2000 they had 160 days of rain and for the year 1996 there was a precipitation of 1,450 mm, and in 2000 there was annual precipitation of 1,900 mm. These irregularities were due to the variability of meteorological systems operating in the study period.

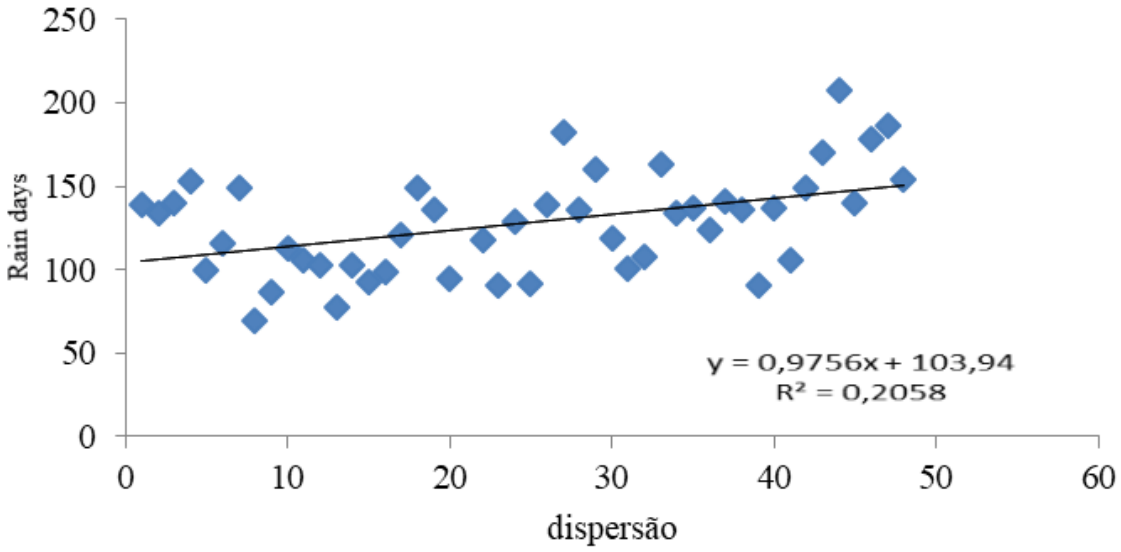

Figure 2. Dispersion of days with occurrences of rain in the period 1968-2015 for the municipality of Paudalho – PE.

Source: Medeiros (2021).

In Figure 3, irregular variability in rainfall can be seen for the municipality of Paudalho, in the average four-monthly rainfall for the period of the series under study. Rainfall fluctuations from 10 to 75 mm are observed, ranging from 0 to 55 days with rain for the period 1968 to 2015. In 1968 there was precipitation of 70 mm for 33 days. In the four months of 1984, there were 55 days with rainfall with 40 mm of precipitation. In the four months of 1987, the lowest index of rainy days was registered, with 0 days with 32 mm of precipitation. In 1989, the highest rainfall recorded in the series under study was noted, with a rainfall of 75 mm with a period of 25 days with rain. In the years 2001 and 2002 there were regularities of precipitation with 60 mm with a period of 25 days of rain. In 2015 there were 13 days of rain with precipitation of 40 mm.

A straight line trend with a positive slope and low significance R2 is observed, demonstrating high dispersion and irregularities in the distributions with rainy days and high dispersion.

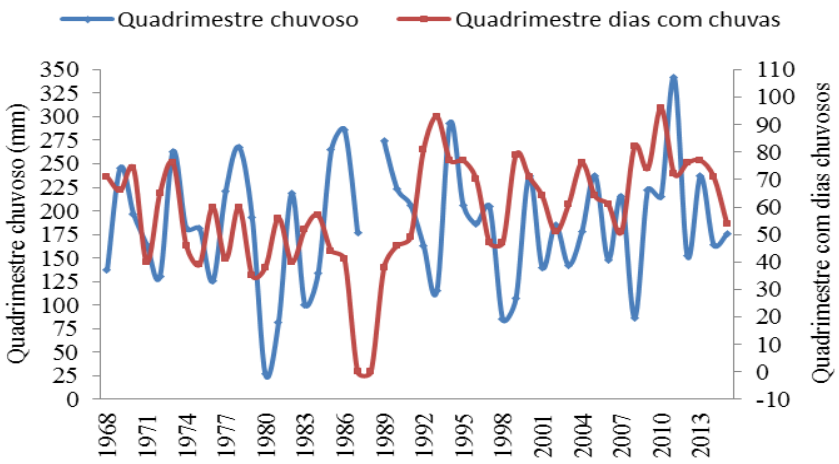

Figure 3. Average totals of precipitation in the rainy four-month period followed by the days with occurrences of rain in the period 1968-2015 in the municipality of Paudalho - PE.

Source: Medeiros (2021).

Figure 4 It is observed that in the rainy four-month period between the months of April, May, June, and July, the correlations presented a coefficient of determination (R^2), of low significance and high dispersion in the occurrences of annual rainfall irregularities, the irregularities have interconnected the fluctuations of the synoptic systems of meso and micro-scale then from local and regional contributions.

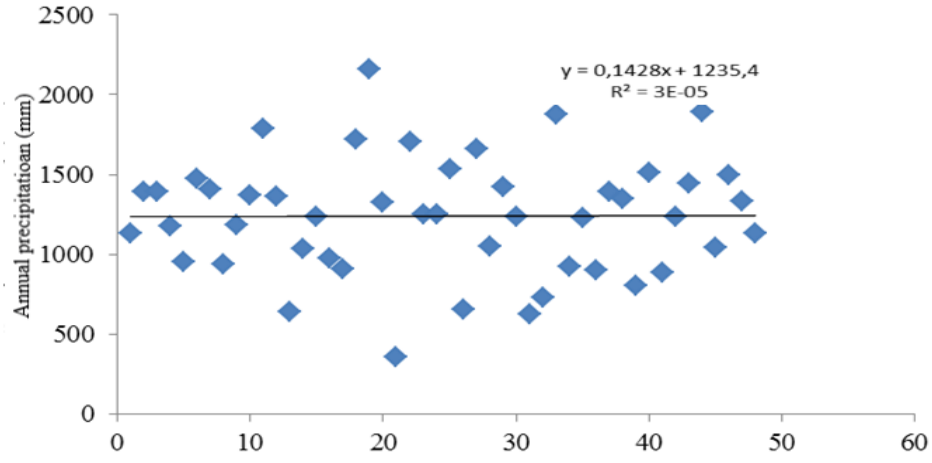

Figure 4. Dispersion of annual rainfall for the period 1968-2015 for the municipality of Paudalho – PE.

Source: Medeiros (2021).

In Figure 5, the variability of irregularities regarding the occurrence of rainfall for the area under study is highlighted. It is observed that the precipitation of the dry quarter varies from 10 to 75 mm, and from 5 to 55 days of precipitation for the series under study. In 1968, precipitation of 70 mm is observed for 32 days with rain. It stands out in the series peaks with rainy days as in 1984 with 55 days for precipitation of 40 mm; in 1990, 50 days were recorded for 20 mm; in 2010 53 days were registered for 65 mm; the year 2013 registered 50 days with the occurrence of a 50 mm rain gauge. In 1989, the precipitation index was recorded with 75 mm for 25 days of rain.

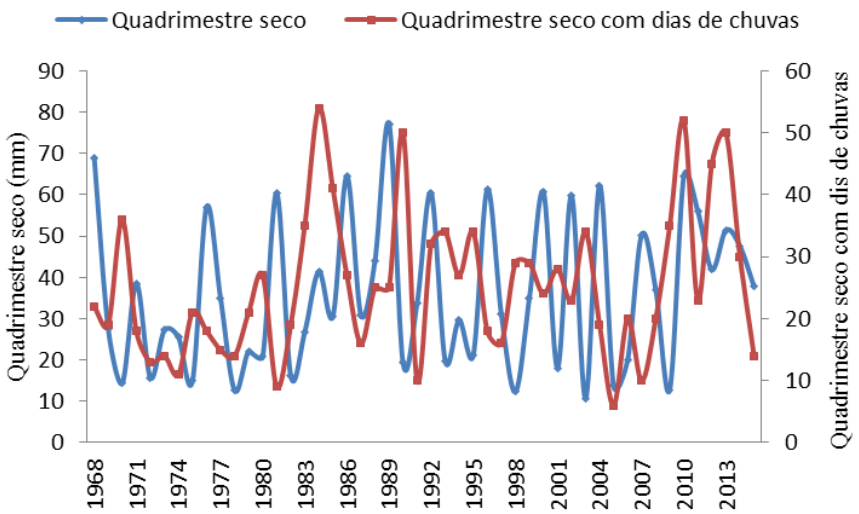

Figure 5. Average totals of precipitation in the dry quarter followed by the days with occurrences of rain in the period 1968-2015 in the municipality of Paudalho - PE.

Source: Medeiros (2021).

CONCLUSIONS

The rains that occurred in the period from 1967 to 2015 show great spatial and temporal variability, noting that even with the occurrence of days with rain above 160 days, there was a rainfall index between normality and the occurrence of days with smaller rainfall, the rainfall index were good to those of the climatological; these oscillations were due to large-scale factors in the period that caused floods, inundations, floods, flooding, landslides, overflows of lakes and lakes, streams and streams.

The analysis of precipitation data and the number of days with occurrences of precipitation during the period 1967 - 2015, between October, November, December, and January, months considered dry, shows variability in rainy days with fluctuations from 6 to 8 days and below the climatological average.

The effects of sea and land breeze and the influence of sea temperature prevail over rainfall fluctuations and the number of days with rain in the studied area.

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