FREQUENCY ANALYSIS OF RAINY AND DROUGHTY MONTH FROM THE CLIMATOLOGICAL POINT OF VIEW IN DOLJ COUNTRY

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ABSTRACT. Nowadats, drought is affecting large areas from the Romanian territory. In the south in the last 30 years, there was a decrease in rainfall and atmospheric drought effect gradually intensifies. Dolj country presents a great vulnerability to drought, identified in annual and monthly level during 1980-2009, with specific methods of standard deviation of precipitation, widely used in specialty literature.

Keywords: Dolj, drought, rainfall, rainfall standardized anomalies

1. INTRODUCTION

Under the environmental report, drought can cause degradation of agricultural land and reduce soil biological potential, while on the economic plan, this affects, first of all, primarily agricultural production and threatening food security of the population. From a social perspective, drought generates poverty, especially among the rural population, human activities affecting the health of the population.

"Drought is defined as a complex climatic and hydrological factors that reduce the intensity of a certain region of the water cycle over a longer or shorter period of time and firstly cause stagnation in growth or drying plants." (N. Topor, 1963). "Octavian Bogdan (1999) complements this definition considering that drought is "a complex phenomenon, characterized by insufficient moisture in the atmosphere and soil (in the root system) influenced by thermal regime and increase potential evapotranspiration".

Dolj Country is part of the historical province of Oltenia, located in the south-west of Romania, about 50 km east of the Carpathian loop that combines the Balkans, so to the west end of the vast mountain depressions between two units (fig. 1).

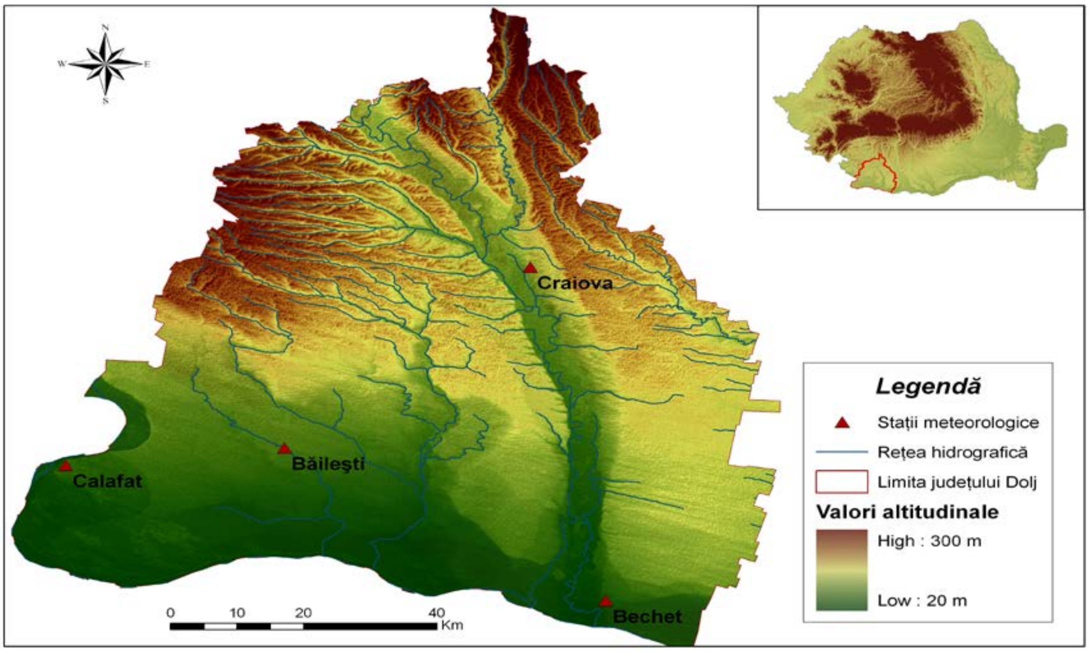

Fig. 1 ***Location of weather stations in Dolj county***

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In this study were analyzed the frequency of rainy and dry months in the period 1980-2009, in Dolj Country, appointed by N. Topor, "the focus of drought" in Romania emphasizing the phenomenon of atmospheric drought with methods presented in section 2.2.

2. DATA SOURCES AND METHODS

2.1. Data sources and types

Climate data used here come from weather stations archives in the studied area : Craiova, Bechet, Calafat and Bailesti, which belong to the National Network of National Meteorological Administration. Rows of data cover a period of 30 years (1980-2009). The climate elements analyzed for identification of atmospheric droughts will be precipitation amounts. The chosen weather stations cover the entire territory and present different situations in terms of precipitations amounts which are influenced by local conditions of weather stations location (Table 1).

Table 1. ***Location of weather stations in Dolj country***

Serial number	Weather station	The average altitude	Latitude	Longitude
1	Bechet	40	$43^{O}47'$	$23^{O}56'$
2	Băileşti	53	$44^{O}01'$	$23^{O}19'$
3	Calafat	44	$43^{O}59'$	$22^{O}56'$
4	Craiova	108	$44^{O}01'$	$23^{O}19'$

2.2. Research methods used

To achieve the proposed study will be used both statistical and mathematical general methods and specific methods for studying the main climate elements.

2.2.1. Among *statistical and mathematical methods* I used the percentage deviation and the standard deviation methods and also the method of least squares to calculate trends in precipitation used to identify the phenomenon of drought;

2.2.2. Among *specific methods* I used: standardized precipitation anomaly (ASP) and weighted standardized precipitation anomaly (ASPP).

Precipitation standardized anomaly is calculated as: $ASP = \frac{x_i - \overline{x}}{\sigma}$ where:

xi = the amount of precipitation in a given year

$\overline{x}$ = Average annual amount of precipitation for the period analyzed (in this case, 30 years for most stations)

σ = standard deviation (also known as mean *square deviation*, *standard deviation*)

Standard deviation is calculated by taking the square root of the variance (σ2) and the formula for calculating the variance (σ^2) is:

$$\sigma^2 = \frac{\sum_{i=1}^{n}\left(x_i - \overline{x}\right)^2}{n}$$ where *n* is the number of the year.

To avoid undue influence of precipitation standardized anomaly values recorded during the months which are usually dry or less rainy, the ASPP is calculated as follows: they are weighted by multiplying the fraction's ASP, which is of that the average annual rainfall (annual average obtained by dividing the average month to the average of year). (Croitoru, 2006). Once calculated these abnormalities, according to their results we could highlight the conclusions regarding the classification of a period (month, year) in a category, naming it dry, wet or normal (Table 2).

Table 2. ***Character of the rainfall anomaly years according to standardized precipitation***

Rating	**ASP**
Dry	-0,51 … ≤-2,5
Normal	-0,50 … 0,50
Rainy	0,51 …≥ 2,5

3. RESULTS

3.1. Variability in annual quantities of precipitation

Rainfall is characterized by great variability in the frequency, intensity and duration. Annual rainfall regime as an important general feature we notice a decrease in rainfall from north to west (which is over 600 l / m²) to the south - east (where it falls below 400 l / m²) while increasing the influence of aridity. In each case, at the four weather stations we can notice a decrease in rainfall in 1983, where the annual amount is below 400 mm (Fig. 2).

Years like 1983 and 1999 are regarded as deficient rainfall, in Dolj country (Fig.3).

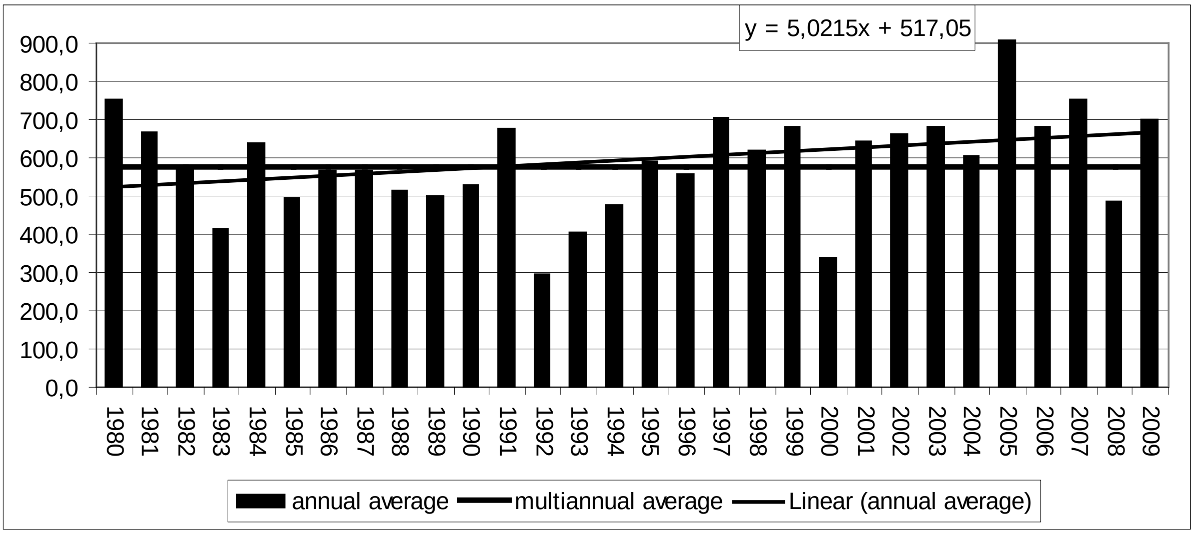


Fig. 2. ***Variability in annual quantities of precipitation station Craiova***

The analysis of table No. 3, one can observe a decreasing trend of rainfall increase with decreasing altitude, namely from *Craiova* to *Calafat*, where decreasing to a value 5,0215 mm/year, respective to 3,6462 mm/year.

Table 3. ***Trend slope values of the evolution of precipitation***

Station	Trend slope value (mm/an)
Craiova	5,0215
Bechet	2,7086
Băilești	2,8664
Calafat	3,6462

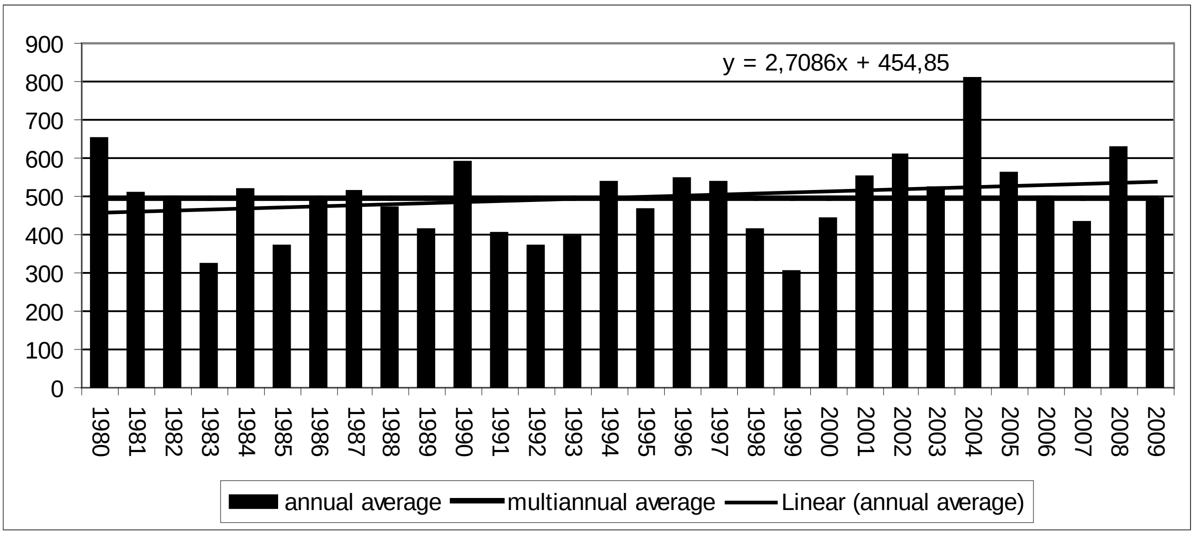


Fig. ***3 Variability of annual quantities of precipitation at Bechet weather station***

At *Bailesti* weather station, the record of the annual maximum level is seen as at *Calafat station* in 2005, when there was a value of 850 l/m in May at the top, where there was a quantity of 112, 3 l / m (Fig. 4).

Low is surprisingly common in dry year 2000, where the annual amount of precipitation was 271.5 l/m², in September recorded an amount of 3 l/m², and in November of 3.2 l/m². The year 2001, shows a doubling of rainfall and in the coming years until 2009 the amount of precipitation to exceed 500 l/m², annual average (Fig. 5).

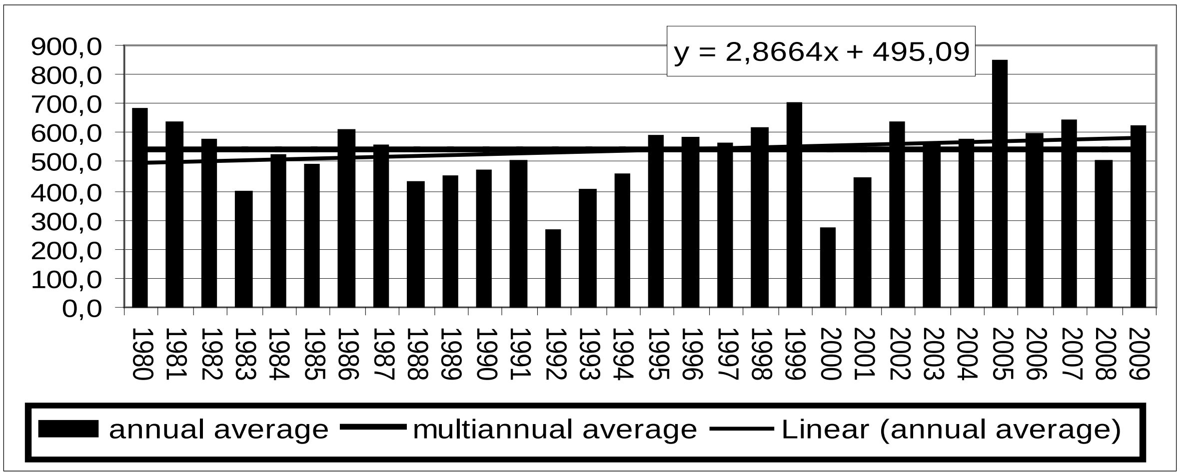


Fig.4 ***Variability of annual quantities of precipitation at Bailesti weather station***

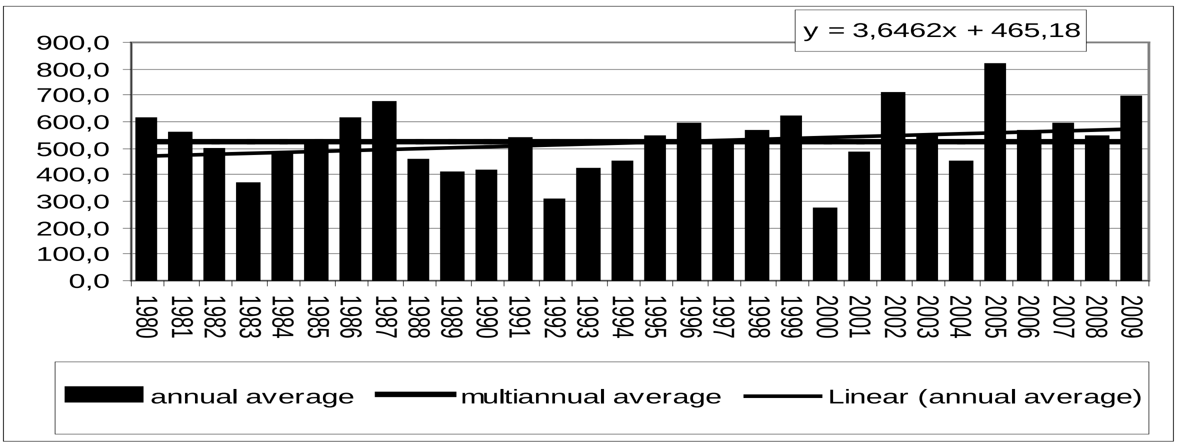
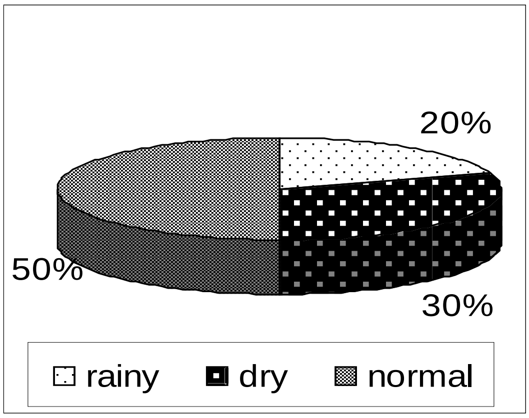


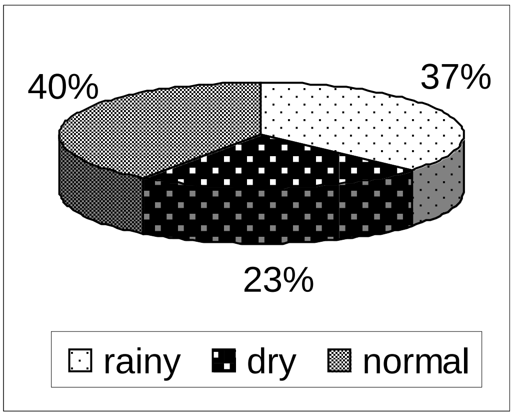
Fig. 5 ***Variability of annual quantities of precipitation at Calafat weather station***

3.2 The standardized anomaly in precipitation

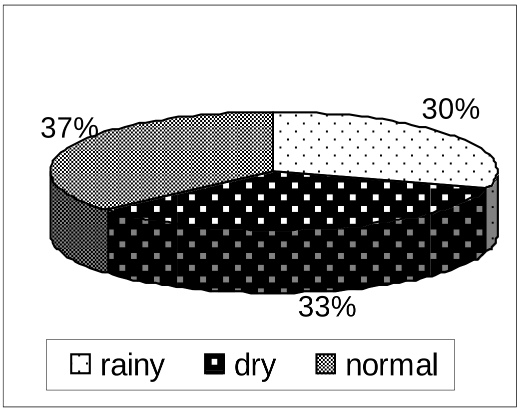
From north to south, the percentage of the average yearly frequency on rainfall areas suffers some differences. The rainy domain at the *Craiova station*, registers a percentage of 37%, subsequently decreasing towards the south of the county, at *Bechet*, where this domain has a 20% share.



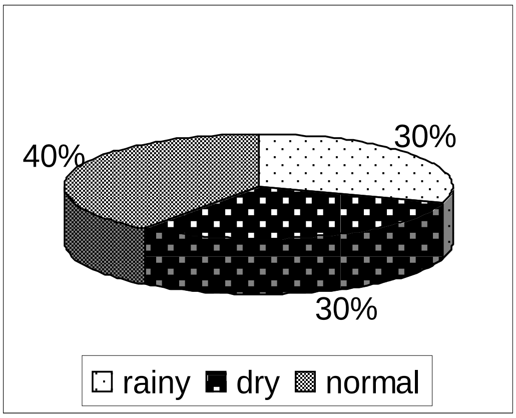
a. Bechet



b. Craiova



c. Calafat



d. Băilești

Fig.6 The average yearly frequency on rainfall areas in the Dolj county (1980-2009)

A contrary situation is registered when it comes to drought, where at *Bechet* the dry domain has a 30% value, in comparison to the 23% registered in the north, at *Craiova*.

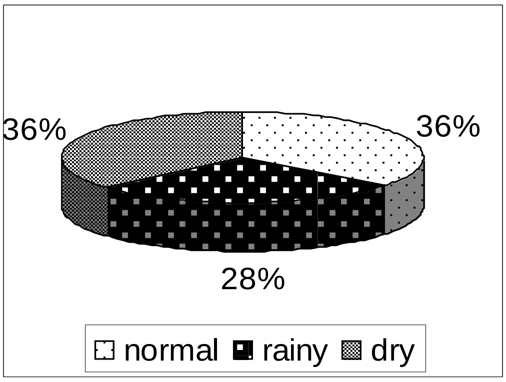
The normal range for the share of two stations, the situation is different recorded a 40% to *Bechet* station and 30% to *Craiova station*. The altitude of the weather station also generates differences in the case of the *Calafat* and *Băilești* stations, in the south-west of the country. At *Băilești* the dry domain has a 30% share in comparison to dry domain at *Calafat*, which registers 33%. The differences are also noticed in the case of the normal domain, where at *Băilești* registers 40%, and at *Calafat* registers only 37%. Similarities exist in the rainy domain, where both stations have an equal percentage of 30%.

3.3 Wheighted anomaly of stadardized precipation

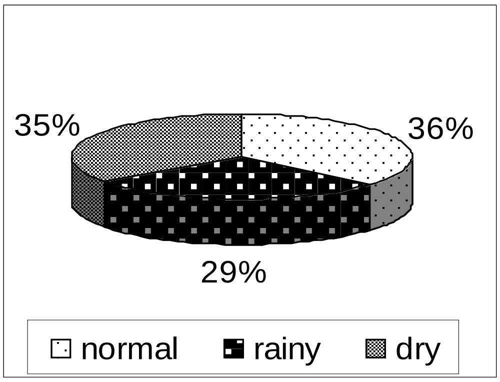
From the analysis resulted in commun period of 30 years, at the four stations in Dolj country, emerge the following:

At the *Bechet station* during the 30 year period of time (360 months), have been counted 129 normal months (35,83%), 99 rainy months (27,5%) and 132 dry months (36,66%). At the *Craiova station*, for the same period have been counted 131 normal months, (36.38%), 103 rainy months (28,61%) and 126 months (35%).

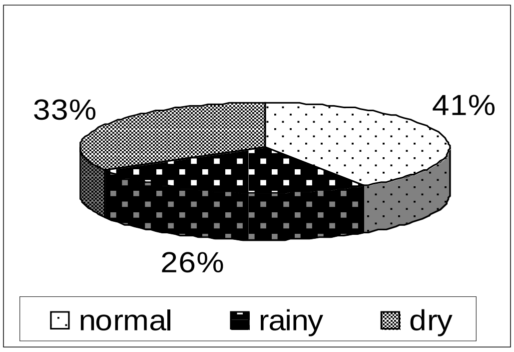
At *Calafat* have been counted 148 normal months (41,11%), 92 rainy months (25,55%) and 120 dry months (33,33%). At the *Băilești station*, during 30 year interval analized (360 months) were counted 143 normal months (39,72%), 92 rainy months (25,55%) and 125 dry months (37,72%).



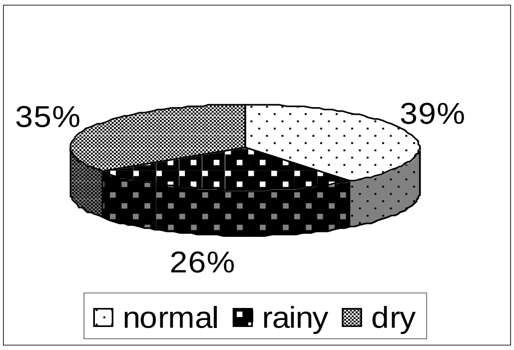
a. Bechet



b. Craiova



c. Calafat

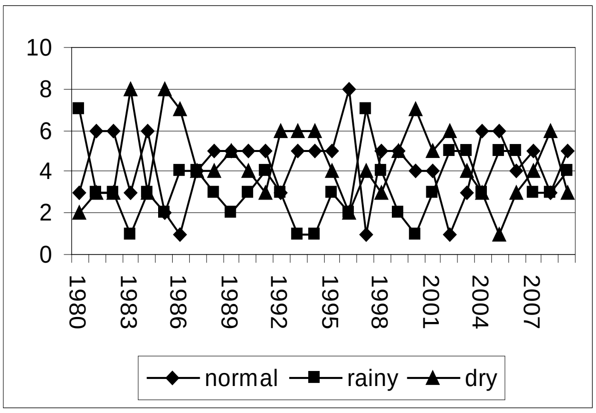


d. Băileşti

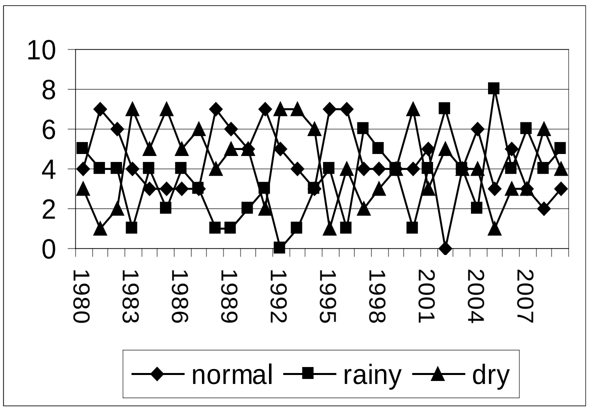
Fig.7. The average monthly frequency on rainfall areas in the Dolj county (1980-2009)

3.4. *Year by year frequency of the normal, rainy and dry months*

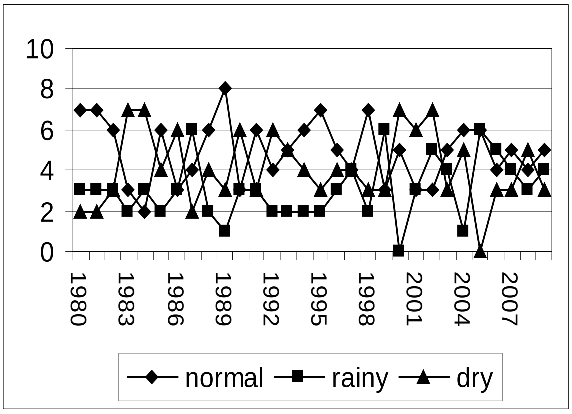
From analizing the frequency of the rainy and dry months at the *Bechet station* graphic, it has been noticed that, during the years, four years have registered one rainy month per year. These years are 1983, 1993, 1994 and 2000. In the matter of the presence of only one dry month during a year, it is observed that it was registered in the year 2005, a rainy year.

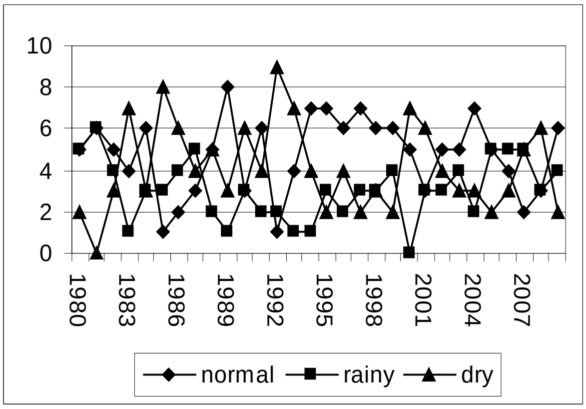


a. Bechet



b. Craiova





c. Calafat **d. Băileşti**

Fig.8 ***The frequency of the normal, rainy and dry months at the Dolj country (1980-2009)***

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At the *Băilești station* we have a notable situation, because in the 30 year interval analyzed, years that have not registered any dry months have been observed, like the year 1981. In the same time we have year that have not registered and rainy months, the year 2000, when the drought did a large amount of damage in the county. A similar situation is noticed at the *Calafat station*, where in the year 2000 there are no rainy months registered, and in the year 2005, when no dry months are registered.

At the *Craiova station*, in the year 1992 there have not been registered any rainy months, and in the year 2002, there have not been registered any normal months. There have only been rainy and dry months, with the rainy domain having the larger share, 7 months, and the dry domain having a share of 5 months.

4. CONCLUSIONS

Given the negative consequences on the human activities, for this risk phenomenon, the drought has always manifested interest, especially in the southern part of the country. Year to year, under the influence of the atmospheric circulation, the quantity of rainfall registers large variations from the multiannual averages. Thus, during the exceptionally rainy years, the quantities of water have exceeded about twice the average amounts, and during the dry years they have been reduced to less than half the average amounts.

Trend of decreasing precipitation amounts from north of south influences the percentage of the rainfall areas, therefore the dry domain holds take a fairly large share, detrimental to the rainy domain. In the matter of the absolute monthly frequency on rainfall, during the 30 years analyzed, the normal domain between 129 (at the *Bechet station*), and 148 cases, (at *Calafat*), the rainy domain between 92 months, (at *Băilești* and *Calafat*), and 103 rainy months, registered at the *Craiova station*. The lowest value for the dry domain is registered at the *Calafat station*, which is 120 dry months, and the highest value is registered at the *Bechet station*, which is 132 dry months.

In order to reduce the risk phenomenon of the drought, which affects Dolj country, propositions of mitigation methods are being made, such as the usage of appropriate agriculture techniques, which favor neither the erosion processes, nor the soil compactasion and salinisation. The increase if the albedo of the active surface should not be favored, especially of the dry surface, the increase of the temperatures and the potential evapotranspiration, which favors the generalization of the drought in the micro-climate and topiclimat space.

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