DROUGHT – A RISK FACTOR IN AGRICULTURE IN WESTERN PLAIN OF AUTUMN 2011

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Abstract: *Drought is a dangerous meteorological phenomenon, affecting relatively large areas of land in the long run, causing property damage and environmental degradation. Meteorological drought is characterized by the absence of rainfall in at least 14 consecutive days in cold season (October-March) and at least 10 consecutive days in warm season (April-September) or if precipitation occurred, totalized an amount not exceeding 0.1 mm. Pedological drought occurs when there is an insufficient amount of water in soil, coming from precipitation or from ground waters. In this study we used temperature and precipitation data recorded at meteorological stations in the Western Plain of Romania from the period August-November 2011 and we compared them with climatological averages. To illustrate the synoptic context and to identify the characteristic types of circulation in the analized period, were used reanalyzed maps of pressure and geopotential at 500 hPa level. Autumn 2011 was a particularly dry one. The drought was installed as meteorological drought in August, has increased gradually in each autumn month, and has culminated in November, a month without precipitation. November 2011 was the driest month of the last thirty years. Begun in late summer, drought and the absence of irrigation have delayed the campaign, resulting a delayed planting, passed over the optimal time. The rape culture was more affected, followed by cereal grains. The amount of rainfall recorded in the period September-November 2011 at each of the meteorological stations analyzed was very small compared to the amount of normal quantities of precipitation for the fall. Basically precipitation recorded in the Western Plain in autumn 2011 did not reach even half of normal for this season, which had negative effects in various fields. Crops established in autumn 2011 were affected by prolonged drought.*

Key words: *drought, pedological drought, deficiency of precipitation, moisture reserve, anticyclonic ridge*

INTRODUCTION

Agriculture is an important user of weather information, their capitalization with other specialized information can be done in order to prevent and reduce weather risk in agriculture, and to establish sustainable development strategies.

Drought is a dangerous meteorological phenomenon, affecting relatively large areas of land in the long run, causing property damage and environmental degradation.

Destructive impact of drought and the growing area of their production, which comprises about one fourth of the total land surface of Earth, make this phenomenon to be considered, beside pollution, the environmental risk with the greater scale and stability.

Climate analysis on Romania, taking into account the past 40 years, highlight the decrease of annual amounts of precipitation, especially in southern and southeastern areas of the country, areas with high risk to droughts due the higher temperatures. In recent decades, meteorologists have observed extending of drought even to the west and central regions. The plains of Romania shall be treated as more and more vulnerable to different types of drought: meteorological, hydrological or pedological. The implications are especially important as those regions are considered the first important agricultural areas of the country.

Droughts that occur in the second half of summer and extended in the months September to November affecting winter crops in stages of germination, making them enter into winter underdeveloped and with little resistance.

In 2011, after a month July in which the rainfall measured at most stations in western Romania have exceeded climatological norms, followed a prolonged drought that lasted from early August until the second decade of December. In addition to low amounts of rainfall have contributed to drought the high temperatures.

Drought in the fall of 2011 has created problems in many fields. Begun in late summer, drought and the absence of irrigation have delayed the campaign, resulting a delayed planting, passed over the optimal time. The rape culture was more affected, followed by cereal grains.

DEFINITION OF DROUGHT CONCEPT

Drought may mean different things to different categories of people according to their specific interests and economic situation. In order to elaborate a universally accepted definition of drought difficulties appear related to establishing thresholds and temporal rainfall intensity. Defining drought has several variants, in terms of area of occurrence, characteristics, extending in the time, and induced effects.

The International Meteorological Vocabulary (*WMO*, 1992) gives two definitions of drought:

(1) Prolonged absence or marked deficiency of precipitation;

(2) Period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance.

Drought and dryness are complex phenomena, because many factors participate in their triggering: rainfall, soil available water supply for plant, moisture and air temperature, evapotranspiration, wind speed. It is characterized mainly by the absence of rainfall and potential evapotranspiration growth.

Drought can be classified as:

- ***Meteorological drought*** - when rainfall completely missing for a long time or when precipitation falls in very small quantities
- ***Pedological Drought*** - when there is an insufficient amount of water in soil, coming from precipitation or ground water
- ***Hydrological drought*** – when decreases substantially the level of ground-water, the flowing waters and the stagnant ones.

Meteorological drought is mainly due to lack of rainfall, air relative humidity lower than 40% with high temperatures in air.

In Hellman's conception a dry period is characterized by the absence of rainfall in 5 days, while it has not rained at all or, if it rained, rainfall did not exceed that required daily. Also, a drought is characterized by the absence of rainfall in at least 14 consecutive days between cold season (October-March) and at least 10 consecutive days between warm seasons (April-September) or if precipitation occurred, totaled an amount not exceeding 0.1 mm. A persistent dryness causes drought installation.

Drought has as effects: decreased agricultural production, vineyards and livestock, increasing prices, increasing inflation, reduced nutritional status of population, disease, energy crisis, and can be controlled by systematic monitoring and immediate notification by the development of defense plans against the effects of disaster.

In Romania, drought occurs due to specific synoptic configurations. In principle, it is the persistence of a field of high pressure, due to expansion over our country of an Eastern European ridge, the Azores High, Scandinavian anticyclone or North African anticyclone, respectively the existence of a high pressure field due to the presence of an anticyclone over

central Europe or anticyclone belt formed by joining the ridge Azores High with ridge East European anticyclone. In these conditions, prevailing air masses are strongly continental, very low in moisture.

DATA AND METHODS

For this study, were analyzed precipitation and temperature data recorded at meteorological stations in the Western Plain of Romania, subordinated to the Regional Meteorological Center Banat Crişana: Arad, Banloc, Chişineu Cris, Jimbolia Sînnicolau Mare, Timişoara. But were pursued precipitation and temperature data from weather stations located in the hills and mountains, to get a broader picture of droughts.

We used temperature and precipitation data from the period August-November 2011 and compared with climatological averages. Although August is a summer month, we took into account data from this month to get a better picture of the context and the moment when meteorological drought has been installed, followed by pedological drought.

To illustrate the synoptic context and to identify the characteristic types of circulation in the analized period, were used reanalyzed maps of pressure and geopotential at 500 hPa.

Monthly amounts of precipitation recorded in the period August to November 2011 at the meteorological stations selected for this analysis are presented in Table 1.

Table 1.

Monthly amounts of precipitation (mm) recorded between August-November 2011

Nr	Meteorological Station	August	September	October	November
1	Chişineu-Criş	1.1 mm	10.2 mm	25.7 mm	0.3 mm
2	Arad	2.4 mm	9.8 mm	35.2 mm	0.1 mm
3	Sînnicolau Mare	-	17.7 mm	25,4 mm	-
4	Jimbolia	3.0 mm	19.2 mm	38.0 mm	-
5	Timişoara	1.3 mm	11.7 mm	33.8 mm	-
6	Banloc	22.3 mm	13.0 mm	42.8 mm	-

RESULTS AND DISCUSSION

In August 2011, the precipitation recorded at weather stations and hidrologic stations in the west side of Romania were well below climatological normals. There were stations that lacked rainfall throughout August (Sânnicoulau Mare) and stations where precipitation values were extremely small (1.1 mm Chişineu Cris, Timisoara 1.3 mm). The largest quantities did not exceed 40 mm even in mountain areas and were in the first half of August. Between 17 to 31 August, it did not rain to the weather stations in the Western Plain, so we can already talk about the meteorological drought.

For September and October, precipitation deficit decreased slightly compared with the values recorded in August, but remained high compared to the multiannual averages.

So, in September, the precipitations were well below climatologic normals. The amount of precipitations to the weather stations in the Western Plain did not exceed 20 mm, which represents less than half of normal for September.

Rainfall occurred mainly in the first decade of the month. In the second decade it was a very warm weather, with maximum temperatures that reached even 33-34^{o}C and low rainfall, only on 20.09.2011. In the last decade of September no precipitation were reported in the west side of the country.

The maps below, made by Foreign Agricultural Service (FAS) illustrates the percentage deviations relative to climatologic normal values for the last two decades of September 2011 (Figure 1a, b).

In late September 2011, the moisture reserve available in the 0-20 cm field layer recorded low and very low values, and pedological drought was moderate, high and extreme in

Dobrogea, Oltenia, Wallachia, Banat, most of Crişana, Maramureş and Moldavia, and in south-western Transylvania.

Analyzing the general synoptic context for September 2011 it shows that southern and western movements have dominated, favoring the advection of warm and dry air masses over the country. The Mediterranean Cyclone, which is usually already active in this time of year, and that causes rainfall in the west, has made its presence felt occasionally, especially in the first half of the month. In the last part of the month a large anticyclone field has been installed at the ground level, supported by a warm ridge in upper level. Figure 2 shows the mean geopotential at 500 hPa in September 2011, according to NCEP reanalysis.

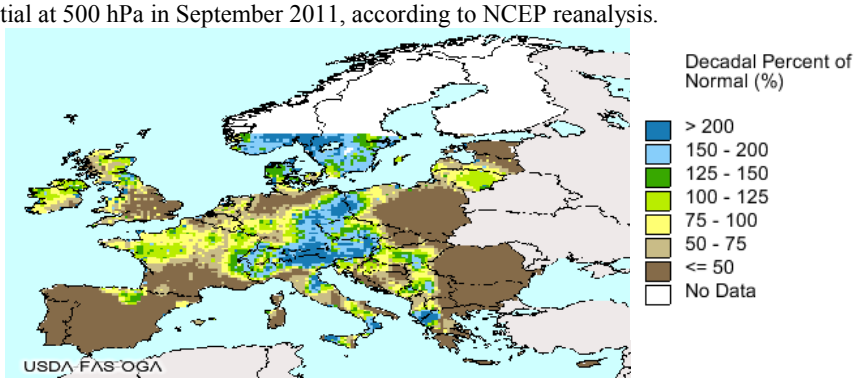

Figure 1a. Percentage deviation between 11-20.09.2011

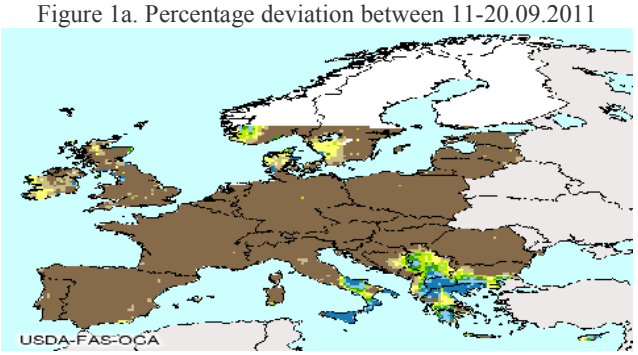

Figure 1b. Percentage deviation between 21-30.09.2011

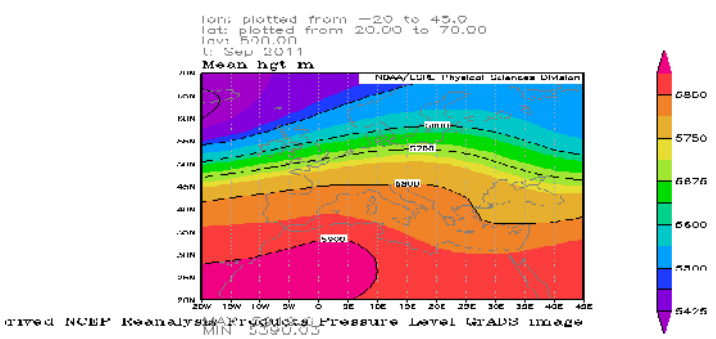

Figure 2. Mean geopotential (m) at 500 hPa, in september 2011

In October 2011 the precipitations recorded values below the average multiannual which led to extended drought in most of the territory. Only in the southern extremity of the analyzed area were registered small positive deviations. In the rest of the region deviations still remained negative, but had lower values than in previous months.

The interval of ten days without precipitation from late September was extended with another seven days, till early October. It was followed by a period characterized by unstable weather, with rains and showers. In some days precipitation fallen in 24 hours sparse exceeded 10 mm. From October 26 a nice weather has been installed again, without rain.

Figure 3a, corresponding to the first decade of October, indicates that precipitation deficits remained high. In figure 3b it is shown the percentage deviation of precipitation for the last decade of October 2011. It may be noted that the deficit of precipitation fell, and there are even some positive deviations in the western part.

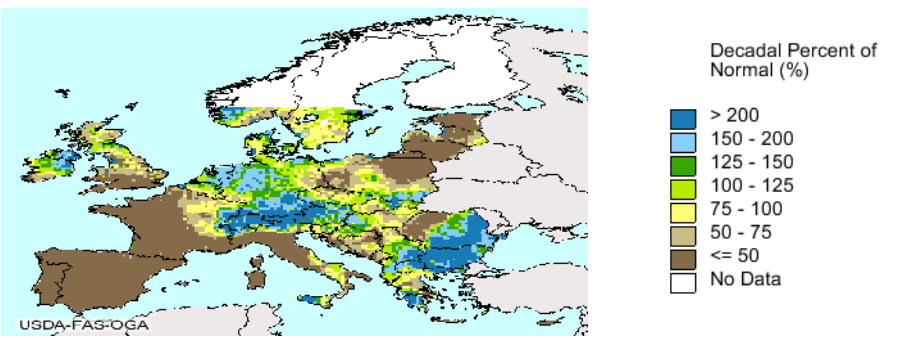

Figure 3a. Percentage deviation between 01-10.10.2011

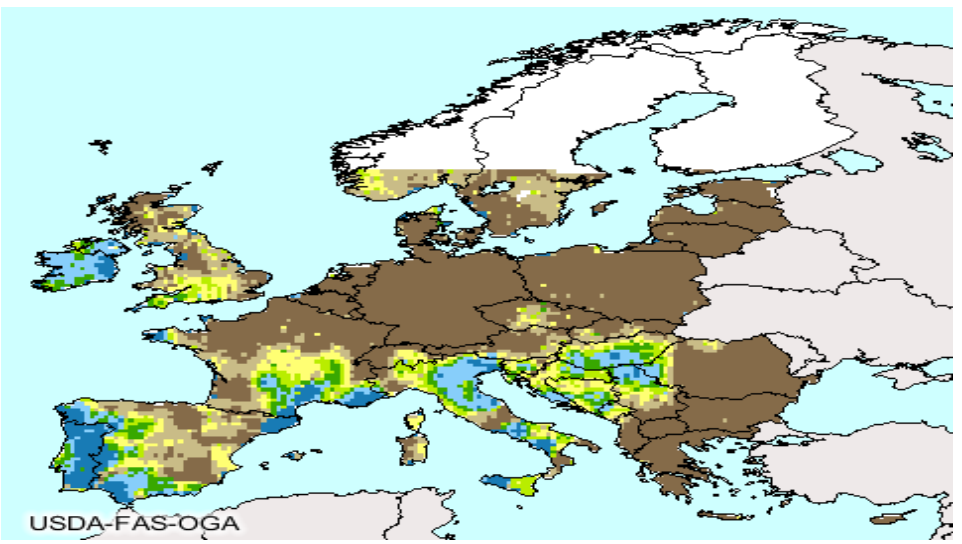

Figure 3b. Percentage deviation between 21-31.10.2011

In these conditions at the end of October in the west and south-east pedological drought was signaled, with varying degrees of intensity, from moderate to strong.

Synoptic charts indicate for the first days of October, a persistent anticyclone field at ground level and a warm ridge at upper levels. Then pressure decreases gradually and a series of frontal systems attached to Icelandic Low crosses west. Air circulation became northern favoring penetration of cold and moisture air to our region of interest. This structure with thalweg geopotential over Central and Eastern Europe continued until the end of the month, when the pressure and geopotential increased again. The mean geopotential at 500 hpa, for October 2011 is presented in Figure 4.

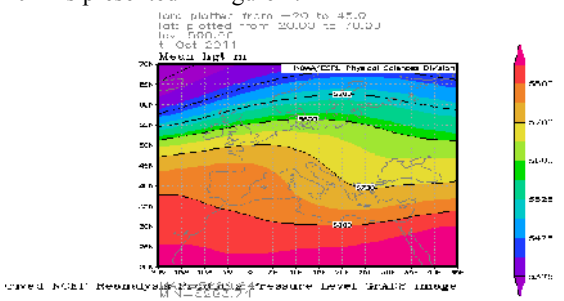

Figure 4. Mean geopotential (m) at 500 hPa, in october 2011

But drought has enhanced in November 2011, when rainfall completely missing or, in the best case, there were only a few drops of rain. Even at the mountains the amounts of precipitation was extremely low. Basically we can talk about a record high in the absence of rainfall, November 2011 being the driest month of the last thirty years.

The maps below (Figure 5 a, b) illustrate very well the lack of precipitation. Notice that in the first decade of November rainfall was in excess only in south-western Europe and in the last decade the rainfall deficit and drought have included most of the European continent.

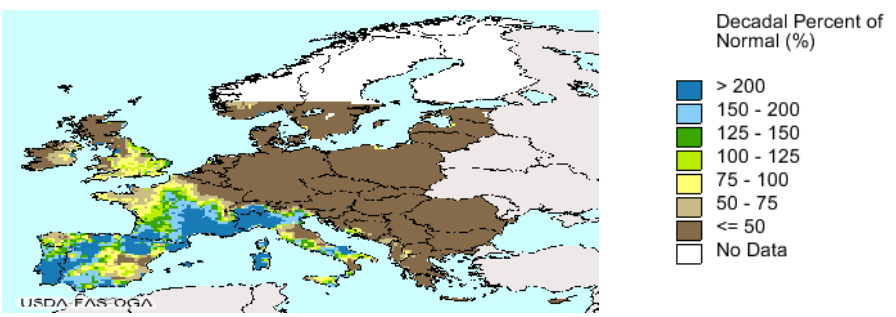

Figure 5a. Percentage deviation between 01-10.11.2011

According to press releases issued by the ANM at November 30 2011 in most of Dobrogea, Wallachia, Banat and Crişana, southern and south-eastern part of Moldavia and Oltenia, pedological drought remains moderate and strong.

In terms of weather November 2011 was characterized by the persistence of a blocking anticyclone structure over central Europe. The atmospheric blocking is caused by the existence of some strong anticyclone, extending throughout the tropospheric column. They block the western movement of air masses and turn it into meridional circulation.

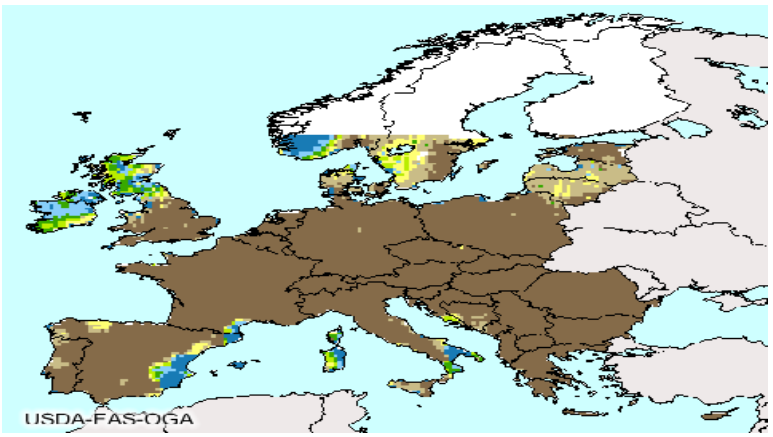

Figure 5b. Percentage deviation between 21-31.11.2011

The main effect of atmospheric blocking is a stagnant weather pattern for a period ranging from several days to several weeks. Blocking atmosphere that characterized November 2011 is well observed in Figure 6, which shows average geopotential at 500 hPa levels.

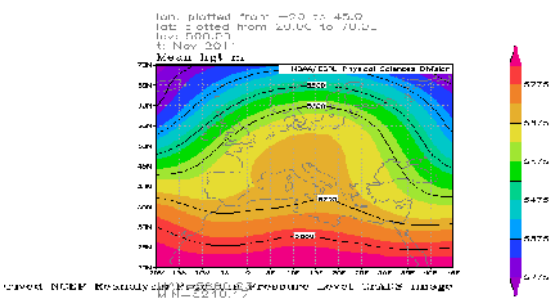

Figure 6. Mean geopotential (m) at 500 hPa, in november 2011

Table 2

The amounts of precipitation recorded in autumn 2011 and the amount of normal amounts of precipitation for the period September-November

Nr.	Meteorological station	Amount of rainfall recorded in autumn 2011 (September-November 2011).	Normal amounts of precipitation for the period September-November
1.	Chişineu Criş	36,2 mm	132,4 mm
2.	Arad	45,1 mm	138,3 mm
3.	Sânnicolau Mare	43,1 mm	119,6 mm
4.	Jimbolia	57,2 mm	132,3 mm
5.	Timişoara	45,5 mm	127,4 mm
6.	Banloc	55,8 mm	125,0 mm

CONCLUSIONS

Autumn 2011 was a particularly dry one. The drought was installed as meteorological drought in August, has increased gradually in each autumn month, and has culminated in

November, a month without precipitation. Precipitations deficits for the fall of 2011 shown in Table 2, in which are presented the precipitations recorded in autumn 2011 and precipitations that would have to fall in the autumn season, according to climatological data.

The graph in Figure 7 shows the comparative data in Table 2. Clearly observed that the amount of rainfall recorded in the period September-November 2011 at each of the meteorological stations analyzed is very small compared to the amount of normal quantities of precipitation for the fall. Basically precipitation recorded in the Western Plain in autumn 2011 did not reach even half of normal for this season, which had negative effects in various fields.

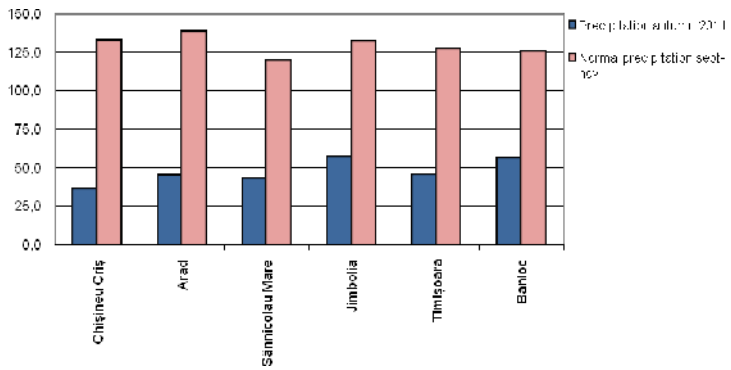

Figure 7 Comparative graphic – precipitation in autumn 2011 versus normal precipitation in autumn

Crops established in autumn 2011 were affected by prolonged drought. Farmers had difficulties in performing the work, and manufacturing costs had increased. Although most farmers were able to make sowings near term, drought had delayed the germination of seeds and their emergence. All this can lead to a fall in production for next year by 30% to cereals and reduce the area cultivated with rape up to 80%. Viorel Matei, president of the National Federation of Agricultural Producers in Romania (FNPAR), said: "Due to drought, rape is compromised in 80% and wheat crops, which must arise in all, are arising only in proportion of 30-60%, depending on the area. Even if it rains from now on record crop production will decrease by at least 30-35%."

Agriculture will face major challenges in the coming years, given the dependence of the changing climate and therefore of the effects of extreme weather on crop production and not only. The risks in food production due to increasing frequency of extreme events such as heat waves, droughts or floods, can lead to lower yields and lower stability of product. Therefore, application of best agricultural practices compatible with future climatic conditions, can contribute proactively to preserving and protecting the environment.

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